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Telecom Regulatory Authority of India

सत्यमेव जयते

Telecom Sector in India:
A Decadal Profile

Telecom Regulatory Authority of India
Mahanagar Doorsanchar Bhawan, Jawaharlal Nehru Marg,
(Old Minto Road), New Delhi - 110 002

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FOREWORD

The Telecom sector in India has, over the last one decade, witnessed a rapid growth. The Teledensity has increased substantially from 4.3 in March, 2002 to 78.1 in February, 2012, with the rural areas registering an increase from 1.2 in March 2002 to 38.5 in February, 2012.

Conducive regulatory environment through policies of the Government and regulatory measures put in place by the Telecom Regulatory Authority of India (TRAI) have contributed to a competitive environment for the service providers and accessibility to telecom services at affordable tariff, to the consumers.

I am happy that at the request of TRAI, NCAER undertook a Study on the growth story in telecom sector in India covering the years 2001 to 2011. This Study has been a collaborative effort between the NCAER team led by Dr. Shashanka Bhide, Senior Research Counsellor and the TRAI team led by Shri Raj Pal, Advisor (Economic Regulation). I hope all stakeholders will find this publication useful.

(Dr. J.S. Sarma)
Chairman

New Delhi
Dated: 3rd May, 2012

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EXECUTIVE SUMMARY

The report presents the evolution of the telecommunications sector in India in the last decade. The telecommunications sector plays an increasingly important role in the Indian economy. It contributes to Gross Domestic Product (GDP), generates revenue for the government and creates employment.

From 2001 to 2011, the total number of telephone subscribers has grown at a Compound Annual Growth Rate (CAGR) of 35 per cent. The comparable rates in the 1980s and 1990s were 9 per cent and 22 per cent, respectively. However, the composition of the subscribers shows that mobile subscribers have led the way. The increase in teledensity has mainly been driven by the increase in mobile phones.

Demand side factors—ultra low cost of handsets, low tariffs and ultimately the ease of using a phone—as well as supply side factors have made mobiles popular in India.

The number of Internet subscribers has increased but the number of data subscribers far exceeds the former. The Digital Subscriber Line (DSL) is the most favoured technology to access the Internet through the personal computer (PC). Other services like Village Public Telephones (VPTs), Public Call Offices (PCOs), Public Mobile Radio Trunk Service (PMRTS) and Very Small Aperture Terminal Services (VSAT) show slower growth.

The data show that private providers dominate the four services including wireless subscriptions, data services, PMRTS and VSAT, while public service providers dominate the other sectors.

International comparisons show that India has one of the lowest mobile tariffs in the world. Between 2007 and 2010, prepaid and blended rates show a decline of 25.3 and 21.5 per cent, respectively. In contrast, postpaid tariffs show a decline of only 8.23 per cent. The majority of the subscriptions in India are of the prepaid type. This has been termed as the budget telecom network model, an innovation that took birth in South Asia.

Usage statistics also show that Indians talk more on the phone than their international counterparts. The revenue statistics show that service providers are earning 50 per cent of their revenue from calls and 8.3 per cent from Short Message Service (SMS). Ringtones form the dominant category of value-added services (VAS). The size of the VAS market is also growing over time.

Teledensity shows wide regional variations across states. There is widespread variation in broadband availability across regions too. However, the states are making efforts to improve their ICT abilities over time.

The roles of three main agencies in the telecommunications sector—DoT (Department of Telecommunications), TRAI (Telecom Regulatory Authority of India) and TDSAT (Telecommunications Dispute Settlement and Appellate Tribunal)—are an important aspect of the policy making and regulatory processes.

The Indian telecom sector has undergone major transformations through significant policy reforms. The regulatory reforms in the telecom sector from 2000 to 2011 can be broadly classified into the following three distinct phases.

Phase 1 – 2000–2003: Telecom sectors were opened up to competition.
Phase 2 – 2004–2007: Regulator encouraged competition and also set the stage for future growth.
Phase 3 – 2008–2011: More choices were brought in for consumers in terms of technology and services.

Planned investment outlay in the telecommunications sector has increased over time. Majority of the investment over the decade has come from the private sector. The private sector performs better in terms of return on average capital employed.

The telecom sector has received on average 8.2 per cent of total inward FDI between 2000–01 and 2010–11. Most of the Foreign Direct Investment (FDI) has gone to the cellular mobile segment.

Mobile telephony and economic growth positively reinforce each other. The micro studies on the impact of mobile phones are more telling. Fisheries, as an industry, has hugely benefited from introduction of mobile phones.

The impact of mobile phones on agricultural productivity and revenue varies on the type of service, literacy status of farmers and the type of complementary infrastructure available. However, middle men and traders in both fisheries and farming are dependent on the mobile to monitor their business needs. Small and medium enterprises are also realizing the benefits of mobile telephony either through increases in productivity or finding new business ventures through the use of mobile phones.

Several studies have also examined the impact of mobiles on individual sections of society. Mobiles are now being seen as an empowerment tool since research has shown that mobiles have a positive impact on the social status of women in India. Studies indicate that mobile phones make women feel more secure.

The urban poor also show evidence of economical benefits from using mobiles. Mobiles also affect people interaction by increasing their tele-interaction with each other.

Mobiles are now being used to deliver services like health, education, banking, commercial services, and so on.

The three major challenges of the next decade are (i) to overcome the digital divide, (ii) growth of broadband sector, and (iii) development of the telecommunications manufacturing sector.

1 INTRODUCTION

1.1 BACKDROP

The ubiquitous sight of a shop offering to re-charge your mobile phone is symbolic of the telecom revolution that has changed the face of India in the first decade of the twenty-first century with significant social and economic impact. The total number of telephone subscribers in India stood at 943.49 million in February 2012 as against 28.53 million in April 2000.[1]

The purpose of this report is to review the extraordinary journey of the Indian telecom sector in the 2000s. The report presents the growth story in telecom sector in India in terms of significant policy changes and regulatory initiatives and consequent socioeconomic impacts.

1.2 BRIEF OVERVIEW OF THE TELECOMMUNICATIONS SECTOR

The subscriber base for telecom services in India is large but skewed in favour of urban areas. Urban teledensity is 4.4 times that of rural density (Table 1.1). Further, wireless phones dominate the market in India and wireline phone segment constitutes merely 3.4 per cent of the total subscriber base. The numbers of Internet and broadband subscribers are a very small fraction of the population. However, the number of people capable of accessing the net through mobile phones is substantially higher, if wireless data subscription through mobile is an indication.

[1] Telecom Regulatory Authority of India.

Table 1.1 : Snapshot of the Telecommunications Sector

Variable	Date	Status
Teledensity†	February 2012	78.10
Urban teledensity†	February 2012	169.37
Rural teledensity†	February 2012	38.53
Total number of subscribers	February 2012	943.49 million
Total number of wireless subscribers	February 2012	911.17 million
Total number of wireline phones	February 2012	32.33 million
Number of Internet subscribers	December 2011	22.39 million
Number of broadband subscribers	February 2012	13.54 million
Number of wireless data subscribers	February 2012	431.37 million
Production of telecom equipment#	2010–11	Rs 535 billion* (Rs 510 billion in 2009–10)
Total exports of telecom items#	2010–11	Rs140 billion* (Rs 135 billion in 2009–10)
Total imports of telecom items #	2009–10	Rs 450.3 billion
India's export of telecom consultancy#	2010–11	Rs 12.7 million up to September 2010 (Rs 72.70 million in 2009–10)
FDI in telecom‡	2010–11	Rs 75.46 billion
Gross revenue of telecom services sector	2010–11	Rs 1,717 billion

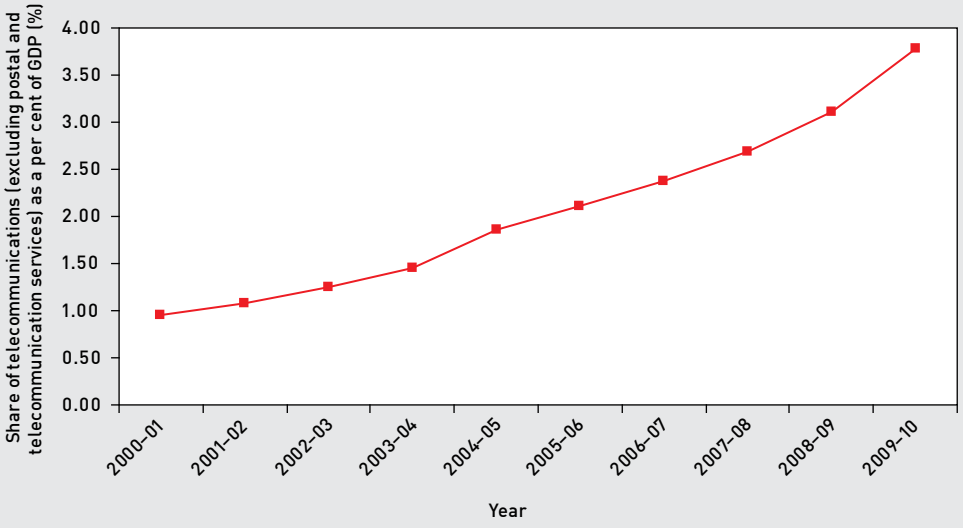
Source: Telecom Regulatory Authority of India.
† Number of telephone subscribers per 100 people.
* Projected.
#*Annual Report 2010–11*, Department of Telecommunications, Ministry of Communications and Information Technology, Government of India (2011), www.dot.gov.in
‡ Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India (http://dipp.nic.in/).

The share of revenue from telecom services is higher than manufacturing/production of telecom equipment. About a quarter of the domestic telecom production is exported and the needs of telecom equipment in India are largely met by imports. Most of the Foreign Direct Investment (FDI) has gone to the cellular mobile segment.

The pace of growth of the telecom sector, particularly the telecom services has increased its significance to the overall economy in the past two decades. The share of telecommunication services (excluding postal and miscellaneous services), as per cent of the total GDP, has increased from 0.96 in 2000–01 to 3.78 in 2009–10 (Figure 1.1).

The importance of telecommunications sector for the Indian economy can be judged by its contribution to GDP, tax revenue, and jobs. Studies have suggested that mobile phones have a positive impact on GDP.[2] The potential impact of wireless broadband is also estimated to be highly positive. [3] Further, the industry generates tax revenues for the government.[4] The 3G spectrum auction combined with the bid values for broadband wireless access licenses yielded more than Rs 100,000 crore in 2010 to the Government of India, amounting to approximately 1 per cent of the GDP.[5] Employment data shows that the share of employment in the transport, storage and communication sectors went up from 3.7 per cent in 1999–2000 to 3.8 per cent in 2004–05.

Figure 1.1 : Share of Telecommunications as per cent of GDP, 2000–01 to 2009–10



Sources: National Accounts Statistics of India (2009) and various issues (NAS); EPW Research Foundation, Mumbai.

Note: The telecommunications sector of Gross Domestic Product (GDP) is sum of the GDP of the phones of the public sector and private sector. Intermediate consumption in the overall public telecommunications sector has not been subtracted out but they form a relatively small proportion of the sector.

[2] McKinsey and Company (2006), *Wireless Unbound: The Surprising Economic Value and Untapped Potential of the Mobile Phone,* http://ww1.mckinsey.com; and Vodafone (2009), *India: The Impact of Mobile Phones*, Vodafone Policy Paper Series No. 9, http://www.vodafone.com

[3] Analysys Mason (2010), *Assessment of Economic Impact of Wireless Broadband in India*, Report for GSMA.

[4] COAI and OVUM (2005), *OVUM Report on Economic Benefits of Mobile Services in India: A Case Study for the GSM Association,* http://www.coai.com/; and Bhide, S. (2010), *The 3G Auction: What will we do with the extra money?* Macrotrack, National Council of Applied Economic Research, 12(5).

[5] Bhide, S. (2010), *The 3G Auction: What will we do with the extra money?* Macrotrack, National Council of Applied Economic Research, 12(5).

The employment in BPO (Business Process Outsourcing) shows high rates of growth throughout the 2000s.[6] The mobile telephone industry generated 3.6 million jobs both directly and indirectly.[7] In 2008–09 2.2 million people were directly employed in the IT–BPO industry with 1.9 million in Tier 1 cities and 0.17 million in Tier 2/3 cities.[8] During the same period the IT–BPO industry employed 7.3 million people indirectly in Tier 1 cities.

1.3 IMPORTANCE OF THE TELECOMMUNICATIONS SECTOR

The interplay of three factors—regulation, liberalisation, and technology—makes this sector an interesting study. There are continuous technological changes and evolving regulatory climate. While Indian telecommunication companies, increasingly buoyant and confident, have started venturing outside the country and investing abroad, the telecom manufacturing in India is still to attract investment on a sustained basis.

Mobile phones are popular due to their personal, portable, and digital nature, enabling people to be always connected. There are increasing innovations, especially development of mobile applications. The low cost of handsets in India and the innovative budget telecom network have lowered the barrier to entry of consumers to the market.[9] On the supply side, mobile connections are relatively cheaper than fixed line telephony.[10]

The telecommunications sector plays an increasingly important role in the Indian economy. It contributes to economic growth and the GDP and generates revenue for the government and generates jobs. In short, telecom sector has a multiplier impact on the economy.

We have come a long way. However, certain challenges such as encouraging telecom manufacturing in India, spreading teledensity, and Internet services across India to bridge the digital divide are still to be fully met.

[6] Planning Commission, Government of India (2008), *Report of the High Level Group on the Services Sector*, www.planningcommission.nic.in, accessed August 11, 2010.
[7] COAI and OVUM (2005), OVUM *Report on Economic Benefits of Mobile Services in India: A Case Study for the GSM Association*, http://www.coai.com
[8] NASSCOM (National Association of Software and Service Companies) (2010), *Impact of IT-BPO Industry in India: A Decade in Review*, www.nasscom.in
[9] Figure 2.9 shows that most of the mobile phone models available in the market fall within the range of Rs 1,000–4,000, with the models in other price ranges being substantially smaller. With increasing prices, the number of models available in each range is falling.
[10] Bhavnani, A., Chiu, R.W., Janakiram, S. and Silarzsky, P. (2008), *The Role of Mobile Phones in Sustainable Rural Poverty Reduction*, ICT Policy Division, World Bank, www.worldbank.org

2 TRENDS IN THE TELECOMMUNICATIONS SECTOR

2.1 INTRODUCTION

The last decade, especially since 2003, has seen tremendous growth and dynamism in the Indian telecommunications sector. A phone has been transformed from a "luxury" good to a "necessity" connecting millions of people. Earlier India was primarily concerned with increasing teledensity, i.e. telephones. Now, the idea of phones has itself changed from fixed line/wireline phones to mobile/wirless phones connecting people everywhere and anywhere (except perhaps the rural areas where unfortunately majority of Indians reside). The concept of connectivity itself has changed. The term telecommunications now includes many other services namely Internet services, radio paging services, Very Small Aperture Terminals (VSATs), Public Mobile Radio Trunk Service (PMRTS) and global mobile personal communication by satellite (GMPCS).

Of all the above mentioned segments, wireless and Internet have registered the highest growth in the last few years. The number of total telephone subscribers in India increased from 28.53 million in March 2000 to 943.49 million in February 2012.[11] Wireless subscriptions increased from 1.88 million in March 2000 to 911.57 million in February 2012 and wireline subscriptions increased from 26.65 million in March 2000 to 32.33 million in February 2012. As a result, India has the second largest mobile market in the world after China. India reached its Eleventh Five Year Plan (EFYP) target of 600 million subscribers in 2010 itself.[12] The number of total Broadband subscribers in India is 13.54 million in February 2012.

2.2 INTERNATIONAL COMPARISONS

The total number of telephone subscriptions in the world including fixed line and cellular sector grew at a Compound Annual Growth Rate (CAGR) of 17.43 per cent between 2000 and 2010.[13] A total of more than US$ 3,670 billion (6 per cent of the world's GDP) was spent on telecommunication services by governments across the world in 2008.[14] India's expenditure on telecommunication services in 2008 was to the tune of US$ 52 billion. This was 4.3 per cent of the country's total GDP. Government's expenditure on telecommunications in India increased at the rate of 14 per cent during 2005–08.

This section compares India's position to that of the world in telephones and Internet availability and usage. India has risen through the ranks to be amongst the top telephone and Internet users in the world in absolute numbers but on a relative scale (to population) it still ranks low.

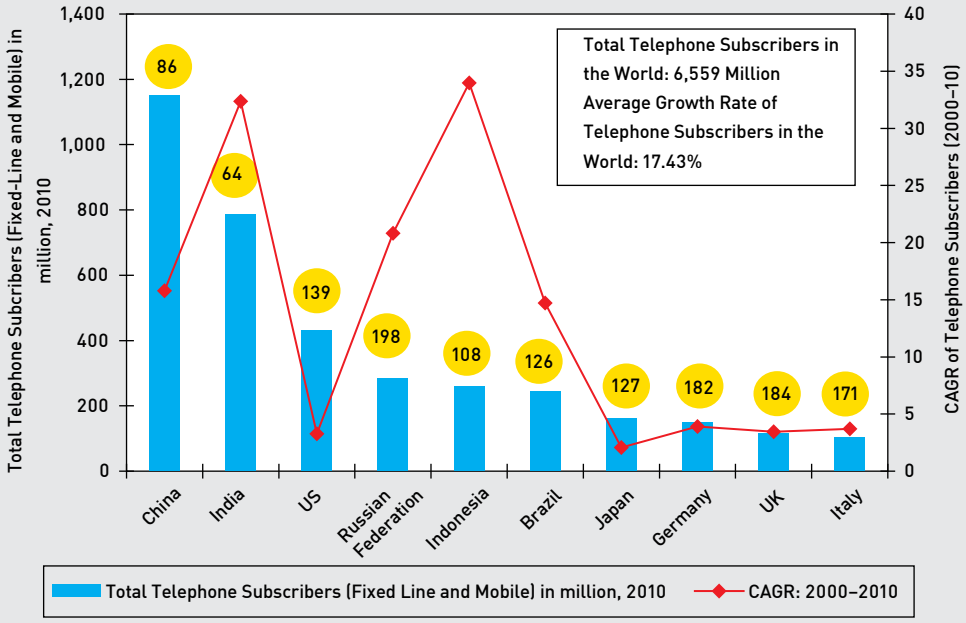
[11] All Indian subscription numbers in this paragraph are from Telecom Regulatory Authority of India.
[12] Planning Commission, Government of India (2010), *Mid-Term Appraisal of Eleventh Five Year Plan.* Available online at www.planningcommission.nic.in
[13] International Telecommunications Union. Available online at www.itu.int
[14] The rest of the data in this paragraph are from World Development Indicators. Available online at www.worldbank.org

2.2.1 Telephones

2.2.1.1 Telephone Subscriptions

Available international comparisons till 2010 show that India has the second largest number of telephone subscribers in the world (222 countries), accounting for 12 per cent of the world's total telephone subscribers as shown in Figure 2.1. It is also one of the fastest growing in terms of telecom subscribers. Total telephone subscribers in India have increased at a CAGR of 32 per cent in 2000–10 against the world average growth rate of 17.34 per cent. However, India's teledensity, 64, is still lower compared to the world average of 108 (Teledensity as on February 2012 is 78.1). This indicates low penetration of telephones in the rural areas.

Figure 2.1 : India's Position in Telephone Subscriptions



Source: International Telecommunication Union (ITU). Available online at www.itu.int
Note: Teledensity numbers are shown in the circles above the bars of the respective countries.

Teledensity has increased in India and around the world especially in the developing countries due to the rise of mobile phones. As of 2010, the ratio of mobile phones to fixed lines in the world ranged from 0.4:1 to 386.5:1.[15] The average ratio of mobile phones to fixed lines in the world stood at 21.5:1 in 2010. In India the same ratio is 21.4:1 in 2010 whereas the comparable numbers for China and U.S. are 2.9:1 and 1.8:1, respectively.

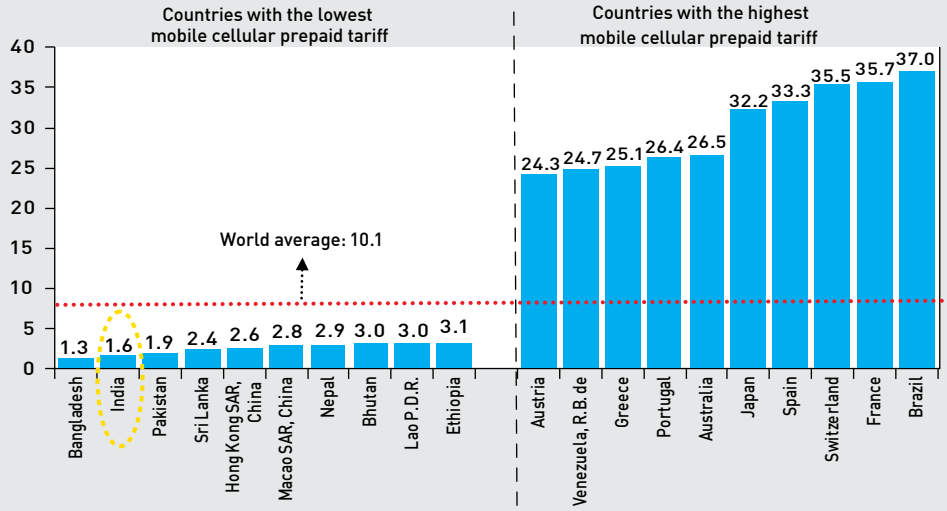
2.2.1.2 Tariffs

Mobile cellular prepaid tariffs ranged between US$ 1.3 and 37 per month across countries in 2008 (Figure 2.2).[16] Average mobile cellular prepaid tariff in the world is US$ 10.1 per month. Mobile tariffs are the lowest in countries such as Bangladesh, India, Pakistan, Sri Lanka, Nepal, Bhutan, and so on. Mobile tariffs in India are the

[15] International Telecommunication Union (ITU). Available online at www.itu.int
[16] Mobile cellular prepaid tariff is based on OECD's (Organisation for Economic Co-operation and Development) low-user definition, which includes the cost of monthly mobile use for 25 outgoing calls per month spread over the same mobile network, other mobile networks, and mobile to fixed line calls and during peak, off-peak, and weekend times as well as 30 text messages per month.

second lowest (US$1.6 per month) in the world after Bangladesh. Countries with the highest mobile tariffs in the world include Austria, Venezuela, Greece, Portugal, Australia, Japan, Spain, Switzerland, France, and Brazil. This particularly low tariff in South Asia was an innovation (driven by intense competition, low purchasing power and strict regulatory environments) from this region called the "budget telecom network model" (Box 2.1).[17]

Figure 2.2 : India's Position in Mobile Cellular Prepaid Tariffs (US$ per month), 2008



Source: World Development Indicators. Available online at www.worldbank.org

Box 2.1 : The Budget Telecom Network Model

This model first emerged in South Asian markets of India, Pakistan and Bangladesh to cater to "customers who only use a few calling minutes per month. This innovation rests on the reduction of transaction costs of generating and transmitting a monthly bill for prepaid customers. Low-value recharge cards, especially electronic reload, give the greatest payment flexibility making this model work" (OECD, 2009). This model is advantageous for people with low, irregular incomes, no permanent address and no credit history (Castell et al., 2005 and Sinha, 2005). Also, these contracts allow exact monitoring of use (Waverman et al., 2005 and Sinha, 2005).

Low purchasing power of customers forced companies competing against each other to innovate. Vodafone (2009) estimates that the own-price elasticity of mobile is minus 2.12, i.e. a 10 per cent price fall would increase demand by approximately 21 per cent, keeping everything else constant. This implies that the fall in prices of mobile phones brought in more customers, increasing total revenue of operators. Operators in South Asia are as profitable as their Western counterparts (OECD, 2009). Lately Indian operators have experienced a decline in their profits Margins.

Sources: Castells, M., Qiu, J.L., Fernández-Ardévol, M., and A. Sey (2005), *Mobile Community and Society: A Global Perspective*, Annenberg Research Network on International Communication.
Organisation for Economic Co-operation and Development (2009), *ICTs for Development: Improving Policy Coherence*. Paris, France.
Sinha, C. (2005), *Effect of Mobile Telephony on Empowering Rural Communities in Developing Countries*, International Research Foundation for Development (IFRD) Conference on Digital Divide, Global Development and the Information Society. Available online at www.irfd.org
Vodafone (2009), India: *The Impact of Mobile Phones*, Vodafone Policy Paper Series No. 9. Available online at http://www.vodafone.com
Waverman, L., Meschi, M. and M. Fuss (2005), *The Impact of Telecoms on Economic Growth in Developing Countries*, Vodafone Policy Paper Series: Africa: The impact of mobile phones, No. 2, Vodafone Group. Available online at www.umich.edu

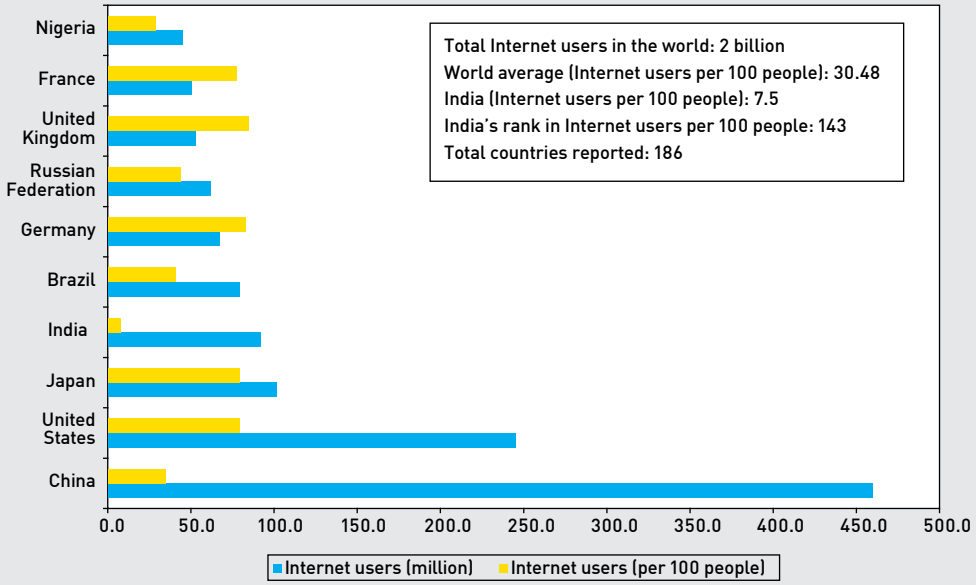
[17] OECD (Organisation for Economic Co-operation and Development) (2009), ICTs for Development: Improving Policy Coherence. Paris, France.

2.2.2 Internet

2.2.2.1 Internet Users[18]

India is ranked fourth amongst Internet users in the world, accounting for 4.56 per cent of the world's total Internet users in 2010 as shown in Figure 2.3. Internet users in India expanded at a significantly high CAGR of 32.27 per cent during the period 2000–10 while those in the world expanded at an average rate of 17.46 per cent. However, India ranks low in terms of Internet users per 100 people in the world (143 out of 186) with only 7.5 per 100 people using Internet, compared to the world average of 30.48. The growth numbers in terms of users are dazzling but as the next section will show, India is still far behind in Internet subscriptions.

Figure 2.3 : Internet Users in India and in the World, 2010



Source: World Development Indicators, World Bank. Available online at www.worldbank.org

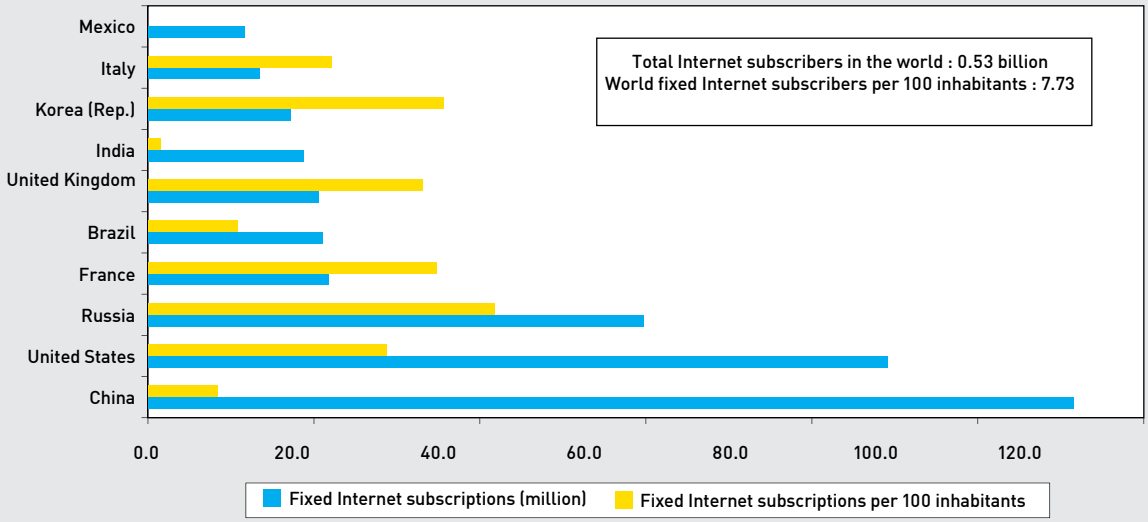
2.2.2.2 Internet Subscriptions[19]

Out of the 91.8 million people using Internet in India, there were only 18.7 million fixed Internet subscribers in 2010 as shown in Figure 2.4. India was ranked the seventh highest (out of 214 countries) in this category in 2010. The country accounted for 3.54 per cent of the world's total fixed Internet subscribers in 2010. The number of fixed internet subscribers per 100 inhabitants in 2010 was 1.53 as compared to the world figure of 7.73.

[18] Internet users include subscribers who pay for Internet access (dial-up, leased line, and fixed broadband) and people with access to the worldwide computer network without paying directly, either as the member of a household, or from work or school. Therefore, the number of Internet users will always be much larger than the number of subscribers, typically by a factor of 2–3 in developed countries and more in developing countries (International Telecommunication Union).

[19] Internet subscribers include people who pay for access to the Internet (dial-up, leased line, or fixed broadband). The number of subscribers measures all those who pay for Internet use, including the so-called "free Internet" used by those who pay via the cost of their telephone call, those who pay in advance for a given amount of time (prepaid), and those who pay for a subscription (either flat rate or volume-per-usage based) (International Telecommunication Union).

Figure 2.4 : India's Position in Fixed Internet Subscriptions in the World, 2010



Source: International Telecommunication Union. Available online at www.itu.int
Notes: The 2009 numbers have been used for the China and Russia figures.
Brazil: Dial up portion estimated based on CETIC.br (CGI.br).
Mexico: Preliminary estimates.
Italy: In terms of broadband lines (excluding internet dial-up subs.).
Source: Agcom-Cocom.

2.3 GROWTH OF TELECOMMUNICATION SERVICES IN INDIA

Telecom services in India can be basically divided into two major segments: (a) telephones, wireline and wireless, and (b) Internet services. In addition, it also comprises of other smaller segments including radio paging services, VSATs, PMRTS and global mobile personal communication by satellite (GMPCS). As mentioned earlier, wireless phones and Internet services have registered the highest growth in the last few years.

2.3.1 Total Subscriptions of Telephones

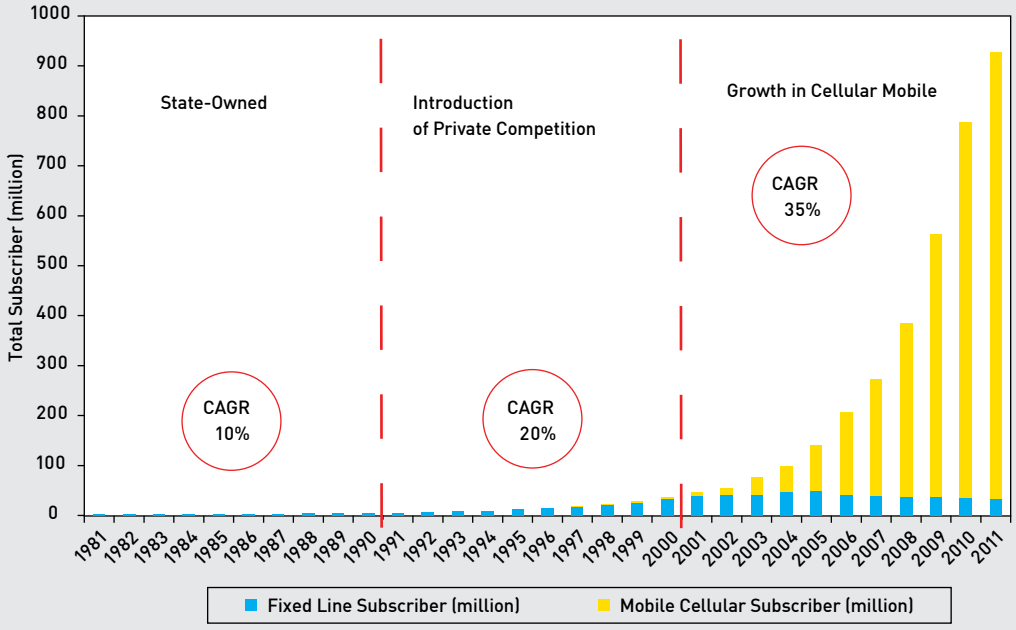
Growth of telephones sector can be summarised in three stages (Figure 2.5). Stage I: Before 1990. This refers to the period when the telecom sector was mainly state owned; Stage II: 1991–2000. This refers to the period between the onset of reforms but the absence of wireless phones; and Stage III: post-2001. This refers to mainly the era of wireless.

As can be seen in Figure 2.5, the total subscriptions of telephones witnessed a sluggish growth (CAGR of 10 per cent) in the state owned era corresponding to the period 1981–90. The foundation of growth of this sector was laid with the introduction of reforms in 1992 mainly in the form of increased competition due to opening up of the sector to private players. This facilitated easy market access for telecom equipment and a fair regulatory framework for offering telecom services to the Indian consumers at affordable prices. As a result, telephone subscriptions grew at a CAGR of 20 per cent during 1991–2000.

The introduction of wireless phone in mid-1990s coupled with increased competition has completely changed the picture. The number of mobile phone connections crossed

fixed line connections in September 2004.[20] As a result the number of telephone subscriptions grew at a CAGR of 35.3 per cent during the period 2001–11. Total telephone subscribers in India increased from 28.53 million in March 2000 to 943.49 million in February 2012.[21] Wireless subscriptions increased from 1.88 million in March 2000 to 911.17 million in February 2012 and wireline subscriptions increased from 26.65 million in March 2000 to 32.33 million in February 2012.

Figure 2.5 : Total Number of Telephone Subscribers in India, 1981–2011 (million)



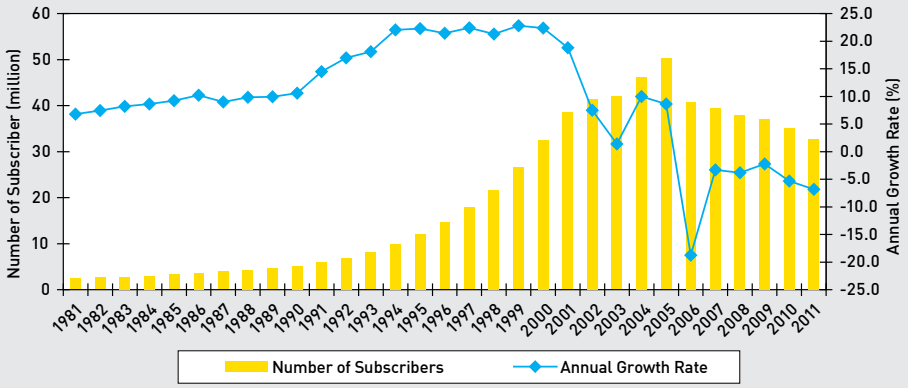
Sources: World Development Indicators. Available online at www.worldbank.org
Telecom Regulatory Authority of India.
Note: These are subscriptions at the end of each calendar year.

2.3.1.1 Wireline Subscriptions

Wireline subscriptions increased from 2.3 million in 1981 to 32.44 million in 2000 to reach its peak at 50.18 million in 2006. Thereafter, it started registering negative growth (Figure 2.6). By the end of February 2012, wireline subscriptions came down to 32.33 million. India has followed the worldwide trend where the mobile phone is a substitute to fixed line phone, through competition has forced the landline services to become more efficient in terms of quality of services. The landline network quality has improved and landline connections are now usually available on demand.

[20] Bhavnani, A., Chiu, R.W., Janakiram, S. and P. Silarzsky (2008), *The Role of Mobile Phones in Sustainable Rural Poverty Reduction.* ICT Policy Division, World Bank. Available online at www.worldbank.org
[21] All Indian subscriber numbers in this paragraph are taken from Telecom Regulatory Authority of India.

Figure 2.6 : Total Number of Wireline Subscribers and Growth Rate in India, 1981–2011



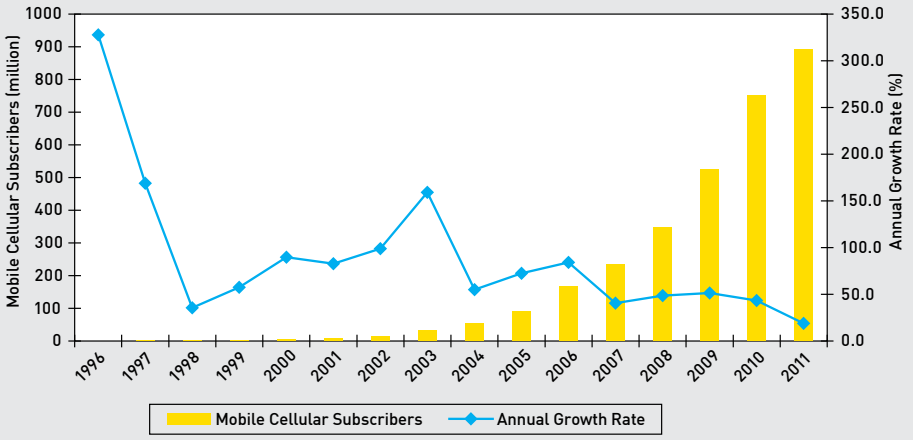
Sources: World Development Indicators. Available online at www.worldbank.org
Telecom Regulatory Authority of India.

Note: These are subscriptions at the end of each calendar year.

2.3.1.2 Wireless/Cellular/Mobile Phone Subscriptions

Cellular or mobile segment has been the key contributor to record growth in telephone subscriptions with its wide range of offers of services. It has led the growth wave of telecom sector in the country. After triple digit growth rate in the first two years, growth rate reduced to 35.6 per cent in 1998. The annual growth rate of wireless phones increased again till 2003 and peaked at 159.2 per cent. Since then the growth rate has tapered down and has averaged around 51.8 per cent during 2004–11. In 2011, growth rate significantly came down to 18.8 per cent (Figure 2.7). Mobile phones accounts for nearly 96.6 per cent of the total telecom subscriptions as of February 2012.[22]

Figure 2.7 : Total Number of Wireless Subscribers and Growth Rate in India, 1996–2011



Sources: World Development Indicators. Available online at www.worldbank.org, Telecom Regulatory Authority of India (2011).
Note: These are subscriptions at the end of each calendar year.

[22] Telecom Regulatory Authority of India.

More than 95 per cent of wireless connections are prepaid. In India GSM mobile system is pre-dominant. There is a clear distinction between the Global System for Mobile Communications (GSM) and Code Division Multiple Access (CDMA) technologies. At the end of December 2011, GSM accounted for 87.9 per cent of the wireless subscriptions and was growing at a faster rate.[23] Boxes 2.2 and 2.3 explain these technologies in detail.

Box 2.2 : Global System for Mobile Communication (GSM)

The GSM family of technologies has provided the world with mobile communications since 1991. In over 20 years of development, GSM has been continually enhanced to provide platforms that deliver an increasingly broad range of mobile services as demand grows. Where the industry started with plain voice calls, it now has a powerful platform capable of supporting mobile broadband and multimedia services. GSM is now used in more than 218 countries and territories serving more than three billion people according to the GSM Association. GSM supports voice calls and data transfer speeds of up to 9.6 kb/s, together with the use of short message service (SMS).

GSM operates in the 900 MHz and 1.8 GHz bands in Europe and India; and the 1.9 GHz and 850 MHz bands in the US. By having harmonised spectrum across most of the globe, GSM's international roaming capability allows users to access the same services when travelling abroad as at home. This gives consumers seamless and same number connectivity in more than 218 countries. Terrestrial GSM networks now cover more than 80 per cent of the world's population.

GSM operators now have upgraded to GPRS (General Packet Radio Service) and EDGE (Enhanced Data rates for GSM Evolution) technologies. GPRS offers throughput rates of up to 40 kb/s, so that users have a similar access speed to a dial-up modem, but with the convenience of being able to connect from almost anywhere. GPRS customers enjoy advanced, feature-rich data services such as e-mail on the move, multimedia messages and location-based services.

Further enhancements to GSM networks are provided by EDGE technology, which provides up to three times the data capacity of GPRS. Using EDGE, operators can handle three times more subscribers than GPRS, triple their data rate per subscriber, or add extra capacity to their voice communications. EDGE allows the delivery of advanced mobile services such as the downloading of video and music clips, multimedia messaging, high-speed Internet access and e-mail on the move.

EDGE uses the same structure, as today's GSM networks, which allows it to be overlaid directly onto an existing GSM network. "For many existing GSM/GPRS networks, EDGE is a simple software-upgrade. Due to the very small incremental cost of including EDGE capability in GSM network deployment, virtually all new GSM infrastructure deployments are also EDGE capable and nearly all new mid- to high-level GSM devices also include EDGE radio technology." (www.gsmworld.com)

Till 2002, Indian mobile operators only deployed GSM. In 2002, the government permitted basic operators to offer limited mobility using the CDMA technology.

Source: www.gsmworld.com

[23] Telecom Regulatory Authority of India.

Box 2.3 : Code Division Multiple Access (CDMA)

According to the CDMA Development Group (CDG), there are 575 million subscribers on CDMA networks globally as on December 31, 2010. CDMA2000, the technology in use since 2000, operates in a relatively small amount of spectrum, 1.25 MHz, in most of the frequency bands designated by the International Telecommunication Union (ITU) including the 450 MHz, 700 MHz, 800 MHz, 1700 MHz, and 1900 MHz AWS and 2100 MHz band. In India CDMA operators get spectrum in the 800 MHz band.

CDMA2000 was designed with mobile Internet in mind. It is an efficient and reliable IP-based platform on which wireless data applications are delivered. CDMA2000 supports thousands of applications across multiple execution environments (e.g. BREW, Java, Linux, Palm, RIM, Windows Mobile, etc.) and customers can choose from a wide variety of handsets, fixed wireless phones, PDAs, smart phones, notebooks, desktop modems and PC cards to access these applications. According to the CDG there are 315 operators across 120 countries which have deployed CDMA 2000 technology.

Source: www.cdg.org

The number of wireless subscribers is based on Home Location Register (HLR) which presents the number of users registered on the network. When compared with the Visitor Location Register (VLR) which shows only those subscribers who make calls or send SMSes or use data regularly and are active over a continuous period, HLR presents a somewhat overstated figure. There is also no double counting of subscribers because each base station in the network is served by exactly one VLR, hence a subscriber cannot be present in more than one visitor location.[24] As per this method, only 73.6 per cent of the total wireless subscribers (670.65 million) were found to be regular users as of February 2012. Even then the growth in telephone subscribers is spectacular given where India was in 2000.

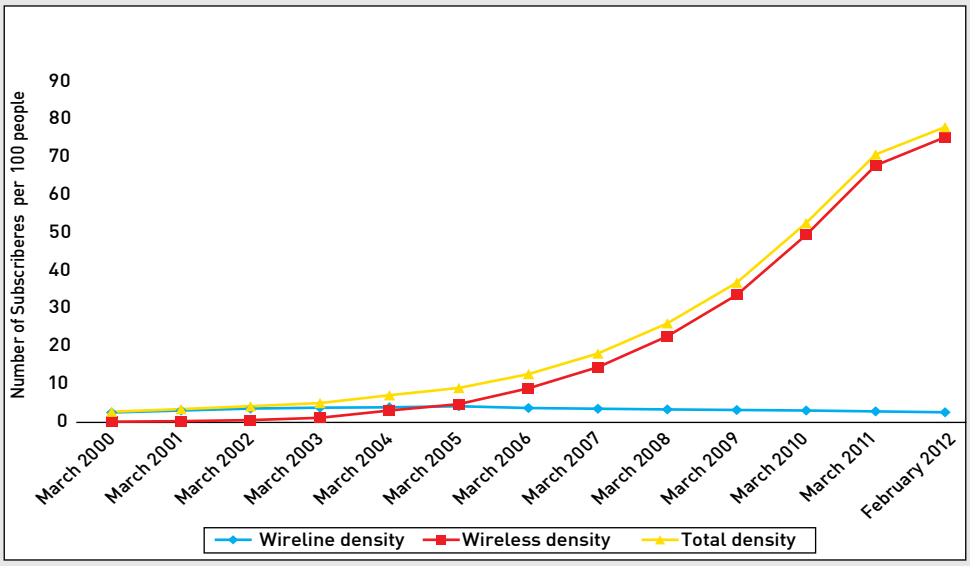
2.3.1.3 Teledensity

With the increase in the number of telecom subscriptions, the total teledensity has increased from 2.81 in 2000 to 78.10 on February 2012, a CAGR of 31.9 per cent. This is mainly driven by the increase in wireless density (Figure 2.8). Wireline density was higher than wireless till 2004 and then declined after peaking in 2005. During the period March 2000–February 2012, wireline density increased at the CAGR of 0.19 per cent.

Wireless density increased at the CAGR of 64.65 per cent during the period March 2000 to February 2012.

[24] The Hindu Business Line (2010), *Only 70% of Mobile Subscriber Base is Active*. Available online at www.thehindubusinessline.com

Figure 2.8 : Teledensity, March 2000–February 2012



Source: Telecom Regulatory Authority of India.

2.3.1.4 Why Wireless?

There is no recent data which can inform us directly about the expenditure of households on communication items in India. However, the 61st round of National Sample Survey (NSS) data for 2004–05 informs us that the monthly per capita expenditure of a household on telephone charges in rural areas was Rs 5.54 out of the total expenditure (food and non-food, except durables) of Rs 558.78. In urban areas the corresponding figures were Rs 37.8 and Rs 1,052.36. This means that in rural areas, households spent approximately 1 per cent of their total expenditure on telephones whereas for households in urban areas this figure was 3.59 per cent. Share of expenditure on mobile phones from other studies is shown in Table 2.1.

Table 2.1 : Estimates of Share of Expenditure on Mobile Phones

Name of the study	Expenditure on mobile phones
Rashid, A.T. and L. Elder (2009), *Mobile Phones and Development: An Analysis of IDRC- Supported Projects*, Electronic Journal on Information Systems in Developing Countries, 36(2), 1–16. www.ejisdc.org. Accessed on January 6, 2011.	Expenditures on mobile phones range from four to eight per cent of income per month.

(*Contd...*)

Table 2.1 : Contd...

Name of the study	Expenditure on mobile phones
Sarin, A. and R. Jain (2009), *Effects of Mobiles on socioeconomic Life of Urban Poor*. Indian Institute of Management, Ahmedabad Working Paper No. 2009-02-05. Available online at http://www.iimahd.ernet.in/. Accessed on November 3, 2010.	More than 70 per cent of the urban poor households spend around 3 per cent of their total household earnings on their mobile every month.
Agüero, A. and H. de Silva (2010), *Bottom of the Pyramid: Expenditure Patterns on Mobile Phone Services in Selected Emerging Asian Countries,* LIRNEasia Teleuse@BOP3 Working Paper Series. Available online at http://lirneasia.net/. Accessed on January 19, 2011.	Monthly expenditure on mobile varies between each quintile for the period 2008–09 (bottom-most – 24.3 per cent, second bottom-most – 11.3 per cent, Middle – 8.4 per cent, second top-most – 5.7 per cent and top-most – 4.4 per cent).

The above estimates show that mobile phones may be a significant part of expenditures for households especially for the bottom half. Mobile phones substitute for fixed lines in developing countries and complements fixed lines in developed countries.[25] Vodafone (2009) finds similar results for India where there is a complementary relationship between wireline and wireless in high mobile penetration states and they act as substitutes in low mobile penetrated states[26]. There has been a lot of literature in the last decade which has examined the question of popularity of the mobile phones in developing countries like India.

The popularity of mobile phones is due to their personal, portable, and digital nature enabling people to be always "connected". Further, the budget telecom network model (Box 2.1) mentioned earlier and the ultra low cost of handsets (Figure 2.9) has made mobiles ubiquitous.[27] More than a quarter of all handsets sold in India are second-hand i.e. re-sold and recycled within India.[28] These factors lower the barrier to entry.[29] On the supply side, it is relatively cheaper to extend mobile connections than fixed line telephony.[30]

[25] Waverman, L., Meschi, M. and M. Fuss (2005), *The Impact of Telecoms on Economic Growth in Developing Countries,* Vodafone Policy Paper Series: Africa: The Impact of Mobile Phones, No. 2, Vodafone Group. Available online at www.umich.edu

[26] Vodafone (2009), *India: The Impact of Mobile Phones,* Vodafone Policy Paper Series No. 9. Available online at http://www.vodafone.com

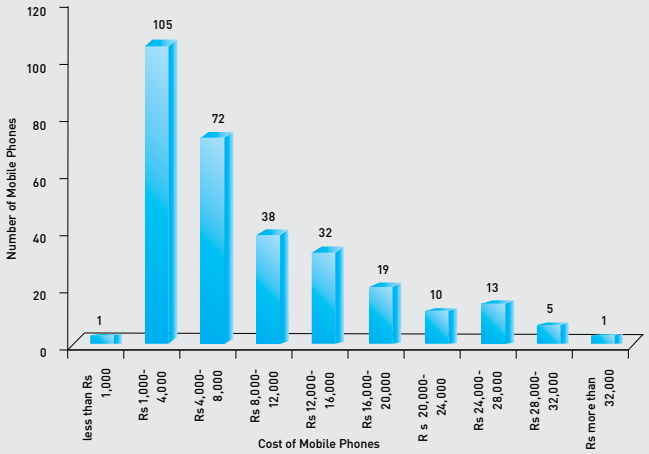
[27] Figure 2.9 shows the number of mobile phones in India at each price brand. The "frequency" represents the occurrence of various brands of handsets with cost as per "class-interval". More than 100 models are available costing between Rs 1,000 and Rs 4,000; 72 models available between Rs 4,000 and Rs 8,000, and so on and so forth. The choices decline with increase in price except there is an aberration in the Rs 24,000–Rs 28,000 range.

[28] Addler, R.P. and M. Uppal (2008), *m-Powering India: Mobile Communications for Inclusive Growth,* Aspen Institute, India. Available online at www.aspeninstitute.org

[29] One more factor that is attributed in Samaan (2003) that may potentially drive adoption of mobile phones is income inequality, i.e. the higher the level of income inequality in a country, the more it is likely that an individual living there owns a mobile phone. This may be due to that mobile becomes a symbol of luxury. Further the study finds evidence of diffusion being slower in countries with low per capita incomes.
Samaan, M. (2003), *The Effect of Income Inequality on Mobile Phone Penetration,* Boston College: Honors Thesis – Department of Economics.

[30] Bhavnani, A., Chiu, R.W., Janakiram, S. and P. Silarzsky (2008), *The Role of Mobile Phones in Sustainable Rural Poverty Reduction.* ICT Policy Division, World Bank. Available online at www.worldbank.org

Figure 2.9 : Mobile Phone Prices in India



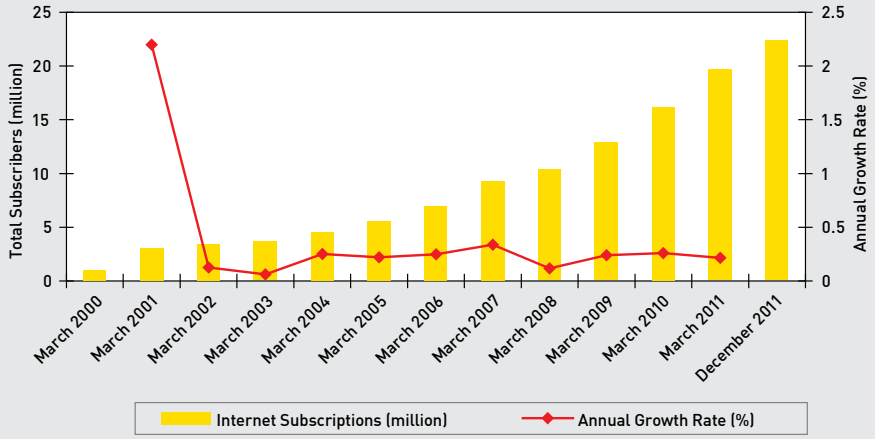
Source: Mobile phone prices in India. Available online at www.fonearena.com
Note: Mobile phone prices are as of February, 2011.

2.3.2 Internet

2.3.2.1 Data Trends

The number of Internet subscribers increased from 0.95 million in March 2000 to 22.39 million in December 2011, grown at a CAGR of 33.3 per cent (Figure 2.10). As of December 2011 this comprises of 13.35 million broadband (>=256 kbps) connections and 9.08 million narrowband (<256 kbps) connections. Latest statistics available till February 2012 indicate that broadband subscribers have increased to 13.42 million.

Figure 2.10 : Internet Subscriptions and Growth Rate, March 2000–December 2011



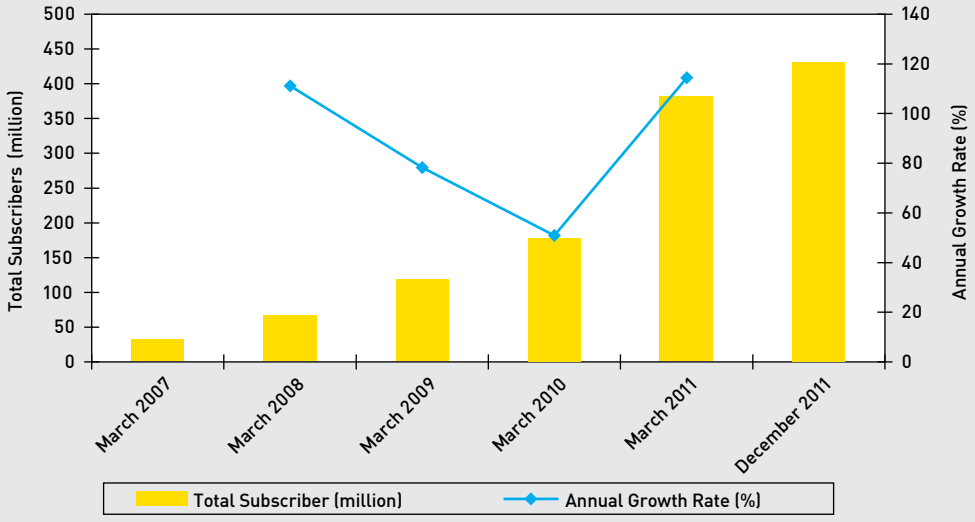
Source: Telecom Regulatory Authority of India.

Despite such impressive growth, the share of Internet users remains a negligible fraction of India's total population. Lack of accessibility, lack of information, lack of literacy, inconsistent power supply, and high maintenance cost of personal computers (PCs) are some of the major reasons for this phenomenon.[31] This implies that mobile Internet access may have a substantial impact on Internet users in the country.

[31] Veeraraghavan, R., Yasodhar, N. and K. Toyama (2009), *Warana Unwired: Replacing PCs with Mobile Phones in a Rural Sugarcane Cooperative*, Information Technologies and International Development, 5(1), Spring, 81–95.

Mobile broadband is getting increasingly popular in India similar to China, especially accessing broadband over the mobile phone.[32,33] There were 431.37 million wireless subscribers in India who had subscribed to data services as of December 2011. This implies that 48.26 per cent of total wireless subscribers were capable of accessing data services/Internet at the end of December 2011. The number of wireless subscribers who have subscribed to data services has increased at the CAGR of 93.1 per cent between March 2007 and December 2011 (Figure 2.11). This growth rate is much higher than the growth in traditional Internet subscribers.

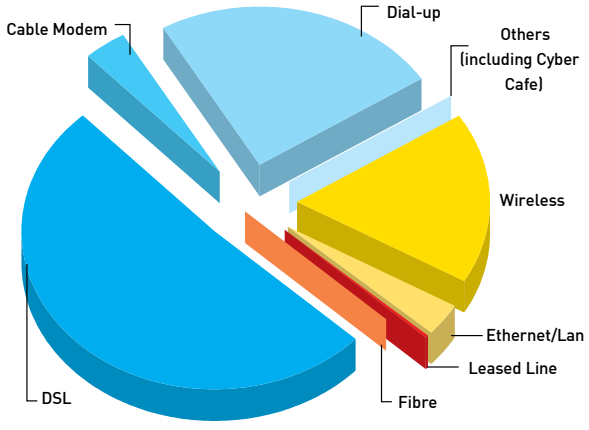
Figure 2.11 : Wireless Subscribers Capable of Accessing Data Services/Internet, March 2007–December 2011



Source: Telecom Regulatory Authority of India.

Broadband subscription is 59.6 per cent of total Internet subscription as of December 2011. Dial-up is the most popular narrowband technology with 24.2 per cent of total Internet connections (Figure 2.12).

Figure 2.12 : Market Share of Internet Access Technologies including Broadband, December 2011

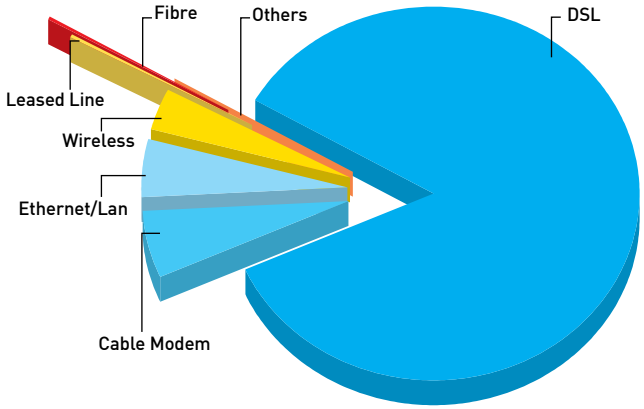


Source: Telecom Regulatory Authority of India.

[32] Organisation for Economic Co-operation and Development (2009), ICTs *for Development: Improving Policy Coherence.* Paris, France.
[33] PricewaterhouseCoopers (PWC) (2010), *Mobile Broadband Outlook 2015.* Available online at http://www.pwc.com/in/

Digital Subscriber Line (DSL) is the most preferred technology used by the service providers to provide broadband services, which constitutes 50 per cent of total Internet subscribers and 85.1 per cent of total broadband subscribers (Figure 2.13). Box 2.4 examines the various broadband technologies in detail.

Figure 2.13 : Broadband Access, Technologies and Market Share, December 2011



Source: Telecom Regulatory Authority of India.

Box 2.4 Broadband Technologies

The classification of high speed Internet connection into Broadband became effective with the introduction of Broadband Policy, 2004 announced by the government on October 14, 2004. Broadband was 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"* (www.trai.gov.in). In short, all Internet connections having minimum download speed of 256 kbps are classified as Broadband.

The popular technologies used to provide Broadband in access network are DSL, Wireless, Cable TV, Satellite and optical fibre. Different technology options have different advantages and limitations and are best suited to different requirements.

DSL Broadband: DSL connections are provided using copper cable of fixed line network. More than 60 per cent Broadband subscribers belong to the top ten metros/tier-I cities and more than 75 per cent connections belong to top 30 cities. DSL connections support a maximum speed of up to 2 Mbps within a limited distance of 3 km from the exchange. Even if one considers that about 50 per cent of available copper loop is capable to deliver Broadband services and only 50 per cent of these capable connections exist within a 3 km range from the exchange, one can provide Broadband capable to support up to 2 Mbps to 25–30 per cent of fixed line connections through DSL (9–10 million). DSL will not be able to satisfy futuristic subscribers' bandwidth demand which is 3–4 Mbps per household.

Wireless Technologies for Broadband: Wireless technologies provide different alternatives to provide Internet/ Broadband. At present in India, majority of wireless Internet connection is working on 2G EDGE technology which can support maximum speed of 144 kbps. Wireless access technologies will include 3G wireless, Broadband wireless access, LTE, WiMAX, and other technologies that might come in future. Wireless in access network may be promising but for supporting growing bandwidth demand, frequent reuse of spectrum is necessary. The spectrum reuse require well laid robust feeder network up to tower. Therefore, even after availability of capable wireless technologies for high speed Broadband, robust feeder network will be necessary.

Third generation (3G) mobile service is one technology that will enhance the mobile experience. The 3G technology marks a quantum jump in mobile services as it helps users to quickly access a range of multimedia services, including video telephony, e-commerce and television on mobile devices like handsets, smart phones and palm tops. The 3G networks deployed by some of the operators are capable of providing throughput of 2 Mb per cell for stationary customers. 3.5G wireless technologies are typically capable of providing Broadband speed of about 14.4 Mbps per cell site with 5 MHz carrier. Some operators have deployed CDMA networks with EVDO which can give about 3 Mbps connection to a subscriber. 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 WiMax: These are the next steps in the technological roadmap. WiMAX is based upon the IEEE 802.16 standard enabling the delivery of wireless Broadband services anytime, anywhere. Both WiMAX and LTE products can accommodate fixed and mobile usage models. WiMAX will provide Broadband connectivity anywhere, anytime, for any device and on any network. This will have huge implications for services like e-governance, e-education and e-medicine.

Cable TV Networks for Broadband: Cable TV networks has the capability to become a cheaper and convenient source of providing Broadband to households as cable TV networks already have access to large number of households. Presently there are estimated 92 million Cable TV households in India. By and large cable TV networks are analog and one way. These networks require upgradation for providing Broadband. The highly fragmented existing cable TV networks in some cases may not be upgradeable and may require total replacement. But there are instances where the existing network has been upgraded by many cable operators to provide Broadband services. Upgradation of cable TV network per line requires significant cost and seems to be one of the reasons for slow upgradation of Cable TV networks to provide Broadband.

The current major Broadband technologies deployed by the cable industry are Data Over Cable Service Interface Specification (DOCSIS) and Ethernet over cable technology. DOCSIS 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 fibre backbone and extended LAN technology using CAT 5/6 cable as the last mile or Ethernet over Cable (EoC) based on deeper fibre 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.

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 up to 20 Mbps. In the Ethernet option it can deliver up to 96 Mbps per cable section with the present version supporting up to 32 users. The newer version can support up to 128 users. But it will require huge amount of funds for upgrading the network which could limit its implementation.

Satellite Technology for Broadband: Use of satellite technology for Broadband offers significant advantages in terms of ubiquitous coverage, simplicity in network design, reliability and rapid deployment and is very effective to serve inaccessible hilly areas where wired access is difficult to lay. Provisioning of Broadband through satellite requires main hub and remote stations. The cost of a main hub and satellite bandwidth is high. As a result, the Broadband connections provided using satellite medium is costly. The low bandwidth support, higher cost of connectivity, and limited availability of satellite transponders have so far limited the use of satellite connectivity to provide Broadband for masses. However, things are changing at the cost front. As satellite beaming technology has advanced the cost of providing Broadband over this medium has come down over the last ten years. Globally, there are operators offering USB dongles that connect directly to the satellite. This medium, however, is expensive if the coverage is done in a limited area. According to operators in India who are planning to enter this segment in a big way, the entire country can be covered with the investment of Rs 10,000 crore. But the issue linked to transponder availability is still a problem with the Indian Space Research Organization (ISRO) not agreeing for an open sky policy, which would allow foreign satellites to sell bandwidth directly into India.

Optical Fibre Technologies: Optical fibre has been mostly laid by the service provider for long haul traffic. There is only a small amount of fibre in the access network resulting in only about 0.53 per cent Broadband connections working on optical fibre. However, with increasing bandwidth demand in the access network, fibre is being increasingly used by the service providers. Already about 7.5 lakh route kilometres of fibre has been laid out by various players. As more and more bandwidth is being demanded in the access networks, the fibre 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 (PONs) which reduce the amount of fibres from the Central Offices (COs) as compared to a point-to-point system.

One, or fibre 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 an Optical Line Terminal (OLT) in the CO, and at or near the customer's premises there is an Optical Network Terminal (ONT).

Optical fibre in the access network is capable of providing high bandwidth throughput for services (even up to 100 Mbps) such as high definition IP Television (IPTV), video on demand (VoD), etc. In metros and big cities, the demand of bandwidth is leading towards a situation where FTTP/FTTB (Fibr to the Premises/Fibre to the Building) will be inevitable.

Sources: Telecom Regulatory Authority of India, www.wimaxforum.org

2.3.3 Other Services

2.3.3.1 Public Call Offices and Village Public Telephones

Total number of Public Call Offices (PCOs) in the country as of December 2011 was 2.37 million as compared to 0.65 million in 2000, showing an increase of 12.5 per cent (CAGR). However, the numbers declined as compared to the previous year (Table 2.2). The declining trend in PCOs could be attributed to the increasing penetration of mobile connections due to reduction in entry level costs and availability of customised tariff schemes in the market.[34]

The number of Village Public Telephones (VPTs) increased from 0.41 million in 2000 to 0.58 million in December 2011. per cent of inhabited villages connected in India is 98.2.[35]

Table 2.2 : PCO and VPT, March 2000–December 2011 (million)

Year	PCO	VPT
March 2000	0.65	0.41
March 2001	0.86	0.37
March 2002	1.08	0.47
March 2003	1.49	0.51
March 2004	1.92	0.52
March 2005	2.77	0.53
March 2006	4.20	0.55
March 2007	5.55	0.56
March 2008	6.19	0.56
March 2009	6.20	0.56
March 2010	4.59	0.57
March 2011	3.33	0.58
December 2011	2.37	0.58

Source: Telecom Regulatory Authority of India.

2.3.3.2 Other Value Added Services: PMRTS and VSAT

The number of PMRTS subscribers has increased from 0.019 million in March 2000 to 0.036 million in March 2008 before declining to 0.033 million in December 2011. The number of VSAT subscribers have gone up steadily from 0.017 million in 2003 to 0.15 million in 2011 (Table 2.3).

Table 2.3 : Number of Subscribers for Other Value Added Services, March 2000– December 2011 (million)

Year	PMRTS	VSAT
March 2000	0.019	-
March 2001	0.023	-
March 2002	0.028	-
March 2003	0.026	0.017
March 2004	0.025	0.028
March 2005	0.026	0.038
March 2006	0.030	0.050
March 2007	0.032	0.061
March 2008	0.036	0.081
March 2009	0.032	0.102
March 2010	0.033	0.124
March 2011	0.034	0.14
December 2011	0.033	0.15

Source: Telecom Regulatory Authority of India.

2.3.4 Public versus Private

Telecom service was initially state owned in India. Two state-owned public sector incumbents, namely Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Limited (MTNL), have till date dominated the fixed line service. However, facilitated by reforms, role of the private sector has increased in the telecom sector since 1992. From the days of a state monopoly with very limited growth, the sector has grown manifold with a number of private players driving growth.

2.3.4.1 Telephones

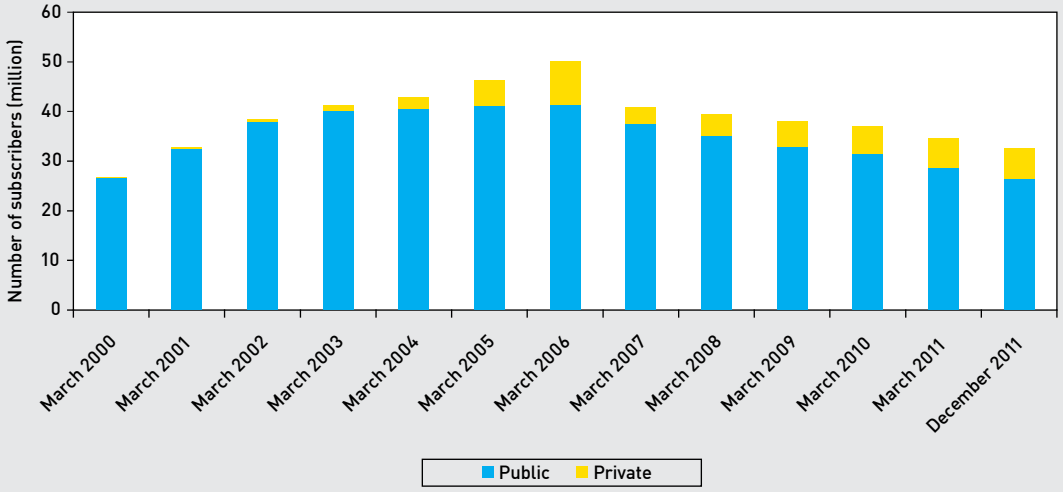
The public and private players share the fixed line and the mobile segments, with the public sector dominating the wireline and private sector dominating the wireless segments. The major players of the telecom sector are

[34] Telecom Regulatory Authority of India.
[35] Telecom Regulatory Authority of India.

currently experiencing fierce competition in both the segments. As a result, players are coming up with new tariffs and discount schemes to gain competitive advantage.

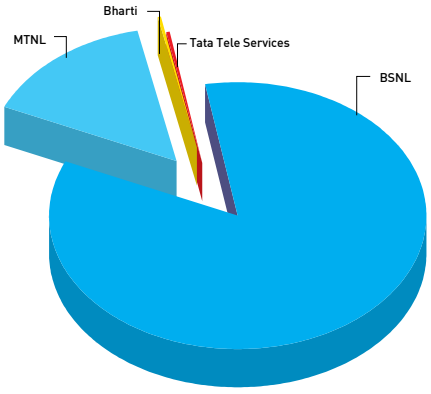
Figures 2.14, 2.15A and 2.15B show the dominance of the public sector in the delivery of fixed line services, which has changed only a little in the last decade. In the wireline segment, the state-owned public sector incumbents, namely BSNL and MTNL have been the dominant players. However, private companies such as Bharti, Reliance and Tata Tele Services have also marked their presence. As a result, share of BSNL and MTNL have come down from 100 per cent in March 2000 to 81 per cent in December 2011. Further, the number of players in the private sector has increased signalling higher competition in this sector.

Figure 2.14 : Public–Private Wireline Subscriptions, March 2000–December 2011 (million)



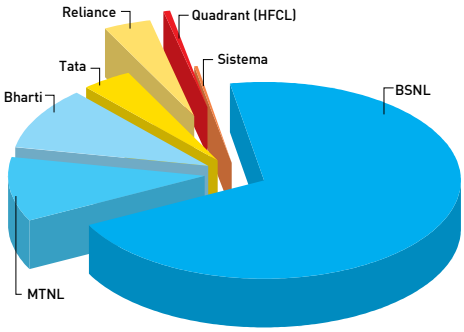
Source: Telecom Regulatory Authority of India.

Figure 2.15A : Share of Service Provider in Wireline Subscriptions, 2001 (%)



Source: Telecom Regulatory Authority of India.

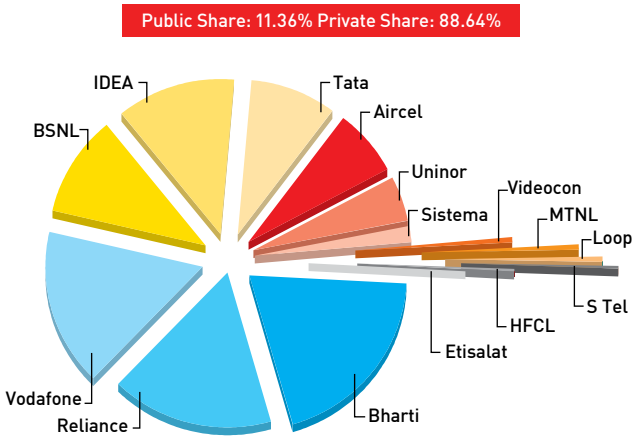
Figure 2.15B : Share of Service Provider in Wireline Subscriptions, December 2011 (%)



Source: Telecom Regulatory Authority of India.

Figure 2.16 shows the share of service providers in wireless subscriptions in February 2012. The two public sector enterprises (PSEs), BSNL and MTNL, were allowed belated entry into the cellular segment in the beginning of the present decade. The sector is dominated by Bharti, Reliance, Vodafone, BSNL, Tata Tele Services, and Idea. There are many smaller players, with operations in only a few states. International roaming agreements exist between most operators and many foreign carriers.

Figure 2.16 : Share of Service Provider in Wireless Subscriptions, February 2012 (%)

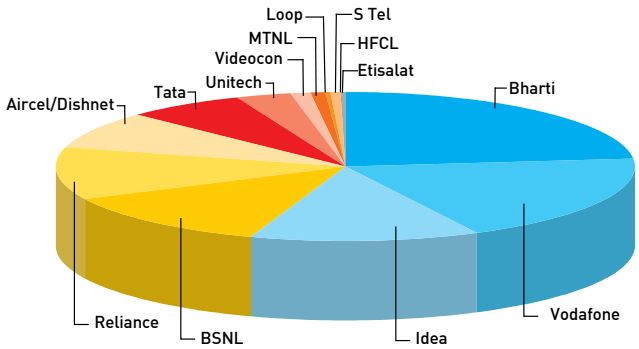


Source: Telecom Regulatory Authority of India.

Next we examine the break-up between public and private providers for wireless phones using two different technologies – GSM and CDMA.

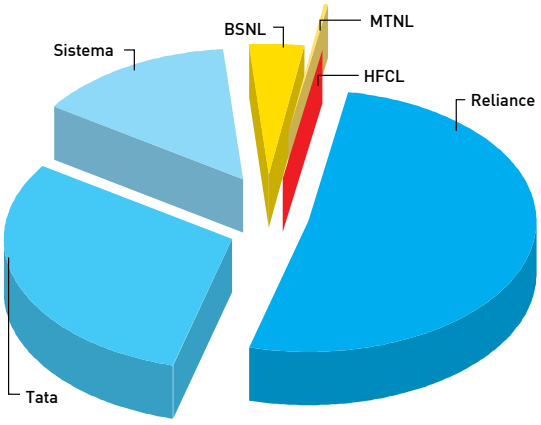
GSM continues to be the dominant technology for wireless phones with 87.9 per cent share. Bharti is the dominant player in GSM segment accounting for 22.35 per cent of the market in terms of market subscriptions followed by Vodafone (18.80 per cent), Idea (13.53 per cent) and Reliance (12.05 per cent) (Figure 2.17). There are as many as 14 operators using GSM technology compared to just six using CDMA. Reliance is the leading player in the CDMA market with 51.32 per cent share (Figure 2.18). Tata is the next big player in this market.

Figure 2.17 : Share of Service Provider in Wireless Subscriptions based on GSM, December 2011 (%)



Source: Telecom Regulatory Authority of India.

Figure 2.18 : Share of Service Provider in Wireless Subscriptions based on CDMA, December 2011 (%)



Source: Telecom Regulatory Authority of India.

2.3.4.2 Internet Services

Internet service was opened for private participation in 1998 with a view to encourage growth of Internet and increase its penetration. This has resulted in the entry of a number of private Internet service providers (ISP) in the country. However, the market is still dominated by state owned companies, BSNL and MTNL (Table 2.4). These two companies together accounted for around 66.3 per cent of the Internet subscriptions in the country in December 2011.

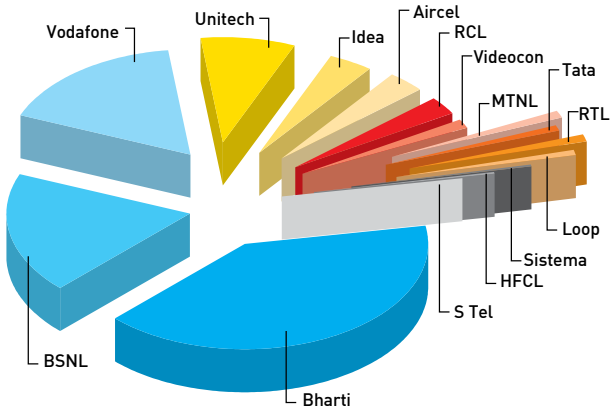
Table 2.4 : Market Share of Leading ISPs in Terms of Subscribers, December 2011

Company	Share (%)
BSNL	54.97
Reliance Communications Infrastructure Limited	15.97
MTNL	11.33
Bharti Airtel	6.12
You Broadband and Cable India Private Limited	1.74
Hathway Cable and Datacom Private Limited	1.61
Tikona Digital Networks Private Limited	1.14
Tata Communications Limited	0.84
Beam Telecom Private Limited	0.81
Asianet Satellite Communications Limited	0.5
Others	4.96

Source: Telecom Regulatory Authority of India.

Bharti is the leading data service provider, followed by BSNL and Vodafone (Figure 2.19). Thus, the private sector is leading the way in one of the most dynamic areas of the telecom sector.

Figure 2.19 : Service Provider-wise Details of Data Services, December 2011 (%)

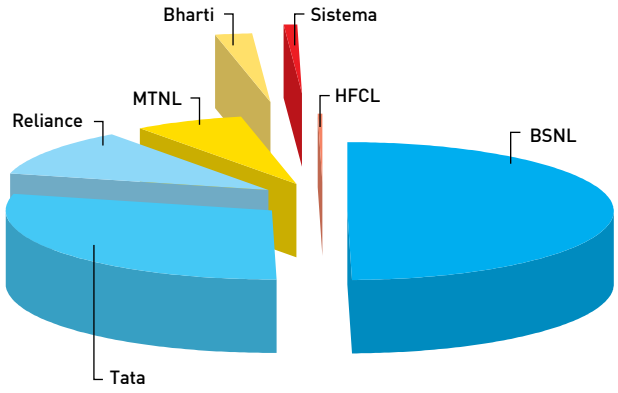


Source: Telecom Regulatory Authority of India.

2.3.4.3 PCOs and VPTs

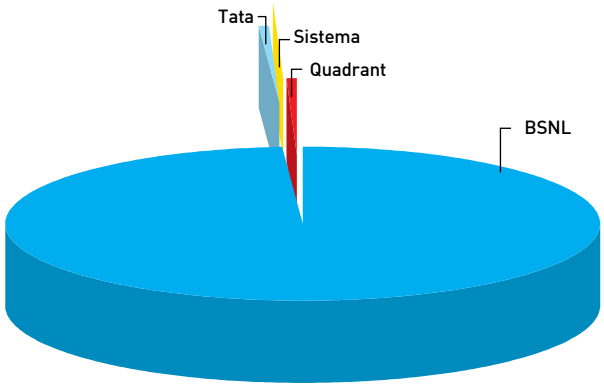
Public sector companies are the leading PCO and VPT service providers in India. As of December 2011 the two public sector companies MTNL and BSNL together accounted for around 56.95 per cent of the PCOs and 98.9 per cent of the VPTs in the country, (Figures 2.20A and 2.20B).

Figure 2.20A : Service Provider-wise Shares in PCO, December 2011



Source: Telecom Regulatory Authority of India.

Figure 2.20B : Service Provider-wise Shares in VPT, December 2011

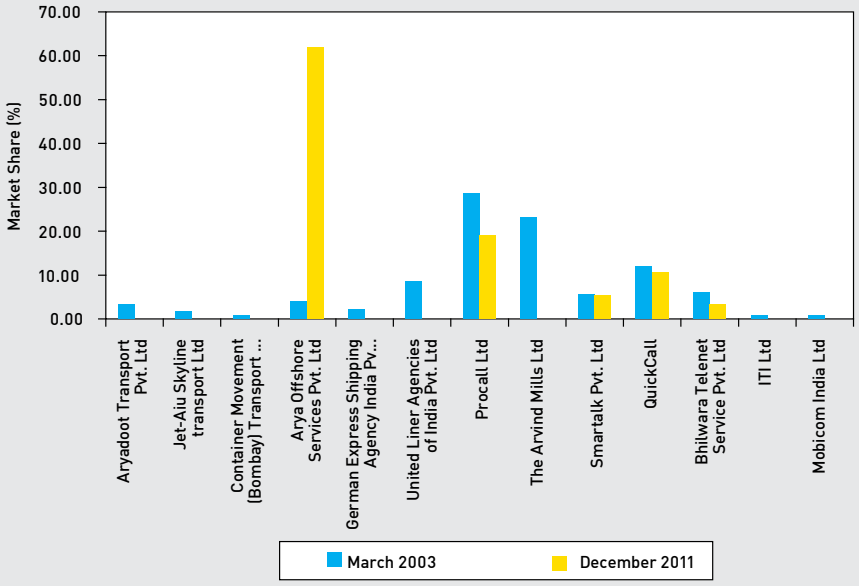


Source: Telecom Regulatory Authority of India.

2.3.4.4 PMRTS and VSAT

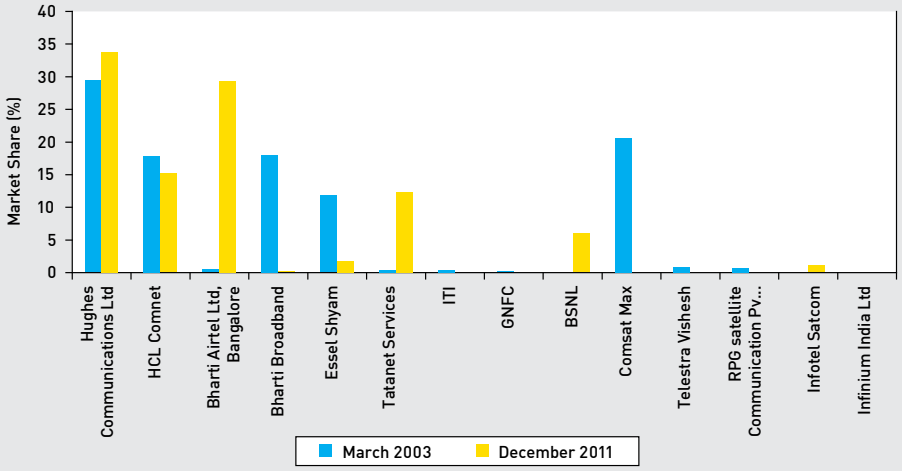
Figures 2.21 and 2.22 show the service provider details of PMRTS and VSAT, respectively. The private sector dominates these sectors. There has also been some consolidation in the market where some companies have dropped out.

Figure 2.21 : Market Share of PMRTS Providers (%)



Source: Telecom Regulatory Authority of India.

Figure 2.22 : Market Share of VSAT Service Providers (%)



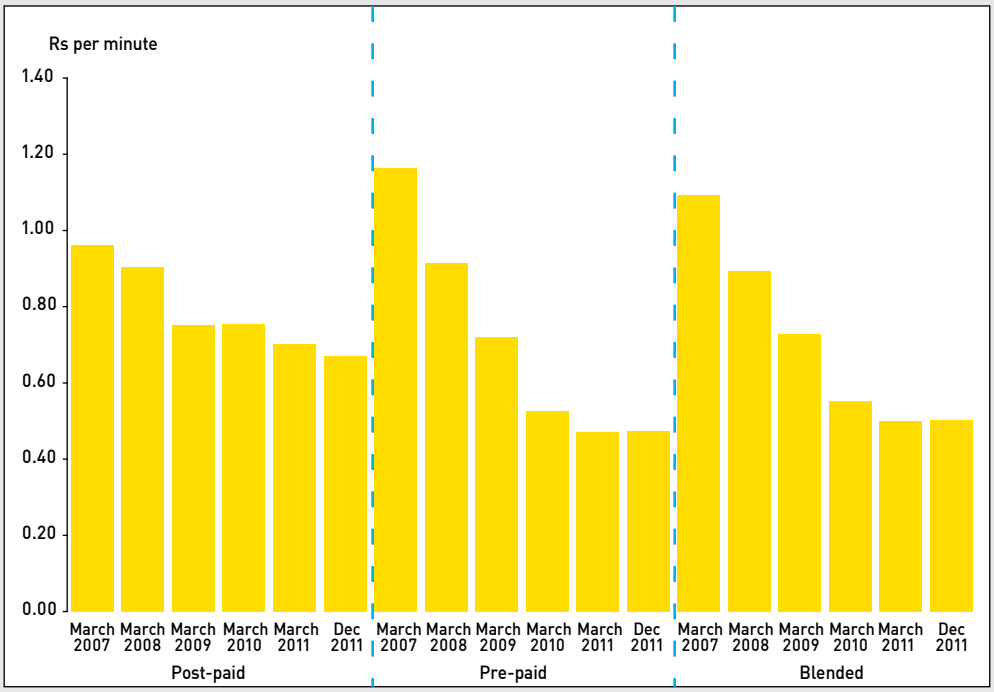
Source: Telecom Regulatory Authority of India.

2.3.5 Revenue and Usage

2.3.5.1 Wireless Phones

Given the overwhelming importance of wireless phones in the Indian telecommunications sector and the added advantage of data availability on a regular basis, this section focuses on wireless phones. Preliminary analysis suggests that policy and regulatory initiatives induced competition (Box 2.5), which in turn led to fall in prices.[36,37,38]

Figure 2.23 : Average Outgo* per Outgoing per Minute (Rs per minute) for Postpaid, Prepaid and Blended (GSM and CDMA), 2007–11



*Outgo includes both rental and call charges.
Source: Telecom Regulatory Authority of India.

All India blended weighted average outgo per outgoing per minute has declined from Rs 1.09 per minute in March 2007 to Rs 0.5 in December 2011 as shown in Figure 2.24 indicating reduction in tariff levels.[39] This rate has declined at a CAGR of 21.5 per cent between March 2007 and March 2011. Prepaid has declined at a faster rate (CAGR 25.3%) than either postpaid (CAGR 8.2%) or blended between March 2007 and March 2011. Not surprisingly, 97 per cent GSM subscriptions and 94 per cent CDMA subscriptions were prepaid. The numbers vary across the circles. In Metros the share of prepaid customers was 91.4 per cent (GSM) and 90.4 per cent (CDMA). In

[36] Malik, P. and L.C. Salazar (2007), *An Analysis of the Reforms of Indian Telecommunication Industry: Policy, Regulation and Indicators,* LIRNEasis Multi-component 6-country study. Available online at http://lirneasia.net/
[37] Malik, P. (2009), *Telecom Regulatory and Policy Environment in India: Results and Analysis of the 2008 TRE Survey.* Available online at http://lirneasia.net/
[38] NCAER (2010), *Infrastructure Development in India: An Assessment of Status and Strategies,* New Delhi, India, Volume II.
[39] Weighted average for all-India was calculated using weights 0.86 for GSM prices and 0.13 for CDMA prices.

contrast, in Circle B the share goes up to 98.4 per cent (GSM) and 96.2 per cent (CDMA). Prepaid service has been one of the most important innovations in the mobile communications history and one can claim that it arose in South Asia (Box 2.1).

Box 2.5 : Competition in the Telecommunications Sector

Malik and Salazar (2007) and NCAER (2010) have argued that policy and regulatory reforms have introduced competition in the sector. A traditional measure of competition is the Hirschman Hirfindahl Index (HHI) which measures the size of the firms in relation to the industry. Lower number means more competition. Based on revenue shares, Malik and Salazar (2007) show that HHI declined from 0.96 in 1999–2000 to 0.54 in 2004–05 in fixed line telephony. HHI has increased from 0.09 in 1999–2000 to 0.27 in 2004–05 in mobile telephony. NCAER (2010) compares HHI circle-wise between 2003 and 2007 for mobile telephony. HHI is much lower in the latter years and is below 0.20 for most circles except Himachal Pradesh, North-East and Jammu and Kashmir. All these figures indicate higher competition in the mobile sector.

Gupta (2007) extensively studies competition in the telecommunications sector and argues for other indicators on the degree of competition. Looking at "entry and exit and growth rates of different operators", Gupta (2007) finds that most companies have maintained their positions. However, there were some companies which shrunk and departed from the industry. Looking at growth rates, most companies had healthy growth rates except for one. Gupta (2007) also advocates looking at advertising and price plans for competition but those data are typically unavailable. Continuously declining ARPUs are a good sign of healthy competition.

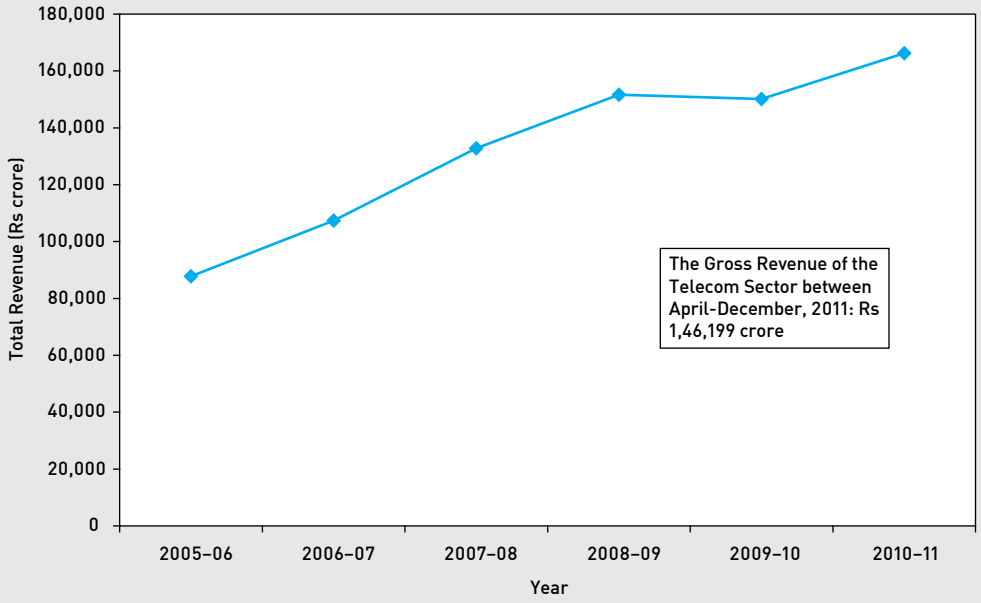
Sources: Gupta, S. (2007), *Competition Policy in Telecommunications in India*. Available online at www.cci.gov.in[40]
Malik, P and L.C. Salazar (2007), *An Analysis of the Reforms of Indian Telecommunication Industry: Policy, Regulation and Indicators,* LIRNEasis Multi-component 6-country study. Available online at http://lirneasia.net/
NCAER (2010), *Infrastructure Development in India: An Assessment of Status and Strategies,* NCAER, New Delhi, India, Volume II.

2.3.5.2 Revenue of the Telecom Sector

The total revenue trend for the last six years is depicted in Figure 2.24A. The total revenue (including other income) of the telecom service sector stood at Rs 1,63,067 crore in 2010–11 as against Rs 87,794 crore in 2005–06 showing an increase of 89 per cent over the last six years. However, revenue from telecom services is Rs 1,56,657 crore in 2010–11 as against Rs 82,687 crore in 2005–06. The total revenue of the public sector companies for 2010–11 is Rs 33,971 crore as against Rs 46,268 crore in 2005–06, showing major decline of 27 per cent over the last six years.[41] The total revenue contribution from the private sector for 2010–11 was Rs 1,29,096 crore as against Rs 41,526 crore in 2005–06 showing a tremendous growth of 211 per cent over the period (Figure 2.24B). The share of the public sector has decreased from 53 per cent to 21 per cent between 2005–06 and 2010–11. Share of the private sector increased from 47 per cent to 79 per cent during the same period.

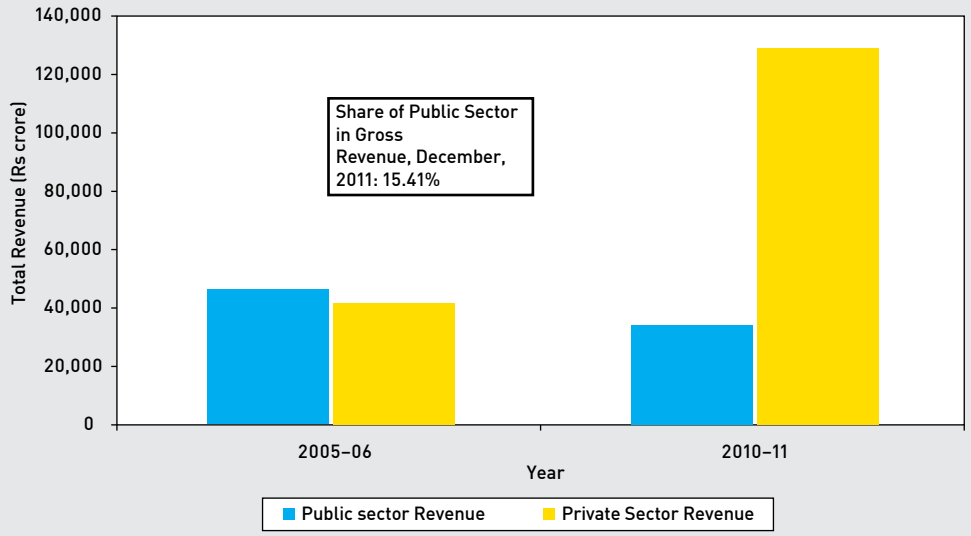
[40] We thank the Competition Commission of India for allowing us to use this paper in this report.
[41] MTNL, BSNL, Rail Tel.

Figure 2.24A : Telecom Sector Revenue, 2005–06 to 2010–11 (Rs crore)



Source: Telecom Regulatory Authority of India.

Figure 2.24B : Telecom Sector Revenue, 2005–06 and 2010–11 (Rs crore)



Source: Telecom Regulatory Authority of India.

EBITDA represents *the Profit (Earning) before Interest, Tax and Depreciation and Amortization.* EBITDA of Telecom Sector for 2010–11 is Rs 23,355 crore as against Rs 31,129 crore for 2005–06. EBITDA has shown a sharp decline of 25 per cent over the last six years. However, EBITDA for public sector companies has declined by 86 per cent but there is an increase of 80 per cent for private telecom service providers during the last six years. Sector-wise EBITDA, PBIT (Profit before Interest and Tax) and PBT (Profit before Tax) for the year 2010–11 and 2005–06 are shown in Table 2.5.

Table 2.5: Sector-wise EBITDA, PBIT, PBT (Rs crore)

Particulars	2005–06			2010-11		
	Public	Private	Total	Public	Private	Total
EBITDA	19,662	11,467	31,129	2,789	20,566	23,355
PBIT	10,233	4,219	14,452	(–)8,398	1,354	(–)7,044
PBT	9,118	2,573	11,692	(–)9,251	(–)7,020	(–)16,270

Source: Telecom Regulatory Authority of India.

The profitability ratios of telecom sector for the year 2010–11 and 2005–06 are shown in Table 2.6.

Table 2.6 : Sector-wise Profitability Ratios (%)

Particulars	2005–06			2010–11		
	Public	Private	Total	Public	Private	Total
EBITDA Margin	42.49	27.61	35.46	8.21	15.93	14.05
Net profit Margin	20.57	(–)0.84	10.44	(–)26.64	(–)7.84	(–)11.53

Source: Telecom Regulatory Authority of India.

Specifically examining revenue from the mobile sector, one finds that the coefficient of variation of gross revenue of all service providers was 2.6 in March 2009, 2.24 in June 2010 and 1.27 in March 2011. This signals that dispersion in revenues of the various service providers is coming down. It may be interpreted as a signal of increased competition in the sector, i.e. higher competition has driven down revenues of individual firms.

A close look at the composition of revenue from the wireless sector reveals that calls account for the majority of revenues followed by revenue from rentals, as shown in Table 2.7. Value-added services (VAS) offered through mobiles form more than 10 per cent of the revenue. Decomposing the VAS revenue one finds that 57 per cent of it comes from entertainment, out of which ringtones occupied the largest share.[42] Information comprised the second largest category of 39 per cent and m-commerce formed the smallest category of 4 per cent.

[42] Telecom Regulatory Authority of India and IAMAI report on Mobile VAS in India: 2010.

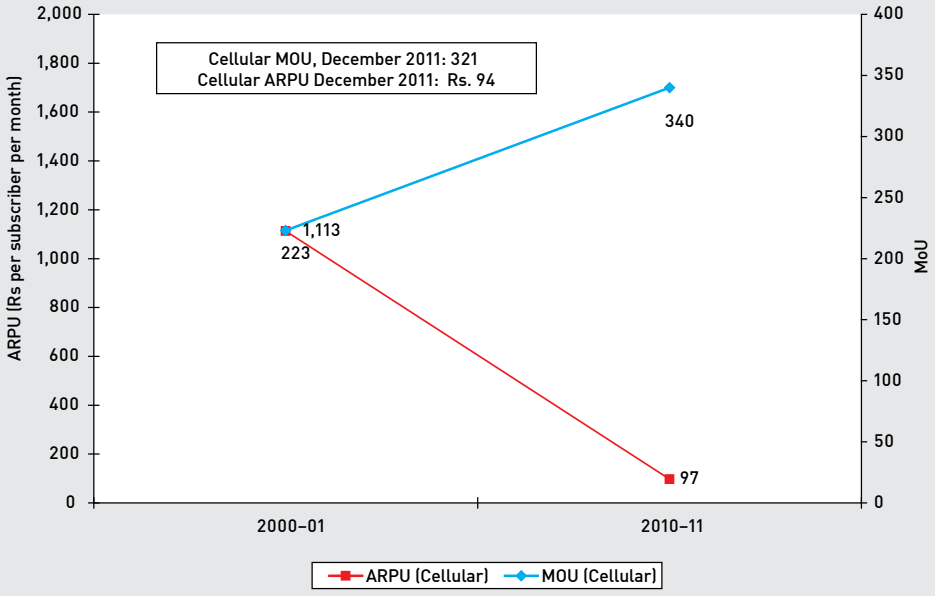
Table 2.7 : Composition of Revenue, December 2011 (%)

Item	GSM	CDMA
Rental revenue	20.42	23
Revenue from calls	50.61	41.7
Revenue from roaming	7.2	1.7
Revenue from SMS	8.73	4.3
Other revenue*	13.04	29.3

Source: Telecom Regulatory Authority of India.
*Other revenue includes revenue from other value added services, installation, etc.

While the consumer has benefited from the mobile revolution, operators are facing a tough challenge of declining Average Revenue per User (ARPU). The declining ARPU is mainly the result of declining call rates, thus enhancing affordability of lower income strata. Declining ARPU has been accompanied by increasing Minutes of Usage (MoU) (Figure 2.25).[43,44] Indian operators work on the low tariff – high volume model and their earnings are similar to their counterparts who work on high tariff – low volume models.[45] The EBITDA analysis in Table 2.5 shows the increase in earnings of the private sector. However, profit margins have declined for both public and private sectors with the decline higher for the public sector (Table 2.6). Moreover, operators are reducing operating costs and hiving off infrastructure elements such as towers into separate entities, thus inviting significant investment. Passive infrastructure sharing has benefited the Indian mobile industry and its customers. Further, initiatives such as network cost optimization, outsourcing of non-core activities as well as low-cost business models have improved operator returns at low ARPUs.

Figure 2.25 : ARPU and MoU for Wireless Subscribers, 2000–01 to 2010–11



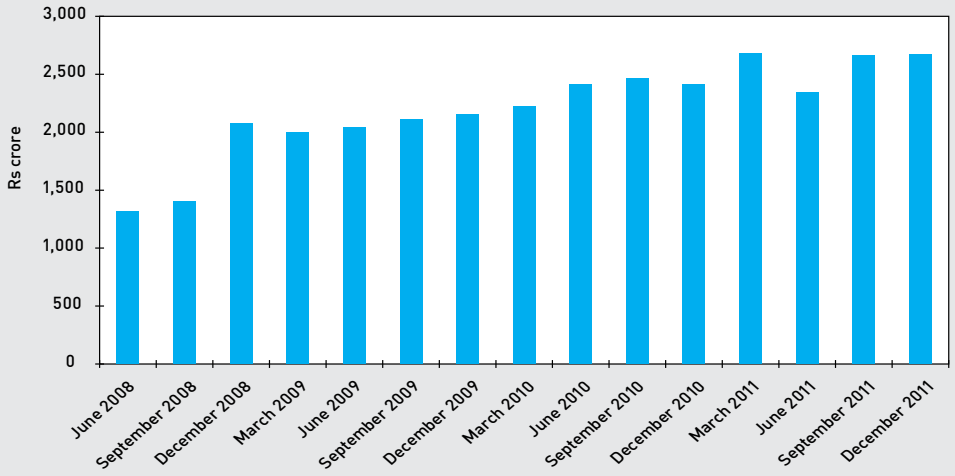
Source: Telecom Regulatory Authority of India.
Note: In 2000–01, only GSM was used in India and, therefore, MoU and ARPU from GSM has been used. For 2010–11, we have calculated a weighted average of GSM and CDMA ARPU and MoU. The weights are as per subscriber ratio of 0.9 to GSM and 0.1 to CDMA numbers.

[43] Vodafone (2009), *India: The Impact of Mobile Phones*, Vodafone Policy Paper Series No. 9. Available online at http://www.vodafone.com
[44] Malik, P. (2009), *Telecom Regulatory and Policy Environment in India: Results and Analysis of the 2008 TRE Survey.* Available online at http://lirneasia.net/
[45] United Nations Conference on Trade and Development (UNCTAD) (2010), *Information Economy Report*. Available online at www.unctad.org

2.3.5.3 Revenue of Internet Service Providers (ISPs)

With increase in subscriptions, revenue of ISPs has increased at a CAGR of 8.8 per cent between December 2008 and December 2011 (Figure 2.26).

Figure 2.26 : Revenue of Internet Service Providers, June 2008–December 2011

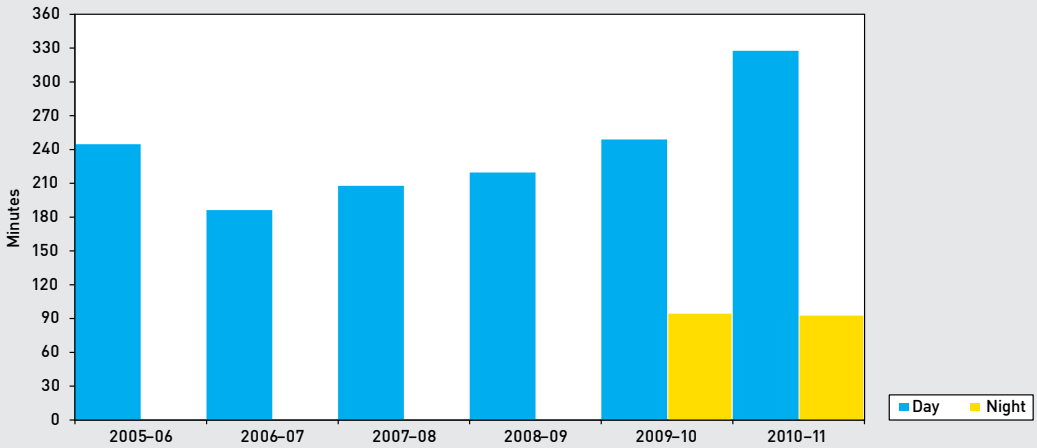


Source: Telecom Regulatory Authority of India.

2.3.5.4 Dial-up Access

Average MoU per subscriber per month for dial-up access is shown in Figure 2.27. The day time MoU has increased at a CAGR of 4.98 per cent between 2005–06 and 2010–11. The night time MoU shows a slight decline.

Figure 2.27 : Minutes of Usage per Subscriber per Month of Dial-Up Access, 2005–06 to 2010–11



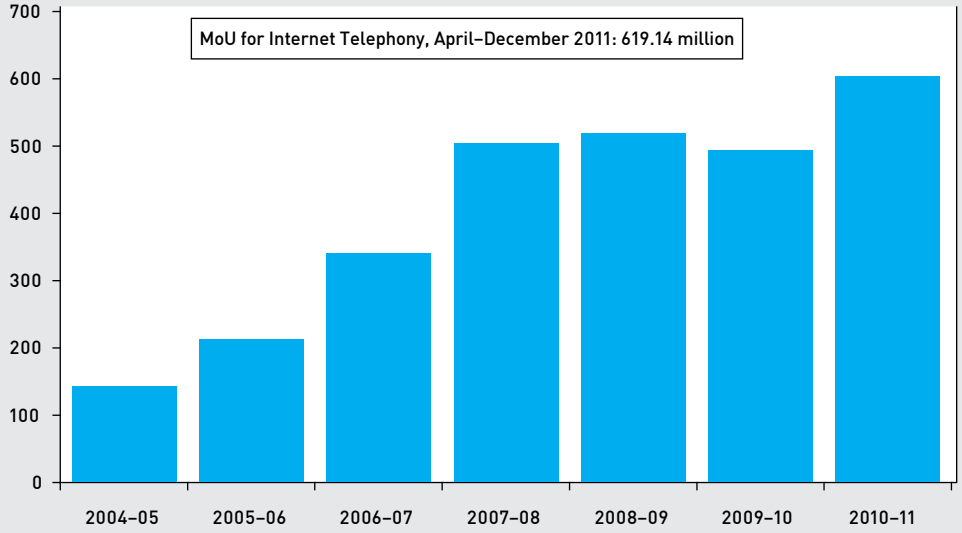
Source: Telecom Regulatory Authority of India.
Note: The numbers are averages of the quarterly MoU for each financial year.

2.3.5.5 Internet Telephony

The Internet telephony was thrown open for ISPs with effect from April 1, 2002. Under the new license conditions in 2007, a subscriber is allowed to use PC or a device adapter conforming to the standard of any international agencies like ITU or IETF, etc. to dial PSTN/PLMN abroad.[46] However, ISPs are not permitted to have interconnection with PSTN/PLMN exchanges to provide Internet telephony within India. There is a demand from ISPs for opening up of Internet telephony in the National Long Distance sector as well.

Total MoU for Internet telephony increased from 142.56 million in 2004–05 to 604.15 million in 2010–11 at the CAGR of 22.91 per cent (Figure 2.28).

Figure 2.28 : Total Duration of Usage for Internet Telephony, 2004–05 to 2010–11 (million minutes)



Source: Telecom Regulatory Authority of India.
Note: The numbers are sums of the quarterly MoUs for each financial year.

2.3.6 Quality of Services

2.3.6.1 Phones

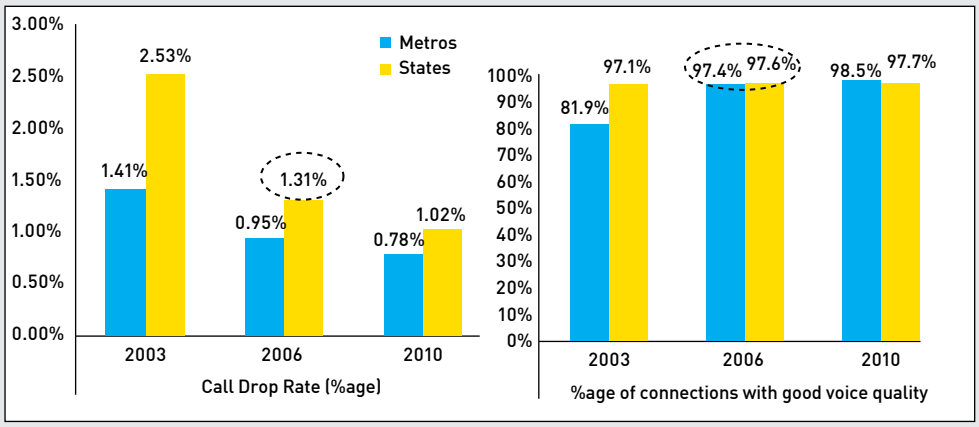
2.3.6.1.1 Wireless Phones

Opening up of the telecom sector to private players resulted in increased competition. This had a significant impact on quality of services (QoS). QoS considerably increased for wireless in both states and metros (Figure 2.29). However, QoS is relatively better in metros than in states.

Table 2.8 shows the latest state of the quality of services in this sector.[47] Majority of the service providers meet the benchmarks. However, there are certain parameters that still require improvements such as call centres, talking to the operator within sixty seconds, refunds after accounts are closed, etc.

[46] Telecom Regulatory Authority of India.
[47] A longer time series cannot be done on all the parameters as criterion have changed over time.

Figure 2.29 : Quality of Services for Wireless, 2003–10



Source: Telecom Regulatory Authority of India
Notes: Figures for metros are average of all metros, and states are average of all states.
These figures should be used for reference purpose only.

Table 2.8 : Quality of Service Performance of Wireless Service Providers, December 2011

S. No.	Parameter	Benchmark	Number of licensees not meeting the benchmarks	
			Quarter ending December 2011	
			Out of 262 (Nos)	Out of 262 (%)
I.				
1	Network availability			
(i)	BTSs accumulated downtime (not available for service)	≤ 2%	1	0.38
(ii)	Worst affected BTSs due to downtime	≤ 2%	8	3.05
2	Connection establishment (accessibility)			
(i)	Call set-up success rate (within licensee's own network)	≥ 95%	1	0.38
(ii)	SDCCH (Stand-alone Dedicated Control Channel)/ paging congestion	≤ 1%	2	0.76
(iii)	TCH congestion	≤ 2%	3	1.15
3	Connection maintenance (retainability)			
(i)	Call drop rate	≤ 2%	2	0.76

(*Contd...*)

Table 2.8 : Contd...

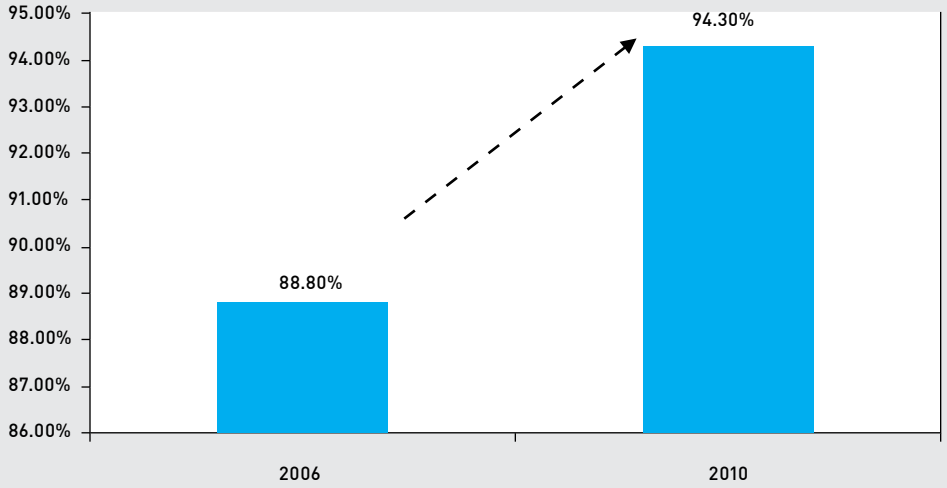
S. No.	Parameter	Benchmark	Number of licensees not meeting the benchmarks	
			Quarter ending December 2011	
			Out of 262 (Nos)	Out of 262 (%)
(ii)	Worst affected cells having more than 3% TCH drop (call drop) rate	≤ 5%	41	15.65
(iii)	Connection with good voice quality	≥ 95%	2	0.76
4	Point of Interconnection (POI) congestion (Number of POIs not meeting the benchmark) (Averaged over a period of quarter)	≤ 0.5%	12	4.58
II.	***Customer service quality Parameters***			
5	Metering and billing			
(i)	Metering and billing credibility: postpaid	≤ 0.1%	4	1.53
(ii)	Metering and billing credibility: prepaid	≤ 0.1%	4	1.53
(iii)	Resolution of billing/charging/validity complaints	100% within 4 weeks	6	2.29
(iv)	Period of applying credit/waiver/adjustment to customers account from the date of resolution of complaints	Within 1 week of resolution of complaint	0	0
6	Response time to the customer for assistance			
(i)	Accessibility of call centre/customer care	≥ 95%	3	1.15
(ii)	Percentage of calls answered by operators (voice to voice) within 60 seconds	≥ 90%	50	19.08
7	Termination/closure of service			
(i)	Percentage requests for termination/closure of service complied within 7 days	100% within 7 days	4	1.53
(ii)	Time taken for refund of deposits after closures	100% within 60 days	9	3.44

Source: Telecom Regulatory Authority of India.

2.3.6.1.2 Wireline Phones

There has been an improvement in QoS for wireline as well. Average percentage of calls answered by the wireline operators (voice-to-voice) within 60 seconds across states increased from 88.8 per cent in 2006 to 94.3 per cent by March 2010 (Figure 2.30). Table 2.9 shows the latest state of quality in this sector.

Figure 2.30 : Average of Percentage of Calls Answered by the Wireline Operators (voice-to-voice) within 60 seconds across States, 2006–10



Source: Telecom Regulatory Authority of India.
Notes: Figures for states are average of all states.
These figures should be used for reference purpose only.

Table 2.9 : Quality of Service Performance of Wireline Service Providers, December 2011

S. No.	Parameter	Benchmark	Number of licensees not meeting the benchmarks	
			Quarter ending December 2011	
			Out of 88 (Nos)	Out of 88 (%)
(i)	Fault incidences per 100 subscribers per month	≤ 5	10	11.36
(ii) a	Percentage of fault repaired by next working day	≥ 90%	9	10.23
(ii) b	Percentage of fault repaired within three days *(for urban areas)*	≥ 100%	20	22.73
(ii) c	Percentage of fault repaired within five days *(for rural and hilly areas)*	≥ 100%	19	21.59

(*Contd...*)

Table 2.9 : Contd...

S. No.	Parameter	Benchmark	Number of licensees not meeting the benchmarks	
			Quarter ending December 2011	
			Out of 88 (Nos)	Out of 88 (%)
(iii)	MTTR	< 8Hrs	7	7.95
(iv) a	Call Completion Rate (in local network)	≥ 55%	2	2.27
(iv) b	Answer to Seizure Ratio (ASR)	≥ 75 %	1	1.14
(v)	Point of Interconnection (POI) congestion (Number of PoIs not meeting benchmark)	≤ 0.5%	0	0.00
(vi)	Metering and billing credibility – Postpaid	≤ 0.1%	13	14.77
(vii)	Metering and billing credibility – Prepaid #	≤ 0.1%	3	3.41
(viii)	Resolutionof billing/charging/credit and validity complaints	100% within 4 weeks	17	19.32
(ix)	Period of applying credit/waiver/adjustment to customer's account from the date of resolution of complaints	Within 1 week of resolution of complaint	15	17.05
(x)	Response time to the customer for assistance			
(x) a	Accessibility of call centre/customer care	≥ 95%	15	17.05
(x) b	Percentage of calls answered by the operators (voice to voice) within 60 seconds	≥ 90%	7	7.95
(xi)	Termination/closure of service	100% within 7 days	2	2.27
(xii)	Time taken for refund of deposits after closures	100% within 60 days	5	5.68

Source: Telecom Regulatory Authority of India.

2.3.6.2 Internet/Broadband Services

2.3.6.2.1 Dial-up Access Service Providers

The TRAI Performance Indicators Report of December 2011 covers only the top 10 of 14 service providers that provides dial up access and finds the following:

- *Service Activation Time:* All except one ISP had met the TRAI benchmark of six hours.
- *Time to Access:* All the ISPs except one have met the TRAI benchmark of 30 seconds.
- *Probability of Accessing the ISP Node:* All the Internet Service Operators have met this benchmark of 80 per cent for first attempt, 90 per cent for second attempt and 99 per cent for third attempt in this quarter.
- *ISP Node unavailability:* All ISPs have met the TRAI benchmark for the parameter "ISP Node unavailability in a month (30 minutes)" except one which had not provided the data.

- *Grade of Service:* All ISPs met the benchmark for this parameter except one ISP which had not reported the data.
- *Mean Time to Restore (MTTR):* As reported by ISPs the Mean Time to Restore (MTTR) the faults varies from five minutes to 24:15 hours. Again one ISP had not provided the data.

2.3.6.2.2 Broadband Services

Out of 155 Broadband service providers, 28 have subscriber bases greater than 10,000 and these 26 service providers share 99 per cent of the total subscriber base. This report covers performance of 26 Broadband service providers. Table 2.10 reports the latest statistics on the quality of Broadband services in India. The quality of Broadband services leaves much to be desired.

An independent study reports that majority of the packages tested within India failed to deliver even 80 per cent of the advertised speeds.[48]

Table 2.10 : Parameter-wise Status of QoS Benchmarks for Broadband Service, December 2011

S. No.	Parameter	Benchmark	Name of service provider not meeting the benchmark
1.	Service provisioning/ activation time		
	Service provisioning/ activation time	100% in ≤ 15 working days	BSNL: Andhra Pradesh (98.90%), Assam (97.70%), Jammu & Kashmir (99.80%), Karnataka (99.90%), Maharashtra (99.90%), Punjab (99.98%), Uttarakhand (99.99%), Uttar Pradesh (E) (98.70%), West Bengal (95.80%), Andaman & Nicobar Islands (52.70%) MTNL: Delhi (97.07%), Mumbai (94.32%) Hathway: Maharashtra (99.80%) Sify: All India (94.99%) Quadrant Televentures: Punjab (99.86%) Tata Teleservices: Maharashtra & Goa (6.00%) Beam Telecom: Hyderabad (97.66%) Tikona: All India (97.07%) Rajesh Multichannel: Mumbai (94.00%) Syscon Infoway: Mumbai (96.00%) You Broadband: All India (99.13%), Maharashtra (98.79%), Gujarat (99.20%), Karnataka (99.04%), Tamil Nadu (99.60%), Andhra Pradesh (99.30%) Spectranet: All India (99.39%) Tata Communications: Andhra Pradesh (99.48%), Mumbai (99.00%), Punjab (99.00%)
2.	Faults repair/restoration time		
	Percentage of faults repaired by next working day	>90%	BSNL: Assam (82.50%), Kolkatta (88.30%) MTNL: Delhi (71.77%), Mumbai (84.63%) Hathway – Gujarat (87.00%), Maharashtra (88.00%), Goa (86.00%) Sify: All India (73.17%) You Broadband: All India (71.80%), Maharashtra (72.22%), Gujarat (76.58%), Karnataka (60.67%), Tamil Nadu (64.42%), Haryana (82.34%), Andhra Pradesh (61.71%) Tata Communications : Assam (88.00%), Tamil Nadu & Puducherry (88.00%)

(*Contd...*)

[48] LIRNEasia (2010). "Broadband Quality in India: 256 kbps package performs better than 2 Mbps ones", www.lirneasia.net

Table 2.10 : Contd...

S. No.	Parameter	Benchmark	Name of service provider not meeting the benchmark
	Percentage of faults repaired within 3 working days	≥99%	BSNL: Assam (86.30%), Jammu and Kashmir (98.70%), West Bengal (98.97%), MTNL: Delhi (89.02%), Mumbai (93.61%) Hathway: Delhi (97.00%), Maharashtra (96.40%), Punjab (97.00%), Uttar Pradesh (98.00%), Chhattisgarh (97.00%) Sify: All India (39.47%) You Broadband: All India (95.70%), Maharashtra (95.94%), Gujarat (96.50%), Karnataka (89.47%), Tamil Nadu (93.52%), Haryana (98.07%), Andhra Pradesh (94.80%) Tata Communications: Assam (96.00%), Mumbai (95.00%), Tamil Nadu & Puducherry (97.00%), Bihar & Jharkhand (96.00%)
3.	Billing performance		
	Percentage of billing complaints resolved within 4 weeks	100% within 4 weeks	BSNL: Karnataka (99.98%), Uttarakhand (99.90%) MTNL: Delhi 98.01%) Bharti Airtel: AP (93.00%), Delhi (95.00%), Gujarat (96.00%), Haryana (92.00%), Karnataka (88.00%), Kerala (85.00%), Kolkatta (86.00%), Madhya Pradesh & Chhattisgarh (99.00%), Maharashtra (98.00%), Mumbai (97.00%), Punjab (97.00%), Tamil Nadu (92.00%), Uttar Pradesh (E) 96.00%), Uttar Pradesh (W) (92.00%) Tata Teleservices: Maharashtra & Goa (94.00%) Asianet Satellite: Kerala (99.99%)
	Percentage of cases to whom refund of deposits was made within 60 days of closures	100% within 60 days	BSNL: Uttarakhand (99.90%) Rajesh Multichannel: Mumbai (00.00%) Tata Teleservices: Maharashtra & Goa (97.00%)
4.	Response time to customer for assistance		
	Percentage of calls answered by operator (voice-to-voice) within 60 seconds	>60%	Hathway: Maharashtra (51.00%) Tikona Digital: All India (22.33%) Vasai Cable: Mumbai (73.97%)
	Percentage of calls answered by operator (voice-to-voice) within 90 seconds	> 80%	MTNL: Mumbai (73.23%) Tikona Digital Networks: All India (37.67%) Vasai Cable: Mumbai (73.97%)

(*Contd...*)

Table 2.10 : Contd...

S. No.	Parameter	Benchmark	Name of service provider not meeting the benchmark
5.	Bandwidth utilisation/throughput		
	Number of intra-network links having bandwidth utilisation >90% during peak hours (TCBH)	Benchmark 0	Alliance: Kolkata (7 links) Five Networks: All India(12 links) Softeng Computers: All India (5 links
	Number of upstream links for international connectivity having bandwidth utilization >90% during peak hours (TCBH)	Benchmark 0	MTNL: Delhi – (1.33%) Syscon Infoway: Mumbai (4 links) Vasai Cable: Mumbai (1 link) Five Networks: All India (5500)
	Percentage international bandwidth utilization during peak hours (TCBH) (Enclose MRTG) <90%	Benchmark <90%	Syscon Infoway: Mumbai (98.00%)
	Broadband connection speed available (download) from ISP node to user	Benchmark >80%	BSNL: Andaman and Nicobar Islands (15.00%)
	Service availability/ uptime (for all users) in percentage	Benchmark >98%	Hathway: Delhi (97.00%), Punjab (97.87%) Tata Communications: Kerala & Lakshadweep (97.00%), Tamil Nadu & Puducherry (92.00%) Ortel Communications: Ortel (96.18%) Vasai Cables: Mumbai (97.55%)

Source: Telecom Regulatory Authority of India.

2.4 REGIONAL VARIATIONS

2.4.1 Telephones

While India has made considerable progress in the telecom sector, there are wide disparities in the penetration of telecom facilities across rural–urban sectors and across states. Therefore, the challenge for the country is to deal with each of these divides and ensure that the telecom services spread to urban poor, rural villagers and neglected states. Table 2.11 reports teledensity across states and regions.

Table 2.11 : Service Area-wise Teledensity, December 2011

Service area	Wireline teledensity			Wireless teledensity			Total teledensity		
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	All
Andhra Pradesh	1.10	7.06	2.75	36.27	182.66	76.90	37.38	189.71	79.65
Assam	0.19	3.87	0.75	28.01	140.85	45.10	28.21	144.72	45.85
Bihar	0.16	2.43	0.47	24.11	189.50	46.70	24.27	191.93	47.16
Delhi	N.A.	N.A.	15.27			220.27			235.54
Gujarat	1.10	6.03	3.10	49.75	135.55	84.56	50.86	141.57	87.67
Haryana	1.12	4.66	2.33	52.53	143.43	83.48	53.65	148.09	85.80
Himachal Pradesh	4.07	8.94	4.61	70.85	458.16	114.03	74.91	467.10	118.64
Jammu and Kashmir	0.45	5.26	1.75	28.81	110.14	50.77	29.27	115.4	52.52
Karnataka	1.34	9.82	4.52	39.16	174.29	89.78	40.5	184.11	94.30
Kerala	8.20	12.12	9.20	48.43	242.85	98.04	56.63	254.97	107.24
Madhya Pradesh	0.23	3.97	1.23	25.23	123.13	51.34	25.46	127.10	52.57
Maharashtra including Mumbai	1.14	9.18	4.90	48.50	140.32	91.44	49.64	149.5	96.34
North-East	0.63	5.89	1.90	37.29	139.63	62.12	37.91	145.51	64.02
Orissa	0.49	4.35	1.14	32.43	207.86	62.11	32.91	212.20	63.25
Punjab	2.68	8.37	5.05	60.65	173.68	107.64	63.33	182.05	112.69
Rajasthan	0.70	5.04	1.74	41.74	154.64	68.80	42.44	159.77	70.54
Tamil Nadu including Chennai	1.98	7.13	4.85	52.31	155.10	109.44	54.3	162.33	114.28
Uttar Pradesh	0.29	3.62	1.03	30.10	154.64	57.94	30.38	158.27	58.97
West Bengal including Kolkata	0.50	5.93	2.05	41.7	160.78	75.62	42.2	166.71	77.67
All India	0.92	6.85	2.71	36.56	161.01	74.15	37.48	167.85	76.86

Source: Telecom Regulatory Authority of India.

Note: Delhi service area, apart from the state of Delhi, includes the areas served by the local exchanges of Ghaziabad and Noida (in Uttar Pradesh) and Gurgaon and Faridabad (in Haryana).

Increase in teledensity has been driven by wireless teledensity. Urban teledensity is approximately 4.4 times higher than rural, showing the digital divide that exists in India. There are wide variations in penetration of telecom services across states. States such as Delhi, Tamil Nadu, Kerala, Himachal Pradesh and Punjab have relatively high teledensity. However, states such as Assam, Bihar, Madhya Pradesh, UP, Jammu and Kashmir and the North-Eastern states have relatively low teledensity. The numbers show that teledensity in Delhi is 5.1 times higher than that of Assam. However, when we divide it even further, we see that Delhi's teledensity is 9.7 times higher than that of rural Bihar.

Himachal Pradesh has the highest total teledensity after Delhi. Assam and Bihar are the worst performing states in terms of total teledensity. Irrespective of their total teledensity, the gap between rural and urban teledensity

is quite close to each other for these states– Assam 5.1, Bihar 7.9, and Himachal Pradesh 6.2.

An ASER report finds that 73.4 per cent of rural households in their sample had a mobile, households with a person knowing how to use a computer was 12.6 per cent and 13.96 per cent of villages had an Internet café.[49] The 61st round of NSS data (Table 2.12) shows there exist vast differences across expenditure quintiles. It is the top 40 per cent of households in both rural and urban areas who own more than one mobile.

Table 2.12 : Mobile Ownership by Households

Type of household	Percentile class	Share of households possessing a mobile as percentage of total households possessing durable (non-food) goods
Rural	0–20	0.09
	20–40	0.40
	40–60	0.64
	60–80	1.03
	80–100	1.46
	Total	0.56
Urban	0–20	0.34
	20–40	0.74
	40–60	0.91
	60–80	1.25
	80–100	1.49
	Total	1.14
All households	0–20	0.12
	20–40	0.46
	40–60	0.71
	60–80	1.12
	80–100	1.48
	Total	0.73

Source: Unit Level data, NSSO (2007–08).

2.4.2 Internet Services

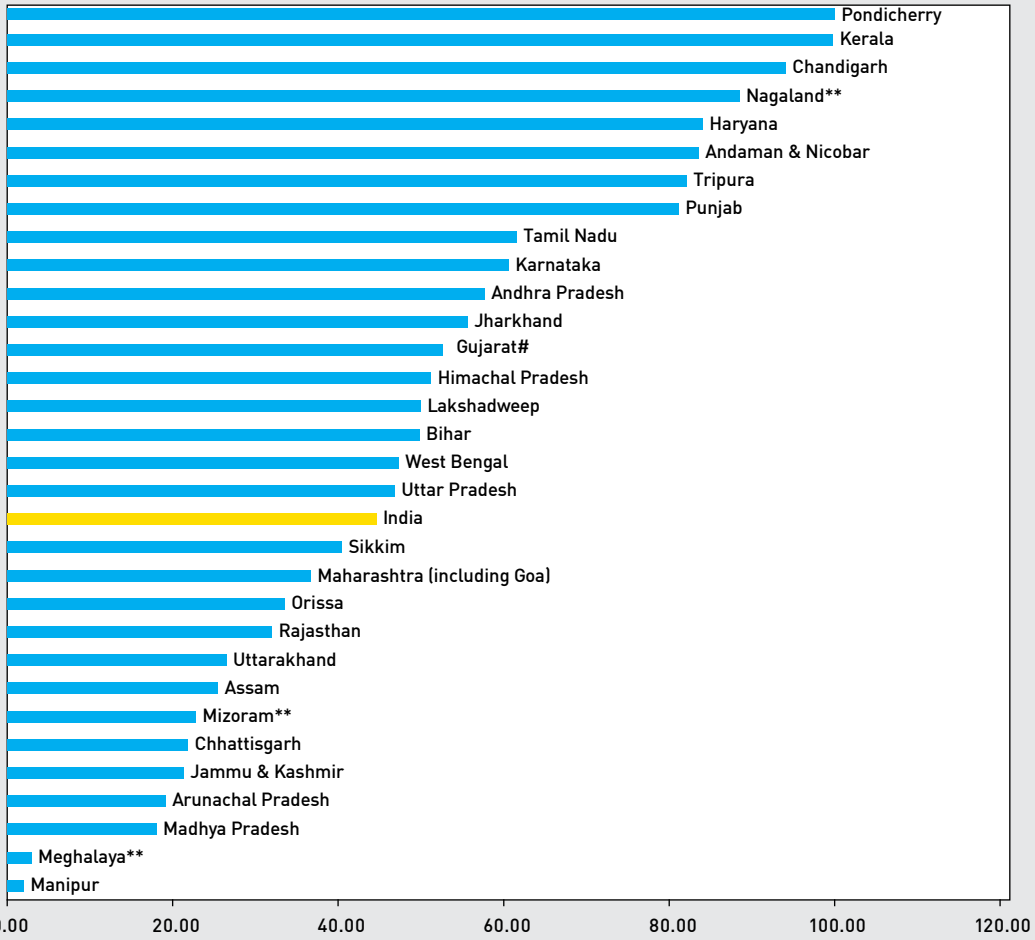
Bharat Nirman-II targets covering 100 per cent of the panchayats in the country with Broadband by 2012. There are wide disparities across states in terms of coverage of village panchayats under Broadband. While on the one hand, village panchayats in states like Pondicherry, Kerala and Chandigarh have 90 to 100 per cent broadband coverage, villages in states such as Manipur, Meghalaya, Madhya Pradesh, Arunachal Pradesh, Jharkhand, Jammu

[49] *Annual Status of Education Report Provisional (Rural) (ASER)* (2012), Pratham Resource Centre. Available online at www.asercentre.org/

and Kashmir, Chhattisgarh, and Mizoram have less than 25 per cent Broadband coverage. Broadband connectivity is particularly low in village panchayats in north-eastern region of the country as shown in Figure 2.31.

Table 2.13 shows state-wise broadband subscribers. The irony is that although all the villages of Kerala may be covered by broadband, only 6.12 per cent of India's Broadband subscribers reside in that state. Maharashtra leads in the number of Broadband subscribers. Sixty per cent of India's Broadband subscribers live in the five states of Maharashtra, Tamil Nadu, Andhra Pradesh, Delhi and Karnataka.

Figure 2.31 : Percentage of Village Panchayats having Broadband, March 2011



Source: DoT. Available online at www.dot.gov.in/
** Equivalent Rural Local Bodies.
# Includes Dadra Nagar Haveli and Daman Diu.

Table 2.13 : State-wise Broadband Subscribers as on March 31, 2011

State	Number of broadband subscribers	Share of subscribers to India (%)
Andaman & Nicobar	4,893	0.04
North East#	33,652	0.28
Himachal Pradesh	53,357	0.45
Uttarakhand	65,502	0.55
Chhattisgarh	75,003	0.63
Jammu & Kashmir	75,358	0.63
Jharkhand	76,949	0.65
Assam	80,619	0.68
Bihar	87,103	0.73
Odisha	164,399	1.38
Haryana	214,404	1.80
Madhya Pradesh	284,946	2.40
Rajasthan	341,722	2.87
Gujarat @	537,679	4.52
West Bengal*	548,444	4.61
Uttar Pradesh	556,986	4.69
Punjab†	703,161	5.92
Kerala	727,254	6.12
Karnataka	1,100,922	9.26
Delhi	1,140,306	9.59
Andhra Pradesh	1,268,072	10.67
Tamil Nadu ‡	1,535,150	12.91
Maharashtra	2,211,180	18.60
India	11,887,068	100.00

Source: Telecom Regulatory Authority of India.
Includes Manipur, Meghalaya, Arunachal Pradesh, Mizoram, Nagaland and Tripura.
@ Including Dadar and Nagar Haveli.
* Including Sikkim.
† Including Chandigarh.
‡ Including Puducherry.

2.4.3 Regional Variations: Constraints and Present Policies

The states are making continuous efforts to improve their ICT (Information and Communication Technology) abilities over time as evidenced by e-readiness indices. e-Readiness can be considered as the ability to pursue and realize value creation opportunities facilitated by ICT. Table 2.14 shows the ranking of top ten states during 2003 to 2008 with Karnataka as the consistent leader.

Table 2.14 : e-Readiness Index

State	2003	2004	2005	2006	2008
Karnataka	1	1	3	1	1
Maharashtra	2	4	6	6	2
Chandigarh	8	5	5	3	3
Tamil Nadu	3	2	2	7	4
Andhra Pradesh	4	3	1	2	5
West Bengal	9	12	15	13	6
Kerala	11	6	4	10	7
Gujarat	5	7	11	12	8
Haryana	15	11	9	4	9
Delhi	7	9	8	5	10

Source: Venkatesan, R., Sen, S. and W. Wadhwa (2010 and various issues), *India's e-Readiness Assessment Report 2008 for States/Union Territories*, National Council of Applied Economic Research and Department of Information Technology, Government of India, New Delhi.
Note: The rankings cannot be compared over time but signal an effort to continuously improve ICT abilities.

The cell phone has to provide to the rural subscriber multiple services like education, entertainment, tele-medicine, banking, IPTV, etc. for it to be valuable or worth the money. The constraints hindering penetration of the telephony in the rural sector are listed below.

a. Acquisition of land: It takes a long time and many formalities to be completed.
b. Right of way: Laying of optical fibre is problematic because that involves jurisdiction of multiple government agencies. Further, government agencies

have started charging exorbitant fees in laying down cables/optical fibre. All these add up to delays.

c. Non-availability of backhaul connectivity: This is a major problem in rural areas as mentioned in point (b) above.
d. Lack of infrastructure sharing in rural areas.
e. Lack of power supply: This is a problem because it is either not available or available only for a few hours.
f. Operation and maintenance costs: These are higher in rural areas because of poor transportation, difficulty in supply of spare parts, lack of power supply and non-availability of skilled labour.
g. Low ARPU: Low ARPU in urban areas is made up by high traffic. Private companies are not attracted due to low revenues in rural areas.
h. Affordability of services: Costs of handsets, Modem, PC, UPS, etc. are quite high when compared to their incomes.
i. Low literacy level: This is a major problem especially in using Broadband. It is also a problem if most of the content is delivered in English.
j. Unavailability of locally relevant applications: Rural subscribers need to access relevant information in a manner that is readily accessible. For example, sending messages to illiterate farmers is useless. Also, the information should be available as and when the farmer needs it and not the other way around.

Given the digital divide in rural and urban India, government has been trying to put various measures to increase rural teledensity. The EFYP aims at bridging the digital divide between the urban and rural areas and extending Broadband connectivity. The Plan envisages providing 200 million rural telephone connections by 2012, that is, to reach a rural teledensity of 25 per cent. Bharat Nirman programme targets to achieve rural teledensity of at least 40 per cent by 2014, and broadband coverage of all 2,50,000 village panchayats. It also envisages setting up of Bharat Nirman Common Service Centres at panchayat level by 2012.[50]

The Universal Service Obligation (USO) policy came into effect in 2002 aiming to widen the reach of telephony services in rural India. The USO Fund (USOF) was established by an Act of Parliament. As per the Act, all telecom operators are bound to contribute 5 per cent of their revenues to this fund. Initially, only basic service providers were under the purview of USOF. Later, its scope was expanded to include mobile services also. Although, it increases the cost burden for the telecom companies, USOF helps in building the telecommunication infrastructure in the rural areas. In addition, the central government may also give grants and loans.

USOF was established with the fundamental objective of providing access to 'basic' telegraph services to people in the rural and remote areas at affordable and reasonable prices. Subsequently the scope was widened to provide subsidy for enabling access to all types of telecom services including mobile services, Broadband connectivity and creation of infrastructure like OFC (optical fibre cable) in rural and remote areas. Several schemes are being undertaken in the country under USOF (Box 2.6).

[50] Bharat Nirman , Government of India website. http://www.bharatnirman.gov.in/

Box 2.6 : USOF Schemes Currently Undertaken

Stream I – Public Access

- Operation and maintenance of Village Public Telephones (VPTs) in the revenue villages identified as per Census 1991 and installation of VPTs in the additional revenue villages as per Census 2001.
- Provision of Rural Community Phones (RCPs) after achieving the target of one VPT in every revenue village where, if the population of a village is more than 2000 and no public call office (PCO) exists there, a second public phone shall be installed.

Stream II – Provision of household telephones in rural and remote areas as may be determined by the central government from time to time.

- For rural household Direct Exchange Lines (DELs)/Rural Direct Exchange Lines (RDELs) installed prior to April 1, 2002, support towards the difference in rental actually charged from rural subscribers and rent prescribed by TRAI for such subscribers shall be reimbursed until such time the ADC prescribed by TRAI from time to time takes into account this difference. Also, following the phasing out of the ADC Regime, support will be provided for rural wire line RDELs installed prior to April 1, 2002 for a limited duration of three years.
- Support for RDELs installed after April 1, 2002.

Stream III

- Creation of infrastructure for provision of mobile services in rural and remote areas. The assets constituting the infrastructure for provision of mobile services shall be determined by the central government from time to time.

Stream IV

- Provision of Broadband connectivity to rural and remote areas in a phased manner.

Stream V

- Creation of general infrastructure in rural and remote areas for development of telecommunication facilities. The items of general infrastructure to be taken up for development shall be determined by the central government from time to time.

Stream VI

- Induction of new technological developments in the telecom sector in rural and remote areas. Pilot projects to establish new technological developments in the telecom sector, which can be deployed in the rural and remote areas, may be supported with the approval of the central government.

Source: USOF. Available online at www.usof.gov.in
Under USOF, funds worth Rs 15,046 crore have been disbursed till December 2011 (Table 2.15).

Table 2.15 : Universal Service Obligation Fund Position (Rs crore)

Financial Year	Funds collected as UAL	Funds allocated and disbursed	Reimbursement of LF and spectrum charges	Potential available balance
2002–03	1,654	300	2,300	
2003–04	2,143	200	2,300	
2004–05	3,458	1,315	1,766	
2005–06	3,215	1,767	583	
2006–07	3,941	1,500		
2007–08	5,406	1,290		
2008–09	5,515	1,600		
2009–10	5,778	2,400		
2010–11	6,115	3,100		
2011–12 (up to December 2011)	3,350	Allocated: 1650 Disbursed: 1575		
Grand Total	40,574	Allocated: 15, 121 Disbursed: 15, 046	6,949	18,579

Source: USOF. Available online at www.usof.gov.in

2.5 TRENDS IN TELECOMMUNICATION MANUFACTURING

The booming mobile telecom sector has increased demand for telecom equipment. Service providers need fixed and mobile switches, transmission equipment, fibre and copper cables, IN platforms, test equipment, etc. Infrastructure providers need fibre, duct and tower. There were 400,000 towers as of April 2011 with a sharing (tenancy) ratio of 1:5 and growth of about 20 per cent per annum. There are 15 major players in this segment. Further, application developers need backend and platform systems. Last, network equipment and handset manufacturers need equipment for this dynamic sector. This has provided excellent opportunities to domestic and foreign investors in the manufacturing sector. On the supply side, the telecom equipment manufacturing sector was de-licensed in 1991.

As a result, manufacturing sector has witnessed a steady growth in the last few years. A large telecom manufacturing base has now been established in the country. India ranked fourth in telecom equipment manufacturing in the Asia–Pacific region in 2009 and is expected to move to the third spot by 2014. India had a 5.7 per cent share of the region's total telecom equipment production revenue of $180 billion in 2009.[51]

The Indian telecom industry manufactures a vast range of telecom equipment using state-of-the-art technology. Table 2.16 shows the status of the Indian telecom manufacturing sector for the period 2002–03 to 2009–10. Notably, the telecom revenue of the manufacturing sector is much smaller than the services sector and has actually declined in 2009–10 on a year-on-year basis. Exports have shown steady increase between 2002–03 and 2009–10. Also, imports are more than exports signaling that India is importing a majority of its equipment.

[51] Telecom Regulatory Authority of India.

Table 2.16 : Telecom Equipment Manufacturing in India (Rs crore)

Year	Telecom revenue	Total equipment requirement	Total imports	Equipment production	Total exports	Exports as per cent of domestic production
2002–03	45,672			14,400	402	2.79
2003–04				14,000	250	1.79
2004–05	71,674	30,359	14,269	16,090	400	2.49
2005–06	86,720	44,843	27,010	17,833	1,500	10.64
2006–07	1,05,319	57,698	34,042	23,656	1,898	8.41
2007–08	1,29,083	82,870	41,600	41,270	8,131	19.7
2008–09	1,52,360	93,600	44,800	48,800	11,000	22.54
2009–10	1,57,985	1,24,800	67,216*	57,584	13,500	23.44

Source: Telecom Regulatory Authority of India.
Note: * Projected.

Telecom equipment industry for the financial year 2009–10 registered 19 per cent growth rate year-on-year basis.[52] Every item showed a positive growth except network storage, fixed line phones, and structured cabling and telecom cables. Given the 3G and BWA auctions in 2010, all expectations were that the telecom equipment industry would do even better. However, its revenue plunged by 2.52 per cent to Rs 1,17,039 crore in 2010–11 from Rs 1,20,069 crore in 2009–10.[53]

The revenue of carrier equipment, comprising of equipment for broadband, wireless, WiMax, etc., fell by 12.12 per cent to Rs 58,294 in 2010–11.[54] Wireless infrastructure segment dropped 23.78 per cent to Rs 18,629 crore in 2010–11. The Broadband infrastructure segment revenue fell to Rs 944 crore in 2010–11 from Rs 2,190 crore in 2009–10. Network integration business registered a fall of 18.71 per cent from Rs 9,200 crore in 2009–10 to Rs 7,479 crore in 2010–11.

The user device segment comprising of mobile handsets, fixed phones, datacards, and tablets increased by 16.04 per cent to Rs 34,772 crore.[55]

Table 2.17 shows the top telecom equipment players in the country. Nokia is the leading telecom equipment player in India, followed by Cisco and Nokia Siemens Networks.

[52] Jhingan, H. (2010), *A Modest Innings for Telecom Equipment – growth 19% yoy*, Voice and Data, Available online at voicendata.ciol.com
[53] Voice and Data (2011), *Indian telecom equipment revenue dips 2.5% in FY 2011*, Available online at http://voicendata.ciol.com/, June 23.
[54] Voice and Data (2011), *Indian telecom equipment revenue dips 2.5% in FY 2011*. Available online at http://voicendata.ciol.com/, June 23.
[55] Voice and Data (2011), *Indian telecom equipment revenue dips 2.5% in FY 2011*. Available online at http://voicendata.ciol.com/, June 23.

Table 2.17 : Revenue of Top 10 Telecom Equipment Players (Rs crore)

Rank	Company	Revenue		Growth rate (%)
		2009–10	2010–11	
1	Nokia	12,900	12,929	0.2
2	Cisco	5,400	7,100	29.8
3	Nokia Siemens Networks	6,500	6,177	–5
4	Ericsson	8,749	6,173	–29.4
5	Wipro	5,256	5,752	9.4
6	Samsung	4,700	5,720	21.7
7	Huawei	7433	5688	–23.5
8	Tech Mahindra	4,238	4,735	11.7
9	TCS	4,365	4,437	1.6
10	ZTE	4,720	4,118	–12.8

Sources: Available online at http://www.cybermedia.co.in/press/pressrelease181.html
Voice and Data, June 2011.

In general, however, the manufacturing sector is hampered by poor research and development (R&D) in the area and sourcing of inputs, which are mostly imported.[56] Further, most of the telecom products manufactured in India are basically assembled here with the Intellectual Property Rights (IPR) lying outside.

2.6 CONCLUSION

The last ten years has changed the landscape of the Indian telecommunications world. Teledensity has increased but its composition is vastly different to what could be envisaged ten years ago. Wireless teledensity dominates the Indian scene. We have seen advent of other technologies too. Internet/Broadband services have also started spreading. Wireless Broadband shows a lot of potential for India. The "prepaid" model has brought in more customers. However, the spread of phones and Internet has been especially slow in the rural areas. Telecom manufacturing, although growing, is still small. Those are two areas of concern.

[56] Telecom Regulatory Authority of India.

3 EVOLUTION OF TELECOM REGULATION

The transformation of Indian telecom sector over the years from a government monopoly to one with private service providers along with public sector undertakings like Mahanagar Telephone Nigam Limited (MTNL) and Bharat Sanchar Nigam Limited (BSNL) depicts the evolution of regulatory and policy environment. Until the mid-1980s, the telecommunications industry in India was functioning as a department of the government. MTNL was established in 1986 to provide telephone and telex services under a non-exclusive license in the two largest metropolitan cities of Delhi and Mumbai. Videsh Sanchar Nigam Limited (VSNL) was also established in the same year to provide international long distance (ILD) services. Department of Telecommunications (DoT) retained responsibility for providing all other telecommunication services throughout India except Delhi and Mumbai. The Telecom Commission was established in 1989 as an executive body under the Ministry of Communications with administrative and financial powers of the Government of India to deal with various aspects of telecommunications and to implement the government's policy in matters concerning telecommunications.

In October 1999, the services portion of DoT was detached from it and brought under a new Department of Telecommunications Services (DTS). DTS was corporatised in October 2000, as a new entity, BSNL, for providing telecommunications services in the entire country except Delhi and Mumbai. VSNL was privatised in February 2002 with the sale of a strategic stake.

Telecom equipment manufacturing was de-licensed in 1991 and value added services were declared open to private sector in 1992, following which radio paging, cellular mobile and other value added services were gradually opened to the private sector. A major breakthrough in this process was the clear enunciation of the government's intention to liberalise the telecom sector in the National Telecom Policy resolution of 13 May 1994.

3.1 NATIONAL TELECOM POLICY (NTP), 1994

National Telecom Policy (NTP), 1994 recognised that the required resources for achieving the targets set under the policy would not be available from government sources and concluded that investment and involvement from private sector were required to bridge the resource gap. NTP 1994 provided for opening up of the telecom sector in basic services as well as value added services like cellular mobile telephone services (CMTS), radio paging, VSAT services, etc. It allowed participation of private companies in the telecom field except national long distance (NLD) and international long distance (ILD) services.

3.2 NEW TELECOM POLICY (NTP), 1999

The most important milestone and instrument of telecom reforms in India is NTP 1999. This Policy laid down a clear roadmap for future reforms and contemplated opening up of all segments of telecom sector for private sector participation. It clearly recognised the need for strengthening the regulatory regime as well as restructuring the departmental telecom services into a public sector corporation so as to separate the licensing and policy functions of the government from that of being an operator.

Main features of NTP 1999 were:

- Strengthening of the Regulator.
- Opening of NLD and ILD services to private sectors.
- License to private telecom operators on a revenue sharing basis, plus a one-time entry fee. Resolution of problems of existing operators envisaged.
- Direct interconnectivity and sharing of network with other telecom operators within the service area

NTP 1999 was amended in November 2003 which permitted a licensee to make available wireline and wireless services using any technology in a pre-determined license area after conversion of the license to a Universal Access Service License (UASL).

3.3 INSTITUTIONAL FRAMEWORK FOR TELECOM POLICY REGULATION IN INDIA

The policy and regulatory framework for telecommunications in India consists of, among others, the following key bodies:

3.3.1 Department of Telecommunications

Department of Telecommunications (DoT), under the Government of India, is responsible for the telecommunication industry. It is entrusted with the task of formulating policies for the development of the sector and awarding telecom licenses. The department is accountable for spectrum management. It also allocates frequency and manages radio communications in close coordination with international bodies. It is also responsible for enforcing wireless regulatory measures and monitoring the wireless transmission of all users in the country. Telecom Commission, an exclusive policy-making body, works under the department.

Telecom Commission was established in 1989 as an executive body under the Department of Communications to formulate a policy for approval of the government and to implement the Government's policy in matters concerning telecommunications.

The Universal Service Support Policy (USSP) came into effect on April 1, 2002. The Indian Telegraph (Amendment) Act, 2003 was enacted in December 2003 for giving statutory status to the Universal Service Obligation Fund (USOF). The fund is to be utilized exclusively for meeting the universal service obligation (USO). The office of Administrator, USOF has been set up w.e.f. June 1, 2002 for the purpose of implementation of USSP.

3.3.2 Telecom Regulatory Authority of India (TRAI)

In the context of privatisation of telecommunication services following New Economic Policy (NEP), 1991 and NTP 1994, a multi-operator scenario emerged both in the basic as well as cellular services in which private operators were competing with government or government-owned entities. For an orderly and healthy growth of the telecommunications sector as also for protection of consumer interests, it was felt necessary to separate the regulatory functions of the government from the service providing functions. Accordingly, the government decided to set up an independent telecom regulatory authority. An ordinance was issued on January 25, 1997, establishing the Telecom Regulatory Authority of India (TRAI) as an independent regulatory agency for the telecom sector. Apart from regulating licenses issued by the central government, TRAI was also vested with certain quasi-judicial authority to adjudicate and settle disputes.

In 2000, the Telecom Regulatory Authority of India Act, 1997 was amended by the Telecom Regulatory Authority of India (Amendment) Act, 2000. Under the amended Act, a clear distinction is made between recommendatory and regulatory functions of TRAI as envisaged under sub-section (1) of section 11 of the Act. It has also been made mandatory for the central government to seek the recommendations of the Authority in respect of matters specified in sub-clauses (i) and (ii) of section 11(1)(a) of the Act, especially with respect to the need and timing for introduction of new service providers, and terms and conditions of license to a service provider. TRAI recommendations continued to be non-binding on the government but the amendment formalised the recommendatory function of TRAI. While in general TRAI could provide recommendations, either suo moto or on a request from the government, in the case of these two issues the government was required to seek the recommendations of TRAI. The government was also required to provide any information requested by TRAI to enable it to make its recommendation. In a case where the government concluded that TRAI's recommendations could not be accepted, or needed modifications, it would have to refer the recommendation back to TRAI. Thereafter government would take a final decision. The composition of the authority was also changed. The authority now consists of a chairperson, two whole-time members and two part-time members, appointed by the central government. Vide notification dated January 9, 2004, the central government notified the broadcasting and cable services to be telecommunication services and TRAI came to deal with these services too.

TRAI is the Regulator for the sector and has a mix of mandatory and recommendatory powers. It mandates in areas related to tariffs, interconnection and standards for quality of service. The mission of TRAI is to create and nurture conditions for growth of telecommunications in the country in a manner and pace, which will enable India to play a leading role in emerging global information society.

The principal recommendatory functions of TRAI may be exercised either on its own initiative or on request from the licensor. This function mainly covers introduction of new service providers, formulating the terms and conditions of licenses to be awarded to service providers, and revocation of licenses. The recommendatory function also covers, "measures to facilitate competition and promote efficiency in the operation of telecommunication services so as to facilitate growth in such services".

TRAI has developed a process to make its recommendations as well as to discharge its mandatory functions which allows all the stakeholders and the general public to participate in policy formulation by offering their views whenever sought for.

The principal mandatory functions of TRAI include fixing tariffs, ensuring compliance with the terms and conditions of licenses, formulating the terms and conditions of interconnection arrangements between service providers, and establishing and ensuring standards of quality of service to be provided by service providers.

In pursuance of the above objectives, TRAI has issued from time to time a large number of Regulations, Orders and Directions which provided the required directions to evolution of Indian telecom sector from government monopoly to a multi-operator and multi-service competitive sector. The Regulations, Orders and Directions issued by TRAI cover a wide range of subjects including tariffs, interconnection, and quality of service.

3.3.3 Telecom Disputes Settlement and Appellate Tribunal

Telecom Disputes Settlement and Appellate Tribunal (TDSAT) was set up in May 2000 to resolve disputes between a licensor and a licensee, two or more service providers, and between a service provider and a group of consumers. TDSAT also hears and disposes off appeals against any direction, decision or order of TRAI.

3.4 LICENSING FRAMEWORK

3.4.1 Cellular Mobile Telephone Service

India was initially divided into 23 Service Areas consisting of 19 Telecom Circle Service Areas and 4 Metro Service Areas for providing CMTS. Subsequently, Chennai Metro Service area has been merged into Tamil Nadu Service Area.

The first phase of liberalisation in mobile telephone service started with issue of licenses for CMTS in the four metro cities of Delhi, Mumbai, Kolkata and Chennai to eight private companies in November 1994. Subsequently, 34 licenses for 18 Territorial Telecom Circles were also issued to 14 private companies during 1995 to 1998. During this period a maximum of two licenses were granted for CMTS in each service area and these licensees were called first and second cellular licensees. These licensees were to pay fixed amount of license fees annually based on the agreed amount during the bidding process. Subsequently, they were permitted to migrate to NTP 1999 regime wherein they were required to pay license fee based on revenue share, which is effective from August 1, 1999.

MTNL and BSNL were issued licenses for provision of CMTS as third operator in various parts of the country. Further, 17 fresh licenses were issued to private companies as fourth cellular operator in September/October 2001, one each in four metro cities and 13 Telecom Circles.

Consequent upon announcement of the Guidelines for Unified Access (Basic & Cellular) Services licenses' on November 11, 2003, some CMTS operators migrated from CMTS license to UASL.

No new CMTS and basic service licenses are awarded after issuing the guidelines for UASL.

3.4.2 Unified Access Service

A Unified Access Service licensee can provide wireline as well as wireless services in a service area. Wireless services include full mobile, limited mobile and fixed wireless services. The licensee can also provide various value added services. A restriction for authentication of subscriber terminal has been placed in case of limited mobility facility based on Short Distance Charging Area Linked Numbering Scheme. However, the same facility without any restriction can be availed by adopting numbering plan for cellular mobile services and using Home Zone Tariff Schemes.

Basic and cellular services licensees are permitted to migrate to UASL regime. The service providers migrating to UASL can continue to provide wireless services in already allocated/contracted spectrum. No additional spectrum will be allotted for migration to UASL. Guidelines for such migration were announced on November 11, 2003.

3.4.3 National Long Distance Telephony

NTP 1999 envisaged the opening up of NLD service beyond the service area to the private operators. The government accordingly decided to open NLD service without any restriction on the number of operators. NLD service was opened to the private sector with effect from August 13, 2000. An NLD operator can carry inter-circle traffic in the country. The licence for NLDO is issued on non-exclusive basis, for a period of 20 years and is extendable by 10 years at one time.

3.4.4 International Long Distance Telephony

The government opened the ILD service from April 1, 2002 to private operators without any restriction on the number of operators. ILD service is basically a network carriage service, providing international connectivity to networks operated by foreign carriers. The licence is valid for 20 years from the date of licence agreement.

3.4.5 Licensing of Internet Services

Internet services were launched in India in 1995 by VSNL. In November 1998, the government opened up the sector to private operators. A liberal licensing regime was put in place with a view to increase Internet penetration across

the country. NTP 1999 envisaged opening up of Internet telephony whereupon government decided to permit ISPs to process and carry voice signals (Restricted Internet Telephony) with effect from April 1, 2002.

In 2007, the government decided to issue a single licence to ISPs which permitted restricted Internet telephony.

3.5 SPECTRUM MANAGEMENT

In 1992 the government invited competitive bids for two non-exclusive cellular mobile licenses for a 10-year period, extendable by five years, for the four metropolitan cities of Mumbai, Delhi, Kolkata and Chennai. The license specified the use of GSM standards for offering cellular services. Eight licenses were issued in 1994. In case of circles the government invited tenders for two non-exclusive licenses for each circle. Selection among technically qualified bidders was on the basis of the highest levy (later converted to license fee) which was measured over 10 years of license period.

The cellular licenses provided for an initial spectrum allocation. In Metros each licensee was allocated 4.5 MHz in the 900 MHz spectrum and in circles the allocation was 4.4 MHz. The license fees-based cellular service, however, could not take off smoothly as operators reported huge loss. NTP 1999 provided for a new policy framework for cellular mobile service providers for replacing license fee regime by a revenue sharing arrangement. The initial license period was increased to 20 years, extendable by 10 years.

Further, NTP 1999 recognised that the number of cellular operators in a given geographical area would necessarily be limited on account of scarcity of spectrum. NTP 1999 also announced that apart from the two private operators already licensed, DoT/MTNL would also be licensed to be the third operator in each service area. In order to ensure a 'level playing field' between different service providers in similar situations, license fee would be payable by DoT also. However, as DoT is the national service provider having immense rural and social obligations, the government would refund it to DoT.

TRAI on June 23, 2000, recommended that all new operators barring DoT/MTNL should be selected through a competitive process by a multistage bidding process (multistage informed ascending bid) which would be preceded by prequalification round. The government accepted TRAI's recommendation and issued a tender document for cellular mobile telephone service in March 2001.

The licenses for the fourth operator were issued in 2001 based on an auction with start-up spectrum of 2×4.4 MHz. In addition to entry fee, licensees were required to pay a percentage of annual revenue (adjusted gross revenue) as spectrum charges. The auction was held for 21 circles. However, bids were received in only 17 circles. No bids were received for West Bengal, Bihar, Odisha and Andaman and Nicobar Telecom Circles.

In 2001, basic service operators in India were permitted to offer limited mobility services over wireless local loop (WLL [M]) using CDMA technology in their coverage areas. They were also able to offer all-India mobility using the CDMA WLL (M) technology. This created a potential disadvantage for the GSM cellular operators as they had paid substantial amounts to obtain their licences and WLL (M) services were increasingly seen as largely substitutable for GSM services. Therefore, government decided to move towards a UASL regime for basic and cellular services, which was introduced in October 2003. Under this new regime, both basic service operators and cellular carriers gained freedom to offer basic and/or cellular mobile services using any technology, which has ensured a fair competitive market for the service providers.

Spectrum allocation in India was initially done by bundling start-up spectrum with the license. The additional allocation of spectrum was at the discretion of the licensor on a case-by-case basis. In 2002, government introduced a subscriber linked spectrum allocation process, which provided for a maximum allotment of 12.5 MHz of spectrum per operator in each service area. The initial allotment of spectrum along with the licence was 4.4 MHz for GSM and 2.5 MHz for CDMA. This could

be further scaled up to 6.2 MHz for GSM and 5 MHz for CDMA operators depending on availability and the operator's ability to justify the need for it. For additional spectrum they had to meet the subscriber linked criterion laid down by DoT.

In 2008 DoT revised the criteria for additional spectrum allocation. According to this, the subscriber base required for additional spectrum allocation was hiked two to six times for different circles.

3.5.1 3G and BWA Spectrum Auctions

TRAI in its recommendations dated September 27, 2006 on "Allocation and Pricing of Spectrum for 3G and Broadband Wireless Access" recommended allocation of 3G spectrum in the 2.1 GHz band, and allocation of BWA spectrum in the 2.3 GHz band through e-auction.

DoT issued 'Guidelines for Auction of Spectrum for 3G and BWA Services' in August 2008, which inter alia envisaged a market determined price of 3G/BWA spectrum through a transparent process. Notice inviting applications (NIA) was issued on February 25, 2010. A maximum of four and minimum of three blocks were identified in various telecom circles for auction. 3G auction started on April 9, 2010 and ended on May 19, 2010. A total of nine companies participated in the auction out of which seven companies won 3G auction in various telecom circles.

Auction of BWA spectrum started on May 24, 2010 and ended on June 11, 2010. Total 11 companies participated in this auction. Two blocks of 20 MHz in 2.3 GHz band was auctioned. Six companies won the BWA auction in various telecom circles.

The overall auction proceeds was Rs1,06,262 crore. In the 3G auction the pan India winning price was almost five times and in the BWA auction it was more than seven times the reserve price.

3.5.2 Tariff Regulation

TRAI is empowered to fix tariffs for telecommunication services under Section 11(2) of TRAI Act of 1997 as amended in 2000. The tariff regulation for telecommunication services in India was initiated with the notification of Telecommunication Tariff Order, 1999 (TTO 1999). This order provided the broad and long term policy framework for telecommunication services in the country. In 1999, basic service was a monopoly market served by the government department, other than in Delhi and Mumbai which were served by MTNL. Cellular service was marked by duopoly with only two private operators in each service area. The tariff reforms initiated vide TTO 1999, aimed to provide a consistent and transparent framework for regulating tariffs in order to, inter alia, achieve affordable prices through regulation and/or competition; enhance transparency of subsidies and provide a basis for better targeting the policies to achieve social objectives; and improve the availability of services to the customer.

TTO 1999 specified Standard Tariff Package (STP) consisting, inter alia, of monthly rental and call charges, for basic and cellular services. The service providers were required to offer STP as mandated by TRAI. Apart from STP, the service providers were allowed flexibility to offer Alternate Tariff Packages (ATP) subject to the ceiling rates specified in STP. Though national roaming service in cellular mobile was initially forborne in TTO 1999, it was brought under tariff regulation in January 2002 by fixing ceiling tariff for that service.

First structural review of cellular mobile tariff was done three years after the implementation of the above tariff order by TRAI in the year 2002. Taking note of the emerging market scenario, the Authority came to the conclusion that a stage had been reached when market forces could effectively regulate cellular tariff. Accordingly, TRAI forbore the tariffs for cellular mobile services vide 23rd Amendment to TTO dated September 6, 2002.

In the case of basic services, TTO 1999 had specified availability of STP, which inter alia, comprises of rental, call charges, free calls, etc. along with all other ATPs on offer by the service providers in the market. However, in 2003 TRAI decided that mandating a standard package was no longer necessary for urban basic service subscribers. In view of the overall competition and the implementation of ADC regime, TRAI decided to forbear with respect to basic services except for rural subscribers where STP was continued. The service providers were free to offer ATPs in addition to STP (28th Amendment to TTO dated November 5, 2003).

Thus, as per the existing tariff regulatory framework, tariffs for telecommunication services are forborne except for: (i) rural fixed line services; (ii) national roaming services; and (iii) leased circuits.

3.5.3 Interconnection and Access regulation

Interconnection is the lifeline of telecommunications. Interconnection allows subscribers, services and networks of one service provider to be accessed by subscribers, services and networks of other service providers. Interconnection Usage Charges (IUCs) are charges payable by one telecom operator to the other for use of the latter's network either for originating, terminating, or transiting/carrying a call. Under section 11(b) of the TRAI Act, 1997, TRAI has been entrusted with discharge of, inter alia, the functions of regulating the terms and conditions of interconnectivity between service providers and arrangements amongst the service providers of sharing their revenue derived from providing telecommunication services. The regulatory framework for interconnection was first established through the regulation issued by TRAI in May 1999, titled "The Telecommunication Interconnection (Charges on Revenue Sharing) Regulation 1999" specifying certain principles for determining interconnection charges and revenue sharing arrangements. Subsequently, TRAI considered it important to specify an IUC regime that would give greater certainty to the Inter-operator settlements and facilitate interconnection agreements. TRAI notified an IUC Regulation on January 24, 2003, which contained, inter alia, charges for origination, transit and termination of calls in a Multi-Operator environment. This IUC regulation introduced the regime of calling party pays (CPP) which is perhaps the biggest factor in growth of telecom services in India. By introduction of CPP regime all incoming calls could be received free of charge. This regulation was superseded by a regulation on October 29, 2003. In this regulation TRAI prescribed identical termination charges for all types of calls and, therefore, simplified the implementation of the regime. The IUC amendment that became effective from April 1, 2009 reduced the domestic termination to 20 paise per minute and increased international termination to 40 paise per minute.

3.6 RECOMMENDATIONS MADE BY TRAI

Over the years TRAI has been making recommendations to the government for shaping the regulatory and policy regime for telecom sector. These recommendations cover the whole gamut of regulatory and policy related issues like promoting competition, mergers and acquisitions, accelerating growth of rural telephony, accelerating growth of Internet and broadband, licensing framework, spectrum management, infrastructure sharing, national broadband plan, telecom equipment manufacturing, telecom infrastructure policy, and green telecom. A list of important recommendations made by TRAI is given in the Appendix.

3.7 REGULATORY TIMELINE

The Indian telecom sector has undergone major transformations through significant policy reforms. The regulatory reforms (Table 3.1) in the telecom sector from 2000 to 2011 can be broadly classified into the following three distinct phases.

Phase 1 – 2000–2003: Telecom sectors were opened up to competition.

Phase 2 – 2004–2007: Regulator encouraged competition and also set the stage for future growth.

Phase 3 – 2008–2011: More choices were brought in for consumers in terms of technology and services.

Table 3.1: Regulatory Reforms

Year	Regulatory Reforms
2000	Regulatory mechanism further strengthened through TRAI (Amendment) Act, 2000. The Act provides for establishment of a separate dispute settlement mechanism called Telecom Dispute Settlement and Appellate Tribunal.
	Corporatisation of Department of Telecommunication's operational network into a public sector undertaking called Bharat Sanchar Nigam Limited from October 1, 2000.
	National Long Distance Service opened for competition.
	BSNL and MTNL permitted to enter as third cellular operator in their respective circles.
2001	Additional basic service operators permitted. New licenses for basic services issued.
	Fixed service providers permitted to provide limited mobility in the form of Wireless in Local Loop on a restricted basis.
	Fourth cellular operator, one each in four metroes and thirteen circles was permitted. In all, 80 licences (56 in private sector, 22 to BSNL, and 2 to MTNL) were issued.
	TRAI issued its first Interconnection Regulation for Basic and Cellular services.
	Communication Convergence Bill, 2001 was introduced in Lok Sabha on August 31, 2001; referred to standing committee.
	National Long Distance service opened up to competition.
2002	International Long Distance service opened up to competition.
	Reduction of licence fees.
	Internet or IP telephony service allowed.
	Tariffs for national roaming service brought under regulation. Ceiling tariffs notified.
	Tariffs for cellular mobile services were forborne provided that every service provider shall specify a monthly rental and airtime charge per minute with pulse duration of 30 seconds, as Reference Tariff Package of the service provider.
	Reference Interconnect Offer (RIO) regulation issued.
	Universal Service Obligation Fund (USOF) established.
2003	Interconnection Usage Charges (IUC) and Calling Party Pays (CPP) regime introduced for cellular services.
	National and international long distance tariffs also forborne subject to a ceiling of Rs 8.40 per minute in NLD.
	Basic service tariffs except rural fixed-line forborne by TRAI.
	Government allows the issuance of unified licences that will allow local wireline players to provide cellular service and vice versa. DoT amends NTP 1999 to recognise unified telecom licence and unified access licence that will allow local wireline players to provide cellular service and vice versa.
	TDSAT allows basic operators to offer WLL limited mobility services.
	TRAI imposes ADC charges on cellular operators with effect from December 15, 2003.
	Government approves intra-circle mergers.

(*Contd...*)

Table 3.1: Contd...

Year	Regulatory Reforms
2004	Broadcasting notified as telecommunication service under Section 2(i)(k) of TRAI Act.
	Intra-circle guidelines established.
	Broadband Policy 2004 formulated.
	TRAI issues regulation on Reporting System on Accounting Separation making it mandatory.
	TRAI issues directive on carry forward of unused balance during grace period applicable at the time of recharge for cellular prepaid subscribers.
	TRAI mandates that a tariff plan once offered by a service provider shall be applicable for a minimum period of six months from the date of enrolment of the subscriber to that tariff plan. No increase in any item of tariff permitted during the six month-period. However, the operator is free to reduce tariffs at any time.
	27 UAS licenses issued.
2005	FDI limit increased from 49 to 74 per cent.
	TRAI announces new Access Deficit Charges (ADC) regime.
	TRAI fixes ceiling tariff for international bandwidth (ceiling tariff is reduced for higher capacities by about 70 per cent and lower capacity by 35 per cent).
	TRAI revises ceiling tariff for domestic bandwidth (revised ceiling tariff for different capacities marked a reduction with respect to the prevailing market rate in the rage of 3 to 70 per cent).
	TRAI provides its recommendations on the growth of telecom services in rural areas.
	Entry fee for NLD licences reduced from Rs 100 crore to Rs 2.5 crore. Entry fee for ILD reduced from Rs 100 crore to Rs 2.5 crore.
2006	Number portability proposed
	Annual licence fee for NLD as well as ILD reduced to 6 per cent of AGR.
	TRAI issues amendment to IUC, moving away from a per-minute ADC regime to a revenue share regime. Revenue share fixed at 1.5 per cent of AGR to be paid to BSNL.
	22 UAS licenses issued.
	DoT announces new criteria for additional spectrum.
	TRAI issues recommendations on number portability and NGN.
2007	TRAI issues the Telecom Unsolicited Commercial Communications Regulations.
	TRAI issues Telecom Consumers Protection and Redressal of Grievances Regulations.
	TRAI issues "International Telecommunication Access to Essential Facilities at Cable Landing Stations Regulations, 2007".
	TRAI issues Telecommunication Consumers Education and Protection Fund Regulations.
	One UAS license issued.
	TRAI orders reduction in tariff for national roaming services.
	Domestic Leased Circuits Regulations, 2007 issued.
2008	Access Deficit Charges (ADC) abolished.
	122 UAS Licensees issued.

(*Contd...*)

Table 3.1: Contd...

Year	Regulatory Reforms
2009	TRAI issues the Regulations on the Standards of Quality of Service of Basic Telephone Service (Wireline) and Cellular Mobile Telephone Service.
	Interconnect usage charges reduced.
	Mobile Virtual Network Operator (MVNO) guidelines for 3G as well as 2G disclosed.
	TRAI issues regulation on Telecommunication Mobile Number Portability.
	DoT releases guidelines on Voice over Internet Protocol (VoIP).
2010	3G and Broadband Wireless Access (BWA) spectrum auctions completed.
	Mobile number portability implementation in Haryana service area.
2011	Mobile number portability launched countrywide.
	The Telecom Commercial Communications Customer Preference Regulation issued.
	Draft National Telecom Policy 2011 released.

4 INVESTMENT

4.1 INTRODUCTION

The goal of the government was to boost the abysmally low teledensity prevailing till the late 1990s even in urban areas. It simply was not feasible for the government to finance the investment needed to push the growth of telephones especially with the 1991 financial crisis in India. Further, technologies and equipment needed to be imported.[57] Private sector, after a few hiccups in the initial years, have done spectacularly well in the 2000s and has also started investing abroad. The focus of this chapter is on investment trends, both domestic and foreign, in the 2000s.

4.2 TOTAL INVESTMENT

4.2.1 Plan Outlay

Table 4.1 shows the total outlay on telecommunications. Plan outlay on telecommunications has increased from Rs 47 crore in the First Five Year Plan to Rs 2,58,439 crore in the Eleventh Five Year Plan (EFYP) (2007–12). Share of telecommunications in the total Plan outlay has increased from 2.27 per cent to 7.09 per cent during the same Plan period. The growth rate of the plan outlay on communications shows that the big change came in the Sixth Five Year Plan.

Table 4.1 : Total Plan Outlay and Outlay for Communications in Five Year Plans (Rs crore)

Plan	Communications outlay	Growth rate of communications outlay	Total outlay	Percentage of communications outlay
First Five Year Plan (1951–56)	47		2,069	2.27
Second Five Year Plan (1956–61)	66	40	4,800	1.38
Third Five Year Plan (1961–66)	164	148	7,500	2.19
Fourth Five Year Plan (1969–1974)	415	153	15,901.47	2.61
Fifth Five Year Plan (1974–78)	781	88	38,853.24	2.01
Sixth Five Year Plan (1980–85)	2,722	249	97,500	2.79
Seventh Five Year Plan (1985–1990)	8,123	198	1,80,000	4.51
Eighth Five Year Plan (1992–97)	25,110	209	4,34,100	5.78
Ninth Five Year Plan (1997–2002)	47,280	88	8,59,200	5.50
Tenth Five Year Plan (2002–2007)	98,968	109	15,25,639	6.49
Eleventh Five Year Plan (2007–2012)	2,58,439	161	36,44,717	7.09

Sources: Department of Telecommunications (DoT), Ministry of Communications, Government of India (2006), *Report of the Working Group on the Telecom Sector for the Eleventh Five Year Plan*. Available online at www.planningcommission.nic.in
Planning Commission, Government of India (2008), *Eleventh Five Year Plan Document 2007-2012*. Available online at www.planningcommission.nic.in

[57] Desai, A.V. (2006), *India's Telecommunication Industry: History, Analysis, Diagnosis*, Sage Publications India, New Delhi.

Outlay on communication in EFYP increased more than two and a half times as compared to the previous Plan. Given the digital divide, EFYP has envisaged to pay special attention to enhance the rural connectivity.

The broad objectives of telecom sector during the EFYP are as follows:

1) To reach a telecom subscriber base of 600 million.
2) To provide 200 million rural telephone connections by 2012, that is to reach a rural teledensity of 25 per cent.
3) To provide telephone connection on demand across the country at an affordable price.
4) To reach a target of 20 million broadband connections and 40 million Internet connections by 2010 (as envisaged by Broadband Policy 2004).
5) To provide broadband connection on demand across the country by 2012.
6) To provide third generation (3G) services in all cities/ towns with more than 1 lakh population.
7) To facilitate introduction of mobile TV.
8) To provide broadband connectivity to every secondary school, health centre, (General Practitioner) on demand in two years.
9) To make India a hub for telecom equipment manufacturing by facilitating establishment of telecom specific SEZs.
10) Broadband coverage for all secondary and higher secondary schools and all public health care centres was stipulated by 2007 and broadband coverage for all GPs was stipulated by 2010.
11) Linkage is to be provided between block headquarters and the nearest exchange for completing state-wide area networks.

The first two objectives have been achieved. There has been progress in others.

4.2.2 Public Sector versus Private Sector

The overall trend shows private sector is leading in total investments.

In the first four years of the Tenth Plan (2002–06) the total estimated public investment was Rs 36,753.77 crore versus foreign direct investment (FDI) of Rs 42,394.21 crore (this number is only up to June 2006). Only in the first year was the public investment of Rs 13,110.91 crore larger than the FDI amount of Rs 9,863.5 crore in 2002–03. However, most of the private sector investments were made in the cellular mobile sector.[58]

Box 4.1 displays some additional statistics on the public versus private investment. It shows that the private sector companies are more productive than the public sector ones in terms of returns on capital employed and employees per subscribers.

Box 4.1 : Capital Employed, Return on Capital Employed and Capital Investment (Gross Block) in the Telecom Services Sector

Private versus public investments are examined using capital employed, return on capital employed, capital investment and employment in telecom sector.

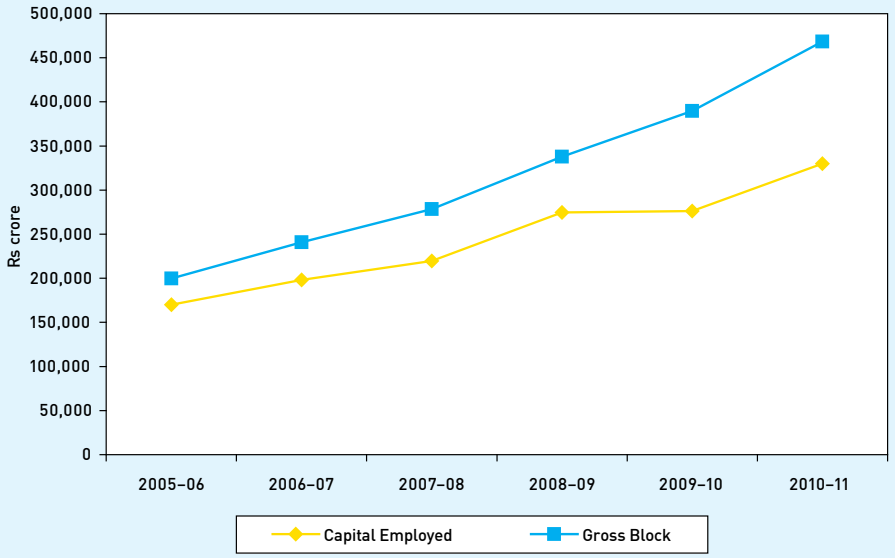
The "capital employed" represents the funds necessary for a business to function or the funds deployed to operate the business. Capital Employed is sum of Net Block, Capital Work in Progress and Working Capital. The sector-wise capital employed for the years 2005-06 and 2010-11 are given below. The capital employed and Gross Block for the last six years is depicted in the graph below.

[58] The data reported in this paragraph have been taken from Department of Telecommunications (DoT), Ministry of Communications, Government of India (2006), Report of the Working Group on the Telecom Sector for the Eleventh Five Year Plan. Available online at www.planningcommission.nic.in

Sector-wise Capital Employed and Gross Block (Rs crore)

Particulars	2005–06			2010–11		
	Public	Private	Total	Public	Private	Total
Capital Employed	1,05,784	64,303	1,70,087	89,066	2,40,866	3,29,932
Gross Block	1,26,546	73,297	1,99,843	1,97,339	2,71,018	4,68,356

Capital Employed and Gross Block (Rs crore)



Source: Telecom Regulatory Authority of India.

The analysis of above information reveals that:

- The capital employed has shown growth of 94 per cent over the last six years.
- The capital employed by public and private sector companies has shown a decrease of 16 per cent and growth of 275 per cent, respectively over the last six years.
- The Gross Block has shown growth of 134 per cent over the last six years.
- The Gross Block of public and private sector companies has shown an increase of 56 per cent and 270 per cent, respectively over the last six years.

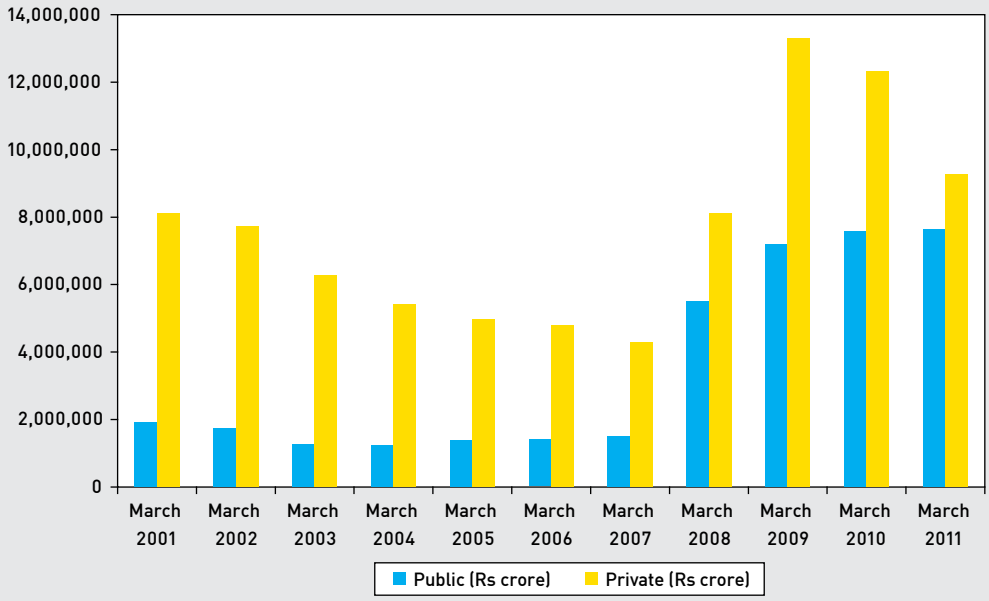
The "return on the average capital employed" for 2006–07 for the telecom service industry was 10.64 per cent. Return on capital employed of PSUs for this period was 9.51 per cent against 12 per cent of the private sector.

The direct employment generated by the telecom service sector was about 4,32,771 in 2006–07 as against 4,29,400 in 2005–06. The PSUs' share was about 85 per cent of the total direct employment. For the year ending March 2007, one employee had been appointed for every 193 subscribers in public sector companies whereas the ratio is one employee for 2,110 subscribers in private sector companies.

To understand the public versus private divide over the decade, we examine CapEx database, which collects data on ongoing investment activities in India and provides a continuous update on the progress in implementation of the various investment projects.[59] We use the total live projects in the last quarter (January–March) of each financial year starting from March 2001 to March 2011 to calculate the share of public and private sectors. Projects that are currently under various stages of announcement or implementation are called "outstanding" or "live" projects.

Figure 4.1 shows that the private sector has dominated throughout. The March 2009 to March 2011 data shows that the gap between public and private sector investment is coming down.

Figure 4.1 : Public and Private Sector Live Projects, 2001–11 (Rs crore)



Source: Centre for Monitoring Indian Economy Ltd. (CMIE). 2011. *CapEx Database*.

4.3 FOREIGN DIRECT INVESTMENT (FDI)

This section examines the current policy and decadal trends in FDI. Initially domestic companies were encouraged to tie up with foreign ones so as to bring in more capital and improved technology.[60] However, with disastrous financial results, foreign firms wanted to exit by late 1990s. The policymaker changed the rules and most of the foreign companies were bought out by domestic companies. FDI was limited to 74 per cent.

4.3.1 Current Policy

Table 4.2 shows the prevalent FDI policy in India. FDI is fully open for manufacturing and infrastructure sectors. For services, FDI is limited to 74 per cent, with automatic approval up to 49 per cent. Beyond that, it would require the approval of Foreign Investment Promotion Board (FIPB).

[59] Centre for Monitoring Indian Economy Ltd (CMIE). 2010. *CaPeX Database*.
[60] Desai, A.V. (2006), *India's Telecommunication Industry: History, Analysis, Diagnosis*, Sage Publications India, New Delhi.

Table 4.2 : Foreign Direct Investment Policy

S. No.	Sector/Activity	FDI cap/ equity	Entry route	Other conditions
1.	Basic and cellular, Unified Access Services, National/International Long Distance, V-SAT, Public Mobile Radio Trunk Services (PMRTS), Global Mobile Personal Communications Services (GMPCS) and other value added telecom services	74% (Both direct and indirect foreign investment)	Automatic up to 49% FIPB beyond 49%	Subject to guidelines notified in para 5.38.1 to 5.38.4 of consolidated FDI policy circular No. 2/2010 of DIPP
2.	ISP with gateways, *ISP without gateway, Radio-paging, End-to-End Bandwidth provider.	74%	Automatic up to 49% FIPB beyond 49%	Subject to licensing and security requirements notified by the Department of Telecommunications and para 5.38.5 (i) to (iii) of consolidated FDI policy circular No.2/2010 of DIPP
3.	a) Infrastructure Provider providing dark fibre, right of way, duct space, tower (Category –I) b) Electronic Mail and Voice Mail	100%	Automatic up to 49% FIPB beyond 49%	Para 5.38.6 (i) to (iv) of consolidated FDI policy circular No.2/2010 of DIPP i.e. subject to the condition that such companies shall divest 26 per cent of their equity in favour of Indian public in five years, if these companies are listed in other parts of the world. Also subject to licensing and security requirements, where required.
4.	Manufacture of Telecom Equipment	100%	Automatic	
5.	Guidelines for calculation of total foreign investment, i.e. direct and indirect foreign investment in Indian companies			Para 4.1 (and its sub-paras) of consolidated FDI policy circular No.2/2010 of DIPP
6.	Guidelines for transfer of ownership or control of Indian companies in sectors with caps from resident Indian citizens to non-resident entities.			Para 4.2.3 of consolidated FDI policy circular No.2/2010 of DIPP
7.	Guidelines on downstream investment by Indian Companies	-	-	Para 4.6 (and its sub-paras) of consolidated FDI policy circular No. 2/2010 of DIPP

Source: DoT. Available online at www.dot.gov.in.
Note: The government has revised the guidelines for ISPs on 24 August 2007 and the new guidelines provide for ISP licenses with 74 per cent composite FDI only.

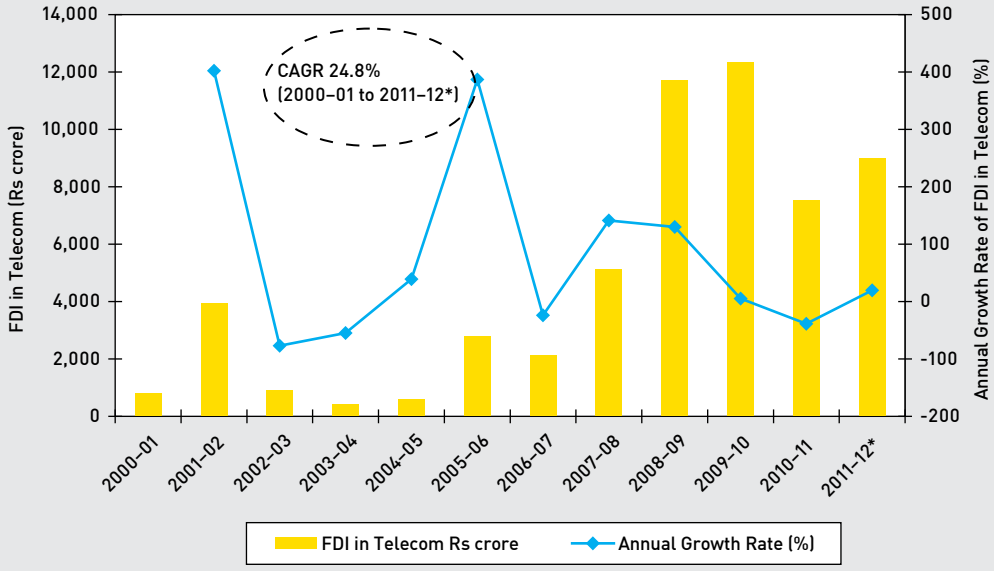
4.3.2 Inward FDI

4.3.2.1 Data Trends

FDI in the telecom sector has grown at a Compound Annual Growth Rate (CAGR) of 24.8 per cent between 2000–01 and 2011–12 (April–February, 2011–12). However, this hides significant variations over the decade as shown in Figure 4.2. Growth rate peaked in 2001–02,

2005–06 and 2007-08. The 2008–10 numbers signal that the worldwide slowdown probably resulted in increased FDI inflow to India and the telecommunications sector benefited from that. However, the continued uncertainty in worldwide economic conditions coupled with domestic factors such as inflation, and infrastructure implementation bottlenecks have probably contributed to reducing FDI in 2010–11. In 2011–12, there has been a resurgence of FDI.

Figure 4.2 : FDI in Telecom Sector (Rs crore) and Growth Rate of FDI in Telecom, 2000–01 to 2011–12



Source: Department of Industrial Policy and Promotion (DIPP). Available online at http://dipp.nic.in/
Note: FDI amount includes the inflows received through SIA/FIPB route, acquisition of existing shares and RBI's automatic route only.
* The FDI inflow data for the year 2011–12 includes the flows for the months from April 2011to February 2012.

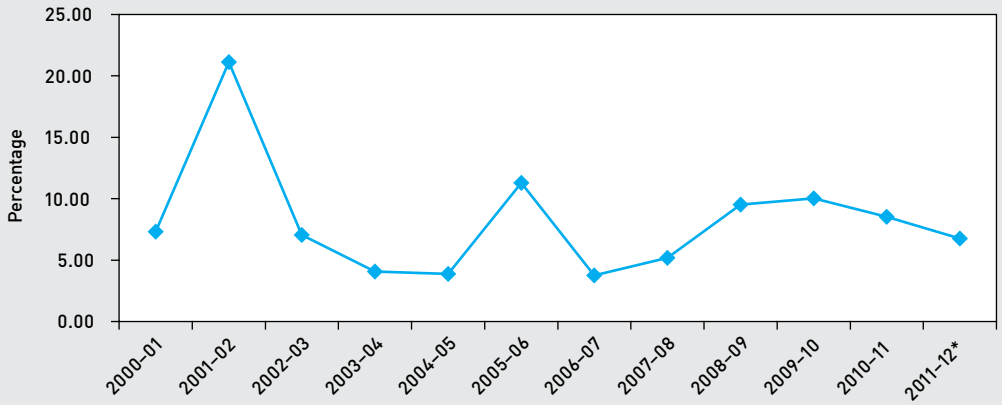
Box 4.2 : The Impact of the Crisis on Foreign Direct Investment in Telecommunications

Compared with other infrastructure investments in developing countries, FDI plays a very important role in the case of telecommunications. Privatisation and greenfield investments by transnational corporations (TNCs) accounted for 83 per cent of projects with private sector participation from 1996 to 2006 (concessions and management contracts made up the rest). Privatisation projects were mainly related to fixed-line telephony while most greenfield projects were associated with mobile telephony. Over the same period, foreign companies invested over US$ 100 billion in telecom projects in developing countries. Reliance on foreign investment is particularly high in Latin America and Africa. A relatively small group of TNCs account for the foreign investments. In Latin America TNCs are mainly from Spain, Italy and Mexico. In Africa TNCs originate mainly in France, West Asia and Africa, while in Asia most of the top investors are of Asian origin. Thus, in both Africa and Asia South–South investments are significant.

Source: International Telecommunications Union (ITU). 2009. Confronting the Crisis: Its Impact on ICT Industry. Available online at www.itu.int

Figure 4.3 shows the share of telecommunications sector in FDI. The share of FDI as percentage of total FDI has averaged around 8.34 over the last decade. The trends shown in Figures 4.2 and 4.3 are broadly similar except in the latter we see that the telecom sector's share of total FDI increased from 2006–07 till 2009-10. Thereafter the share has been declining.

Figure 4.3 : Share of FDI in Telecom Sector as Percentage of Total FDI, 2000–01 to 2011–12

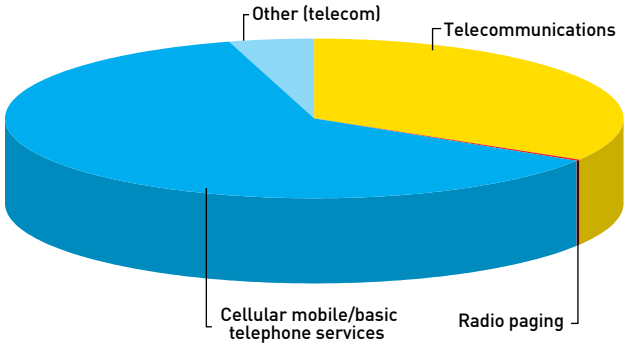


Source: Department of Industrial Policy and Promotion (DIPP). Available online at http://dipp.nic.in/
Note: FDI amount includes inflows through SIA/FIPB route, acquisition of existing shares and RBI's automatic route only.
* The FDI inflow data for the year 2011-12 includes the flows for the months from April 2011 to February 2012.

The sub-sectors in the telecommunications industry include telecommunications, radio paging, cellular and basic telephone services and others.[61] Figure 4.4 shows the share of FDI each sector has attracted as percentage of total FDI in telecom. Most of the FDI in telecom industry has gone to the cellular mobile segment, the sector which has experienced the fastest growth. Cellular mobile and basic telephone services received the highest share of FDI in telecommunications—Rs 6,635 crore during January–March 2011.

Table 4.3 shows that most of the FDI inflows to India have been routed through Mauritius, probably to take advantage of the agreement between India and Mauritius. Singapore, Russia, Japan and the U.S.A. are the other important sources of FDI for telecommunications in India.

Figure 4.4 : Sector-wise FDI Inflows: April 2000–August 2010



Sources: DoT. Available online at www.dot.gov.in
DIPP. Available online at www.dipp.nic.in

[61] Department of Industrial Policy and Promotion (DIPP). Available online at http://dipp.nic.in/

Table 4.3 : FDI in Telecommunications Sector: April 2000–August 2010

S. No.	Country	FDI inflow (Rs crore)	Percentage of inflow
1.	Mauritius	29,883.09	66.28
2.	Singapore	6,642.95	14.32
3.	Russia	1,902.39	3.95
4.	Japan	1,533.44	3.14
5.	U.S.A.	1,059.76	2.35
6.	Others	801.56	1.82
7.	Cyprus	764.79	1.62
8.	U.K.	433.44	0.94
9.	NRIs (as individual investors)	333.01	0.77
10.	Netherlands	269.56	0.61
11.	Germany	242.04	0.59
12.	U.A.E.	232.30	0.49
13.	British Virgin	221.71	0.47
14.	Australia	179.99	0.40
15.	Spain	174.48	0.40
16.	Hong Kong	113.63	0.25
17.	Korea (South)	93.85	0.20
18.	Thailand	73.51	0.17
19.	France	70.72	0.17
20.	Cayman Islands	78.73	0.17
21.	Sweden	67.02	0.16
22.	Italy	60.81	0.14
23.	New Zealand	56.89	0.12
24.	Switzerland	44.41	0.1
25.	South Africa	40.13	0.08
26.	Finland	31.33	0.07
27	Taiwan	17.36	0.04
28.	The Bermudas	17.15	0.04
29.	Maldives	10.89	0.02
30.	Saudi Arabia	8.1	0.02
31.	Bahamas	8.17	0.02
32.	Kuwait	6.34	0.01
33.	Chile	4.5	0.01
34.	Seychelles	3.49	0.01
35.	Czech Republic	3.17	0.01
36.	Korea(North)	2.15	0
37.	Greece	1.38	0
38.	Israel	1.43	0
39.	Liechtenstein	1.2	0
40.	China	0.98	0
41.	Canada	0.63	0.00
42.	Bulgaria	0.63	0.00
43.	Oman	0.45	0.00
44.	Sri Lanka	0.47	0.00
45.	Philippines	0.38	0.00
46.	Malaysia	0.32	0.00
47.	Ireland	0.10	0.00
48.	Belgium	0.09	0.00
49.	Qatar	0.02	0.00
50.	Austria	0.00	0.00
51.	Indonesia	0.00	0.00
	Grand Total	45,494.95	9,985

Source: DoT. Available online at www.dot.gov.in

The cumulative inflows between August 1991 and December 2008 show that five states have attracted 53.97 per cent of the total telecommunication FDI inflows. Delhi has attracted majority of the FDI inflows in the telecom industry with 34 per cent, followed by Maharashtra with 13.8 per cent, Tamil Nadu with 2.98 per cent, Himachal Pradesh with 1.64 per cent and Karnataka with1.56 per cent.[62]

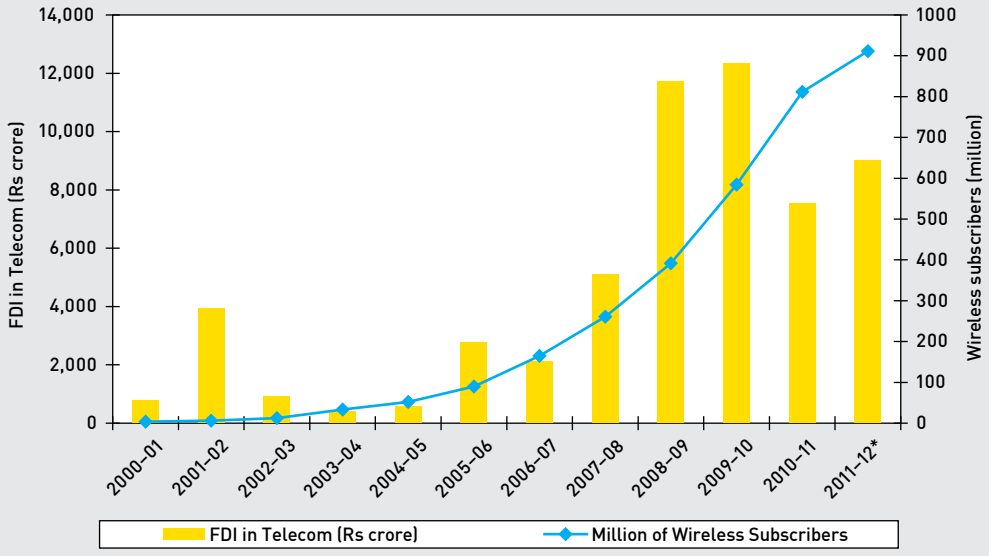
[62] DIPP. Available online at www.dipp.nic.in

4.3.2.2 Analysis

Limited evidence suggests that literacy rate, GDP per capita, and tax revenue had a positive impact on inward FDI flows to India.[63] In this section we focus on examining graphically the relationship between FDI in telecommunications and other telecommunication indicators. We specifically concentrate on the mobile phone segment as most of the FDI has gone into that sector.

Figure 4.5 shows that there is no significant correlation between inward FDI and the number of wireless subscribers. FDI has gone up and down with the number of subscribers steadily increasing.

Figure 4.5 : FDI in Telecommunications (Rs crore) and Wireless Subscribers (million), 2000–01 to 2011–12*

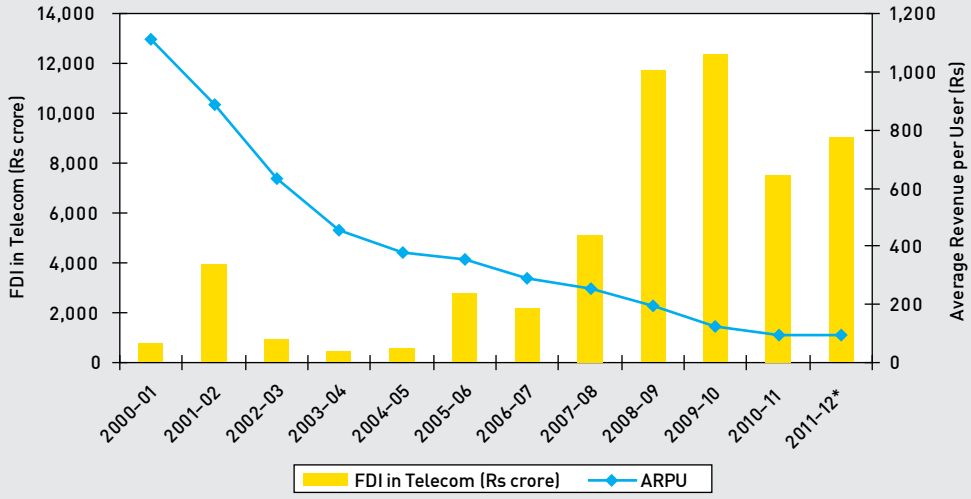


Sources: DIPP. Available online at www.dipp.nic.in
Telecom Regulatory Authority of India.
Note: * The FDI inflow data for the year 2011–12 includes the flows for the months from April 2011 to February 2012.

Figure 4.6 shows the relationship between Inward FDI in the telecommunications sector and Average Revenue Per User (ARPU) for the years 2000–01 through 2011–12. Again, there does not seem to be any correlation between the two.

[63] Green, K. (2005), *Foreign Direct Investment in the Indian Telecommunications Sector*, Munich Personal RePEc Archive No. 18099. Available online at mpra.repec.org

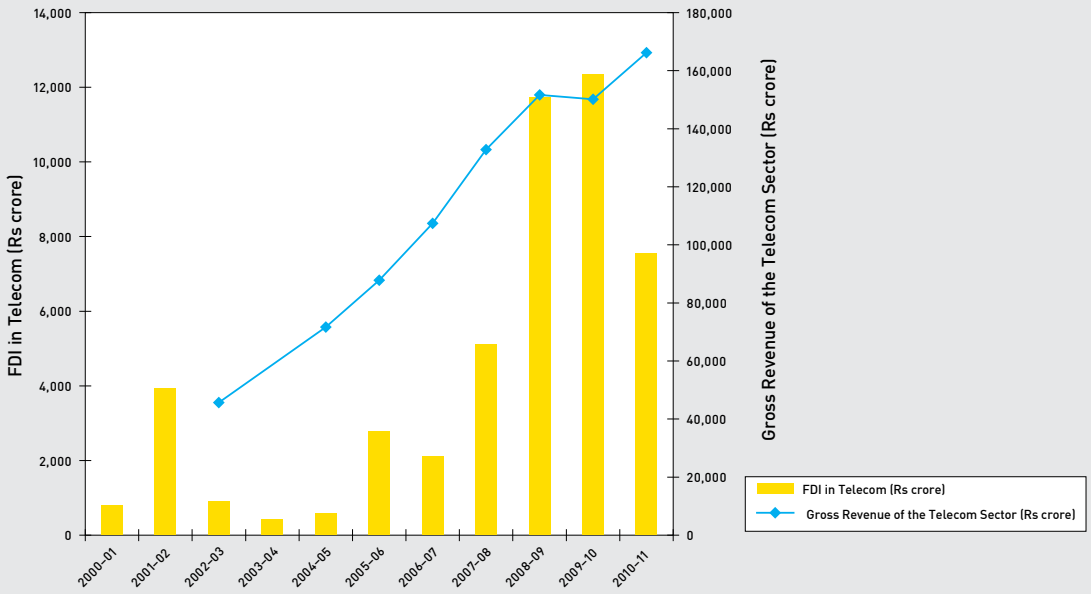
Figure 4.6 : FDI in Telecommunications (Rs crore) and ARPU Rs per minute (GSM), 2000–01 to 2011–12*



Sources: DIPP. Available online at www.dipp.nic.in. Telecom Regulatory Authority of India.
Note: * The FDI inflow data for the year 2011–12 includes the flows for the months from April 2011 to February 2012.
The ARPU in 2011–12 is the weighted average of the Blended ARPU of GSM (0.9) and CDMA (0.1) as of December 2011.

Figure 4.7 indicates that the stupendous growth in revenue has attracted majority of FDI inflows to this sector. This makes economic sense since FDI will flow into the sector which is making the most profits.

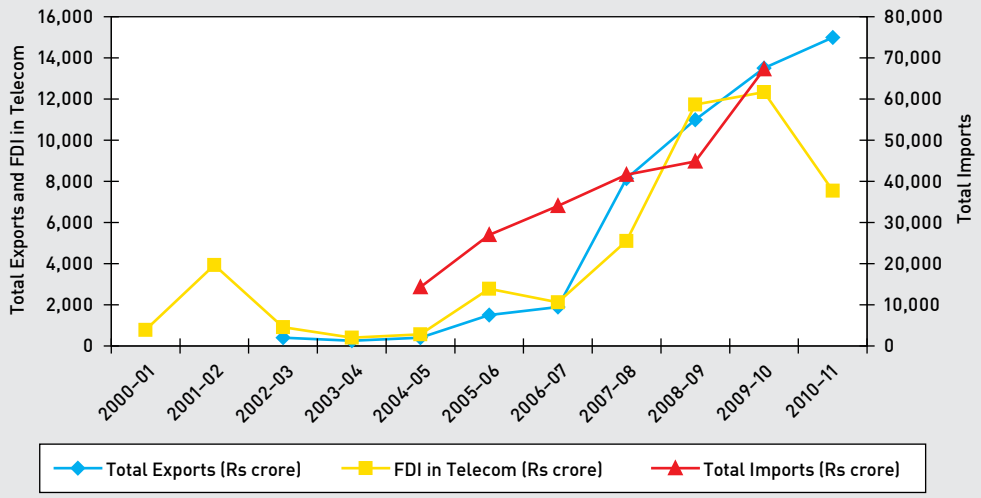
Figure 4.7 : FDI and Gross Revenue in Telecommunications Sector (Rs crore), 2000–01 to 2010–11



Sources: DIPP. Available online at www.dipp.nic.in, Telecom Regulatory Authority of India.

Figure 4.8 shows that since 2005–06 there are indications of positive correlation between FDI and telecom exports. However, imports are much higher than both exports and FDI indicating that most of the Indian domestic needs are being met by imports.

Figure 4.8 : FDI Inflow, Exports and Imports in Telecommunications Sector (Rs crore), 2000–01 to 2010–11



Sources: DIPP. Available online at www.dipp.nic.in
Telecom Regulatory Authority of India.
Note: The total imports for 2009–10 are projected figures.

This section shows that the telecom sector is attracting a larger share of FDI, but it is not on a sustained basis.

Increased saturation of the urban markets is encouraging Indian telecommunications companies to look abroad for increased profits. Africa provides a natural market given that it is one of the fastest growing telecommunication markets in the world.

4.4 CONCLUSION

Since the eighties, the Indian telecommunications industry has attracted the attention of the government. It allocated increasing portion of the plan outlay in this sector. That, unfortunately, was not enough to decrease the waiting list of phones. The advent of cell phones and liberalisation of the sector have changed the industry. Over the last decade, private investment has dominated over public sector investment in this sector. The share of foreign investment in India has a chequered history. Indian telecommunications industry attracted significant FDI in 2001–02 but dropped sharply after that. There was a revival in 2005–06 and again we see a decline before reviving in a major way again in 2008. The graphical analysis suggests that large revenue in the telecom sector has made it attractive for foreign investors.

Majority of FDI has gone into the cellular services industry. The telecom manufacturing industry continues to lag. Therefore, there is not much relationship between FDI and exports and imports in India. Buoyant by their success, the Indian telecommunication companies are investing in other emerging countries, especially the ones in Africa.

5 SOCIOECONOMIC IMPACT

5.1 INTRODUCTION

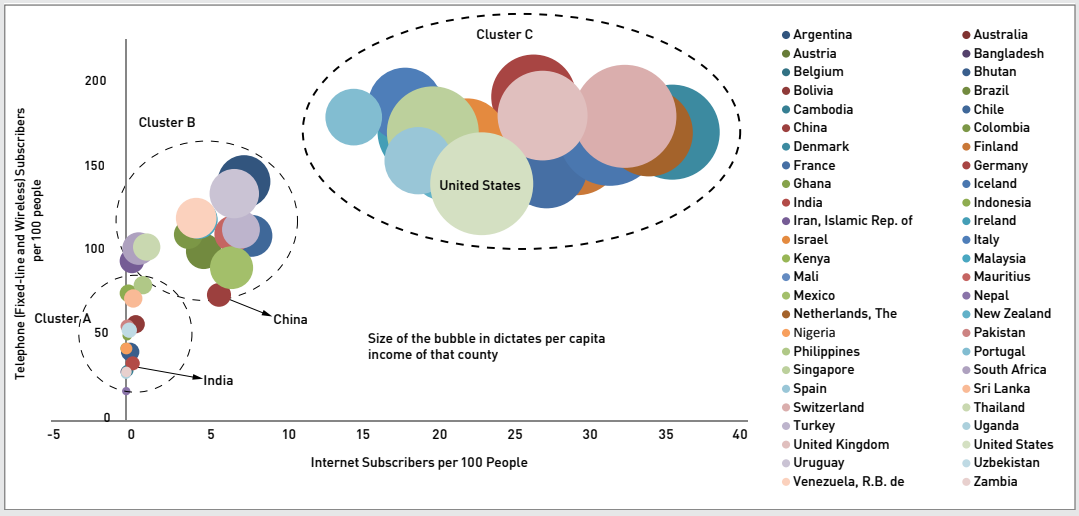
This chapter focuses on the impact of the Indian telecommunications on socioeconomic development. It ranges from the macro impact on Gross Domestic Product (GDP), total productivity to individual sectors such as agriculture, fisheries and to individual groups such as gender and the urban poor. Further, with telecommunications now being used in health, education, and governance sectors, the mode of delivery of development services has changed. In this chapter we analyse the uptake of these services in India.

5.2 MACRO IMPACT

5.2.1 Economic Growth

Testing for the impact of telecommunication on economic growth for developing countries, one finds that a 10 per cent higher penetration would increase GDP by 0.59 per cent.[64] Figure 5.1 graphically analyses the relationship between economic growth (per capita income), teledensity and Internet access. Around 50 countries are plotted in the graph based on these three indicators.

Figure 5.1 : Relationship between Economic Growth and Telecom Services: 2008



Source: World Development Indicators. Available online at www.worldbank.org

[64] Waverman, L., Meschi, M. and M. Fuss (2005), *The Impact of Telecoms on Economic Growth in Developing Countries*, Vodafone Policy Paper Series: Africa: The Impact of Mobile Phones, No. 2, Vodafone Group. Available online on www.umich.edu

Figure 5.1 depicts a strong positive relationship between economic growth and telecom/Internet services. Countries can be divided into three clusters.

Cluster A represents countries with very low per capita income as depicted by the small size of the bubble. These countries also have very low teledensity and Internet accessibility. This group includes countries such as India, Nepal, Nigeria, Philippines, Sri Lanka and Zambia.

Cluster B represents countries with medium level of per capita income. These countries also have relatively higher teledensity and Internet accessibility as compared to those in Cluster A. This group includes countries such as Argentina, Brazil, Chile, China, Columbia, Mexico, Turkey and Venezuela.

Cluster C represents countries with high level of per capita income as depicted by the big size of the bubble. These countries have very high teledensity and Internet accessibility. This group includes countries such as Denmark, France, Germany, Iceland, Italy, Portugal, Singapore, Spain, Switzerland, United Kingdom and United States.

Figure 5.2 indicates mixed relationship between incomes and teledensity. Statistically significant relationship between income and phones has been found by empirical studies on India.

The relationship between GDP and telecommunications sector especially wireless phone in India has been widely examined. Mobile services industry generated an annual GDP contribution of Rs 313 billion in mid-2000s by one estimate.[65] Another study tested the impact of telecommunications, especially wireless phone, on GDP for India.[66] McKinsey (2006) analyses that there is both direct and indirect impact. The "direct impact from mobile operators, indirect impact from other companies in the wireless business system (hardware and software vendors, handset vendors, and so on), and a second form of indirect impact: the surplus enjoyed by end users". It finds that the economic impact of wireless phones in India in 2005 ranged from 1.3 to 1.9 per cent of GDP. It also finds that increasing the mobile penetration ratio by 10 per cent would produce end-user value of $10 billion, equivalent to 0.61 per cent of GDP.

Using Indian state level data for mobile phones, one study finds that a 10 per cent increase in teledensity will increase Gross State Domestic Product (GSDP) by 1.12 per cent, keeping everything else constant.[67] Similarly they find that a 1 per cent increase in GSDP per capita or income by 10 per cent will increase teledensity by 24.5 per cent, keeping everything else constant.

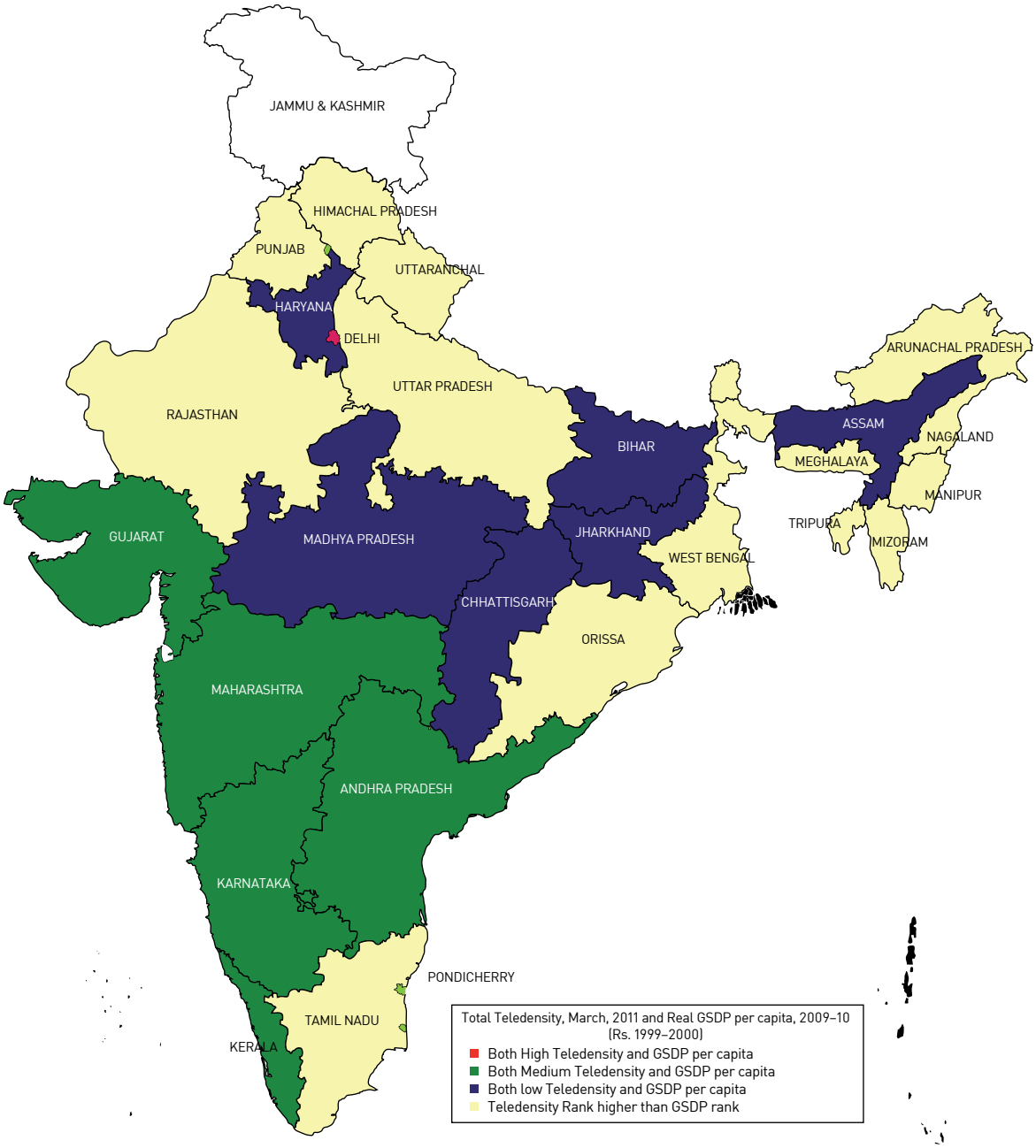
Analysys Mason studied the potential impact of wireless broadband and found that a 1 per cent increase in wireless broadband penetration will contribute 0.11 per cent (Rs 162 billion) to Indian GDP in 2015.[68]

5.2.2 Job Creation

Employment data shows that the share of employment of the transport, storage and communication went up from 3.7 per cent in 1999–2000 to 3.8 per cent in 2004–05. The employment in Business Process Outsourcing (BPO) shows high rates of growth throughout the 2000s.[69] The mobile telephone industry generated 3.6 million jobs both directly and indirectly.[70] There were 2.2 million people directly employed in the IT–BPO industry in 2008–09.[71] In 2008–09 the IT–BPO industry employed 1.9 million directly and 7.3 million indirectly in Tier 1 cities and created 0.17 million jobs in Tier 2/3 cities.

[65] COAI and OVUM (2005), OVUM Report on *Economic Benefits of Mobile Services in India: A Case Study for the GSM Association*. Available online at http://www.coai.com/
[66] McKinsey & Company (2006), *Wireless Unbound: The Surprising Economic Value and Untapped Potential of the Mobile Phone*. Available online at http://ww1.mckinsey.com
[67] Vodafone (2009), India: *The Impact of Mobile Phones*, Vodafone Policy Paper Series No. 9. Available online at http://www.vodafone.com
[68] Analysys Mason (2010), Report for GSMA: *Assessment of Economic Impact of Wireless Broadband in India*, Discussion Document.
[69] Planning Commission, Government of India (2008), *Report of the High Level Group on the Services Sector*, Available online at www.planningcommission.nic.in
[70] COAI and OVUM (2005), OVUM Report on *Economic Benefits of Mobile Services in India: A Case Study for the GSM Association*. Available online at http://www.coai.com
[71] NASSCOM (National Association of Software and Services Companies) (2010), *Impact of IT–BPO Industry in India: A Decade in Review*. Available online at www.nasscom.in

Figure 5.2 : Total Teledensity (June 30, 2010) and GSDP per capita (2008–09)



Teledensity (No. of subscriptions per 100 people)	GSDP per capita (Rs)	Category
0–50	11515–31405	Low
51–100	31406–51405	Medium
101 and above	51406–71815	High

Sources: National Accounts Statistics. Telecom Regulatory Authority of India.
Note: Telecom data are available circle wise and GSDP data state wise. They are not strictly comparable but give an indication of the relationship between the two variables.

5.2.3 Revenue

Mobile telephone industry generated Rs 145 billion per annum for the public exchequer through license fees, spectrum fees, import duties, taxes, etc.[72] The 3G spectrum auction combined with the bid values for Broadband Wireless Access licenses yielded the government more than Rs 1,00,000 crore in 2010, amounting to approximately 1 per cent of GDP.[73] The government has collected Rs 25,331 crore as Universal Subscriber Levy between 2002 and 2009[74].

In conclusion, the teledensity does impact GDP, employment and government revenue.

5.3 ICT AND ECONOMIC DEVELOPMENT

Global experience shows that mobile phone technology is being used from mid-2000 onwards to achieve economic and development goals (Table 5.1).

The importance of the mobile phone in development has been articulated best in the paper by Jensen (2007).[75] The 'Law of One Price' (that is the price of a good should not differ between any two markets by more than the transportation cost between them) did not work in countries like India characterised by incomplete information. The mobile phone has the ability to transcend this information gap prevailing in the country. Jensen (2007) shows this empirically for the fishing industry in Kerala. Abraham (2007) finds similar results.[76]

Veeraraghavan et al. (2009) discusses an experiment in rural Maharashtra where they replaced a PC-based system with an SMS-based mobile phone system and found the latter to be more successful with the farmers

Table 5.1 : Summary of ICT4D Phases

Issue/Phase	ICT4D 0.0 (1960s–mid-1990s)	ICT4D 1.0 (mid-1990s–mid-/late-2000s)	ICT4D 2.0 (mid-/late 2000s onwards)
Iconic technology	PC database	Telecentre	Mobile Phone
Key application	Data processing	Content (and interaction)	Services and Production
The poor	Who?	Consumers	Innovators and Producers
Key goal	Organisational efficiency	Millennium Development Goals	Growth and Development
Key issue	Technology's potential	Readiness and availability	Uptake and Impact
Key actor	Government	Donors and NGOs	All Sectors
Attitude	Ignore→Isolate	Idolise→Integrate	Integrate→Innovate
Innovation model	Northern	Pro-poor→Para-poor	Para-poor→Per-poor
Dominant discipline	Information systems	Informatics/development studies	Tribid of computer science, information systems and development studies
Development paradigm	Modernisation	Human development	Development 2.0

Source: Organisation for Economic Co-operation and Development (2009), ICTs for Development: Improving Policy Coherence. Paris, France.

[72] COAI and OVUM (2005), OVUM Report on *Economic Benefits of Mobile Services in India: A Case Study for the GSM Association*. Available online at http://www.coai.com
[73] Bhide, S. (2010), *The 3G Auction: What Will We Do with the Extra Money?* Macrotrack, National Council of Applied Economic Research, 12(5).
[74] Department of Telecommunications website (www.dot.gov.in).
[75] Jensen, R. (2007), *The Digital Provide: Information (Technology), Market Performance and Welfare in the South Indian Fisheries Sector*, Quarterly Journal of Economics, 122(3), August, pp. 879–924.
[76] Abraham, R. (2007), *Mobile Phones and Economic Development: Evidence from the Fishing Industry in India*, 4(1), Information Technologies and International Development, Fall, 5–17.

in terms of convenience, popularity and expense.[77] However, the SMS-based mobile phone system had its limitations in the sense that it took a long time to enter long strings of information. Mittal et al. (2010) also finds that "the final leg of delivering connectivity from a communications provider to a customer (last mile)" is served better by a mobile phone than a personal computer for fishermen especially the ones out at sea because of its "low cost, real-time delivery and expanded reach".[78]

Sood (2006), in a comprehensive study across various regions and occupations, finds that mobile phones helped in various ways including accessing market information, coordinating travel and transport, increasing paying work days and managing remote activities.[79] The ease of use, portability and comfort level of the mobile phone has made it the vehicle of choice for delivery of development programmes.

The above studies emphasise the importance of increasing the teledensity in rural areas and providing wireless broadband.

5.4. MICRO STUDIES ON THE IMPACT OF ICT

The impact of mobile phones has been mainly examined for three sectors namely agriculture, fisheries and small and medium enterprises (SMEs). Mobiles are found to have a statistically significant impact on output of fisheries. There is indication of positive impact of telecommunications on agriculture and SMEs.

5.4.1 Agriculture

The research looking at the impact of mobile phones on agriculture in India is still relatively new. There have been several initiatives using ICT in India (Box 5.1). A recent study qualitatively analyses two different services—IFFCO Kisan Sanchar Limited (IKSL) and Reuters Market Limited (RML)[80]. Table 5.2 shows the mobile services that are offered to farmers by IKSL and RML.

Mittal et al. (2010) finds that all farmers, in general, use mobile phones for social rather than business purposes. However, they benefit from the mobility of being able to make and receive calls at their farms including talking to experts or coordinating with their hired labour.

The two most sought-after pieces of information are seeds and mandi (market) price. Although all small farmers benefited from using mobile phones, the farmers from Maharashtra benefited more in terms of yield improvements, better prices and increased revenues. The research suggests that farmers benefited from improved access to information on seed variety, best cultivation practices (benefited especially from this), protection from weather related damages, handling plant diseases and price (Box 5.2 illustrates one such case). The farmers in Maharashtra are better able to utilise the text messages which they can retrieve at any time.

In contrast, the farmers in U.P. and Rajasthan preferred voice messages because of difficulties in handling SMSes.

[77] Veeraraghavan, R., Yasodhar, N. and K. Toyama (2009), *Warana Unwired: Replacing PCs with Mobile Phones in a Rural Sugarcane Cooperative*, Information Technologies and International Development, 5(1), Spring, 81–95.
[78] Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 246. Available online at www.icrier.org
[79] Sood, A. (2006), The Mobile Development Report, *The Socioeconomic Dynamics of Mobile Communications in Rural Areas and Their Consequences for Development*. Center for Knowledge Societies.
[80] Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations Working Paper No. 246. Available online at www.icrier.org

Box 5.1 : Rural Initiatives in ICT

ITC e-Choupal
This is a profit-driven project run by ITC Limited. ITC has initiated an e-Choupal effort that places computers with Internet access in rural farming villages. The e-Choupals serve as a social gathering place for exchange of information and an e-commerce hub. Mittal et al. (2010) find that farmers experienced 10 to 40 per cent productivity gains by using ITC services and benefited from being able to sell locally and getting local costs reimbursed.

n-Logue
n-Logue is a profit-driven project. It currently relies on cor-DECT (cordless-Digital Enhanced Cordless Telecommunication), a fixed Wireless Local Loop (WLL) technology, to provide the backbone to its IP network. Its low costs, ease of deployment, and minimal maintenance requirements make cor-DECT ideally suited for rural use.

DakNet11
DakNet uses wireless technology to provide broadband connectivity. Developed by MIT Media Lab researchers, DakNet has been successfully deployed in remote parts of both India and Cambodia at a cost much less than that of traditional landline solutions.

Bhoomi project of Karnataka state government
The Bhoomi project has revolutionized the way people access information of land records. Several of the 7,00,000 land records are available online for banks, judicial courts and hundreds of village kiosks all across the State.

Initiative of Tamil Nadu state government
So far 26 software and hardware offerings have been certified which conform to the standards and have been authorized for use in Tamil Nadu government and its institutions. A "Tamil Software Development Fund" has been set up to encourage the development of innovative Tamil software. The fund has supported seven projects till date.

Gyandoot in Madhya Pradesh
The Gyandoot project was started with the installation of a low-cost rural Intranet covering 31 village information kiosks in five Blocks of the Dhar district. Villages that function as Block headquarters or hold the weekly markets in tribal areas or are located on major roads (e.g., bus stops) were chosen for establishing the kiosks. Each kiosk caters to about 25 to 30 villages. Each kiosk was expected to earn a gross income of Rs 4,000 per month.

Rural "e-Seva" (in East Godavari District of A.P.)
The project is a tool to bridge the digital divide in the rural areas and has used information technology for providing access to various services to the people living in rural areas. Under this project web enabled rural kiosks termed e-Seva centres have been established at the mandal (a sub-district unit of administration) level. The project is based on BOOT (Build-Operate-Own-Transfer) Model.

Fisher Friend
Qualcomm's Wireless Reach Fisher Friend project is a partnership with MSSRF, TATA Teleservices and Astute

that enables fishing communities to earn their livelihood in a safe and proactive manner by leveraging 3G CDMA wireless and ICT technologies. Fisher Friend is an application that runs on 3G CDMA phones and empowers fishing communities with real-time access to market data. It can:

- Save lives by providing timely weather alerts to survive danger at high seas.
- Enhance livelihoods by providing real-time data on fish migration and market prices.
- Increase knowledge base by providing updates on government schemes, policies and developments of interest to fishing communities.

State Wide Area Network (SWAN)

All the states are developing their own wide area networks, popularly known as SWANs.

Source: Telecom Regulatory Authority of India.

Table 5.2 : Mobile Information Services for Farmers

Parameter	IFFCO-IKSL	Reuters-RML
Beginning of the service	June 2007	October 2007 (pilot in January 2007)
Locations surveyed	Uttar Pradesh, Rajasthan	Maharashtra
Cost	Free voice messages	Rs 175 for 3 months
	Helpline service at a cost of Rs 1/min.	Rs 350 for 6 months Rs 650 for one year
Nature of delivery	Voice message	SMS – Text message for two crops as subscribed by the farmer
Number of daily messages	Five	Four
Information provided	Crop/animal husbandry advisory • Market prices • Fertiliser availability • Electricity timings • Government schemes • News (commodity specific and general)	• Weather • Crop advisory (1 crop) • Market price (for 2 crops and 3 markets each)
Other services	Customised advisory through helpline	None
Number of subscribers (at the time of investigation)	Uttar Pradesh: 2,00,000 Rajasthan: 65,000	82,000 (all-India) 77,000 (Maharashtra)
Comments	• If the message is not immediately received by farmer, it can be retrieved by dialling a number at a cost of Rs 1 per min. • Messages delivered at unpredictable times of day. • Revenues are generated from the sale of SIM cards.	• Messages will be retrieved/saved if the farmer's phone is switched on within 24 hours of message delivery. • Messages delivered at preset times of day. • Subscription is the only revenue source.

Source: Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations Working Paper No. 246. Available online at www.icrier.org

Box 5.2 : Impact of Information

Name: Jagdeesh
Age: 40
Education: Middle school level
Location: Village Khanvaas, District Dausa (Rajasthan)
Land size: 9 acre (shared between three brothers)

Impact of mobile phone:

a) Cost savings from preventing potential crop loss: The farmer acted on time weather information received through IKSL to protect a harvested crop (Gwar, used as livestock fodder) that was lying on the ground exposed to the rains. He estimates that, but for this ability to act, he would have lost 50 per cent of this crop, resulting in a loss of between Rs 5,000 and Rs 6,000.
b) Increased Revenue: The farmer made use of information provided by IKLS concerning planting techniques and disease control to make changes in his farming practice. In his description, he shifted from 'guess-based' actions to following modern scientific cultivation practices. He attributes a 25 per cent increase in annual earnings, from Rs 100,000 to 125,000 to these changes.

Source: Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 246. Available online at www.icrier.org.

The research by Mittal et al. (2010) suggests that large farmers, although did not rely on mobile phones for any information, were better able to use the information. In contrast, the traders and brokers who are engaged in the wholesale markets of agricultural produce were heavily dependent on mobile phones for "dealing with truck breakdowns, shifting crops en route according to the supply and demand situation, communicating instructions to staff and dispensing advice to farmers (especially small farmers)".

5.4.2 Fisheries

This industry has been relatively more extensively studied than agriculture and this section summarises some of the major results from those studies.

Using micro-level survey data, Jensen (2007) examined three regions in Kerala which adopted mobile phones at three different times between 1997 and 2001 and found that "law of one price" prevails once the introduction of the mobile phone reduced the information asymmetries.[81] It also led to less wastage of the produce. Further, it led to a change in behaviour patterns of the fishermen. They still continued catching fish in their local areas but the number of fishermen selling in the local catchment area declined with the introduction of mobile phones in their respective regions.

Abraham analysed Kerala fishermen.[82] The key result from this study is that most of the mobile phone usages took at the marketing end (commission agents, wholesale merchants, retail merchants) rather than at the production end (fishermen). Generally there was less time and resources wasted, law of one price prevailed and the phones provided fishermen-at-sea with feelings of additional security.

[81] Jensen, R. (2007), *The Digital Provide: Information (Technology), Market Performance and Welfare in the South Indian Fisheries Sector*, Quarterly Journal of Economics, 122(3), August, pp. 879–924.
[82] Abraham, R. (2007), *Mobile Phones and Economic Development: Evidence from the Fishing Industry in India*, 4(1), Information Technologies and International Development, Fall, pp. 5–17.

The Fisher Friend Programme mentioned in Box 5.1 was evaluated in another study.[83] In this programme mobile phones were used as an information platform rather than a mere medium of communication. Two pieces of information especially useful to fishermen are (i) optimal fishing zones and (ii) weather. The Fisher Friend Programme was still in its pilot phase when evaluated by the authors. Its accessibility was limited to five nautical miles from shore, but the programme showed immense potential. The limited evidence suggests that the fishermen benefited from the programme because they were able to haul in bigger catches, reduce wastage, and save time and costs (a case study is illustrated in Box 5.3). And the mobile phone proved immensely useful in times of emergencies like net repair or engine breakdown.

Box 5.3 : Technology Helps Deliver a Big Catch: Taking a Chance on New Information

Name : A. Alphonse
Location : Koyalam Village (Pondicherry)
Segment : Fibre Boat (small–medium fisherman)
Service : Fisher Friend
Impact of mobile phone:
a) Revenue – Increased catch
b) Information sharing – Ability to contact other fishermen from the sea

Evaluating sea conditions using traditional methods, the fishermen of this village judged that fishing would be poor on a particular day and did not venture out to sea.

One of the fishermen, who was part of the Fisher Friend programme, chose to rely on the optimal fishing zone information delivered on his mobile and discovered a large pool of fish. He immediately called a friend on land with his mobile and the news spread among the villages. This prompted the fishermen to venture out to sea, resulting in an overall haul worth Rs 25,00,000 for the village.

Source: Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 246. Available online on www.icrier.org

A more recent study finds that 56 per cent of fishermen amongst the 400 surveyed used mobile phones.[84] However, the use varied regionally. The lowest usage of mobile phones was found in Kalyani, West Bengal (21 per cent; N=99). Seventy per cent of fishermen (N=100) from Guntur, Andhra Pradesh used mobiles. Similarly, Pondicherry – 71 per cent (N=101). In Nagapattinam, Tamil Nadu only 61 per cent of fishermen (N=100) used mobiles. Venkatesan et al. (2010b) find that fishermen used it both for business (83 per cent for coordinating departure and 75 per cent for status of fish collection), social purposes (71 per cent used it to contact relatives) and emergencies.

[83] Mittal, S., Gandhi S. and G. Tripathi (2010), *Socioeconomic Impact of Mobile Phones on Indian Agriculture*, Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 246. Available online at www.icrier.org
[84] Venkatesan, R., Joshi, L., Bhattarjee, M., Grover, M., Koti, J., Somayajulu, U.V., Praharaj, P., Verma, V. and M. Chaudhary (2010b), *Impact Assessment and Economic Benefits of Weather and Maritime Services*, National Council of Applied Economic Research, New Delhi.

5.4.3 Small and Medium Enterprises (SMEs)

Vodafone (2009) use a case-study-based approach to analyse the impact of mobiles on the manufacturing sector.[85] This study focuses on SMEs in the manufacturing sector. This is because there are about 12.84 million SMEs in India which contribute 39 per cent of India's manufacturing output and employ 31.2 million workers in rural and urban parts of the country. A typical SME consists of a self-employed person. Approximately 80 per cent of SMEs are unregistered with an initial investment of Rs 0.5 million each; less than 2 per cent of SMEs have access to bank credit and 90 per cent of their products and services are consumed domestically.

The analysis finds that SMEs use mobile communications in two ways—build business models around mobile services or use mobiles to increase productivity and efficiency. An example of the former is JustDial which is a mobile Yellow Pages service in Mumbai which provides directory services just by dialing the company's number.

The company was moving (when interviewed) to SMS-based services too where more information could be provided. The company earns money from the various businesses that pay them to be included in their list. JustDial, which had start-up capital of $1,000 14 years ago in 1995 (in 2009), has annual revenues of $17 million and a $100 million valuation in 2008. The company attributes this dizzying rise to the telecom revolution.

An example of increase in SMEs' productivity and efficiency by the usage of mobile phones is vegetable vendors. A vegetable vendor serving a 12-storey block of over 100 flats in East Delhi takes orders from his customers on his mobile phone. He then delivers items at the doorstep of the client at an appropriate time. This whole process takes him three hours. He utilises the balance time in other remunerative activities. Both the vegetable vendor and his customers are better off, the former from increased income and the latter from better service. In conclusion, mobile phones have a positive impact on SMEs whether they are in agriculture, manufacturing, or services.

5.5 INDIVIDUAL SECTIONS OF SOCIETY

The regional variations of teledensity were examined in Chapter 2. In this section, we analyse the impact of mobile phones amongst various groups within the society.

5.5.1 Gender

The telecom sector has had a positive impact both socially and economically on Indian women. The BPO sector has brought increased employment opportunities. Further the possession of a mobile phone both increases a woman's productivity and her status in the household. Disparities, however, continue to exist in the possession of a mobile phone in India.

Cherie Blair Foundation for Women et al. (2010) carried out a survey among 2000 women in Bolivia, Egypt, India and Kenya.[86] It showed that India has a mobile gender gap of 31 per cent which was the largest amongst the four countries mentioned above. The female mobile penetration ratio is 28 per cent as compared to the male mobile penetration ratio of 40 per cent in India. This survey also showed that although ownership ratio is low, these members borrow from family and friends to use the phone.

The Cherie Blair Foundation for Women and GSMA Development Fund and Vital Wave Consulting (2010) points out that ownership or access to mobile for women has both economic and social impacts. For all the four countries, the study showed that, "93 per cent of women felt safer because of their mobile phone; 85 per cent of women reportedly felt more independent because of their mobile phone; 41 per cent of women reported of having increased income and professional opportunities once they

[85] This section has been summarised from Vodafone (2009), *India: The Impact of Mobile Phones*, Vodafone Policy Paper Series No. 9. Available online at http://www.vodafone.com

[86] The next two paragraphs in this section are from Cherie Blair Foundation for Women, GSMA Development Fund and Vital Wave Consulting (2010), *Women and Mobile: A Global Opportunity: A Study on the Mobile Phone Gender Gap in Low and Middle Income Countries*. Available online at www.cherieblairfoundation.org

owned a mobile phone; and women in rural areas and lower income brackets stood to benefit the most from closing the gender gap".

Box 5.4 shows that the BPO sector in India has provided jobs to rural women. Further Box 5.5 shows that the possession of a mobile phone increases a woman's productivity and capacity to earn.

Box 5.4 : BPO Opportunities for Rural Women in India: The Case of Source for Change

Growing demand for BPO services in India is generating new jobs outside metropolitan areas. In the western state of Rajasthan, rural women with modest education are earning new income from employment opportunities in the BPO industry. Since 2007, the company named Source for Change is providing ICT-enabled services to clients in other parts of India as well as abroad.

Source for Change was founded with the idea that social values can be achieved through private marketplace. It provides BPO services from its data entry centre in Bagar, a town of about 10,000 people, most of whom speak only Hindi or Rajasthani. Bagar has one of the lowest rates of female school attendance in India. This all-women rural enterprise addresses both business and social needs. For its clients, it competes in the marketplace with high-quality services such as data entry, web research and local language call services. It has given some rural women the chance to gain technology skills and employment in a location with few similar options.

The company interviewed 27 women, of whom the 10 best candidates were hired. Following two months of training in English and computer skills, they began working as business process associates. For admissions into the training programme, candidates had to have completed 10th grade at school. They also needed to pass a test related to English writing, critical thinking, problem-solving and professionalism.

There are 25 computers and a server in the office. Internet services are provided by BSNL, through which the company enjoys broadband access to the Internet at the speed of 1.2 Mbps. The company has reliable electricity for 20–22 hours per day. If the electricity is out during work hours, a generator ensures uninterrupted work flow. As of early 2010, the operation had grown to 25 employees in Bagar, and there are plans for further expansion. Source for Change aims to have about 500 employees by the end of 2012. It hopes to offer various IT-based careers to some 5,000 women in rural India in future. The idea is to set up more small centres in other rural areas. The company intends to develop a "hub and spoke" system comprising centres with 30–50 employees. With the planned configuration, different centres should be able to share resources. For instance, an IT specialist may serve multiple centres.

The success of Source for Change has led people in Bagar to accept the radical notion of rural women producing high quality IT services. A challenge for the company has been a general lack of trust among urban-based corporate clients in high-quality BPO services being provided from a rural location. In spite of this scepticism, some clients have been found both inside India and abroad. As of 2010, the main clients of Source for Change included Pratham (India), the University of California–Los Angeles (United States) and Piramal Water (India).

For the women concerned, working for Source for Change has led to a stronger social standing in their families and communities. Initially, local people in Bagar were sceptical to the idea that women would be able to perform

the required IT-enabled work. Those employed soon rose from the status of oddities to community leaders. Women are often also more likely than men to invest their incomes to the benefit of their families. The experience of Source for Change suggests that there is scope for more BPOs based in rural areas. Policymakers should identify existing bottlenecks and remove those to foster further BPO dissemination in rural areas.

Source: United Nations Conference on Trade and Development (UNCTAD) (2010), *Information Economy Report*. Available online at www.unctad.org

Box 5.5 : Improvement in Productivity due to Mobile Phone: Case Study of a Woman

Meena, 36, hails from Rajasthan. Due to falling ill in her childhood, she never went to school and remained illiterate. However, she can recognise numbers. She got married at the age of 12 or 13 and moved with her husband to Delhi. Meena has three kids, two boys and one girl. She sends all the kids to school. Meena is the main breadwinner in the family. Her husband has an irregular job as a mason and mainly stays at home for the kids.

Meena is a masseuse for females bringing the traditional art of massage from Rajasthan to neighbourhoods in South Delhi. Both she and her husband have mobile phones (paid Rs 1500 for each phone). She has a prepaid plan and buys talking time equivalent to Rs 15 to 20 at any point of time. In a month, she and her husband spend about Rs 300 out of her income of Rs 10,000 (approximately 3 per cent) on mobile phone calls.

Meena has had her phone for two or three years now and found that possessing the phone increased her income significantly. Before acquiring the phone she could service only three clients but now she can easily serve up to four clients because the mobile saves her time and resources (approximately a difference of Rs 100 per day and Rs 3000 per month). Earlier she would go from house to house asking whether they needed her services. Now the phone enables her clients to get in touch with her as needed. Further, the phone helps her to keep track of her kids while she is at work. However, she mostly uses the phone to call up her relatives.

But being illiterate how does she give her clients missed calls? Her answer is that she is now able to recognise some of the English alphabets because of the mobile phone and uses that ability to make calls.

Mobile phones have led to increased literacy and not just the other way around.

Source: Author's interview.

Lee (2009) finds a positive impact of mobile phones on the status of women in India.[87] Using National Family Health Survey data 2005–06, the analysis indicates that mobile phones increase women's economic independence and mobility. Further, these also decrease both men and women's tolerance for domestic violence. However, no significant effects are found on child preferences or other measures of women's autonomy. The effects of the mobile phone can be large, as large as to be equivalent to more than five extra years of education. Table 5.3 presents some of the key results from this study. Only the coefficients on the mobile phones affecting the composite/summary measures are reported. Control variables in these equations include the landline phone, women's education, place of residence, such as whether they are living in rural areas, Northern or Eastern parts of India, and a standard of living index (not reported in Table 5.3).

Table 5.3 : Status of Women

Dependent variable	OLS (Ordinary Least Squares) Regressions		Composite scores, ordered probit regressions			
			Domestic violence		Autonomy	
	Preference for son	Total children desired	Beating wife justified	Control issues	Decision making	Permission to travel
Mobile phone	–0.008 (0.0058)	–0.01 (0.0088)	–0.13* (0.01)	–0.09* (0.01)	–0.08 (0.02)	–0.07* (0.01)
Landline phone	–0.002 (0.0060)	0.04* (0.0092)	–0.13* (0.01)	–0.12* (0.02)	0.03* (0.02)	–0.12* (0.01)
Observations	84,048	84,080	82,019	63,334	21,387	85,916
R-sq (Total variation explained in the dependent variable by the explanatory variables)	0.06	0.12	0.03	0.02	0.01	0.02

Source: Lee, D. (2009), *The Impact of Mobile Phones on the Status of Women in India*, Stanford University. Available online at www.stanford.edu
* One per cent of significance. Other control variables not reported in this Table. Standard errors in parentheses.

5.5.2 Youth

Mobile phone amongst teenagers and youth is quite popular especially in the metros. Given the young demographic profile of India, it is important to understand how the young adults use the mobile phone and its resultant impact on this group. Two studies have been undertaken on this. While one focused exclusively on Mumbai, the other studied both Mumbai and Kanpur. The focuses of these studies were different and gave different sets of information. One indicates the percentage and usage of mobile phones by the youth whereas the other also examines the social dynamics of the mobile phone.

The Mumbai market is an interesting study for researchers since it is the second largest market in the Metros. The GSM cellular data indicates that as of December 2004, Mumbai with 35,97,138 GSM mobile subscribers was right behind Delhi with (38,38,458 subscribers).[88] In November 2010, Mumbai had 1,97,52,162 customers versus Delhi's 2,11,50,429.[89] This implies that between December 2004 and November 2010, the number of GSM subscribers grew at the rate of 449.11 per cent in Mumbai while in Delhi it was slightly higher at 451.01 per cent for the same period.

[87] Lee, D. (2009), *The Impact of Mobile Phones on the Status of Women in India*, Stanford University. Available online at www.stanford.edu
[88] www.coai.com
[89] www.coai.com

MACRO (2004) interviewed 165 people between 15 to 30 years of age in Mumbai across various socioeconomic classifications.[90] The study showed that there was a gender divide with more females owning prepaid than postpaid connections as it helped them to budget their telephone expenses. Total usage of talk-time is higher in females (71%) than in males. Working respondents tend to use most of their talk time. "81 per cent of the users refilled their SIM cards on a monthly basis and the re-fill slip was of Rs 324".[91] In contrast, postpaid billing amount was in the range of Rs 700–1000 per month, with one-third of postpaid customers having a bill of more than Rs 1000 (70 per cent of these customers also belong to the highest socioeconomic status).

The purchase of the phone was need-based (72%) and 72 per cent of respondents indicated that their phone was always turned on (and this tendency was higher in females). Sixty per cent of the respondents indicated that their phone was to primarily keep in touch with their friends and to call up home when away (the latter case is more prevalent in females). The phones were mostly used to make local calls and text messaging. There were some indications of playing games on the mobile phone. Last 58 per cent of the respondents thought that the mobile phone was a necessity.

Matanhelia (2010) concentrated her research on mobile phones to college-going adults (18–24 years) in Mumbai and Kanpur.[92] The research showed that there were substantial differences between youth in Mumbai and Kanpur and there were differences between genders between the two cities. More important, the cell phone signalled a coming of age for the youth and marked out private spaces for them. This has important implications for the mobile phone industry as the Indian population is relatively young – the demand for the mobile phone industry will only go up.

In conclusion, this section finds that mobiles, especially in Mumbai, are a necessity especially for safety concerns. Mobile phones are being used to stay connected with family and friends. The latter research finds that mobiles are being used slowly and increasingly for other purposes. But the most important point is that mobile phone helps the young adult to develop his/her individuality. The last key element the research indicates is the differences between cell phone usage in Kanpur and Mumbai.

5.5.3 Urban Poor

Although many urban areas have more than 100 per cent coverage, there may be division within urban groups with regard to their accessibility to phones. Sarin and Jain (2009) analyse the impact of mobile phones using survey data of 1,774 households living in 84 slums from the three cities of Delhi, Ahmedabad and Kolkata.[93]

The main research questions raised by the study and their responses are as follows:

- *Determinants of usage and ownership*

  - Pre-existing economic status is a good determinant for owning or not owning a mobile phone.
  - Users of mobile phones, on an average, tend to be more literate.
  - Users of mobile phones are more likely to be self-employed or in regular wage jobs.
  - The survey indicates that the primary use of mobiles is either for talking to friends and relatives or for work. On an average, 60 per cent of users said that the people whom they talk to, either connected with work or for personal reasons, own phones, whereas this number is only 36 per cent for non-users. The authors conclude that users and non-users live in different networks.
  - The survey indicates the following household disparities:

[90] The next four paragraphs are summarised from Market Analysis and Consumer Research Organisation (2004), *Study of Mobile Phone Usage among the Teenagers and Youth in Mumbai*. Available online at www.itu.int.
[91] Market Analysis and Consumer Research Organisation (2004), *Study of Mobile Phone Usage among the Teenagers and Youth in Mumbai.* Available online at www.itu.int.
[92] Matanhelia, P. (2010), *Mobile Phone Use by Young Adults in India: A Case Study,* Doctoral Dissertation, University of Maryland, College Park, USA. Available online at www.umd.edu.
[93] This section is a summary from Sarin, A. and R. Jain (2009), *Effects of Mobiles on Socioeconomic life of Urban Poor*, Indian Institute of Management, Ahmedabad Working Paper No. 2009-02-05. Available online at www.iimahd.ernet.in.

- Eighty nine per cent of primary users in a household are males. This indicates the gender divide that we have talked about in the earlier section.
- Average age of primary users was 32 while occasional and non-users were likely to be younger than 28.
- "The survey indicated that primary users on average earned three times more than secondary users and eight times than that of non-users". This is not surprising considering that users indicate usage of mobiles for work.

- More than 70 per cent of households spend around 3 per cent of their total household earnings on their mobile per month and nearly 57 per cent re-charge at least once a week. The interview explained in Box 5.5 broadly conforms to these numbers.
- Usage data indicates that only 25 per cent of users subscribed to any additional service and if they did, it was for caller tunes/ring tones (94 per cent). Sports, jokes, news and horoscope followed next at 8 per cent, 6 per cent and 2 per cent, respectively. SMS is hardly used; less than 20 per cent of users had used it for any activity.

■ *The perceived impact of mobiles*

- Reduce costs and increase efficiency.
  - Sixty five per cent of users indicated that their travel costs came down because of the mobile.
  - Fifty seven per cent of users associate their usage of mobiles with increased access to sources of credit.
- Mobiles increased prices or wages and number of new customers and suppliers.
  - Fifty eight per cent of users reported that they received higher prices for the goods they sell because of mobiles.
  - Sixty per cent of users reported that mobiles enabled them to find new customers (Box 5.5).
- Around 60 per cent of users reported economic improvement in their lives because of the mobile.
- Mobiles also changed the nature of social interaction.

5.5.4 Social Interaction/Social Capital

Mobiles have changed the way we interact. Receiving and sending "missed calls" was a frequent feature of Bottom of Pyramid (BOP) users as this saves call charges.[94] The same study reports that around 91 per cent of BOP users had multiple sims to take advantage of price differences thereby saving on call charges.

"Mobiles facilitate three types of social capital: As an amenity and share commodity; to mediate strong links—with family, friends, and community members—and to mediate weak links—with individuals 'outside' the community, e.g. businessmen, government officials, tradesmen, etc".[95]

"Connectivity" is a "doubled-edged sword".[96] One may gain freedom but it also may mean informing friends and relatives of your whereabouts. Women feel more secure by carrying a mobile phone. Parents are able to keep in touch with their children.

Mobile has changed the way the urban poor interact in India. Seventy five per cent users of mobiles have increased their knowledge of welfare and whereabouts of friends and relatives in contrast to 35 per cent of non-users[97]. However, the frequencies of meetings have gone down. Forty two per cent of users reported a decrease in the frequency whereas 25 per cent of non-users reported a decline over the same time period.

[94] Prem, A. (2009), *Teleuse Survey: What Women Want, Voice and Data*. Available online at voicendata.ciol.com/
[95] Bhavnani, A., Chiu, R.W., Janakiram, S. and P. Silarzsky (2008), *The Role of Mobile Phones in Sustainable Rural Poverty Reduction*, ICT Policy Division, World Bank. Available online at www.worldbank.org
[96] Sinha, C. (2005), *Effect of Mobile Telephony on Empowering Rural Communities in Developing Countries*. International Research Foundation for Development Conference on Digital Divide, Global Development and the Information Society. Available online at www.ifrd.org
[97] Sarin, A. and R. Jain (2009), *Effects of Mobiles on Socioeconomic life of Urban Poor*, Indian Institute of Management, Ahmedabad Working Paper No. 2009-02-05. Available online at www.iimahd.ernet.in

5.6 APPLICATIONS OF TECHNOLOGY

Globally, consumers are increasingly turning to their mobile devices for a number of activities. According to KPMG Consumer and Convergence IV 2010 almost half of global consumers conducted banking transactions with their mobile devices in 2010.[98] Nearly three times as many people shopped at a retailer's website in 2010 than in 2008, a 29 per cent increase. An impressive two-thirds of consumers around the world today use cloud computing applications and services.

In Japan, for example, mobile operators KDDI has launched a handset called Mamorino—a mobile phone equipped with location tracking and emergency alert features. Mamorino is a mobile phone for young children, equipped with GPS tracking and a feature that only allows the phone to place outgoing calls and texts to four pre-programmed contacts. The handset, developed by Kyocera for Japanese mobile operator KDDI, has a simple design with an LCD screen, just 3 one-touch keys, a call-end key, front jog wheel and an action key. The location tracking feature allows parents to check the child's location at any time, and it also has a location alert feature that allows the child to easily inform the parents of his/her own location. Furthermore, the handset is equipped with an emergency alert that projects a loud alarm if the child pulls at it. Also, in the event of an emergency, a special service allows the emergency alarm to automatically notify local security service personnel.

In India mobile is still predominantly used for voice calls, but value added services are on the surge. Table 5.4 highlights that from social networking to email, from mobile banking to Bollywood ringtones, it is all happening on the mobile device. With the advent of next generation technologies these applications will pick up in the world's largest telecom market. Along with demand, supply-side factors also need to be taken care of to meet the demand. Table 5.5 shows the bandwidth required for various applications.

Table 5.4 : Increased Use of Mobile Devices (%)

Activities	Devices								
	Personal computer			Mobile phone			Other devices		
	2007	2008	2010	2007	2008	2010	2007	2008	2010
Chatting or instant messaging	93	94	70	6	5	29	1	1	1
Conversation (e.g., Skype)			70			29			1
Accessing maps/directions		89	75		4	23		7	2
Reading books			63			21			16
Playing games	72	68	77	6	7	17	22	25	6
Accessing news and information	96	95	83	1	2	13	2	2	4
Social networking	94	96	88	3	1	11	3	3	1
E-mailing			89			10			1
Banking/personal finance		96	90		2	8		1	2
Browsing the web			93			6			1
Watching TV/movies/videos	58	63	77	7	5	5	35	31	18
Shopping	98	97	90	1	2	5	1	1	5

Source: KPMG (2010), *Consumers and Convergence IV*. Available online at http://www.kpmg.com/
Note: Countries included in this survey are China, India, US, Russia, Brazil, Japan, Germany, UK, France, Spain, South Korea, South Africa, Poland, Romania, Australia, Canada, The Netherlands, Czech Republic, Hungary, Sweden, Slovakia, and Ireland.

[98] KPMG (2010), *Consumers and Convergence IV*. Available online at http://www.kpmg.com/

Table 5.5 : Bandwidth Required for Various Applications

Application	Minimum bandwidth required
Internet surfing	Up to 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 require higher bandwidth)
High Definition Video per channel	4–8 Mbps
Online gaming/video on demand/video streaming/IPTV	3–4 Mbps

Source: Telecom Regulatory Authority of India.

5.6.1 e-Education

One of the eight goals of the United Nations' 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 Net Enrolment Rate (NER) in India the country is likely to achieve 100 per cent NER well before the 2015 deadline. The Eleventh Five Year Plan places the highest priority on education as a central instrument for achieving rapid and inclusive growth. India has notified the 'Right of Children to Free and Compulsory Education Act 2009' bill for providing free and compulsory education to all children aged 6 to 14 with effect from April 1, 2010. India has various targets for education under different plans and schemes.

There are various initiatives from the government for increasing the use of Information Communications and Technology (ICT) in education. The Sarva Shiksha Abhiyan (SSA) scheme has a component of Computer Aided Learning (CAL), wherein a provision of Rs 50 lakh per district has been made as Innovation Fund. 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 speed.

Internationally, countries are also emphasizing the various programmes in education through ICTs. In USA virtually every school has Internet access. FCC (Federal Communications Commission) has issued a new order which will help bring affordable and super-fast fibre connections to the United States.

Lectures in the US are now available through podcasts which can be downloaded in iPod and students can listen to these in their own time. Although, extremely useful in the Indian context, iPods are prohibitively expensive here. Perhaps one can think of developing class lessons in MP3 format for India. 3G technology can also make a difference. Mobile Broadband is a key technology in India which can be used for educational purposes.[99]

[99] PricewaterhouseCoopers (PWC) (2010), *Mobile Broadband Outlook 2015*. Available online at http://www.pwc.com

In India, many states have provisions in their IT policies to encourage the use of IT in schools, colleges, and other educational institutions. Some states like Maharashtra, Kerala, West Bengal, etc. have included the participation of private entities for providing the IT infrastructure and training. Kerala has launched programmes like IT@school and Akshaya project for encouraging digital literacy in the state.

5.6.2 e-Health or m-Health

Healthcare is potentially one of the most important areas where telecom can make an impact. It has been estimated that at least $5 trillion is spent worldwide on providing healthcare. Savings of between 10 to 20 per cent 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. Telemedicine, which has been in operation in India since 1999, can fill the gap of supplying medical help to remote areas without the specialists actually moving to live in these areas.[100]

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 imparted through broadband video and other applications.

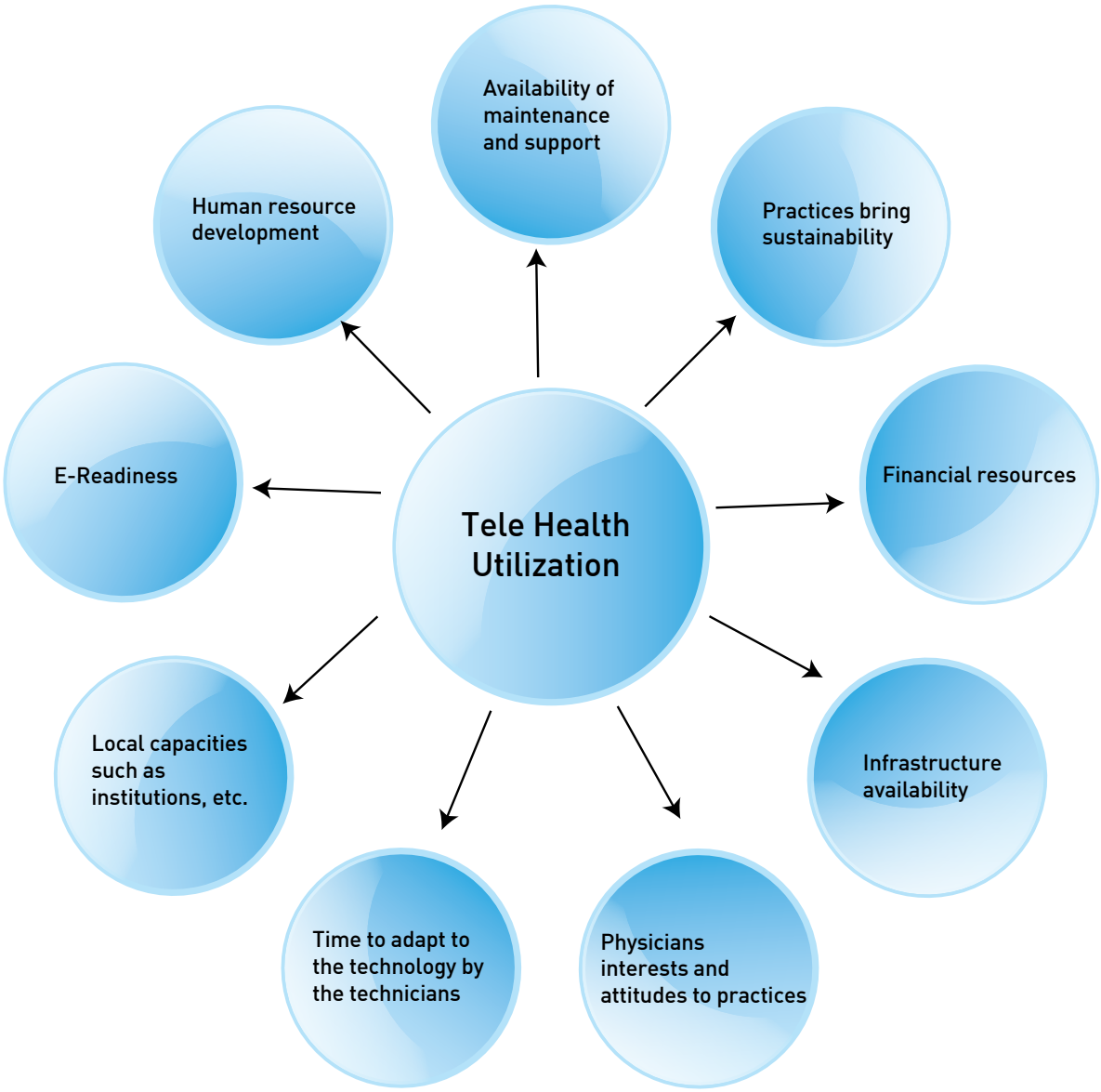
Industry players are already taking initiatives in this regard. For example, Aircel has partnered with the Apollo group to launch the first tele-health care delivery, 'Aircel Apollo Mobile Health Care' for consumers in India. This aims to reach out to the masses anytime anywhere with the help of products such as tele-medicine and tele-triage to begin with. Tele-medicine provides interactive health care in real-time online utilizing modern technology and telecommunications. This allows the patients to consult physician/specialist over video for immediate health care. Tele-medicine is an invaluable tool in health care as it helps patients to get service from doctors even in remote areas without the need of the patient's physical presence at the doctor's clinic.

There have been several studies examining the utilization of tele-medicine in rural parts of India and its impact on the health. Srinivasan (2008) examined the utilization of Tele-health in India.[101] In India infrastructure is not the problem since that is provided by Indian Space Research Organisation (ISRO) but human capital and retaining a trained professional for more than six months is the problem. Figure 5.3 illustrates the factors influencing the uptake of tele-health utilization in developing countries. Table 5.6 lists the super specialty consultations in India.

Kuppuswamy and Pandian (2008) examined mobile tele-ophthamology in India, i.e. medical equipment along with tele-medicine hardware, software, and VSAT system in a bus/van to study eyes.[102] The authors adopted case study and in-depth interview approaches to study the Sankara Nethralaya. It is a 29-year-old institution providing eye care. One of its activities is to provide primary remote consultations using a mobile unit. More than 200 patients come for screening if there is a three day camp. The authors find that people do not value primary health care because only 30 per cent of people go to hospitals for further treatment. However, patients go to the hospital if they are referred to Chennai to undergo cataract surgery.

[100] Mishra, S. K., Kapoor, L. and I. P. Singh (2010), *Telemedicne in India: Current and the Future, Telemedicne and e-health*, 15 (6), July /August, 568–75
[101] Srinivasan, K. (2008), *Utilisation of Telehealth in India*, Munich Personal REPC Archive Paper No. 15001. Available online at http://mpra.ub.uni-muenchen.de
[102] Kuppuswamy, S. and V. Pandian (2008), *Impact of Satellite Based Telemedicine Systems in Rural Areas of Tamil Nadu*, Calicut Medical Journal, 6(4).

Figure 5.3 : Factors Influencing Tele-health Utilisation in Developing Countries



Source: Srivinasan, K. (2008), *Utilisation of Telehealth in India*. Munich Personal REPC Archive Paper No. 15001, http://mpra.ub.unimuenchen.de/

Table 5.6 : Super Specialty Consultations

S. No.	Duration*	2002–2007~	Patients~	Patients/month (rounded)	Patients/annum (rounded)
	1	2	3	4	5
1.	5.5 years	NH, Bangalore	18070	274	3285
2.	4.5 years	SRMC	3300	61	733
3.	5 years	AIMS	1270	24	254
4.	6 years	Apollo, Chennai	3932	55	655
5.	1.5 years	Fortis	1132	63	755
6.	5 years	SGRH	48	1	10
7.	3 years	TMC, Mumbai	550	15	183
8.	2 years	PGIMER, Chandigarh	1106	46	553
9.	4 years	SGPGI, Lucknow	754	16	189
10.	5 years	AIIMS	450	8	90

Source: Srivinasan K. (2008), Utilisation of Telehealth in India, Munich Personal REPC Archive Paper No. 15001. Available online at http://mpra.ub.unimuenchen.de/.
~ Data published in the Proceedings of the Telemedicine Users Meet 2007 [(2), (3) and (4)].
* extrapolated from (3) and (4).

The patient data is collected through various processes like history, data-entry, biometrics and integration of medical equipment. The data is stored and shared between healthcare professionals to diagnose, treat and follow-up, be it regular treatment, post–surgery, etc.

In Japan KDDI has launched the Smart Sports service which tells subscribers how much they have walked and how many calories they have burnt. It also allows users to choose from 100 exercise programmes to find the one that suits them the best. Even a relatively older model of Sony Ericsson has a fitness module which is able to show how many steps one has walked and calories one may have burned in the process. Chipmaker Qualcomm, a major stakeholder in the 3G ecosystem, is working on taking this mobile health services to a whole new level. Boston-based Vitality has developed a prescription pill bottle cap with a built-in Qualcomm wireless chip that reminds you to take your medicine at a certain time every day. If you forget, it will call or send text message to you. If you need a refill, there is a button inside the cap that will call your pharmacy. The whole system uses AT&T's cellular network to handle all the data.

Stethoscope maker Littmann has developed a next generation auscultation device featuring "Bluetooth" technology that wirelessly transfers heart, lung and other body sounds to the software for further analysis. This allows the data to be transferred to a 3G phone which in turn can transmit to a doctor's phone sitting miles away for diagnosis.

Indian software companies are developing their own applications. ZMQ Software System has developed a programme to provide women with information on prenatal care via SMS.[103]

Ramachandran, et al. (2010) examine the impact of using mobile on health.[104] They studied Accredited Social Health Activists (ASHAs), who focus on maternal health. These

[103] Ramey, M. (2009), *Prenatal Care through SMS*. Available online at http://www.mobileactive.org/prenatal-care-through-sms
[104] Ramachandran, D., Canny, J., Das, P.D. and E. Cutrell (2010), *Mobile-izing Health Workers in Rural India*. Proceedings of the 28th International Conference on Human Factors in Computing Systems. Association for Computing Machinery. Available online at www.portal.acm.org

women workers receive training to work with pregnant women and new mothers. They also receive a monthly income. The authors worked with one of the government programmes in Orissa and interviewed all agents, such as trainers, doctors, actual workers, pregnant women and their family members, village leaders and prominent women in the village. The researchers observed that the clients routinely ignored the advice of ASHAs. Village power dynamics, low literacy, lack of experience and motivation of the health workers limited them in using and dispensing their information. Then the authors introduced ASHA workers to camera-ready mobiles with seven videos of one minute each on various issues.

The workers were then trained to make their own videos too, a week later. They were also trained to access the videos on their own. Over three months, the researchers saw both increased motivation amongst the workers, increased uptake of advice by the pregnant women and her family; or at least increased interaction. The women were very creative in their use of videos and the authors' limited observations saw that the clients were also more interested and impressed with the videos.

5.6.4 m-Governance

Mobile Governance, or m-Governance, is an upcoming area too with far more potential impact than e-Governance programmes. Table 5.7 lists some of the m-Governance applications.

Table 5.7: Some Applications with Mobile Governance

Project	Applications
Bhoomi, Karnataka	Landowners register with Bhoomi by paying a fee. Will get an SMS whenever there is a transaction on the land.
PDS, Chhattisgarh	Register phone and Fair Price shop (FPS). Access to information on availability and supply of food grains and about times and truck numbers that deliver supplies to the FPS in order to involve the public in enforcing accountability.
SMSONE, Maharashtra	"A Local SMS community Newsletter" service provided to different communities, each comprising 1000 registered users. The community is served with messages that are relevant to them, practically covering all aspects of their daily life from health camps to be held, non-supply of water or electricity, and traffic congestion, to reminders of bill payments.
Mysore City Corporation	Citizens message their problem related to civic services to a pre-assigned number through SMS. An acknowledgment number is sent back with the connected officer's name and numbers.

Source: Thomas, K.T. (2009), *Exit PC, Enter Mobile*, The Hindu Business Line. Available online at www.thehindubusinessline.com.

5.6.4 m-Commerce

Imagine being able to walk into a fast food joint and buy a burger using your mobile phone! m-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 organizations or between organizations and individuals. m-Commerce in India is still in a nascent stage, but 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 queues. A survey on "ICT adoption among Micro, Small and Medium Enterprises (MSMEs) in India" by Internet and Mobile Association of India (IAMAI) indicates that

B2B e-commerce market size (in terms of transaction value or value of business generated) as of December, 2007 was $78 billion.[105] B2B e-commerce has been increasing at a rapid pace and was expected to touch $89 billion by December 2009 at a CAGR (Compound Annual Growth Rate) of 8.77 per cent. TRAI projects that this may reach the figure of $100 billion by the end of 2010 assuming the same growth patterns.[106] Growth of mobile broadband will enable the growth of m-commerce.[107]

5.6.5 m-Banking

Access to basic financial services continues to be an unrealized dream for millions of our citizens; even more so for those in rural and remote areas. 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 16,000 people, a very high number when compared to developed countries. The Australian Government in its report "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.[108] It has the potential of furthering financial inclusion by making small ticket retail transactions cheaper, easier and faster for the banking sector as well as for the small customers.

Initiatives in this direction are already happening. Yes Bank has partnered with handset maker Nokia to enable users to pay electricity and water bills and even transfer funds to another person through mobile phones. Soon one will be able to board a train without a penny in one's pocket by wiring a ticket using the mobile.

In developed markets such as Japan and Finland such applications are already a reality. NTT DOCOMO in Japan has developed an application that enables subscribers to use their phone almost like a credit card, through a chip that resides in the phone and a vendor device. You can walk into a burger joint or a five-star hotel, eat all you want and then pay by simply tapping your phone on the vendor's device. The success of MPesa in Kenya is well known. Its implementation would require changes in banking laws in India. However, it has the potential to achieve bank inclusion, a much cherished dream.

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.[109]

The computerization of the banking sector, which is regarded as the precursor to other technological initiatives, is almost at completion stage. Government recently approved the framework for providing basic financial services through mobile phones. The framework, developed by an inter-ministerial group, envisages creation of "Mobile-linked No-Frills Accounts" by the banks. The basic transactions permissible over these accounts will include cash deposit, cash withdrawal, balance enquiry, transfer of money from one mobile-linked account to another and transfer of money to a mobile-linked account from a regular bank account. It will also facilitate transfer of funds from various government schemes like NREGS to a "Mobile linked No-Frills Account".

[105] Internet and Mobile Association of India (2009), *Internet Adoption among MSMEs in India: A survey with special focus on online B2b Marketplaces*, www.iamai.in
[106] Telecom Regulatory Authority of India.
[107] PricewaterhouseCoopers (PWC) (2010), *Mobile Broadband Outlook 2015*. Available online at http://www.pwc.com/in/
[108] www.archive.data.gov.au
[109] Reserve Bank of India. 2010. *Operation and Performance of Commercial Banks*. Reserve Bank of India website. (www.rbi.org.in)

The National Sample Survey data reveal that 51.4 per cent of nearly 89.3 million farmer households do not have access to any credit from institutional or non-institutional sources. Only 27 per cent of farm households are indebted to formal sources. Only 13 per cent avail loans from the banks in the income bracket of less than Rs 50,000. With mobile phones reaching 900 million people and more, the government is expecting to enable the population to get access to financial services on mobile device. With the acceptance of the report by the Committee of Secretaries, banks are being advised to implement the framework on priority. Individual banks have started implementation and may complete the rollout by December 2011.

The system will be linked to the Unique Identity (UID) number once it gets operationalised. A customer will have to present his UID number and biometrics for opening the Mobile-linked No-Frills Account. Initially, since the UID system is still not in place, this will not be mandatory. At around 100–150 million, mobile subscribers far outstrip account holders in rural areas.

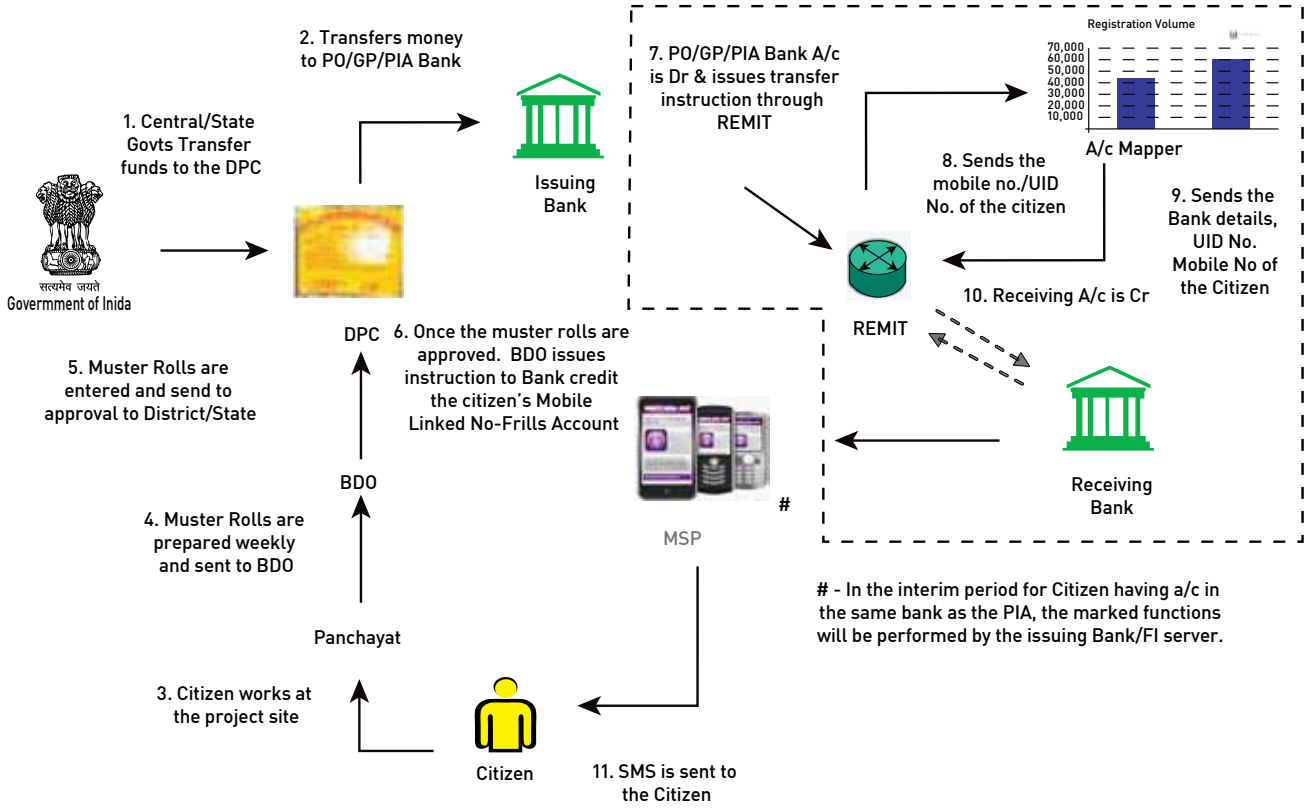
The government aims to achieve the twin objectives of tapping this viable and scaleable delivery models to allow banking based on micro-payments made by the poor and offering connectivity-driven branchless banking models to a population as yet to have any access to basic financial services.

The model enables persons with mobile phones instantly to deposit in or withdraw cash from their "Mobile-Linked No-Frills" bank accounts through a business correspondent (BC) having a mobile phone in the village. Also, the model enables any two mobile users to transfer money to each other's "no-frills" accounts specifying only their mobile numbers without the necessity of any intermediary including BCs. When fully implemented, the model would enable the same BC in the village to be shared by all the banks for supporting basic deposit and withdrawal transactions.

The detailed process of transfer of funds (Figure 5.4) from the government agency account to the citizen is as follows (explained in respect of NREGS):

1. Centre/state transfers funds to DPC (District Project Coordinator).
2. DPC transfers funds to the account of Programme Officer/Gram or Village Panchayat/Project Implementing Agency.
3. Attendance rolls of the workers are recorded on "Muster Rolls" on a daily basis at the project site. The Muster Rolls are consolidated at the Gram Panchayat on a weekly basis. The Muster Rolls are then forwarded to the Block Development Office (BDO) for entry into the system and approval at the district and the state level.
4. Once approved, BDO issues instructions to the bank to credit the workers' salary into the Mobile-Linked No-Frills Accounts electronically or otherwise.
5. Once the salary is credited, a message is sent by the bank to the worker to inform him of the transaction.

Figure 5.4 : Diagrammatic Representation of the Process of Transfer of Funds



Source: Report of the Inter-Ministerial Group, Framework for Delivery of Basic Financial Services on Mobile Phone. Available online on http://www.mpf.org.in/pdf/IMG%20Report.pdf.

5.6.6 Entertainment and Social behaviour

The socioeconomic 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. Already mobile users are accessing content related to astrology, Bollywood and cricket (ABC) in a big way. The changing life style and enhanced popularity of networking sites encourage people to be connected online. More than 33 million Internet users (aged 15 and older) in India visited social networking sites in July 2010.[110] Internationally, Facebook itself have more than 500 million active users in July 2010, out of which 50 per cent active users log on to Facebook on 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.

IPTV (Internet Protocol Television) and Mobile TV are examples of services that is expected to catch the imagination of consumers over the next few years. IPTV is a system where digital television service is delivered using the Internet Protocol over a network infrastructure, which may include delivery by a broadband connection.

A general definition of IPTV is television content that, instead of being delivered through traditional broadcast and cable formats, is received by the viewer through the technologies used for computer networks. For residential users, IPTV is often provided in conjunction with video on demand and may be bundled with Internet services such as web access and VoIP. The commercial bundling of IPTV, VoIP and Internet access is referred to as Triple Play service. More than 11 lakh people subscribe to IPTV services as on March 31, 2011 of which MTNL has close to 6 lakh users. Other operators including BSNL, Bharti Airtel and Reliance Communications have also launched this service in limited areas. Substantial broadband network construction will result in fast IPTV take-up over the next five years. By 2016, India will have 8.7 million IPTV subscribers according to the India Digital TV Forecasts report.[111]

Mobile TV services refer to the provision of television services to subscribers for viewing on handheld or portable devices, which is gaining popularity with 3G services. Certain cellular service providers are already offering mobile television services.

Technically, there are two main ways of delivering television content to mobile devices. The television content could be provided via mobile telecommunication networks or by using broadcasting technologies.

At present, only Doordarshan has launched the service commercially. Telecom companies are also planning to foray into this segment owing to its huge revenue earning potential. The telecom regulator has already given its recommendations for introducing the service.

5.6.7 Location Based Services

Especially in the urban context, location-based services are promising, as information related to traffic flows, air pollution and other environmental data will be on the mobile device. For example, you can get real-time information about the environment—your exposure to pollution in Mumbai. Technology majors such as Google are betting big on location-based services. Traffic police have started using Facebook to track offenders with the help of net and mobile users who post pictures online.[112]

[110] ComScore (2010), *Facebook Captures Top Spot Among Social Networking Sites in India*. Available online at www.conscore.com.
[111] digitaltvresearch.com (2011). *Triple-play subscriptions to quadruple*. Available online at www.digitaltvresearch.com.
[112] Sapre, O. (2010), *Traffic Police on Facebook: Jump redlight and get caught online*, Economic Times. www.economictimes.com.

This will enable advertisers to do target marketing based on consumer's location. So if you walk into a mall, a restaurant owner may SMS you a discount coupon which can be availed right there. Operators will offer dynamic pricing depending on the location of the subscriber. Entertainment services will continue to be in demand although they will move to the next level. From ring tone and wallpaper downloads, mobile phones will start beaming multiple live TV channels. Handset makers such as Nokia are calling it the fourth screen.

5.7 CONCLUSION

This chapter showed that diffusion and usage of mobiles have impacted the Indian economy. All the empirical evidence supports the statement that mobile phones have a positive impact on the Indian economy (GDP/GDP per capita). The size of the impact may vary from study to study but it is significant. The government is also better off and mobile phones have created jobs in the economy.

The impact of mobile phones across industries or demographic groups is positive. The size of this impact is up to debate. However, at the micro level mobile phones show evidence of increasing incomes especially in the urban areas. Urban poor also benefit from using phones.

Emerging technological developments leading to convergence in the ICT sector are enabling service providers to offer a wide range of services, such as multimedia, data, as well as voice, over the same platform through the deployment of advanced systems known as Next Generation Networks (NGNs). The emergence of NGNs, which are IP-based multi-service networks, are driving the changes in the way basic telephone services are delivered. In addition, these networks are expected to transit to a common core system to support a range of access technologies and enable converged services to be provided as applications on such systems. This will enable a lot of different services including voice to be carried over a common network, resulting in reduced costs due to economies of scope and also the efficiency of transport.

NGNs could help develop many more innovative services as demanded by customers with much more flexibility than those offered by traditional networks. Such networks could also offer opportunity for third party service providers to develop and provide value added customer services over the networks owned by other operators.

NGNs, which have separate transport, control and application layers, also enable different operators to compete with each other in different layers. As these layers are open, competition could be very aggressive, giving immense benefits to the consumers while providing new opportunities for service providers. Such networks could also be advantageous for rural areas where there is huge demand for information, telecom and video services and if these services could be delivered at affordable prices, the market could be very large.

New developments in technology may increase the rural usage of phones, especially in farming, health, education and banking.

6 CONCLUSIONS

6.1 INTRODUCTION

A combination of technological change, regulatory initiatives and marketing innovations have catapulted India into the second position in the mobile market and fourth position in the Internet market in the world with double digit growth rates in each sector.

6.2 CHALLENGES AND SUGGESTED POLICIES

As has been highlighted before, improving diffusion and usage of telecommunications is restricted by complementary factors like literacy status, status of women and lack of good infrastructure, namely roads and power, and so on. This chapter focuses on policy areas that may require attention to face the current challenges.

There are three major challenges in this sector: (i) digital divide, (ii) development of the telecommunications manufacturing sector, and (iii) growth of broadband sector.

6.2.1 Digital Divide

Digital divide remains a problem in India whether we talk about teledensity or density related to the Internet. This problem extends across space and gender compounding the existing gaps in India. Even when we talk about the much hyped teledensity statistics, only 70 per cent of our so-called million wireless connections are active. There are efforts at various levels to overcome these divides.

6.2.1.1 Policies

The Telecom Regulatory Authority of India (TRAI) undertook detailed studies on the growth of telecom services in rural India. TRAI gave its recommendations titled "Growth of Telecom Services in Rural India: The Way Forward" on October 3, 2005,[113] which provides for higher quantitative and qualitative growth in telecom sector in rural areas. The recommendations include:

- Sharing of infrastructure to obtain support from the Universal Service Obligation Fund (USOF).
- Supporting backbone infrastructure through USOF.
- Discount in annual license fees and spectrum charges linked with rural coverage.
- Development of suitable applications.
- Reduction in rural VSAT (Very Small Aperture Terminal) license fees and spectrum charges and provision of transponders at affordable rates.
- No right of way charges to be levied for networks in rural areas.
- Niche operators to be supported from USOF and exempted from spectrum charges.

[113] TRAI website.

- No spectrum fees to be charged for use of CorDECT and similar technologies in rural areas as well as for use of 450 MHz[114].
- No prior SACFA (Standing Advisory Committee for Frequency Allocation) clearance required for deployment of towers up to 40 metres in rural areas.
- Funds collected as Universal Access levy should be made available to USOF.

Further, with the objective of accelerating the growth of telecom services in rural areas and after detailed consultations on measures to improve telecom penetration in rural India, TRAI gave its recommendations titled "An Approach to Rural Telephony: Suggested Measures for an Accelerated Growth" on March 19, 2009.[115] The recommendations include the following:

- USOF needs to be separated from the Department of Telecommunications. USOF Act/Rule should be so amended that the funds accrued to USOF through levy is directly managed by the organization and is not routed through the budgetary process of the Union Government.
- USOF should determine the subsidy support for setting up mobile towers in different regions. Further, any ISP/CMSP/UASL (Internet Service Provider/ Cellular Mobile Service Provider/Unified Access Service License) operator who set up towers in designated SDCAs (Short Distance Charging Areas) and shares them should be paid subsidy depending on the number of operators sharing the tower.
- The earlier recommendations of charging a reduced USO levy of 3 per cent on covering 75 per cent development blocks including villages in a licensed service area must be reiterated.
- USOF may devise a scheme to call Expressions of Interest from IP-I/NLD/UAS licensees to provide optical fibre from the USOF subsidized towers to the nearest block headquarters. USOF shall give a maximum subsidy of one lakh rupees per km per sharing (to be distributed over a period of three years) provided it shares it with at least one access service provider.

Other than overcoming rural gaps, mobile phones can be used to overcome gaps in health, education and gender sectors. Mobiles can be used as a policy tool for empowerment, especially in rural areas. Some general policies for increasing ownership and usage of mobile phones by women would include the following:[116]

- Marketing strategies need to be used specifically to target women.
- Phones need to be increasingly positioned or marketed as both a life-enhancing and income-generating tool.
- Mobiles need to be marketed such that they appeal to the local culture.
- Innovative programmes could be created to increase women's ownership rates.
- Culturally relevant and acceptable ways should be identified for promoting mobile phone ownership amongst women, for instance, younger women who use mobile phones may teach older women on how to use those machines.

Policies for conquering digital divide, across space or socioeconomic groups, are not necessarily independent of each other. Mobile coverage in rural areas needs to be improved. Mobile ownership needs to be encouraged. Since poorer customers are relatively more responsive to price changes, mobile phones and services, which can be used in a cost-effective manner, need to be made available. People will only buy a mobile if they see multiple uses for

[114] "CorDECT is a low-cost advanced wireless access system designed keeping in view the economic realities of a country like India. It has been developed by Midas Communication Technologies and IIT Madras, in association with Analog Devices, USA. The technology provides a complete wireless access solution with seamless integration of high quality voice and 35/70 kbps Internet access to its wireless subscribers. The technology is based on the DECT (Digitally Enhanced Cordless Telecommunication) air interface standard specification of the European Telecommunication Standards Institute (ETSI). It supports 10 km of line-of-sight connectivity and has the provision to extend this to 25 km using Repeaters." e-gov (2005), "coRDECT Technology". www.egovonline.net. August 8.

[115] TRAI website.

[116] Cherie Blair Foundation for Women, GSMA Development Fund and Vital Wave Consulting (2010), *Women and Mobile: A Global Opportunity, A Study on the Mobile Phone Gender Gap in Low and Middle Income Countries*, www.cherieblairfoundation.org, accessed January 19, 2011.

it or due to demonstration effects, i.e. seeing their peers using it.

Another important course of action for the government to spread Internet services is to encourage budget telecom network model for delivery of value-added services and other data services. Accessibility of Internet via mobile is the key to making sure that more people have access to broadband. The number of data subscribers is much larger than that of broadband subscribers. Also, applications need to be emphasized on a voice model rather than only SMS due to literacy concerns of large sections of the Indian population, especially the marginalised. Further, the relevance and utility of programmes being offered on the mobile need a thorough examination.

6.2.2 Telecom Manufacturing

Despite significant growth in the telecom network and the subscriber base over the last decade in the country, the telecom manufacturing sector in India has not shown corresponding growth. The contribution of all domestic products has been 12–13 per cent in 2009–10 while Indian products could meet just 3 per cent of the domestic demand. Much of the equipment used for expansion of the Indian network is imported. It appears that the telecom ecosystem has so far failed to adequately spur the manufacturing segment and as a result, the domestic telecom equipment manufacturing segment has not been able to meet the demand forcing the telecom operators to import most of the equipment required for their network.

There is a need to work on removing supply side constraints like infrastructure to encourage domestic manufacturing. Setting up special zones or telecom clusters may encourage manufacturing and overcome infrastructural constraints. That is supported by evidence in the economic literature.[117]

Duty-free import of capital goods and components may help encourage domestic manufacturing. Mobile phones cheaper than Rs 1,000 are not available. Indian market needs cheaper phones for the price-sensitive consumers. Telecom manufacturing companies may consider tying up with Indian Universities and R&D institutions to invent and innovate.

6.2.3 Growth of Broadband

Mobile broadband is getting increasingly popular in India. Technologies are converging across the world. India needs to come up with technological, regulatory and marketing models which would capture this phenomenon. A particular challenge in the telecom sector is that there are a multitude of operating systems in mobiles unlike computers. This means mobile applications have to be developed for each system separately. However, the popularity of Android operating system in mobiles may yet reduce this challenge.

With increasing substitution between the mobile and the computer, greater regulatory coordination may be required between the two arms of the Ministry of Communications and Information Technology—Department of Telecommunications and Department of Information Technology.

6.3 OTHER CHALLENGES

The omnipresence of a mobile phone and cell tower has resulted in new and unexpected challenges.

6.3.1 Road Transport

Several car drivers and two-wheeler riders have a tendency to talk on the mobile phone while driving which is very dangerous. This has become a menace on roads. Although this will not affect the demand for phones or services to decline, it constitutes a negative impact of the phones. Increasingly regulators are aware of this issue and are trying to educate drivers.

[117] Porter, M.E. (1998), *Clusters and the New Economies of Competition*, Harvard Business Review, November 1.

6.3.2 Health

The impact of electro magnetic frequency (EMF) radiation emanating from cell phones and cell towers is a concern (www.dot.gov.in). The effect of the radiation on human health and environment remains inconclusive. However, the negative imagery leads municipalities and towns to protest against opening cellular towers in their neighbourhoods or towns. This only leads to more delay in building the telecom infrastructure.

6.3.3 Green Telecom

India has the second largest and fastest growing mobile telephone market in the world. Power and energy consumption for telecom network operations is by far the most significant contributor of carbon emissions in the telecom industry. However, large parts of the country are power deficient and with increasing coverage of mobiles in off-grid areas, network operations will increasingly have to rely on alternative sources of energy until the rural electrification process is complete. India has presently around 4,00,000 telecom towers, with average power consumption of 3 to 4 kW per tower. Assuming eight hours of operation by diesel generator sets, the average fuel consumption is 8,760 litres of diesel every year per tower. The total carbon emissions on account of diesel use by telecom towers is thus estimated at around 10 mt of CO_2, while the emissions on account of power drawal from the grid by towers is estimated to be around 6 mt of CO_2. The total emission by the Indian telecom industry is expected to be around 1 per cent of the country's total CO_2 emissions. In this context, greening of the telecom sector as well as the need to achieve economy in operations assumes significance.

Given the precarious nature of the Indian power situation, especially in the rural areas, and the need to lower the rural teledensity gap, the policymaker can fund innovation in low-cost solar powered mobiles. This might encourage the Indian manufacturing sector too. This will serve work on teledensity, greening the environment and encouraging the local manufacture of telecom equipment.

Further, there is a need to encourage running of cell towers on renewable energy, bio-diesel, etc. which would lower the carbon footprint.

The telecommunications sector in India has grown by leaps and bounds during the last decade. Teledensity has grown in double digits with wireless subscriptions in the lead. Broadband subscribers to the Internet are also growing, though at a relatively slower pace than wireless subscribers.

Use of mobiles has already started making an impact on the economy of the country. With diffusion of the 3G technology, the telecommunications sector is expected to grow in the rural wireless markets.

TRAI has made recommendations to the government for encouraging, amongst others, rural telephony, telecom equipment manufacturing, green telecommunications, adoption of internet/broadband, etc. to address various challenges faced by the sector.

APPENDIX

Important Recommendations made by TRAI, 2000–2011

S. No.	Title	Date of release
1.	Recommendations on National Broadband Plan	4 May 2011
2.	Recommendations on approach towards green telecommunications	12 April 2011
3.	Recommendations on issues related to telecommunications infrastructure policy	12 April 2011
4.	Recommendations on Telecom Equipment Manufacturing Policy	12 April 2011
5.	Recommendations on National Broadband Plan	8 December 2010
6.	Recommendations on Efficient Utilization of Numbering Resources	20 August 2010
7.	Recommendations on Spectrum Management and Licensing Framework	11 May 2010
8.	Recommendations on An Approach to Rural Telephony – Suggested Measures for an Accelerated Growth	19 March 2009
9.	Recommendations on lock-in period for promoter's equity and other related issues for Unified Access Service Licensees (UASL).	12 March 2009
10.	Recommendations on Growth of Value Added Services and Regulatory Issues	13 February 2009
11.	Recommendations on Provision of Calling Cards by Long Distance Operators	20 August 2008
12.	Recommendations on issues related to Internet telephony	18 August 2008
13.	Recommendations on Mobile Virtual Network Operator (MVNO)	6 August 2008
14.	Recommendations on Permitting New Entity for Allocation of 3G Spectrum	25 April 2008
15.	Recommendations on Terms and Conditions for Publication of an Integrated Telephone Directory for Fixed Line Telephones	24 April 2008
16.	Recommendations on Support for Rural Wireline Connections installed before 1.4.2002 from USOF, on Phasing Out of ADC	27 March 2008
17.	Recommendations on issues relating to mobile television service	23 January 2008
18.	Recommendations on Provision of IPTV services	4 January 2008
19.	Recommendations on growth of broadband	2 January 2008

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S. No.	Title	Date of release
20.	Recommendations on review of license terms and conditions and capping of number of access providers	28 August 2007
21.	Recommendations on Review of Internet Services	10 May 2007
22.	Recommendations on improvement in the effectiveness of National Internet Exchange of India (NIXI)	20 April 2007
23.	Recommendations on infrastructure sharing	11 April 2007
24.	Recommendations on Terms and Conditions for Resale in International Private Leased Circuits (IPLC) Segment	23 March 2007
25.	Recommendations on allocation and pricing of spectrum for 3G and broadband wireless access services	27 September 2006
26.	Recommendations on components of adjusted gross revenue (AGR)	21 Sepember 2006
27.	Recommendations on Next Generation networks	20 March 2006
28.	Recommendations on mobile number portability	8 March 2006
29.	Recommendations on transition from IPv4 to IPv6 in India	9 January 2006
30.	Recommendations on Promotion of Competition in International Private Lease Circuits (IPLC) Segment	16 December 2005
31.	Recommendations on growth of telecom services in rural India	3 October 2005
32.	Recommendations on issues relating to VPN	16 August 2005
33.	Recommendations on spectrum related issues	13 May 2005
34.	Recommendations on publication of telephone directory and directory enquiry services	5 May 2005
35.	Recommendations on Unified Licensing	13 January 2005
36.	Recommendations on office of Ombudsman	10 August 2004
37.	Recommendations on Accelerating Growth of Internet and Broadband Penetration	29 April 2004
38.	Recommendations for allowing ISPs to lay copper cable in last mile	19 March 2004
39.	Recommendations on intra-circle merger and acquisitions guidelines	30 January 2004
40.	Recommendation on Unified Licensing	27 October 2003
41.	Recommendations on WLL(M) Issues Pertaining to TRAI based on Hon'ble TDSAT'S Order	27 October 2003
42.	Recommendations on the Issue of Fresh Licenses to Cellular Mobile Service Providers (CMSPs)	21 February 2003
43.	Recommendations on Issues Concerning Public Mobile Radio Trunked Service (PMRTS) Referred by the DoT	7 January 2003
44.	Guideline for the System on Accounting Separation	27 December 2002
45.	Recommendations to Facilitate VSAT Operations	10 December 2002
46.	Recommendations on Growth of Internet in the Country	9 September 2002
47.	Recommendations on licensing of Receive only VSAT service	7 June 2002
48.	Recommendations on Introduction of Internet Telephony	20 February 2002
49.	Recommendation on INSAT MSS reporting service	19 November 2001

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S. No.	Title	Date of release
50.	Recommendations on opening of the International Long Distance Service	12 November 2001
51.	Recommendations on filling up of vacant slots of cellular mobile telephone service license	23 October 2001
52.	Recommendations on Universal Service Obligation (USO)	3 October 2001
53.	Incorporation of suitable clauses in the License agreement of BSOs for equal ease of Access through Pre-selection	20 July 2001
54.	Recommendations on Allotment of Codes to NLD Operators	19 June 2001
55.	Recommendations on Unified Messaging Service	31 May 2001
56.	Recommendations on licence fee for radio paging service providers	30 April 2001
57.	Recommendations on the issues of fresh licences for radio paging service	27 April 2001
58.	Recommendations on Issues Relating to Limited Mobility through Wireless in Local Loop in the Access Network by Basic Service Providers	8 January 2001
59.	Recommendations on licensing issues relating to Voice Mail/Audiotex	29 December 2000
60.	Recommendations with regard to Cellular Mobile Service Providers (CMSPs)	24 October 2000
61.	Recommendations on Provision of Mobile Community Phone services	20 October 2000
62.	Recommendation on Fresh Licenses for VSAT Service	18 October 2000
63.	Recommendations on issues relating to Licensing of Fixed Service Providers	31 August 2000
64.	Recommendations on issues relating to Cellular Mobile Service	23 June 2000
65.	Recommendations on introduction of competition in National Long Distance Communication	13 December 1999
66.	Recommendations on license fee and terms and conditions of the license agreement for GMPCS service	15 November 1999

ABBREVIATIONS

3G	Third Generation
ABC	Astrology, Bollywood and Cricket
ACMA	Australian Communications and Media Authority
ARPU	Average Revenue per User
ASHA	Accredited Social Health Activist
BC	Business Correspondent
BDO	Block Development Office
BOP	Bottom of Pyramid
BPO	Business Process Outsourcing
BSC	Broadcasting Standards Commission
BSNL	Bharat Sanchar Nigam Limited
CAL	Computer Aided Learning
CDG	CDMA Development Group
CDMA	Code Division Multiple Access
C-DOT	Centre for Development of Telematics
CM	Cable Modem
CMTS	Cable Modem Termination System
CO	Central Offices
CPP	Calling Party Pays
DOCSIS	Data over Cable Service Interface Specification
DoP	Department of Posts
DoT	Department of Telecommunications
DSL	Digital Subscriber Line
DTH	Direct-to-Home
EBITDA	Earnings before Interest, Taxes, Depreciation, and Amortization
EDGE	Enhanced Data rates for GSM Evolution
EFYP	Eleventh Five Year Plan
EMF	Electromagnetic Frequency Radiation
EoC	Ethernet over Cable
FCC	Federal Communications Commission
FDI	Foreign Direct Investment
FIPB	Foreign Investment Promotion Board
FPS	Fair Price Shop
FTTB	Fibre to the Building
GDP	Gross Domestic Product
GMPCS	Global Mobile Personal Communication by Satellite
GPON	Gigabit-capable Passive Optical Network
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSDP	Gross State Domestic Product
GSM	Global System for Mobile
IAMAI	Internet and Mobile Association of India
IBA	Independent Broadcasting Authority
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technology
ICT4D	ICT for Development
IKSL	IFFCO Kisan Sanchar Limited

ILD	International Long Distance
IPR	Intellectual Property Rights
IPTV	Internet Protocol Television
IPV6	Internet Protocol Version 6
IRT	Indian Radio Telegraph Company
ISP	Internet Service Provider
IT	Information Technology
ITC	Independent Television Commission
ITC	Indian Tobacco Company
ITES	Information Technology Enabled Services
ITU	International Telecommunication Union
IUC	Interconnect Usage Charge
KBPS	Kilo Bits per Second
LoI	Letter of Intent
MARR	Multi Access Radio Relay
MDGs	Millennium Development Goals
MLJ	Ministry of Law and Justice
MMS	Multi-Media Messaging Service
MOFCOM	Ministry of Commerce of the People's Republic of China
MoU	Minutes of Use
MSMEs	Micro, Small and Medium Enterprises
MTNL	Mahanagar Telephone Nigam Limited
MVNO	Mobile Virtual Network Operator
NDRC	National Development and Reform Commission
NER	Net Enrolment Rate
NGN	Next Generation Network
NLD	National Long Distance
NTIA	National Telecommunications and Information Administration
NTP	National Telecom Policy
OFTA	Office of the Telecommunications Authority
OFTEL	Office of Telecommunications
OLT	Optical Line Terminal
ONT	Optical Network Terminal
PAS	Personal Access Systems
PBSO	Private Basic Service Operator
PCO	Public Call Office
PC	Personal Computer
PMRTS	Public Mobile Radio Trunk Service
PON	Passive Optical Networks
POP	Point of Presence
PSE	Public Sector Enterprise
PTT	Posts, Telephone and Telegraph
QoS	Quality of Service
RA	Radiocommunications Agency
Rau	Radio Authority
RCPs	Rural Community Phones
RDELs	Rural Household Direct Exchange Lines
RIO	Reference Interconnect Offer
RML	Reuters Market Light
SARFT	State Administration of Film, Radio and Television
SATRA	South African Telecommunications Regulatory Authority
SDCA	Short Distance Charging Area
SME	Small and Medium Enterprise
SMS	Short Message Service
SSA	Sarva Shiksha Abhiyan
TA	Telecommunications Authority
TDSAT	Telecom Dispute Settlement Appellate Tribunal
TEC	Telecom Engineering Centre
TNC	Trans-National Corporation
TTO	Telecom Tariff Order
UASL	Unified Access Service Licensees
UID	Unique Identification
USD	United States Dollars
USOF	Universal Service Obligation Fund
VAS	Value Added Services
VLR	Visitor Location Register
VoD	Video on Demand
VPT	Village Public Telephone
VSAT	Very Small Aperture Terminal
WLL	Wireless in Local Loop
WPC	Wireless Planning and Coordination Wing