ICT Sector Performance Review

for

INDIA[§]

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TABLE OF CONTENTS

List of Tables

List of Figures

List of Abbreviations

ADC	Access Deficit Charge
AGR	Adjusted Gross Revenue
ARPU	Average Revenue Per User
ASSOCHAM	The Associated Chambers of Commerce and Industry of India
BSOs	Basic Service Operators
BTS	Base Transceivers Stations
BSNL	Bharat Sanchar Nigam Limited
BPO	Business Process Outsourcing
CBSE	Central Boards of Secondary Education
CCI	Competition Commission of India

CMTS	Cellular Mobile Telephone Service
CPP	Calling Party Pays
DTS	Department of Telecom Services
DoT	Department of Telecommunications
DTEs	Developing and Transitional Economies
EBITDA	Earning before Interest Tax and Depreciation allowance
EIL	Ericsson India Ltd.
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GoT	Group on Telecom
HHI	Herfindahl-Hirschman Index
ICSE	Indian Certificate for Secondary Education
ICTs	Information Communication Technologies
IGNOU	Indira Gandhi National Open University
IUC	Interconnection Usage Charges
ILD	International Long Distance
IPLC	International Private Leased Circuits
ITIC	Independent tower infrastructure companies
ITU	International Telecommunication Union
ISPs	Internet Service Providers
IT	Internet Telephony
ITeS	Information Technology enabled Services
LLU	Local Loop Unbundling
IVR	interactive voice response
MILLEE	Mobile and Immersive Learning for Literacy in Emerging Economies
MTNL	Mahanagar Telephone Nigam Limited
MHz	Mega Hertz
NIXI	National Internet Exchange of India
NLD	National Long Distance
NSSO	National Sample Survey Organisation
NTP	National Telecom Policy
NLDOs	National Long Distance Operators
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RBI	Reserve Bank of India
RoCE	Return on Capital Employed
TDSAT	Telecom Dispute Settlement Appellate Tribunal
TRAI	Telecom Regulatory Authority of India
TRE	Telecom Regulatory Environment
UAS	Unified Access Service
USL	Universal Service Levy
USO	Universal Service Obligation
VSNL	Videsh Sanchar Nigam Limited
WAS	Wireless Application Protocol

1. Executive Summary

Telecommunication reforms in India saw very little privatisation and much more of market liberalisation accompanied with the introduction of new laws and regulations. Regulatory agencies and regulation have become integral components of the telecom reform process, in order to protect consumers, reassure investors and, in theory, help advance competition. In a country like India the role of the regulator is much beyond regulation of segments that are potentially monopolistic but its performance should also be measured in terms of its ability to foster competition. Studies have shown a close relationship between the nature of a regulatory regime and the investment behavior of the firms subject to that regime. Changes in regulation have often been followed by changes in investment behavior (Graeme Guthrie, 2006).[1]

The results of liberalisation have been impressive. Teledensity has increased from merely 2 percent or so in 1999 to around 61 percent in 2010 and almost 8-10 million mobile subscribers are added every month. Wireless has been the principal engine for telecom growth in the country. The wireless subscriber base has grown from 0.88 million in1999 to 687.71 million in 2010-11. Given that the mobile sector grew at the Compound Annual Growth Rate (CAGR) of 84 .01 percent in the last decade, the telecom subscriber base has already outstripped what was envisaged for the 11th Plan ending in 2102.

Given the importance of the Telecom Regulatory Environment (TRE) on the outcomes of reforms, LIRNEasia has developed a TRE index, which summarizes stakeholders' perception on certain TRE dimensions. The index is created with the help of a survey of the key stakeholders who are asked to evaluate the regulatory environment on a scale of 1 to 5, 1 being highly ineffective and 5 being highly effective. The first survey was conducted in July 2006 in five Asian countries, India, Sri Lanka, Pakistan, Thailand, and the Philippines on six dimensions: i) market entry; ii) access to scarce resources; iii) interconnection; iv) tariff regulation; v) anti-competitive practices; and vi) universal service obligation (USO), for the fixed and mobile sectors. In the last survey carried out in July 2008, a seventh dimension dealing with the "quality of service" was added, and the survey was conducted for the broadband sector in addition to fixed and mobile sectors.

The following figures (fig.1, 2 and 3) summarize the sector assessment results for the most recent survey of 2010-2011 for India.

[1] Graeme Guthrie (2006). Regulating Infrastructure: The Impact on Risk and Investment. Journal of Economic Literature, American Economic Association, Vol. 44(4), pages 925-972.

Figure 1: Sector Assessment Results for the period January 2010- January 2011: Individual Score Chart - I

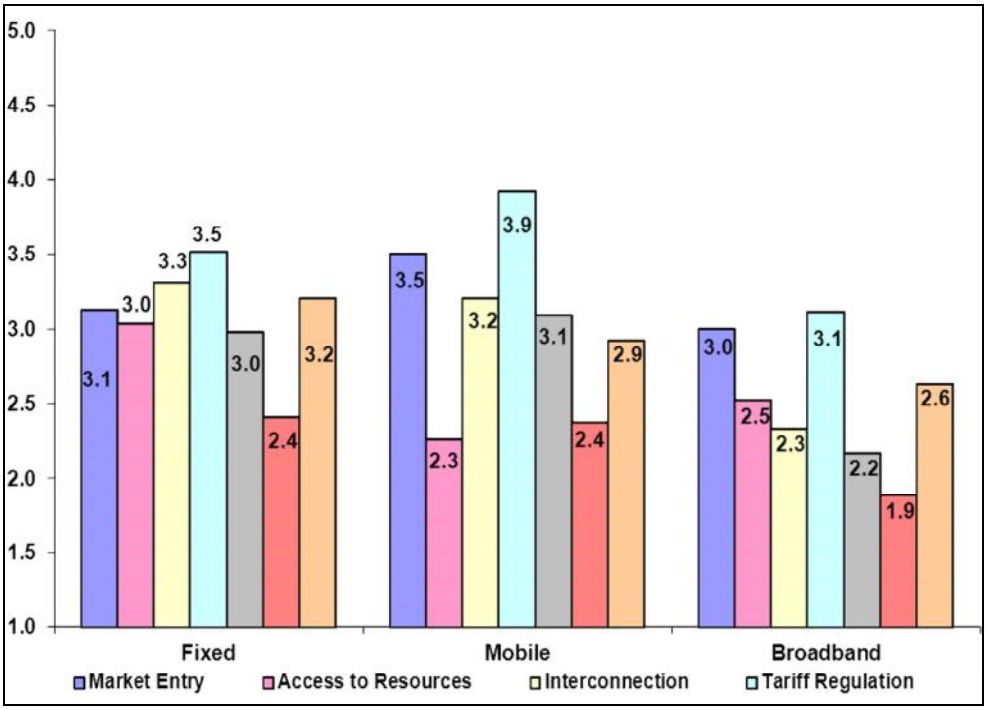


Figure 2: Sector Assessment Results for the period January 2010- January 2011: Individual Score Chart-II

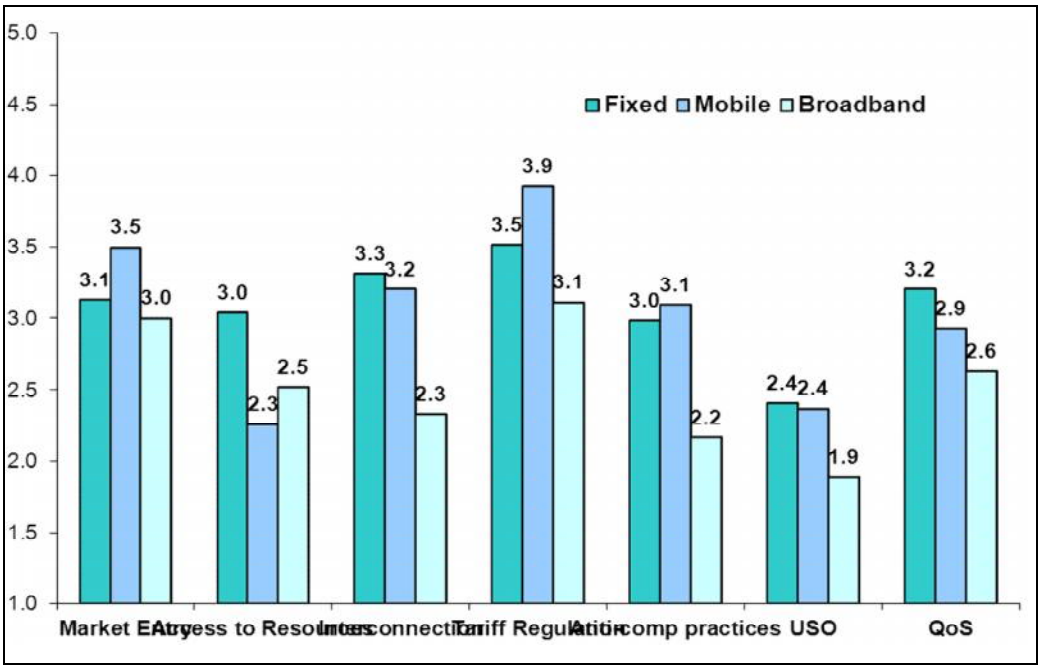
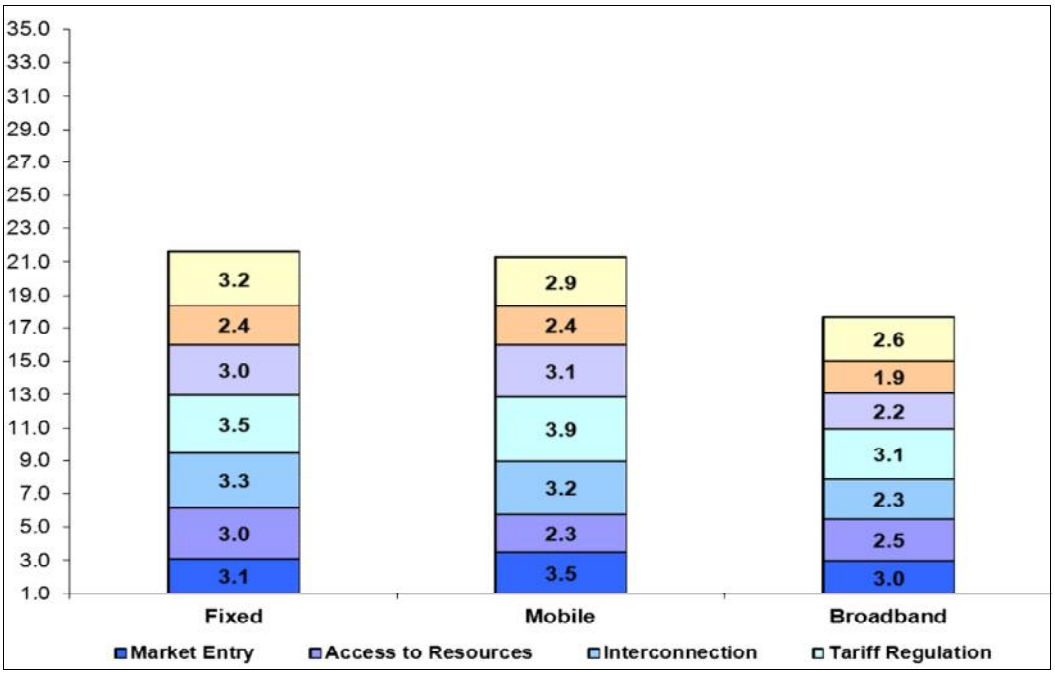


Figure 3: Sector Assessment Results for the period January 2010- January 2011: Total Output Score Chart



Some observations from the survey result those are noteworthy are as follows: (i) The perception of the survey respondents points out to the success of the regulatory environment in voice with the data i.e. broadband having very poor outcomes on almost all the dimensions other than market entry and tariff regulation (ii) The Indian telecom sector growth can be attributed to successful market entry in all the segments, which in turn provided a base for competitive tariff regulation (iii) Universal service is still a concern with wide disparities in rural and urban access. The digital divide in the broadband segment is reflected in the poor scores for USO (iv) the quality of service seems to be compromised with low scores both for mobile and broadband (v) Last, but not the least the spectrum allocation especially 2G has resulted in very poor scores for access to scarce resources for mobile.

The survey points out to the following obvious recommendations: (i) Revamp the USO Policy (ii) Stimulate inter-platform competition in the broadband market in India, with main different platforms such as public switched telephone network (PSTN) for digital subscriber line (DSL) access, fixed wireless (technologies such as WiMax), and wireless (3G and 4G technologies). India is likely to enjoy the benefit of adopting 3G+ technology at a time when devices and applications relevant to enhancing the mobile broadband experience are entering a mature developmental phase. Hopefully, the award of 3G and BWA spectrum and the ensuing services will be able to address the problems of lack of competition and hence the exercise of anti competitive power by the existing providers. (iii) To quote a recommendation of one of the respondent: "Regulatory environment in India needs to evolve to next generation to take cognizance of disruptive changes in underlying infrastructure" and; (iv) Steps have to be taken to exploit the digital dividend, which should include a strategic review of spectrum allocation across various bands (both licensed and unlicensed bands). This will require harmonisation with

ITU allocated bands, developing policies and plans for the use of spectrum by the government especially vacating the commercial spectrum that is being used by defence.

However, given the multiplicity of responsibilities and an insufficient mandate of the TRAI the implementation of these recommendations would require some institutional overhaul. For instance, the USO as operationalised through USF administrator in the DoT is unable to perform due to various pressures form the vested interests in DoT. More recently, it also seems that TRAI is not very professional and many officers in the TRAI are in secondment from DoT. This is partly due to shortage of capacity. The telecom policy is obsolete and is awaiting a revamp, such that it takes into cognizance the new market realities

2. Country overview and macro level perspectives on the telecom sector

With an estimated population of 1,210 million, India is the world's second most populous country. According to India's population census of 2011, almost 70 percent of Indians reside in rural areas, although in recent decades migration to larger cities has led to an increase in the country's urban population. India's literacy rate is 74.04 percent (65.46 percent for females and 82.14 percent for males). The national gender ratio is 940 females per 1,000 males. India's median age is 24.9 and the decadal population growth rate is 17.64 percent between 2001 and 2011. The demographic profile of India, with about 54 percent of the population under 25, offers favourable prospects for rapid economic growth for several decades ahead, which is not the case for most advanced industrial economies or for China.

With a CAGR of GDP[2] of 7.14 percent between 2004-05 and 2009-10, the economy is among the fastest growing in the world. India's GDP was USD 948 billion in 2009–10 (table 1). When measured in terms of purchasing power parity (PPP), India has the world's third largest GDP at USD 4.164 trillion. India's per capita income (nominal) was USD 810 in 2009–10, while in terms of PPP it was USD 3,339.

Table 1: India Country Profile

Item	India	
GDP at factor cost (US$ billion) at 2004-05 prices	948	(for 2009-10) @
GDP at factor cost (US$ billion) at current prices	1293	(for 2009-10) @
Per capita GDP at factor cost (US$) at 2004-05 prices	810	for 2009-10) @
GDP at factor cost (2004-05 to 2009-10) at 2004-05 prices	7.14	(CAGR)
Population million	1170	(for 2009-10)

Source - National Account Statistics Reports, 2011, @: Exchange rate: Rs. 47.4166/US$ 1 (Average exchange rate for 2007-08).

India's sectoral GDP composition reveals the importance of the services sector to the economy. The services sector has been the main driving factor in the growth of the Indian economy, contributing 57.3% to total GDP in 2009/10[3]. It is expected that services will play a major role in India's growth in the future as well. It is in this context that the growth and importance of the Indian ICT sector has to be viewed.

[2] GDP at factor cost (at 2004-05 prices).

[3] The services sector according to the official data comprises Trade, Financing, Insurance, Real estate & Business Services, Community, Social & Personal Services, Transport, Storage & Communication and Hotels & Restaurants.

The ICT sector is an important emerging sector in contemporary India. ICT, in India, contributes to change at various levels – social, political and economic. ICT has brought rural areas much closer to the markets and has improved business transactions. There has been an increased flow of information thereby increasing productivity and innovation. There has also been an increase in the monitoring and accountability of governments through the use of ICT services.

The stellar performance of India's information technology sector has been acclaimed worldwide. Paramount importance has been attached for many years to software and services exports. The contribution of the domestic sector in total ICT sector has decreased from 35.11 percent in 2004-05 to 33.89 percent in 2008-09, and contribution of exports in total ICT sector has increased from 64.5% in 2004-05 to 66.1% in 2008-09.

In absolute terms, the ICT sector's gross value added (GVA) grew from Rs. 656.5 billion (US$ 14.4 billion) in 2000/01 to Rs. 2.5 trillion (US $62.9 billion) in 2007/08, with a compound annual growth rate (CAGR) of 18.4%. Thus, the contribution of the ICT sector to gross domestic product (GDP) at factor cost has increased from 3.4% in 2000/01 to 5.9% in 2007/08. Annual growth rates have been consistently well over 20%, except for 2002/03 when growth was rather low at 11.3%.

India's ICT sector is dominated by services whose share has been steadily growing from 2000/01 to reach 94.2% of the total by 2007/08. On the contrary, ICT manufacturing has been going through opposite trends with its share in the total ICT sector falling from 10.5% to 5.8% during the same period. The contribution of the ICT services sub-sector to the GDP of total services sector grew from 6% in 2000/01 to 10.5% by 2007-08. The increases have been steady, with the exception of a marginal decline in 2002/03.

Within the ICT services sub-sector, the share of telecommunications (communication) has declined. In 2000/01 its share in total ICT services was 54.1% but it had declined to about 39% by 2007/08. On the other hand, the share of computer related services increased from 45.9% in 2000/01 to 61% in 2007/08.

In absolute terms, the GVA of telecommunications grew from Rs. 317.8 billion (US$ 7 billion) in 2000/01 to Rs. 930.7 billion (US$ 23.1 billion) in 2007/08, with a CAGR of 14.4%. The GVA of computer related services increased from Rs. 269.3 billion (US$ 5.9 billion) to Rs. 1.5 trillion (US$ 36.1 billion) during the same period, with a CAGR of 23.4%.

As for total employment in the ICT sector we only have two data points: the NSSO 55th round (1999/00) and the NSSO 61st round (2004/05). According to these sources, total ICT employment increased from 1.5 million in 1999/00 to 2.5 million by 2004/05, with a CAGR of 8.8% (Malik and Mundhe, 2010).[4]

In this background in the following sections we discuss the growth in the telecom sector based on the trends of certain crucial indicators before we present the results of the TRE survey for 2010-2011.

[4] The trends in the ICT sector have been published by Orbicom in a report authored by Malik, P. and R. Mundhe, 2010.

3. Market Structure and Market Dynamics

Malik (2007, 2010)[5] has documented the policy and regulatory developments that have shaped the outcomes of the Indian telecommunications industry. The liberalization initiatives dating back to 1994 initiatives were successful in shifting the industry from a static, monopolistic industry that provides a single product, telephone service to a dynamic, multi-product, multi-operator industry. It should be noted, however, that this change in market structure has taken place without the privatisation of the domestic incumbent service provider BSNL and MTNL. The privatisation of the overseas carrier Videsh Sanchar Nigam Limited (VSNL) in April 2002, with the strategic sale of a stake of 45% to Tatas and the government and employees retaining a stake of 26.13% and 1.97% respectively, represents the first and only instance of the government transferring control of a telecom undertaking to the private sector.

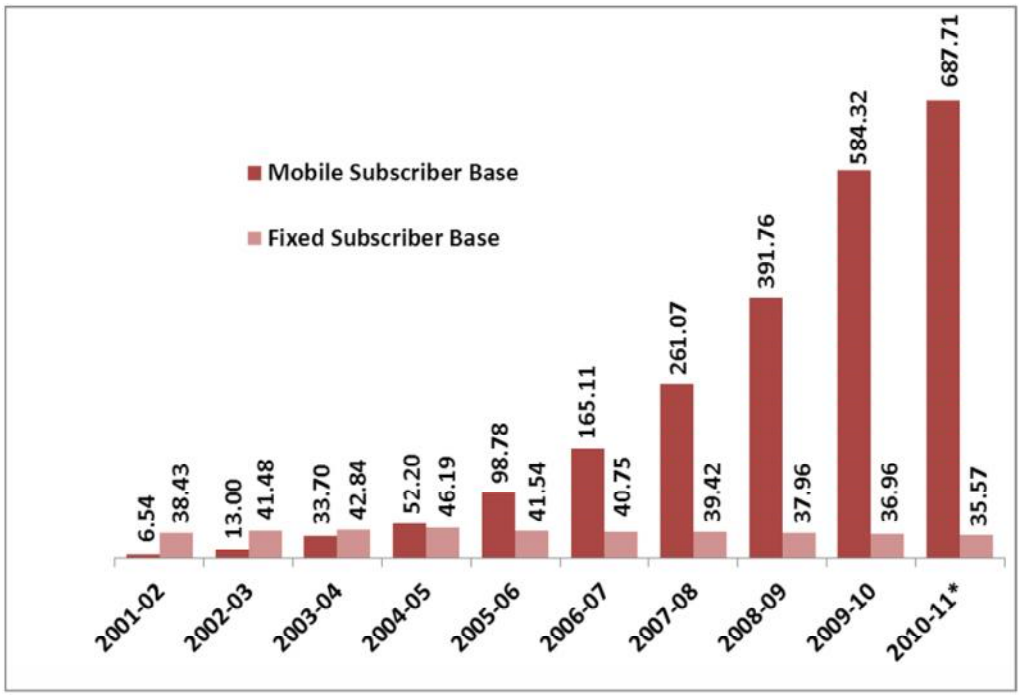
The results of liberalisation have been impressive. Teledensity has increased from merely 2 percent or so in 1999 to around 61 percent in 2010[6] (TRAI, 2000 and TRAI, 2011) (figure 5) and almost 8-10 million mobile subscribers are added every month. Wireless has been the principal engine for telecom growth in the country. The wireless subscriber base[7] has grown from 0.88 million in1999 to 687.71 million in 2010-11(figure 4). Given that the mobile sector grew at the Compound Annual Growth Rate (CAGR) of 84 .01 percent in the last decade, the telecom subscriber base has already outstripped what was envisaged for the 11th Plan ending in 2102.

[5] Malik P., 2007, An Analysis of the Reform's of India Telecommunication's Industry: Policy, Regulation and Indicators, LIRNEasia Multi component 6 country study. Available at http://www.lirneasia.net/wp-content/uploads/2007/04/malik-2007-6cmcs-india.pdf.
Malik P., 2010, Telecom Regulatory and Policy Environment in India: Results and Analysis of the 2008 TRE Survey, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1555459,

[6] Teledensity figure may be overstated here as it includes both fix plus mobile teledensity. In the latter case there is an issue of double counting (also refer to next footnote).

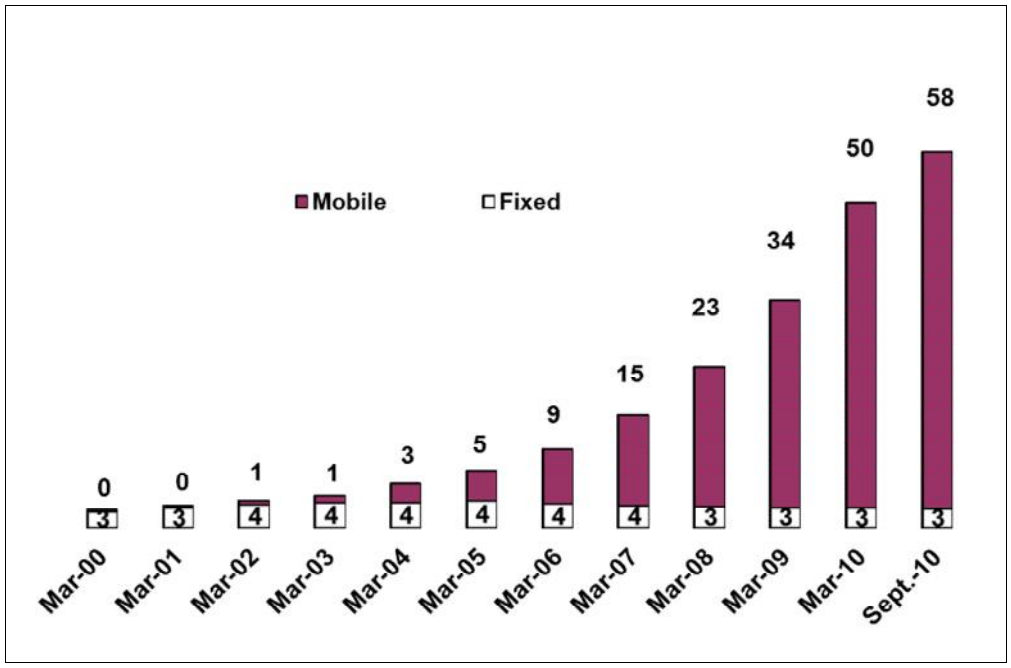
[7] This subscriber base is counted based on subscriptions i.e. mobile numbers. If someone has two SIMs, he is being counted twice in all these numbers.

Figure 4: Fixed and mobile subscriber base (in million)



Source: Performance indicator reports, TRAI, March 2001 to September 2010.

Figure 5: Fixed and mobile teledensity

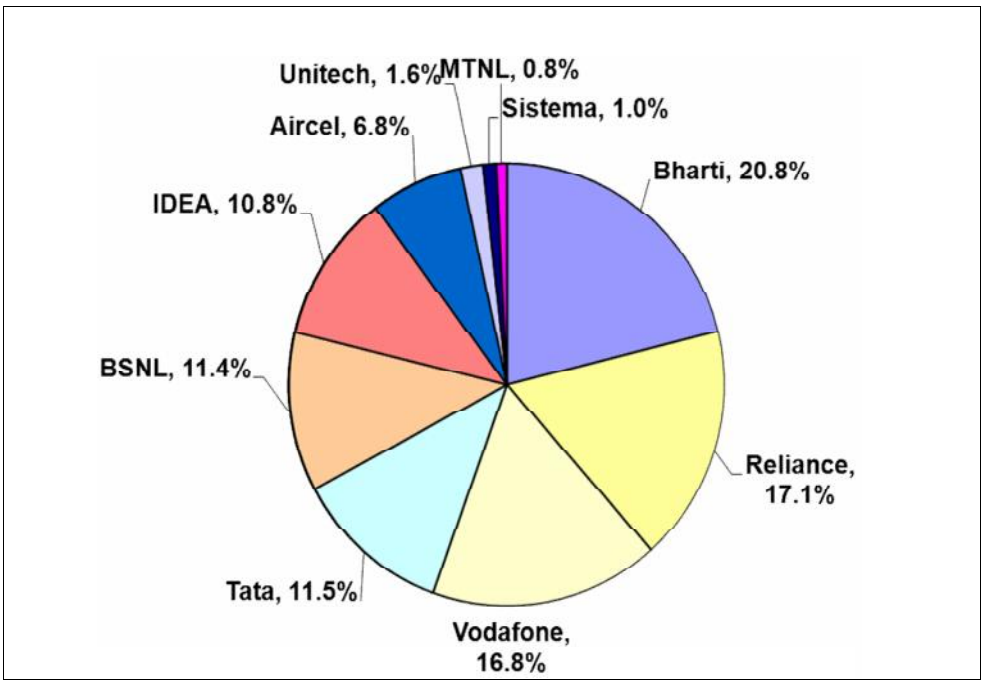


Source: Performance indicator reports, TRAI, March 2000 to September 2010.

In 2010, government-owned companies (BSNL and MTNL) constituted just around 12.20% of total market share in terms of number of mobile subscribers (figure 6). Now there are a considerable number of players in the market, with Bharti being at the top serving 20.8% of the

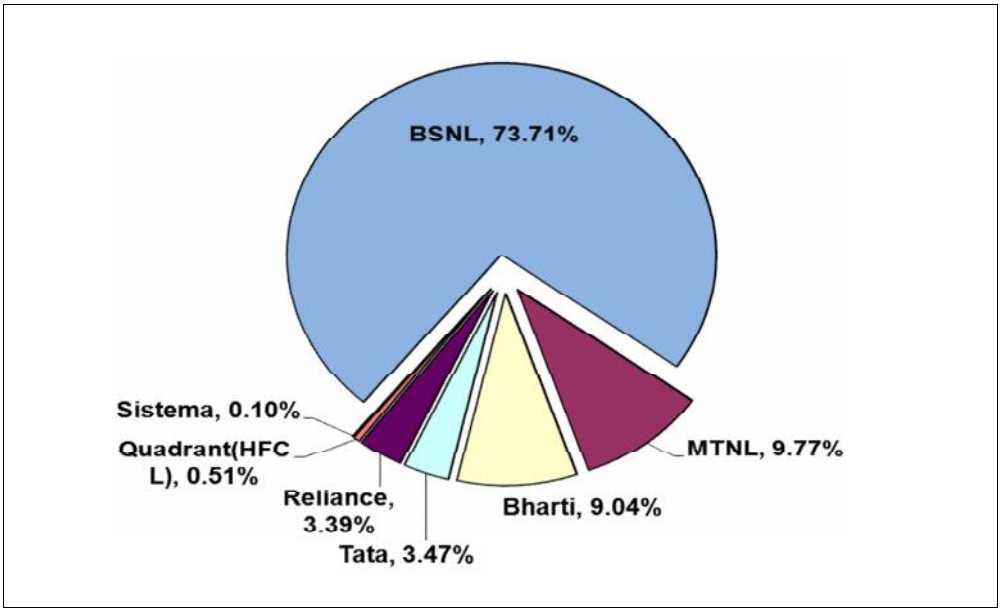
total number of subscribers in the country. The lack of competition in the fixed market segment has meant the continuous dominance of the incumbent BSNL, even in the broadband segment (figure 7).

Figure 6: Top 10 operators' market shares - wireless service providers (GSM+CDMA) as of Sept 30, 2010



Source: Performance indicator reports, TRAI, September 2010.

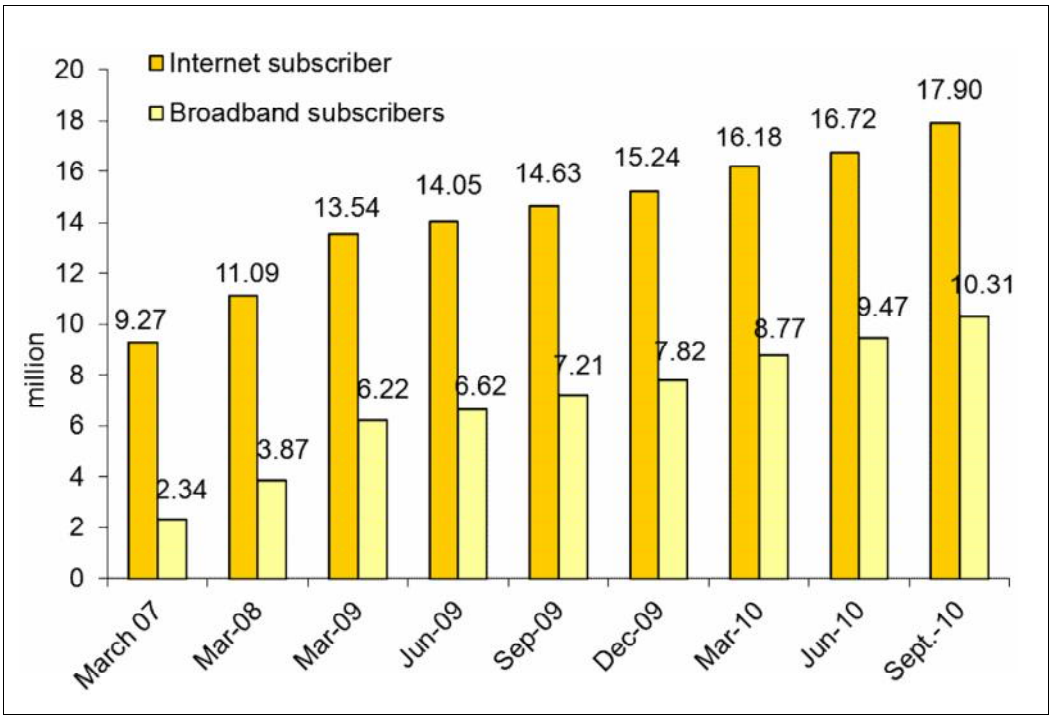
Figure 7: Market shares of fixed line operators as of Sept 2010



Source: Performance indicator reports, TRAI, September 2010.

While India has achieved immense success in voice communication, the penetration of internet and broadband has remained low, mainly due to a limited spread of wireline telephones and non-availability, so far, of mobile broadband technologies. India's broadband story has not, so far, been impressive. China and USA had about 120million and 85 million connections respectively by June 2010 in comparison to India's 10 million. The Government formulated the Broadband Policy of 2004. In this policy, broadband was defined as an "always on" connection with downloads speeds of 256 kbps or more. There were 0.18 million broadband connections at the end of March 2005. This number has grown to 10.30 million by the end of September 2010. However, at the end of September 2010, broadband connections were 57.5% of the internet connections of 17.90 million (figure 8). The Cumulative Annual Growth Rate (CAGR) for the 5-year period from 1st April 2005 to 31st March 2010 is about 117%. In the quarter ending September 2010, broadband registered a quarterly growth of 8.8% and Y-O-Y growth of about 43%. Non-broadband Internet connections consist of dial up connections working upto 56.6 kbps and other connections with speed less than 256 kbps.

Figure 8: Internet and broadband subscriber base



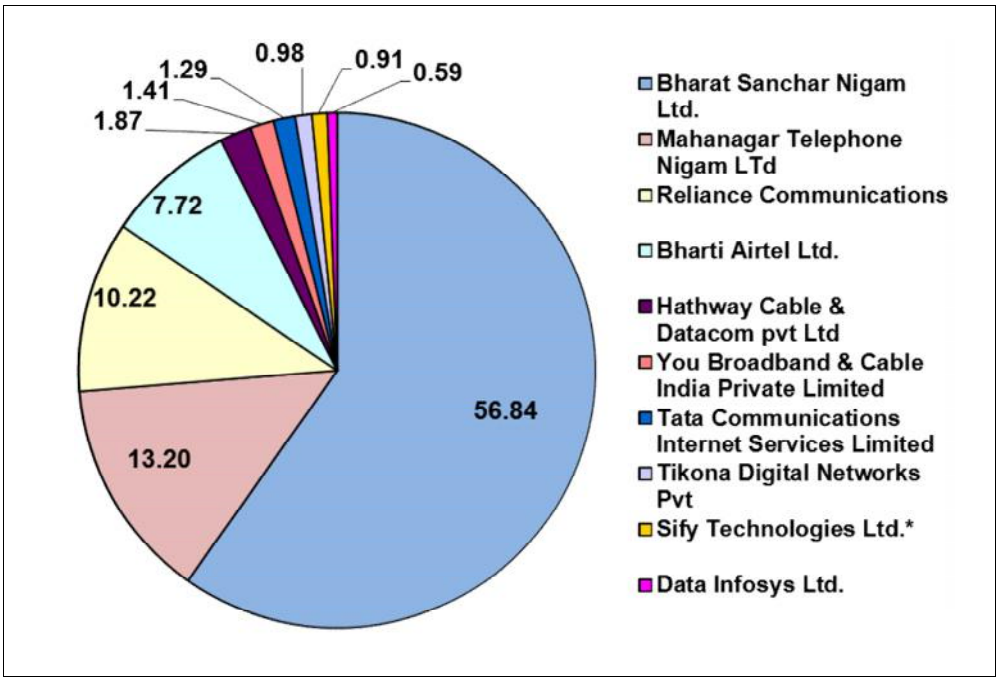
Source: Performance indicator reports, TRAI, March 2007 to September 2010.

Auctions for 3G and BWA spectrum were postponed several times and the Indian success in voice has not been replicated in broadband yet. But the launch of 3G services is expected to set the stage for the rapid spread of broadband after the auctions finally took place in April, 2010. The absence of meaningful applications, language barriers and other demand side factors also explain the slow uptake of Internet and broadband (TRAI, 2010).[8] Following figure 9 gives

[8] TRAI (2010). Recommendations on National Broadband Plan. http://www.trai.gov.in/WriteReadData/trai/upload/Recommendations/124/Broadbandrecommendation08_12_10final.pdf. Accessed on February 25, 2011.

broadband wise market shares as of September 2010.

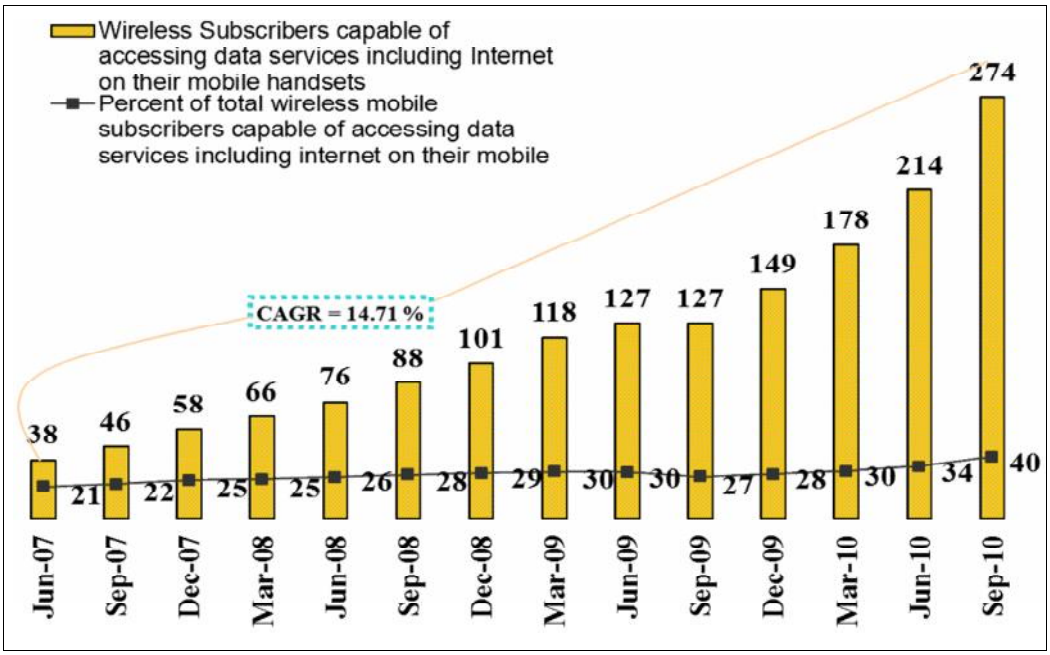
Figure 9: Broadband operator wise market shares as of Sept 2010



Source: Performance indicator reports, TRAI, September 2010.

In the absence of computers and other devices for accessing internet, more and more Indians are using mobile phones to access the internet. A large percentage of mobile subscribers can access internet through their mobiles. Even now about 274 million mobile subscribers (actual subscribers not just SIMs) in India are capable of accessing data services including Internet through their mobile handsets (figure 10). However, most of these are on 2G mobile networks with limited data capabilities. This augurs well for broadband if the operators are able to replicate the business model that worked so well for the low Average Revenue Per User (ARPU) in the voice market in the market for data as well, where mobile will be the platform for internet access with 3G technology.

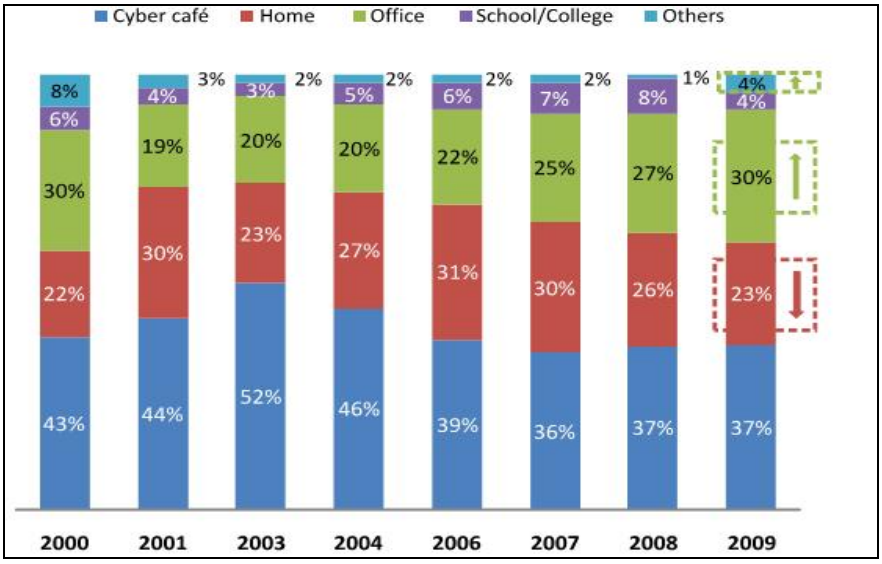
Figure 10: Wireless Subscribers capable of accessing data services including Internet through their mobile handsets



Source: Performance indicator reports, TRAI, June 2007 to September 2010.

There is a large proportion of users who access Internet from office and cyber café. Cyber cafes continue to dominate the share (37%) among various sources (figure 11). However, accessing Internet through home has steadily declined over the years.

Figure 11: Access to internet



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

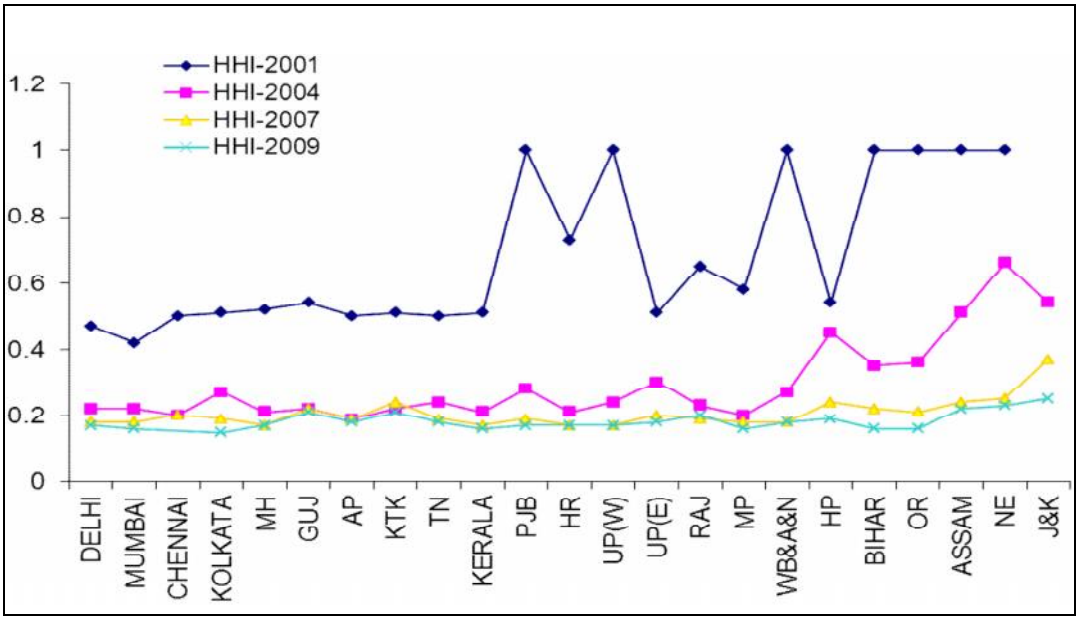
Level of Competition

Competition allows for a range of price and quality options, making service possible to regions and income levels that a monopoly provider would never have considered. In fact one salient reason for opening up the sector for privatisation has been the realisation of scarcity of the incumbent's funds and the consequent pent-up or unmet demand that was met by the new entrants. Competition allowed for aggressive pricing, increase in access as documented earlier in this report. In fact in the mobile sector with 8-9 operators in every circle it is argued that there may be "too much" of competition.

This, as will be argued later was due to mindless market entry without making the entrants pay the true value for the spectrum. The industry is in fact ripe for some consolidation and a relaxation in the merger and acquisition norms as proposed in the NTP-2011 can achieve that. On the other hand, due to the low level of competition in the fixed sector and cable technology not posing a serious challenge for internet access (as the cable industry in India is highly unorganised and fragmented), the competition in the data segment has been not very promising.

The Herfindahl-Hirschman Index (HHI), a measure competition, shows both a low market concentration for the wireless market(GSM+CDMA), and continuous improvement in the level of competition in all the circles (figure 12). The trends are almost the opposite in the internet segment. Based on market share of top 10 service providers, HHI in internet service is concentrated (figure 13) but the concentration is getting worse with time.

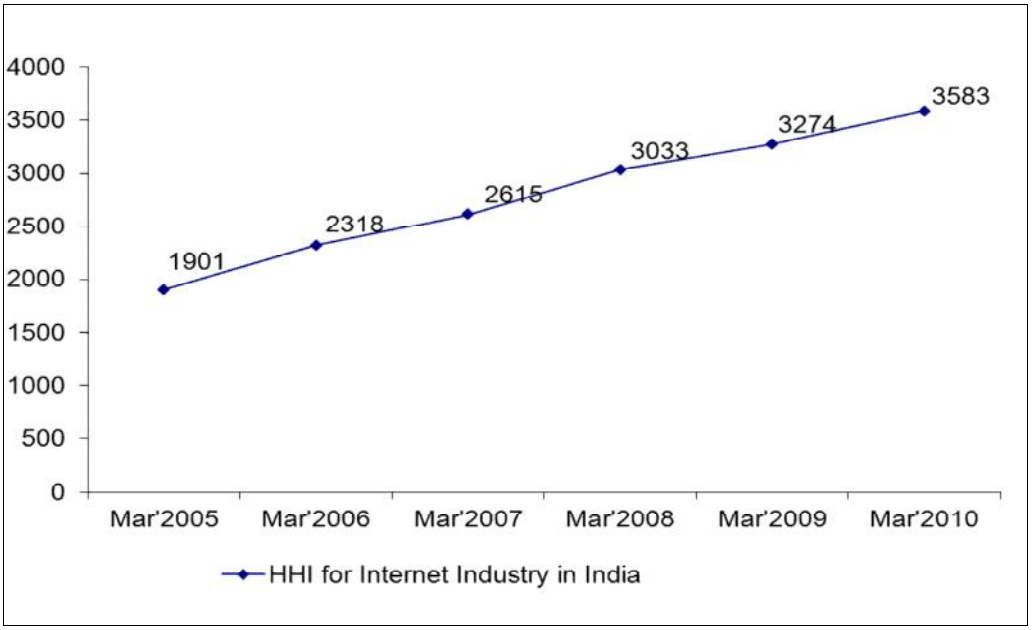
Figure 12: Trend in HHI in mobile sector across circles[9]



Source: Recommendation on spectrum management and licensing framework, TRAI, May 2010.

[9] For licensing purposes, the country is divided into circles where each circle is more or less contiguous with an Indian state or major cities.

Figure 13: HHI for internet industry of India

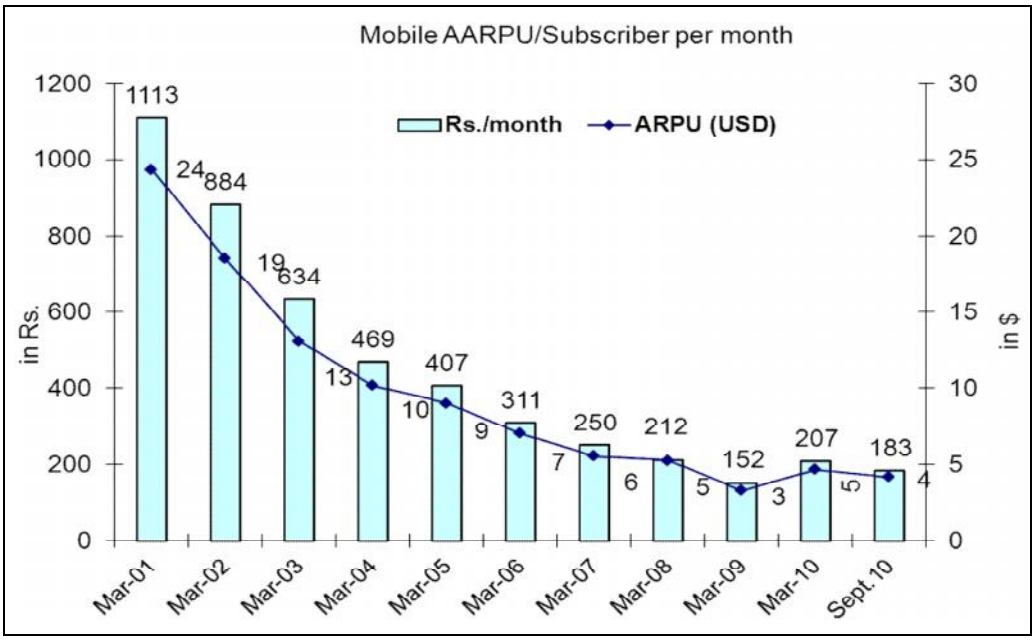


Source: Recommendations on National Broadband Plan, TRAI, December 08, 2010.

Despite having significantly lower ARPUs (figure 14) than their western counterparts, Indian mobile players exhibit similar or higher EBITDA margins (table 2) compared with their western peers. Indian operators have managed to boost mobile penetration and usage without sacrificing margins by employing a number of cost-optimization levers such as network and IT outsourcing, encouraging customers to use self- service and maintaining low subscriber acquisition and retention costs. Indian operators also offer low-denomination, high-margin recharge vouchers and "lifetime validity" schemes to attract low income pre-paid subscribers and increase overall mobile adoption and usage.[10] Further, large Indian operators have set up national backbones to avoid paying carriage charges for long distance traffic and they also encourage subscribers to make more on-net calls through attractive pricing.

[10] See, Ilavarasan, P., & Malik, P. (2010). *Trend in Public and Private Investment in ICT R&D in India and on the Globalization of R&D the Competitiveness of Their Innovation System in ICT.* Country report prepared for a study funded by European Union.
http://is.jrc.ec.europa.eu/pages/ISG/PREDICT/documents/ICT2RandDIndiafinal18012011.pdf
This report discusses the service process innovations adopted by telecom firms in India to allow for the lowest prices with the highest EBITDA margins.

Figure 14: AARPU[11]/subscriber per month



Source: Performance indicator reports, TRAI, June 2007 to September 2010.

Table 2: EBITDA of three telecom operators in India

INR Million	Bharti	IDEA	RCOM	Vodafone[#]
Consolidated revenues	755,083	203,919	227,528	273,548
Consolidated EBITDA	258643	50090	76247	70,832
Consolidated EBITDA margin (%)	34	25	34	25.6

Source: Avendus Securities Private Limited, Sector update - telecom, February 24, 2011

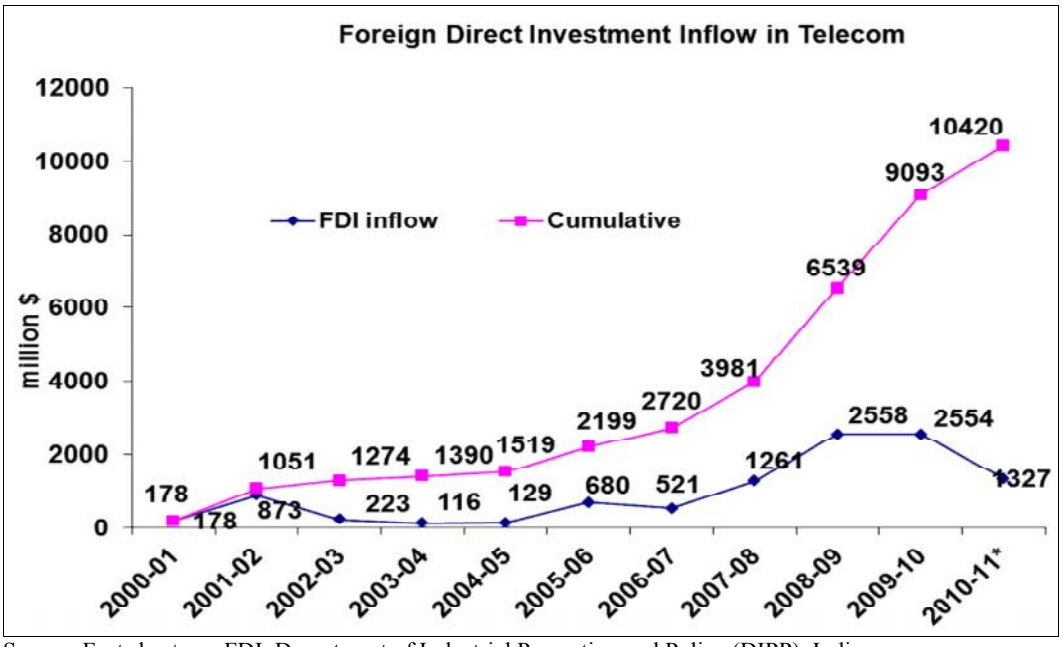
[#]Source: http://www.medianama.com/2011/05/223-fy11-vodafone-india-data-voip-net-neutrality/ (accessed on June 29, 2011); exchange rate used is INR 71.9107/1GBP; figure is for 2010-11.

Financial Summary of the Indian Telecom Industry

Another important feature of the Indian telecom growth story is that it is driven by domestic investment; with only 9 billion USD coming from Foreign Direct Investment (FDI) in 2009-10 (figure 15). Unlike many countries in the region, FDI in telecom only accounts for 8 percent of the total FDI flows to India (table 3).

[11] Average Annual Revenue Per User (AARPU)

Figure 15: Foreign direct investment in telecom in India



Source: Fact sheets on FDI, Department of Industrial Promotion and Policy (DIPP), India.
*2010-11 data is for April-December 2010.

Table 3: Financial Summary of the Indian Telecom Industry(in INR billion unless otherwise specified)

	Indicator	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
1.	Total Revenue	716.74	867.20	1053.18	1290.83	1523.60	1579.8
	Contribution of government companies	421.74 (59%)	452.33 (52%)	454.72 (43%)	432.49 (34%)	411.62 (27%)	357.6 (23%)
	Contribution of private. companies	295.00 (41%)	414. 87 (48%)	598.45 (57%)	858.34 (66%)	1111.98 (73%)	1222.2 (77%)
2.	Total EBITDA	267.86	301.38	391.67	n.a.	n.a.	n.a.
	Government companies' EBITDA	186.13	187.09	195.86	n.a.	n.a.	n.a.
	Private companies' EBITDA	81.72	114.29	195.80	n.a.	n.a.	n.a.
3.	Capital Investment (Gross Block[12])	1788.31	2006.66	2346.87	n.a.	n.a.	n.a.
	Gross Block – government companies	66%	64%	57%	n.a.	n.a.	n.a.
	Cross Block - private companies	34%	36%	43%	n.a.	n.a.	n.a.
4.	Capital employed[13]	1538.64	1700.87	1898.34	n.a.	n.a.	n.a.
	Capital Employed – government companies	n.a.	1042.31	1030.71	n.a.	n.a.	n.a.
	Capital Employed - private sector	599.25	658.56	867.63	n.a.	n.a.	n.a.
	Return on Capital Employed (RoCE)	n.a.	7.82%	10.64%	n.a.	n.a.	n.a.
5.	Cumulative FDI in Telecom	67.14	94.90	116.45	167.47	284.74	407
	(Percentage of total FDI)[14]	3.32	11.28	3.05	5.17	9.54	8
6.	Gross Domestic Product (at factor cost) Current Prices	29715	33896	39522	45814	52821	61332

[12] Gross Block is the Gross Capital Investment or the stock of investment.
[13] Capital Employed is the fund deployed to operate the business.
[14] Telecom FDI inflow as a percent of total FDI inflow.

	Share of Telecom sector to GDP (in%)	2.4	2.6	2.7	2.8	2.9	2.6
7.	Cumulative Telecom FDI (5) as percentage of Capital Investment (Gross Block) (3).	3.75%	4.73%	4.96%	n.a.	n.a.	n.a.
8.	Total Employees of Telecom Companies (in numbers)	436891	429400	432771	n.a.	n.a.	n.a.
	Government companies	394334	382105	369035	n.a.	n.a.	n.a.
	Private companies	42557	47295	n.a.	n.a.	n.a.	n.a.
	Subscribers per Employee at year end						
	Government companies	132	158	193	n.a.	n.a.	n.a.
	Private companies	1089	1678	2110	n.a.	n.a.	n.a.

Source: Telecom Regulatory Authority of India (TRAI) performance indicators reports from 2004 to 2010
Note: n.a. = Not Available

4. Infrastructure: availability, usage and quality

Adequate infrastructure is the bedrock for reliable telecom services. Telecom service providers have always faced the challenge of matching their technology and infrastructure to the customers' demand cycles. In the past, this was easier as the project lifecycles and the capital cycles of the telecom services was long and the corresponding services evolved over a long period of time. Though, for the last few years, the growth has been led by wireless telephony there has been all-round development in the telecommunications infrastructure. The switching capacity, the domestic and long distance network, Internet and Broadband Network, and the mobile network have all grown. In the fixed networks the total equipped switching capacity as on 31st Dec 2006 was about 58 million and in March 2010, 79 million.

Passive infrastructure, one of the most important components of a mobile network, has been a critical area for telecom companies in the past. However, with increasing competition posing an urgent need for telecom companies to expand their coverage and sharpen their focus on core operations so that they can sustain and improve their market position, passive infrastructure has assumed the status of an independent industry during the past few years. At present, there are broadly two kinds of operators in the domestic tower infrastructure industry:

1. Tower infrastructure subsidiaries, which are the spun-off tower divisions of the telecom-operator companies; and
2. Independent tower infrastructure companies (ITICs)

There are elements of the infrastructure, like towers and associated auxiliary equipment that can be shared by more than one service provider. The Cellular Mobile Telephone Service (CMTS)/Unified Access Service (UAS) licence permits sharing of passive infrastructure but there is a category of providers called Infrastructure Provider category I (IP-I) who install towers and associated equipment for use by the service providers. India had around 310,000 telecom towers at the end of February 2010. Out of these, about 80% of the towers belong to IP-I (ITICs) companies and 20% to telecom service providers (Type 1 mentioned above). The existing 310,000 towers cater to 481,333 Base Transceivers Stations (BTS) as of March 2010. This gives an average tenancy ratio of approximately 1.55. These BTSs served 584.32 million wireless subscribers as of March 2010 indicating an average of 1214 subscribers per BTS.[15]

While many infrastructure related issues have been dealt by TRAI in the past, there are issues

[15] TRAI (2011). Consultation Paper on Issues related to Infrastructure Policy

related to design, standardisation, aesthetics, pollution, safety and sharing of telecom tower infrastructure that remain to be addressed. A robust fibre based broadband infrastructure for proliferation of broadband related services in urban and rural areas is very important and is currently inadequate. The National Broadband Plan envisages provision of 75 million broadband connections (17 million DSL, 30 Million cable and 28 million wireless broadband) by the year 2012 and 160 million broadband connections (22 million DSL, 78 million cable and 60 million wireless broadband) by the year 2014. The plan involves setting up of an open access fibre optic network connecting all Gram Panchayats by the year 2012 and all habitations with population of 500 and above by the year 2013.

A Submarine Cable Landing Station has been a `bottleneck facility'. TRAI;s regulatory philosophy in this regard has been the recognition that competition in IPLC segment could be enhanced if ILD licensees entering the market have adequate access to necessary facilities at cable landing stations. To ensure this access, the interconnection regulations should provide for dominant suppliers who control or who are responsible for the operation of the cable landing station to allow other licensees to (a) have access to the cable landing stations; (b) physically co-locate their own equipment necessary for connection in the cable landing stations; (c) interconnect at the cable landing station to any operator's equipment in the cable landing station at any technically feasible point; and (d) access backhaul circuits of all types in a timely fashion, under terms & conditions and rates that are cost oriented, transparent, and non-discriminatory. However, the implementation of the regulations has been weak.

The BTSs installed on the towers are required to be connected to the rest of the mobile network through some kind of a telecom link called backhaul. Presently point to point microwave links are used for this purpose. Considering the ever increasing voice traffic and also possibility of higher data traffic, optical fibre seems to be more suitable for backhaul. The procedure for grant of ROW for laying optical fibre cable is presently complicated, time consuming and expensive. Both connectivity through towers and through tower-less solutions require that these procedures are simplified. National broadband plan recommendations given by TRAI in August 2010 have proposed extensive fibre optic network in the access and backhaul networks. Once this fibre is in place providing backhaul connectivity for the BTSs of multiple service providers would be possible on this fibre. It is not very clear what will happen to the existing optical fibre of the incumbent (most of it being dark and unlit)

5. Beyond telecom: E Applications, Services, Human Resources , Innovation

5.1 M-commerce

Since mobile penetration is high in India, mobile commerce (m-commerce) is considered to be a next big thing. However, m-commerce is still at its nascent stage in India.

Mostly current m-commerce models adopted in India require linking of banking instruments such as bank account, credit card and debit card to mobile through mobile enabled applications. Some of the players who have adopted this model in India are Eko, Paymate, M-check, Obopay, etc.

Security point of view, this model of linking banking instruments to mobile and paying through a wireless application protocol (WAP) mobile phone is important step forward. SMS medium for various merchant services is available, though still such services have not reached a critical stage due to lot of factors like non-tie up with all the banks or people still not comfortable sharing credit/debit card account information etc. Moreover, Know Your Customer (KYC) RBI guidelines make it mandatory to identify customers, which are as stringent as required to open a saving account and get a debit card (Business India, 2009[16]).

The fact is India has so far followed bank-led m-commerce model. However, Telecom companies with their access and reach are in the best position for forward integration into becoming a bank then other way around. According to ASSOCHAM (ASSOCHAM, 2011[17]), currently only 5% of the total mobile subscribers are registered users of mobile banking and more significantly, only 0.5% of them are active mobile banking users. These are also primarily restricted to information based services.

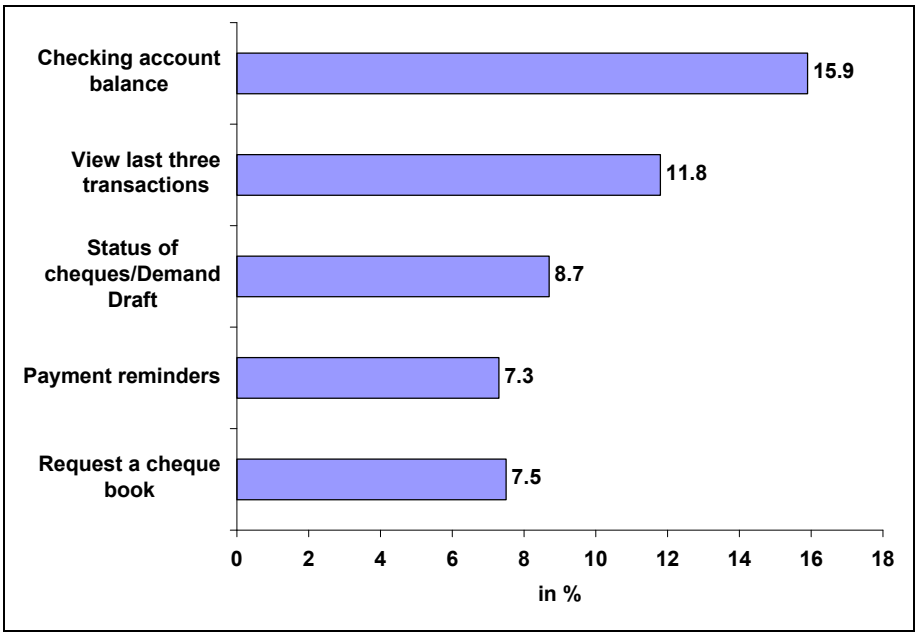
According to Vital Analytics[18] (a Bangalore based market research firm), based on data gathered by the firm in April 2009 for February and March 2009 mobile banking urban Indian customers checking account balance is the most frequently cited reason for using mobile banking followed by viewing last three transactions (figure 16).

[16] Business India, 2009. M-commerce in India Future and Challenges faced, Business India 2.0, Para 3, August 29, 2009 Retrieved from: http://ijsid.wordpress.com/2009/08/29/m-commerce-india-the-future-challenges-faced/ (Accessed April 05, 2009).

[17] The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2011. Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide, ASSOCHAM, January 2011.

[18] Market Report: Mobile Banking in India used by 40 Million Urban Indians (2009), Pluggd.in. Retrieved from: http://www.pluggd.in/mobile-banking-in-india-market-report-297/

Figure 16: Top five most popular mobile banking services, two months ending March 2009



Source: Vital Analytics, 2009. Mobile banking report: "Most popular services and income profile".

Interoperability is another concern for the development of m-commerce and particularly m-banking in India. Different operators follow different mobile banking platforms and even protocols such as HTML, WAP, SOAP, XML, etc. India has concentrated largely on expanding networks and very little is done on creating common platform/standards.

This shows that there is a lot to be done on making m-commerce popular in India. As for financial exclusion, still more than half the population in India do not have a bank account. It is estimated that more than 50% of the Indian population faces complete financial exclusion (no savings account), for urban India the figure is 44% and for rural population it is as much as 76% (ASSOCHAM, 2011).

Initiatives have been taken by the government and by the regulator, Reserve Bank of India (RBI) to support financial inclusion and promote M-Commerce in India (ASSOCHAM, 2011):

1. "RBI issued 'Mobile Banking Transactions in India – Operative Guidelines for Banks' in December 2009 subject to relax / modify the norms as the market evolves and new models and security mechanisms emerge.
2. RBI has increased mobile payment limit to Rs. 50,000.
3. Earlier, only a Closed Wallet was allowed. Now, a Semi Closed Wallet[19] has been allowed. Bharti Airtel was granted the license to use the Semi Closed Wallet by the RBI. In another

[19] Semi closed wallets are the prepaid payment instruments you can load money into your cell phone from a licenced company and make payments with it, but you can't use it to withdraw money. On the other hand, close wallet requires user to register for internet banking/debit card, after linking it to mobile it lets you access your bank account online even through phone. You can also transact money through web-enabled handsets. No virtual money is stored in your mobile account in such cases.

recent development, RBI issued Semi Closed Mobile Wallet license to Itz Cash as well which is a non-bank semi closed pre-paid payment issuer in India.

4. An open wallet system, which may fuel rapid success of these services in India, is yet to be allowed in the country. However, the National and Payments Corporation of India (NPCI) - set up by RBI, as an umbrella institution for all the retail payments system in the country - is currently piloting a Person-to-Person (P2P) money transfer mechanism called the 'Interbank Mobile Payment Service (IMPS)'. Six of the leading banks in India are participating in this pilot, which can help in greater expansion of mobile banking services."

Despite all these initiative m-commerce has not picked up as it should have. Banks are still cheap and secure way of transferring money. However large number of unbaked population and limitations of banks which lead to inconveniences such as long travel and waiting time especially for remote population call for some innovative models lead by mobile service providers (MSPs)

5.2 M-Education

Table 4: State of Education in India

17,282 habitations[20]	Do not have a primary school within a 1km radius. UP leads with 7,568 such habitations
26,513 habitations	Do not have an upper primary school within 3km radius. West Bengal leads with 7,003 such habitations
8,043,889 children	Aged between 6 and 14 years do not go to school
148,696 government schools	Run without a building
1,14,531 primary schools	Have a single teacher

Source: The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2011. Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide, ASSOCHAM, January 2011.

Mobile education (M-education) has great potential in India. Though this segment is at its nascent stage in India (table 4), telecom operators are increasingly developing new applications to enter into this segment. M-education services such as civil services question sets, English

[20] A habitation is a distinct cluster of houses with a local name. It is a centre where people live in a compact and contiguous manner. As in the earlier surveys (census/sample surveys) by government of India, habitations have been classified into rural and urban ones. A village (revenue village) may include one or more habitations, one of which may also be having the village name. Habitation registers have been prepared in all rural areas at Block/Tehsil/Taluk level. A town or town group has been treated as urban habitation. The definition given by the Census of India for urban areas has been accepted for identifying urban areas. More detailed information has been collected regarding rural habitations as compared to the urban ones as no urban habitation is left without school. (Source: http://www.education.nic.in/cd50years/g/z/9H/0Z9H0501.htm)

learning, vocabulary and general knowledge tutorials, exam tips, exam result alerts and school syllabi of Central Boards of Secondary Education (CBSE) and Indian Certificate for Secondary Education (ICSE) boards as well as skill development are being developed by MSPs. These operators usually partner with value added services (VAS) companies to develop the applications.

Aircel offers various education services through application called *mGurujee*, which allows users access to content in areas of engineering, management, civil services and medicine; school syllabi of CBSE and ICSE boards as well as skill development, vocabulary and general knowledge tutorials (see table below).

Education varsities like Indira Gandhi Nation Open University (IGNOU) in India have also started taking advantage of telecom sector development. IGNOU has started m-education service. These services allow IGNOU to send its students enrolled with IGNOU containing information like courses available, subjects offered, etc. This service also allows students to send SMSes to IGNOU to obtain information about the courses and subjects offered, examinations. IGNOU has also designed a software which allows students to update their personal details with IGNOU through mobile. Recently, IGNOU has also signed a deal with Ericsson India Pvt. Limited (EIL) to start the application of Third Generation (3G) Mobile in education delivery.

Tata DoCoMo, another MSP in India, has started English *Seekho* service application in 24 cities. It allows users to take conversational English language lessons on their mobiles through an interactive voice response (IVR) application that guides the user through audio clips. It offers short lessons followed by interactive lessons which enable users to practice what they have learnt through the mobile's keys or through speech recognition (see table below). The operator charges Rs.20-30 per month and call charges are 1 paisa per second.

Table 5: M-Education initiatives in India

Services	Examples
Exam alerts/ results/ issuance of registration id/ question papers etc.	mGurujee (India) – Allows users access to content in areas of engineering, management, civil services and medicine; school syllabi of CBSE and ICSE boards as well as skill development, vocabulary and general knowledge tutorials. IGNOU (India) – Exam alerts, available in five regional sectors with a network of 30,000 – 50,000 students BITES
Language training - Interactive (including tests etc.)	English Seekho (Tata DoCoMo) - allows users to take conversational English language lessons on their mobiles through an interactive voice response (IVR) application that guides the user through audio clips. It offers short lessons followed by interactive lessons which enable users to practice what they have learnt through the mobile's keys or through speech recognition. MILLEE (Mobile and Immersive Learning for Literacy in Emerging

	Economies) - Cellphone applications that enable children in the developing world to acquire language literacy in immersive, game like environments. Aims to make localized language learning resources more accessible to underprivileged children, at times and places that are more convenient than schools. The design methodology comprises best practices in commercial language learning packages and the traditional village games that children in the developing world play. After 10+ rounds of field studies in the past six years, a controlled experiment with 800 rural children in 40 villages in India is being carried out, with early replication underway in Kenya, China and elsewhere.
Mobile education dissemination	Mobile education initiative to rural communities and physically challenged (India) - Strategic alliance between SNDT Women's University, Tata Teleservices, Atom Tech, Indian PCO Teleservices (India) to develop and disseminate mobile education

Source: The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2011. Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide, ASSOCHAM, January 2011.

Even though it is only beginning for m-education in India, with new applications are coming in, m-education is a huge opportunity for telecom operators.

5.3 M-Health

Mobile health (m-health) has potential to increase access to health services significantly. However, there is not much awareness about potential of m-health among doctors and patients in India. Therefore, demand for m-health is not there yet. There some initiatives like Apollo hospital has started using telemedicine to make secondary and tertiary medical expertise available to rural and peri-urban India through an audiovisual enabled delivery system.

Apollo Hospital m-health initiative[21]

One of the first major mHealth interventions was introduced by Apollo Hospitals, using telemedicine to make secondary and tertiary medical expertise available to rural and peri-urban India through an audiovisual enabled delivery system. As qualified doctors are scarce in these areas, telemedicine has filled an important need. From the year 2000 to 2009, over 57,000 tele-consultations were performed across various disciplines, from sexual health to neurology. Apollo is now offering 24/7 consultations for just Rs 45, the equivalent of $1, and has 71 telemedicine centers across India. Due to the success of the program, the Delhi government is looking to expand the program in the near future in a public private partnership.

A few pilots such as the Apollo-Aircel programs are being conducted but currently these services in India have shown little uptake / adoption. There is a lot of scope for immediate deployment of information based services on a large scale (ASSOCHAM, 2011).

Other examples of m-health initiatives are Narayana Hrudalaya has developed mobile service to enable early disease detection and Mobile radiology lab (India) health care institutions can send reports via mobiles to the radiologist. Following table 6 summarizes m-health initiatives in India.

Table 6: M-health initiatives in India

Services	Examples
Telemedicine	Telemedicine helplines which provide information on immediate action steps for a medical condition, including suggesting specialists are available in many countries. Maestros Mediline Systems (India) have an application for BlackBerry phones which allows physicians remote access to patients' ECG and heart performance reports on their BlackBerry smart phones TeleDoc (India) provided handheld mobile phone devices to village health workers in India, permitting them to communicate with doctors
Diagnostic and treatment support	Apollo and Aircel (India) have a program where experts from Apollo diagnose the disease and offer advice, forward the call to the emergency room, and wherever possible fix an appointment with the doctor and deliver the medicine to the patient. Narayana Hrudalaya and SANA use mobile technology to enable early disease detection and thus creates a win-win situation for patients, hospitals and even insurance and wireless companies.

[21] Schafran D., 2010. mHealth India: Untapped Potential & The Innovative Groups Paving the Way, TriplePundit, November 18, 2010. Retrieved from: http://www.triplepundit.com/2010/11/mhealth-india-mobile-health/ (accessed on April 11, 2011).

Remote monitoring and Remote data collection	Mobile radiology lab (India) health care institutions can send reports via mobiles to the radiologist.

Source: The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2011. Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide, ASSOCHAM, January 2011.

5.4 E-Governance/M-Governance

Mobile governance (m-governance) has potential to enhance delivery of government service, therefore significantly transforming traditional government service delivery model to a new level of efficiency. M-governance is basically two way communication model between government and citizen, thereby removing need of middleman/agent services.

The Government of India has been promoting use of ICT in government service delivery (table 7) by creating the National e-Governance Plan (NeGP). This NeGP proposes 27 mission projects related to e-governance/m-governance. Out of these envisaged projects 14 have already completed and working and remaining are expected to takeoff by 2014. Some of the initiatives are mentioned below (ASSOCHAM, 2011)

1. Of the 1,100 citizens and business centric services targeted for delivery, over 600 services are now available electronically. For instance, citizens can now obtain copies of their land records, job cards for employment under Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), and certificates (relating to birth, death, income, and caste) online.
2. So far over 80,000 Common Services Centres (ICT kiosks through which e-governance services will be delivered) have been set up across India; the number is expected to reach one lakh by the end of the fiscal. Estimated number of Common Services Centres is 2,50,000 by 2012, covering all Panchayats.

Table 7: E-governance/M-governance some state wide initiatives

State	Initiative Description
Bihar	The Government has implemented various schemes such as NREGA, Old age Pension, IAY, Uniform for the Girl Child, Scholarship, Food grains for BPL families etc directly touch the lives of the poor many of whom are in villages where implementation and monitoring is an issue. The General Administration Department (GAD) has developed a Web Based Scheme monitoring system where each government official responsible for implementing any of the schemes, has been brought under a Common User Group (CUG) network of a cellular service provider. The responsible official is expected to send an SMS in a pre-defined format to a pre-designated number. This information is then aggregated and displayed in the form of a comparative analysis between districts/blocks within a district can be done. The comparative performance reports across districts would facilitate the Head of the Department in taking remedial action pertaining to any district or block within the District.

Kerala	Has been the first to take up a number of initiatives in this regard and the National e-Governance Plan (NeGP) has enabled the Kerala state government to be at the forefront of implementing ICT projects. The infrastructure that has already been built up such as the State Data Centre, KSWAN, Akshaya (CSC) etc. will provide the perfect platform for the State to take its functioning to the next level of Governance namely M-Governance. The State Government has initiated action to set up about 20 m-government services to be offered by eight departments
Goa	Taking a cue from the Kerala Government, the Goa government is setting up the infrastructure to provide various M-Governance services to its citizens. It is also in the process of setting up a central facility which can be used by other State Governments to provide M-Governance services, using a 'cloud computing' model
Nagaland	Intends to use the central facility set-up by the Goa Government to offer various M-Governance initiatives to its citizens

Source: The Associated Chambers of Commerce and Industry of India (ASSOCHAM), 2011. Mobile Value Added Services (MVAS) - A vehicle to usher in inclusive growth and bridge the digital divide, ASSOCHAM, January 2011.

M-governance Initiatives by Bharti Airtel[22]

- Traffic Automation: Bharti Airtel provides service of traffic automation solution. It is the world's largest BlackBerry supported law enforcement network. The Bangalore Transport Information System (BTIS) is governed by the state-of-the-art technology that is based on recording traffic densities in real-time. Equipped with case history of past offenders, the solution helps traffic police to punish errant drivers on the spot and track offenders. This solution also assists in determining if the vehicle was stolen or whether the driver has a pending fine on his name. It's quick in generating an offense ticket (bill) and prints it on the spot with the help of a hand-held printer, helping in streamlining the process of revenue monitoring and collections.
- Tax Collection: It has also developed a solution facilitating property tax collection by Chennai Corporation, via BlackBerry. The system expedites the process of collection. Bill collectors need not carry loads of documents anymore. Data is uploaded to the main server immediately and the tax payers get to know details of their arrears. Further, tax payers get a computer generated receipt soon after payment through a Blackberry. The online tax collection has helped in bringing down the queues in front of payment counters at the zonal offices.

5.5 Human Resources and Innovation

Examining the impact of information and communication technologies (ICTs) on the Indian labour market is difficult. Impact of ICT varies across sectors as it depends on how and how much ICT has been used in a particular sector. In fact use of ICTs in a sector is likely to foster quality of work and careers, skill enhancement, autonomy at work, equality or reinforce existing

[22] Singh A., 2010. M-Governance : Service On-the-go, Voice & Data, January 05,2010. Retrieved from: http://voicendata.ciol.com/content/NetworkingPlus/110010501.asp (accessed on April 12, 2011)

labour market segmentation, such as those based on gender, observed in traditional sectors (Vijayabaskar and Parthasarathy, 2003).[23]

Direct employment in Indian IT-BPO to reach nearly 2.23 million (table 8); indirect job creation is estimated at 8 million (NASSCOM, 2010).

Table 8: Knowledge professionals directly employed in the Indian IT-BPO sector (in numbers)

	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09E
IT Services and Software Exports	205,000	296,000	390,000	513,000	690,000	860,000	946,809
BPO Exports	180,000	216,000	316,000	415,000	553,000	700,000	789,806
Domestic Market	285,000	318,000	352,000	365,000	378,000	450,000	500,000
Total	670,000	830,000	1,058,000	1,293,000	1,621,000	2,010,000	2,236,614

A study by Vijayabaskar and Parthasarathy (2003), assesses the impact of ICTs in two types of industries in India viz. information technology enabled services (ITES) industry and Automobile industry. It shows that ICTs have a significant impact on quality of work and careers, skill enhancement, autonomy at work, equality or reinforce existing labour market segmentation in both the industries.

6. Institutions and the Policy & Regulatory Environment

The Telecom Regulatory Authority of India (TRAI) was established in January 1997 through an Act of Parliament. The creation of TRAI should have led to a redefinition of the role of Telecom Commission and DoT, but this was not done satisfactorily. TRAI had neither been given power to issue licences nor allowed to set standards and allocate spectrum. In the following years, DoT and TRAI got tangled in court cases and the role and credibility of the regulator was seriously undermined in the process. In January 2000, the government of India issued an amendment ordinance, which led to major changes in the institutional structure of TRAI. TRAI was split into two agencies, a "new" TRAI, divested of all its adjudicatory and dispute-settling powers, and a newly created agency named Telecommunications Dispute Settlement and Appellate Tribunal (TDSAT). The successor TRAI has been further strengthened by three specific mandatory powers that deals with tariff fixation, fixing of interconnectivity charges and laying down standards for service and technology. In addition, it was now mandatory for the government to seek the opinion of TRAI on the need and timing of the new service providers although the recommendations will not be binding. The TDSAT was empowered to adjudicate on disputes

[23] Vijayabaskar M, and B. Parthasarathy, 2003. Diffusion of Information and Communication Technologies in India: Labour Market Implications for Developing Countries: Final Report, Indian Institute of Information Technology, Bangalore (IIIT-B) India, July 31, 2003.

between the licensor and licensee, between two or more service providers and between a service provider and a group of consumers. It was also an appellate authority with respect to any direction, decisions, and orders of TRAI. However, cases involving questions of monopoly and consumer grievance redress by individual consumers are outside this body's jurisdiction. Decisions of TDSAT can be appealed only to the Supreme Court of India.

Universal Service policy was also kept outside the ambit of TRAI. On January 9, 2004, the Universal Service Obligation Fund (USOF) was granted a statutory non-lapsable status with the passing of the Indian Telegraph (Amendment) Act, 2003. The office of the Administrator of the USOF is affiliated to the DOT. However, DoT, which oversees USO fund, has accepted in-principle a proposal by sector regulator TRAI to make the USOF an independent body.

Table 9: Regulatory structure of the Indian telecom sector

Regulatory Body	Function	Comment
DOT: Department of Telecom	Licensing, License fee, frequency management of telecom sector	Policy making and enforcing body
Telecom Commission	Executive and policy making function of ministry	Part of DOT
WPC- Wireless Planning Commission	The national radio regulatory authority responsible for spectrum management, including licensing. Caters for the needs of all wireless users in the country, government or private, security or non security	Wing of the Ministry of Communications, created in 1952
GOT-IT: Group on Telecom and IT	Decides on ad-hoc issues depending on the immediate needs	Prime Minister's council
TRAI: Telecom Regulatory Authority of India	Regulating, issuing directions and settlement of disputes between various service providers. Mandatory for DOT to seek recommendation of TRAI in respect of specified matters and then setting up separate dispute settlement mechanism. Also has the power to call for any information, conduct investigations and to issue directions (directives)	Day to day management of sector
TDSAT: Telecom Dispute Settlement Appellate Tribunal	To adjudicate any dispute: (1) between a licensor and a Licensee (2) between two or more service providers (3) between a service provider and a group of consumers	Dispute settlement body
USOF	Implementation of the universal service policy and disbursement of universal service funds after they have been approved by the parliament	

As it is clear from the above table 9 the various dimensions of the telecom regulatory environment lie under various jurisdictions. The problem with the Indian telecom regulatory structure stems from the division of power. The genesis of TRAI in the TRAI Act of 2000, limited its mandate to tariff regulation and interconnection. The recommendation of the TRAI be it on market entry, spectrum allocation and universal service obligation have been taken by the DoT on a selective basis. With the regulator having no legal mandate on various essential dimensions of the sector the resultant regulatory environment has been ad-hoc and reflects the exigencies and the whims of the policymaker i.e. the DoT. The lack of independence of the USOF from the DoT has further meant that the universal service policy and its implementation is determined by political choices.

Despite the multi-jurisdictional nature of the Indian telecom regulatory structure various important policy and regulatory events in the past (table 10) have resulted in liberalizing the sector, thereby making regulation a less important instrument compared to market competition in determining successful outcomes. However, as has been pointed out by many of the TRE survey respondents (the results of which we discuss in the following section), "Regulatory environment in India needs to evolve to next generation to take cognizance of disruptive changes in underlying infrastructure." Another very important observation made about the structure, which also gets reflected in the survey results is that while the ad-hoc regulatory structure has promoted voice the same regulatory structure will be an impediment in the spread of data services till some serious institutional restructuring is done.

Table 10: Important Policy and Regulatory milestones in Indian telecom sector

Policy Instruments	Milestones
New Telecom Policy – 1999	The service – providing arm of the Department of Telecom separated from the policy making and licensing functions
	Creation of corporatised BSNL in October 2000
	BSNL/MTNL allowed to enter as the third cellular service provider in all circles
	National long distance market thrown open for competition
	Wireless Planning and Co-ordination Committee created to review and enforce spectrum allocation policy
Lowering the Licence fee – 1999	Government changed the prevailing fixed annual licence fee to a revenue share regime
Interconnect Usages Charges (IUC) regime – 2003	IUC regime of 2003 specified the interconnect charges clearly
	Paved the way for a calling party pays (CPP) regime – subscriber no longer had to pay for incoming calls, making the mobile phone highly affordable to the low usage customers who mainly used it for incoming calls
	The termination charges made uniform for all types of calls – cellular mobile, fixed and WLL (M)
Unified Licence (2003-2005)	Allowed an operator to provide fixed and/or mobile service using any technology
	The objective was to allow the exploitation of technological developments to the fullest extent to provide new applications and services
	The first phase of implementation, the Unified Access service licence, was readily adopted by most of the major operators
Lowering of Access Deficit Charge	Feb 2005: The per minute ADC on domestic long distance calls reduced by up to 60%, and the ADC on international calls by up to 40%
	March 2006: The per minute ADC for domestic calls replaced with a revenue share fee of 1.5% of non-rural (wireline) AGR, coupled with a sharp 60% drop in per minute ADC on international calls
	March 2007: ADC on percentage revenue share reduced to 0.75% from 1.5% of AGR. Per minute ADC on outgoing International calls reduced to zero, and on incoming International calls reduced to Rs. 1.
Lowering duty of telecom equipment -	Union Budget 2003-04 cut the customs duties on telecom sector capital goods from 25% to 15% and on cell phones from 10% to 5%

2003-05	Union Budget 2004-05 exempted imports of capital goods for manufacture of mobile handsets from customs.
Roaming Charges	Jan 2007: Roaming rental reduced to zero. Reduction of roaming tariffs to the extent of 22%-56%
Port Charges	February 2007: Port charges reduced by 23-29%.
Infrastructure sharing	April 2007: Recommendations on Infrastructure Sharing of Passive, Active and Backhaul Networks Reiterated the urgency of passive infrastructure sharing. Sought amendment in the license condition to allow active infrastructure sharing Recommended that all the licensees in any service areas should qualify for financial subvention schemes meant for rural areas though at reduced scale compared to the winner in the tender process of USOF Administration.
Auctions for 3G Spectrum	April 2010: GoI concluded a highly successful 3G and BWA spectrum auction in June 2010 Overall auction proceeds of 106,262 crores (USD 23.61 billion)

The telecom sector is witnessing technological convergence and in such a scenario, heavy handed and inconsistent regulation across different delivery mechanisms can distort markets. So while the importance of regulation may be decreasing, the role of competition authorities in the sector is increasing. This may imply empowering the competition authorities to deal with generic issues like collusion and predatory pricing while asking the regulatory authorities to look after more sector specific issues like interconnection charges, pricing or quality of service. However, it is only recently that the Competition Authority of India has been established. Even though the Competition act was passed in 2004, it was only in 2009 that a several provisions were notified that made the body functional. The notification of the merger and acquisition powers of the competition commission of India (CCI) happened only a few weeks ago.

On the other hand the legacy of the TRAI has been that it is vulnerable to the DoT, even though it is independent of the ministry. Our view is that this may be partially true but the major problem is insufficient legally mandated powers that TRAI has. The entire regulatory institution design in India is in dire need of change. In order to make the regulators truly independent it is important that they are accountable to the legislature, which is not the case. The appointment of regulators who possess the competence and integrity so that they may inspire public confidence will contribute immensely to the status of the regulator. There is a need to develop appropriate conventions, preferably enshrined in statutory rules, requiring that regulators are appointed on a fair and transparent basis with a view to ensuring that the regulatory system remains insulated from interference and capture.

The key test of the independence and autonomy of regulator relates to its everyday functioning relationship with the concerned Ministry. Wherever the Ministry chooses to issue policy guidelines to the Regulator they must be general in character and not relate to specific regulatory decisions. Such policy guidelines should also be preceded by consultations with the regulator. Further, these policy directives should be submitted to the Cabinet for approval and should be made available to all concerned stakeholders and the public at large (Planning Commission, 2006).24 The legal statute governing TRAI has largely compromised the independence and autonomy of TRAI, which hence requires amendment based on the regulatory philosophy as proposed by the Planning Commission.

[24] Planning Commission (2006). Consultation paper on Approach to Regulation: Issues and Options

7. Effectiveness of the Telecom Policy and Regulatory environment

In this report we use the TRE instrument[25] to get a perception of informed stakeholders on the telecom regulatory and policy environment of India. The TRE has many uses: it is a diagnostic instrument for assessing the performance of the laws affecting the telecom sector and the various government entities responsible for implementation. The detailed methodology of the application of this instrument is detailed in Samarajiva et al (2007).[26]

The regulatory environment in India is assessed on seven dimensions:(a) market entry; (b) access to scarce resources, mainly spectrum; (c) interconnection; (d) tariff regulation; (e) regulation of anti competitive practices (f) universal service obligations (USO); and (g) quality of Service (QoS).

Respondents to the TRE survey are carefully selected, senior level persons from one of the three following cateogries: those directly impacted by the regulatory environment such as operators, equipment manufacturers, those surveying the sector with broader interest such as industry/invest analysts, and those who represent the consumer interest such as user groups, other government organizations. The respondents were asked to rate the quality of the regulatory environment for each dimension on a Likert scale ranging from 1 (highly ineffective) to 5 (highly effective). Posing questions in this format ensures that responses can be easily analyzed without losing any qualitative information as often occurs when using open-ended questions. Then the scores are averaged over the respondents to get one number to allow for inter temporal and international comparisons. Appropriate weights based on the number of respondents in the three respondent categories are given to calculate the weighted average so that the perceptions of each category are equally represented.

However, a caveat must be added that the average score may mask some other details about the perception, as it may not represent the majority as the cardinality of the response has an effect on the outcome. So, for instance a few people giving a score of 5 can upwardly bias the average and vice-versa.

The survey was implemented between February and March of 2011. The total number of responses received was 48, with respectively 18,12,18 for Category 1, 2 and 3 respectively. [27].

In the sections, which follow, we analyze the survey results and provide possible interpretations to the scores on each of the seven dimensions. While comparisons have been done with the previous survey, it is not quite possible to provide deterministic reasons for the differences in the score, as the respondents were different and the perception not comparable.

7.1 Market Entry

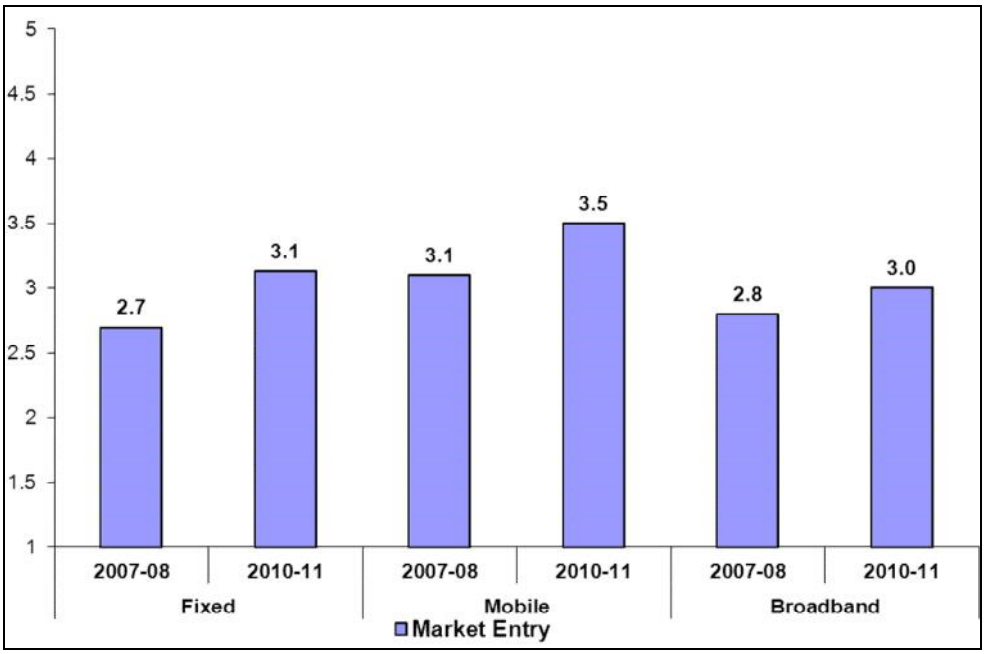
The Indian telecom growth story is predicated on the universal access licensing that was recommended by TRAI in 2003 and accepted by the then TRAI immediately. However, a host of

[25] The original TRE instrument was designed to assess regulatory effects on investment and documented in Samarajiva, R. and A. Dokeniya, (2004), Regulation and Investment: Sri Lanka Case Study, Discussion Paper WDR, World Dialogue for Regulation for Network Economies. Available at www.regulateonline.org.
[26] Available at: http://www.lirneasia.net/wp-content/uploads/2008/05/lirneasia-tre-paper-for-tprc-v8.pdf
[27] See Annex 1 to see the respondent categories and the percentage of respondents in these categories.

service licences still exist within the liberalized of the ILD and NLD sector. The unification process will be completed only when DoT removes all service-based licences and brings them under a single umbrella of a unified licence. The current market entry procedure ignores the technological possibilities opened up due to convergence.

More recently, the TRAI recommended to the DoT that there was no need to cap the number of access providers to be permitted to operate in a particular service area and leave it for market forces to decide. On its recommendations on Mergers and Acquisitions the TRAI has imposed a cap such that no mergers and acquisitions should be allowed if the number of operators fall below the minimum threshold of four.

Figure 17: TRE Score – Market Entry



Market entry in has seen improvement in the voice segment (figure 17) due to a number of private players providing fixed services as well and as many as 5-6 service providers in the mobile segment. Infact market entry scores have to be seen in the light of a liberal regime followed in the previous years as respondents have criticized the market entry procedure of "first come first served" followed in the entry of new players in the year relevant to the survey.

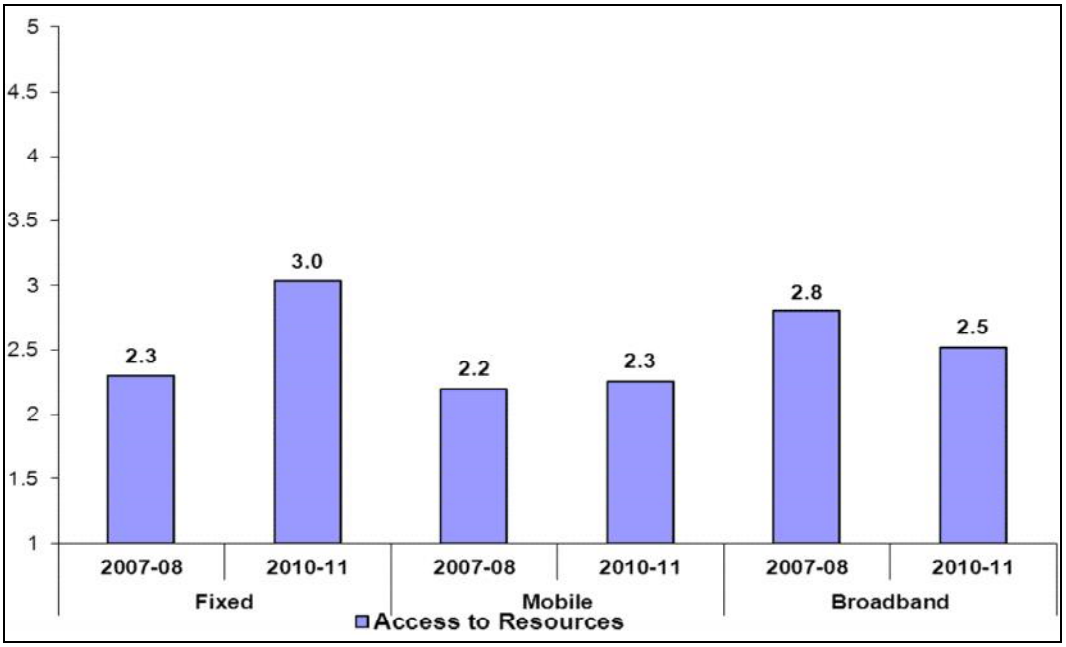
While broadband has been deployed using Cable Modems, xDSL technologies, fiber and wireless, in India xDSL has been predominantly used. The neglect of the broadband segment has been pointed out by many respondents. TRAI itself admits that with the auctioning of 3G and BWA there will be alternate technologies available for broadband. The spectrum for 3G and BWA technologies for provision of high speed data services has been allocated recently. It is expected that wireless broadband will be available to subscribers from early 2011. Of the 687.71 million wireless subscribers (CDMA+GSM) at the end of September 2010, about 274 million (i.e 39.8%) are able to use Internet services from their mobile device. The mobile (those using mobile for accessing internet) Internet user base has tripled from 2007 to 2009. We also have 1.5 million high speed data card subscribers. The high growth of data subscribers, capable of using Internet through mobile devices, makes available a ready population which could adopt

broadband. This has been reflected in the improvement in the market entry score for broadband over the previous survey.

7.2 Access to Scarce Resources

As per the terms and conditions of the CMTS/UAS Licences, the access service providers were initially permitted sharing of "passive" infrastructure viz., building, tower, dark fibre etc. only. However, in April, 2008, in order to ensure an optimum utilization of the available resources and to bring down the cost of providing service, the Government issued 'Guidelines on Infrastructure sharing among the Service Providers and Infrastructure Providers'. As per these guidelines, the service providers were permitted to share the active infrastructures limited to antenna, feeder cable, Node B, Radio Access Network (RAN)and transmission system only. The procedure for grant of Right of Way (ROW for laying optical fibre cable is presently complicated, time consuming and expensive. Both connectivity through towers and through tower-less solutions require that these procedures are simplified. (TRAI, 2011).[28] The delay in obtaining the right of way can be considerably reduced if amendment is made in section 10 of the Indian Telegraph Act, 1885. Last, but not the least the government is thinking of creating a nation wide optical fibre network, but a large amount of fibre network is lying unused and unlit and BSNL's record of active infrastructure sharing is not good. BSNL has ben chosen to provide the optical fibre network under the National Broadband Plan.

Figure 18: TRE Score – Access to Scarce Resources



However, the most blatant act of the government in the allocation of 2G spectrum vitiated the regulatory environment of this dimension, and gets reflected in the score especially in the mobile category (figure 18). By allocating 2G spectrum to 9 companies in January 2008 at an arbitrarily

[28] TRAI (2011). Consultation Paper on Issues related to Telecommunications Infrastructure policy. http://www.trai.gov.in/WriteReadData/trai/upload/ConsultationPapers/238/tdradivconsulation.pdf

decided price of 1651 crores (the price paid by the fourth cellular operator way back in 2001), the then minister violated all the principles of efficient allocation of this scarce resource. Not only was there an implication for the sector, the countries' parliament came to a standstill and the minister is now being charged with economic and criminal offence. The scores, especially for the mobile segment reflect the same disappointment with the procedure. The irrelevance of the fixed sector perhaps explains the ambiguous result for the fixed segment. A minor increse in the score for mobile could be due to the successful auction carried out by DoT for 3G.

7.3 Interconnection

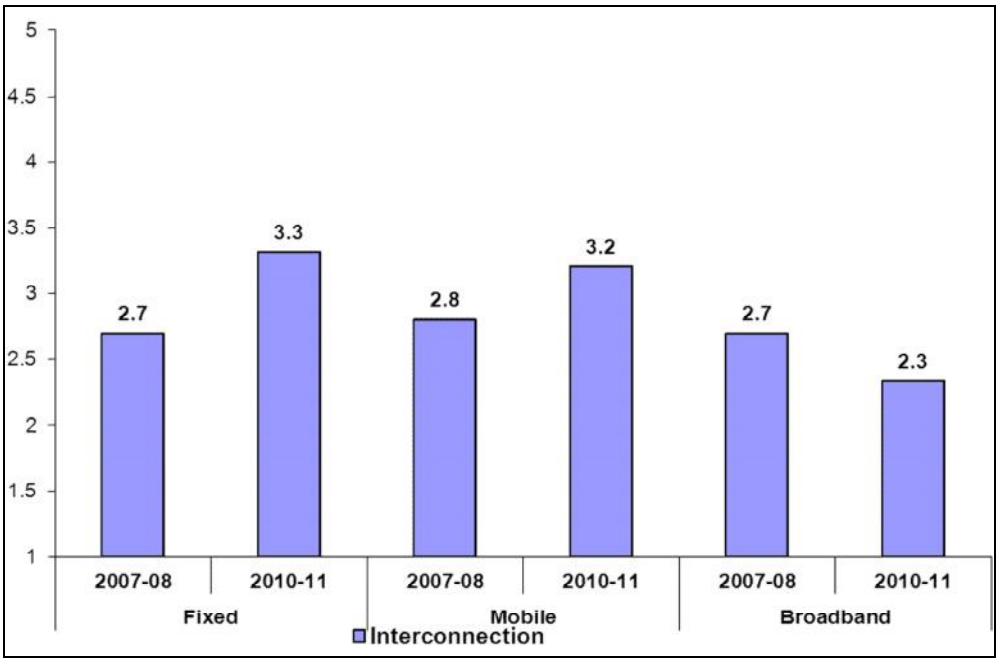
The amendment ordinance of 2000 restored TRAI's powers relating to tariffs and interconnection, which had earlier been deemed by courts to be limited. Even the government would have no right to overrule the TRAI in these two areas. With the TRAI powers clear and singular on interconnection, the interconnection regime in India has been fairly stable from 2003, when the principal interconnection regulation was put in place by TRAI. In December 2008, TRAI undertook another review. The theoretical basis of reviewing the IUC was the following:

Competition in the telecom is effective when service providers recover their costs mostly from their own end users, who can choose among competing service providers, rather than from subscribers of interconnecting networks for whom the terminating access provider is a *de facto* monopolist. The higher termination charge gives distinct cost advantage to large operators over competing new and smaller networks, which in turn helps them to consolidate the termination market by acquiring more subscribers. Termination costs above the actual cost may lead to market distortions. On the other hand, lower termination charge may increase service uptake.

The final regulations that have emerged are as follows:

1) Continue with symmetric termination charge
2) Raised the international termination charges 0.008 USD
3) Retain the present ceiling on carriage charge to 0.014 USD
4) Reduce the transit charge to 0.003 USD
5) Reduced the termination charge further to 0.004 USD from 0.006
6) Symmetric Charges for 2G and 3G voice termination

Figure 19: TRE Score - Interconnection



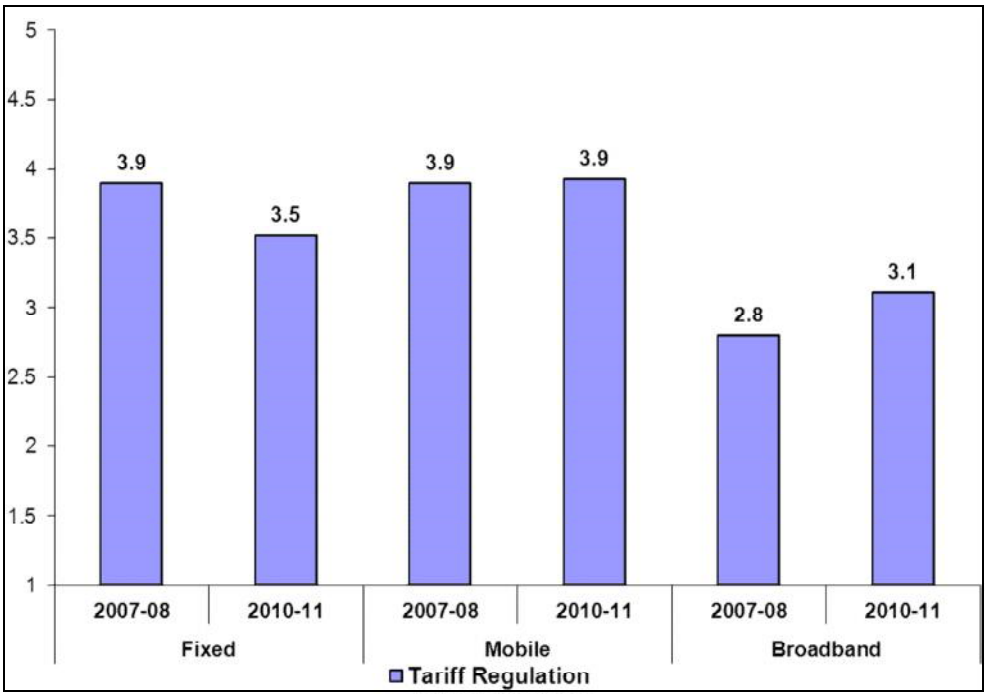
A successful interconnection regime post 2008 shows up in the TRE survey result both for mobile and fixed segments (figure 19).

NIXI has not been effective as Internet Exchange Point despite various efforts made from time to time. Despite all the efforts optimal utilization of NIXI's infrastructure has not been achieved. As on 12th January 2011 only 36 of the total 167 operational ISPs were connected to NIXI. The data available on NIXI website on this date indicates that the weekly traffic exchanged at all the seven nodes is approx 23 Gbps, which is merely 5% of the total national bandwidth of 483 Gbps reported by ISPs at the end of September 2010. Presently NIXI is not a telecom licensee and therefore is not under the purview of TRAI & DoT. There is clear resistance of the service providers to join NIXI which cannot be mandated as NIXI is not a service provider. NIXI being independent agency cannot be regulated in terms of QoS, tariffs and infrastructure (TRAI, 2011).[29]

7.4 Tariff Regulation

[29] TRAI (2011), op.cit, p.40.

Figure 20: TRE Score – Tariff Regulation



The results show that the TRE for Tariff Regulation was the best performing dimension in India for the third time in succession (figure 20). The TRAI did not adopt RPI-X methodology for tariff rebalancing but a slow downward reduction. Despite not having support from the government, the incumbent, or the courts, TRAI proved pro-competitive and was successful to a certain extent in rebalancing telecom rates. This was no small achievement, as tariff restructuring had to be carried out despite the non-transparent and complicated accounting practices of the incumbent, which was the major source of information of the unbundled cost components.

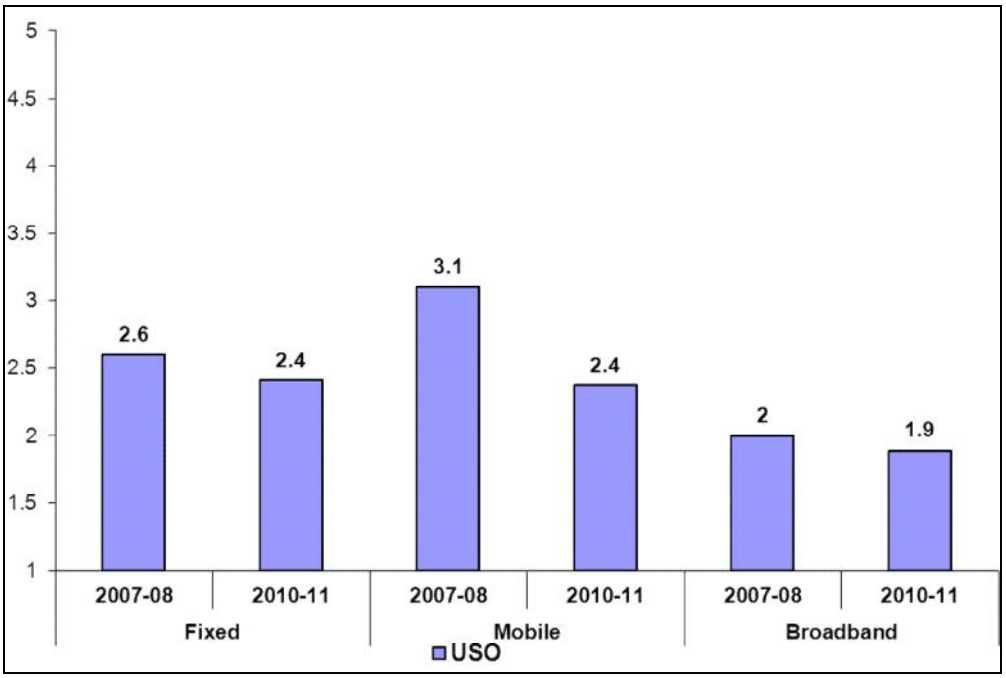
Indian tariffs are among the lowest in the world (though they may not be the lowest in the region because the region itself has some of the lowest prices), and the respondents have given the highest score to this parameter for the second year in succession. This does point out the success of the regulator. Though the regulator has forborne from tariff setting, various regulations have been passed in the recent times to address the tariff concerns, the most important being the regulator slashing of roaming rates as the operators seemed to be exploiting some market power.

Although broadband penetration is low in India, the entry level tariff for broadband services has come down drastically from Rs. 500 a month in 2004 to Rs. 200 a month in 2007. Most of the providers are charging broadband monthly rental between Rs. 200 to Rs. 1600 and providing various options for data transfer.

Though, there is a marginal decline in the tariff regulation score for the fixed service, it may not be statistically significant and it does reflect the fact that calls on mobile are cheaper, especially in the prepaid and there is a substitution away from fixed on that account as well.

7.5 Regulation of Anti-competitive practices

Figure 21: Analysis of TRE Score – Anti-competitive Practices



The improved score for voice services can be explained by the improvement in the HHI numbers across circles in the mobile segment, the presence of multiple players and the availability of substitutes both in fixed and mobile, which does not allow any service provider to abuse its dominant position. Establishment of the CCI and the introduction of number portability has improved the scores for this dimension.

The low scores of the broadband segment (figure 21) are quite expected with the HHI numbers indicating concentration of market power. There are 105 service providers who are currently providing broadband services. However, top ten service providers have captured more than 95% of market and top 5 service providers have about 90% share. State owned companies BSNL and MTNL together have about 70% market share. This indicates that despite of having license for provisioning of broadband services, majority of service providers are unable to penetrate into the market and market is still dominated by few players only.

One of the comments to the survey points out to the anti competitive practices in the BB segment. …"there are some unresolved issues in the implementation of the Broadband Policy, 2004 such as absence of level playing field in grant of unrestricted internet telephony amongst the Universal Access Service Providers (UASPs), the Cellular mobile Service Providers (CMSPs) and the Internet Service Providers(ISPs). The ISPs have already filed cases under Competition Act against the alleged discrimination by DoT in favour of UASPs and CMSPs and litigation is still on."

7.6 Universal Service Obligations

The Indian USO policy was not technology neutral but around March 2007 the government held least cost subsidy auctions for infrastructure companies for setting up infrastructure for mobile telephony. It also invited bids for the last mile connectivity from the mobile phone companies. As mentioned earlier, there are severe problems with the institutional design of the Universal

Service Fund. With no autonomy from the line ministry the projects for universal service are ill defined and not implemented in a timely manner. While a huge distortionary tax of 5% of Adjusted Gross Revenue (AGR) on all service providers and with undisbursed and unspent collections, the entire policy is questionable.

Ironically, India accounts for nearly 50 per cent of the money lying unused in various USOFs across 15 developing countries. India has almost INR 189 billion (USD 4.20 billion) unused from its total of INR 314 billion (USD 7 billion) USF collections (table 11).

In spite of this Communication and IT Minister, has rejected telecom industry's plea to reduce the collection for USOF. Telecom operators had urged the Ministry to reduce the USO levy from the current 5 per cent of their annual revenues to 2.5 per cent.

Table 11: Status of USO funds in India

Financial Year	Funds Collected as Universal Service Levy (USL) (Rs. Crore)	Funds Allocated[30] (Rs. Crore)	Funds Disbursed (Rs. Crore)
2002-03	1653.61	300.00	300.00
2003-04	2143.22	200.00	200.00
2004-05	3457.73	1314.59	1314.59
2005-06	3215.13	1766.85	1766.85
2006-07	3940.73	1500.00	1500.00
2007-08	5405.80	1290.00	1290.00
2008-09	5515.14	1600.00	1600.00
2009-10	6145.73*	2400.00	2400.00
2010-11		2400.00**	2190.18@
Grand total	**31,477.09**	**12771.44**	**12561.62**

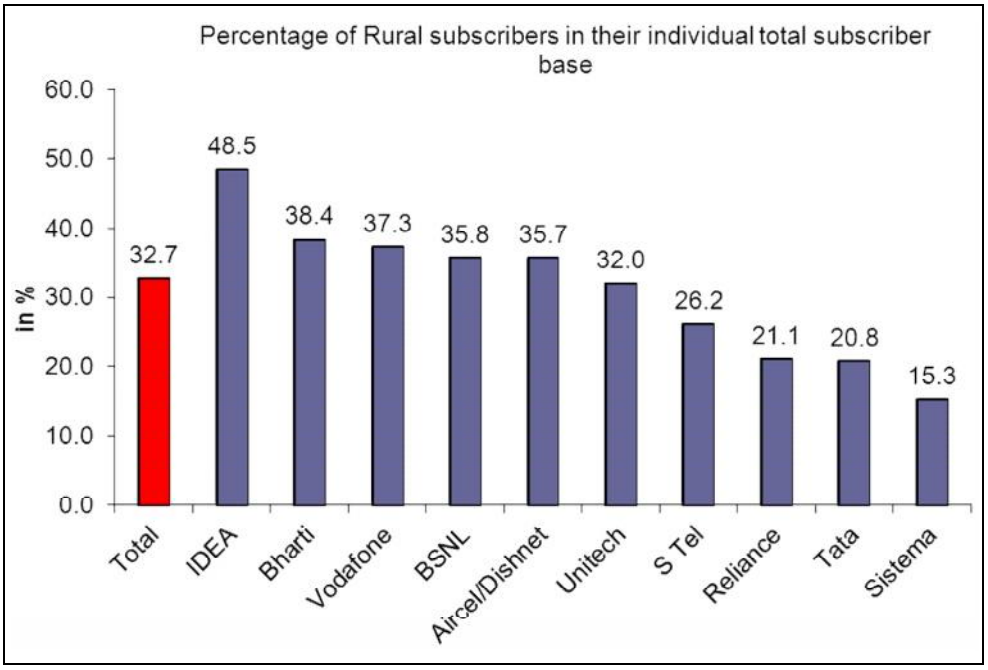
Source Annual Report 2010-11, Department of Telecommunication. @As on 31.12.2010 * Approximate as Collection of 2009-10 is provisional.**Against the Budget Estimate of Rs 3000 Crore for the financial year 2010-2011, a budget allotment of Rs. 2400 Crore was received.

The universal service policy has not been able to achieve what the markets have been able to achieve. Facing saturated urban markets the service providers created innovative schemes keeping in mind the payment capacity of a daily wager. When the industry had a minimum norm of Rs.200 (USD 5) as a minimum recharge, they went down to Rs.10. This offer was a shift from the earlier urban centric monthly income cycle payment plan and was tailor made to the needs of a daily wager. New entrants eager to expand their market shares by increasing the pie and not just by eating each other's market made it inevitable for them to look towards untapped rural markets. The success of the market driven process can be seen from the fact that companies like

[30] Funds have been allocated by the parliament ot the statutory funds, it does not imply yhtat projects have been identified. The disbursement of funds is for projects

Idea have almost 50% of their subscribers in rural areas (figure 22). An almost 30% rural teledensity is an important milestone in it self.

Figure 22: Operator wise percentage of rural subscribers in total subscriber base

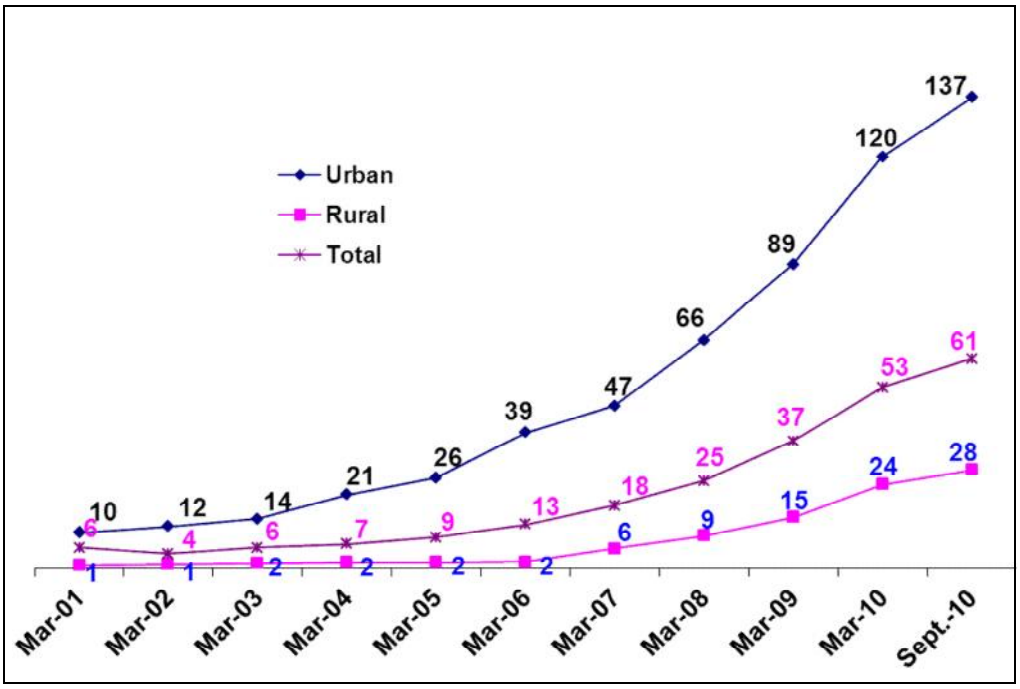


Source: Performance indicator report, TRAI, September 2010.

The gap between the rural and urban teledensity is however a concern (figure 23). Expansion of infrastructure especially backhaul through proper design of a minimalist universal service policy promoting infrastructure expansion will address this gap. According to TRAI[31] to meet the rural mobile target of 11th Five year Plan (2007-12), there is a requirement of additional 40875 mobile towers (phase I, phase II of USOF and additional requirement) for facilitating the next 100 million rural subscribers. To meet the requirement of providing connectivity to these additional towers, there will be a substantial need of backhaul for both voice and the broadband. In the USOF schemes, provision of backhaul for the new towers is not clearly defined. Only recently Broadband roll out has been brought under the ambit of USO

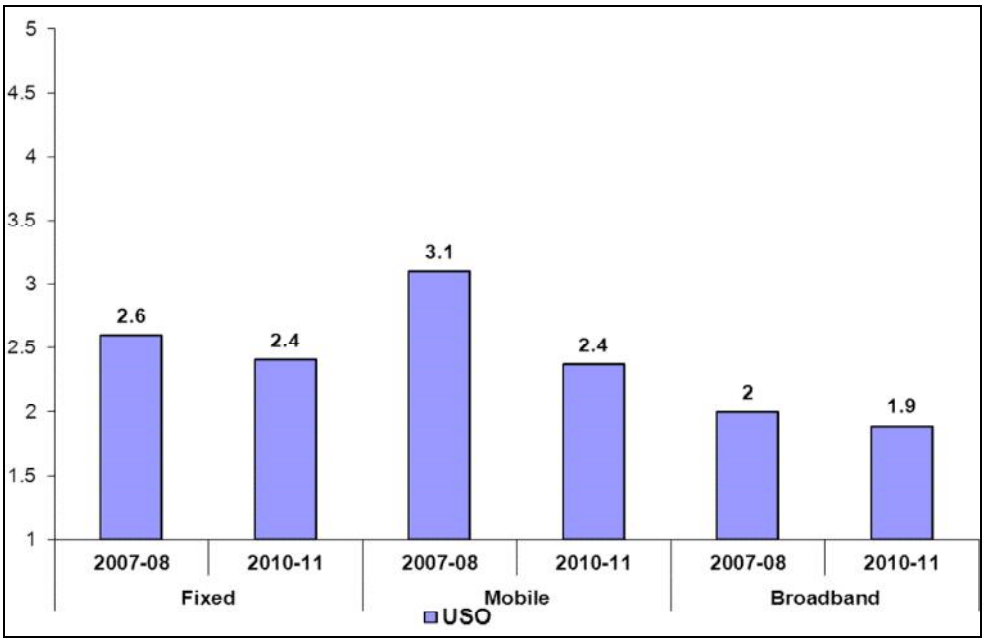
[31] TRAI (2009). Recommendations On An Approach to Rural Telephony –Suggested Measures for an Accelerated Growth, March 19th 2009. http://www.trai.gov.in/WriteReadData/trai/upload/Recommendations/113/recom19mar09.pdf

Figure 23: Growth of teledensity



Source: Performance indicator report, TRAI, September 2010.

Figure 24: Analysis of TRE Score - USO



In light of the inefficacies of the universal service policy and the distortion created by the universal service levy that constrains the market driven expansion of communication services, it is not surprising to find the low scores for this dimension across all sectors (figure 24). In the broadband segment given that the availability of relevant content in the vernacular language is a pre requisite for the growth of broadband and ICT with the rural masses, therefore apart from

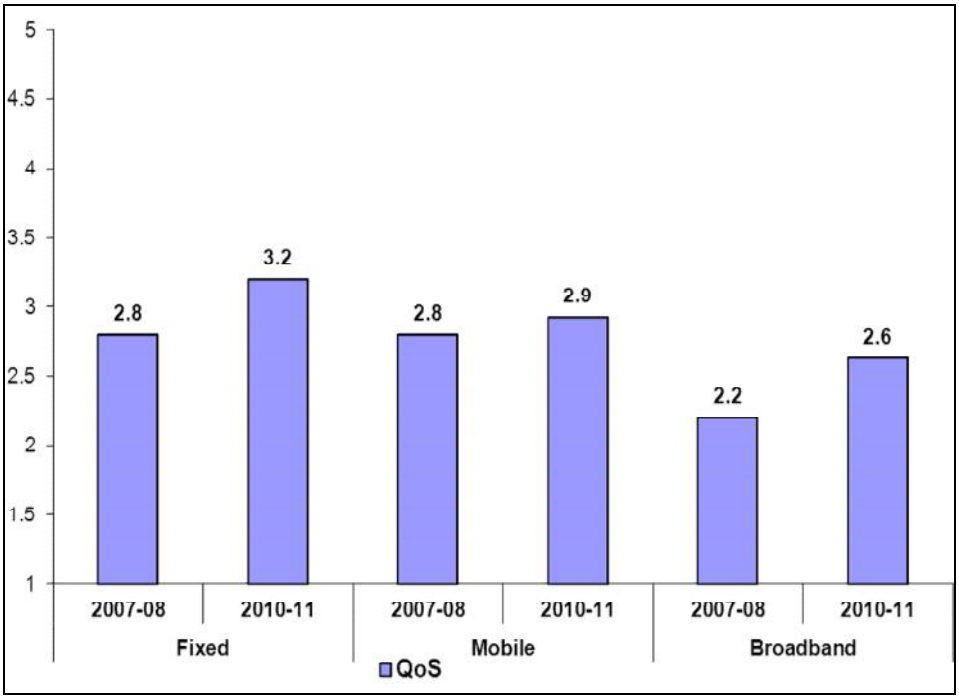
giving the subsidy to the infrastructure providers the content application providers should also be given incentives to develop the contents based on local requirements.

7.7 Quality of Service (QoS)

Indian telecom sector has by all accounts experienced a 'revolution' of sorts but increasingly, it is being pointed out that the low ARPU model is not sustainable as it is conjectured that the operators are cutting back on investments. Issues like frequent call drops, poor connectivity, unwarranted messages, telemarketing calls and absence of a consumer redressal cell still annoy the consumers in the world's fastest growing telecom market. This is despite five years of regulation and nearly 24 consumer advocacy groups continuously expressing displeasure over the QoS of telecom providers in India.

QoS, as defined by TRAI "is the main indicator of the performance of a telephone network, and of the degree to which the network conforms to the stipulated norms." The subscriber's perception of QoS is determined by a number of performance factors specified by the telecom regulator, particularly, network congestion. TRAI has in place regulations for assuring QoS in all the three segments,

Figure 25: TRE scores – Quality of Service



TRAI looks at various parameters to define quality of services by the operators. These include accessibility of call centres, response time to the customers, call drops, voice quality and network congestion. According to the latest QoS survey the percentage of offenders for the following parameters of QoS (wireless) (i) Worst affected cells having more than 3% TCH drop (call drop) rate (15.7%) (ii)Point of Interconnection (POI) Congestion issues (12.3%) (iii) Metering and billing credibility - pre paid (17.8%) (iv) % age of calls not answered by the operators (voice to voice) within 60 seconds (37.3%). Poor customer accessibility in the customer service call centre

is a major reason for poor QoS scores (figure 25). While the QoS surveys report does not show very poor QoS parameters for broadband, the perception and LIRNEasia research (Wattegama, Chanuka)[32] shows that QoS is unsatisfactory in terms of promised and actual speeds.

8. Conclusions

As documented above, the massive progress achieved in the past few decades in bringing electronic connectivity to the hitherto unconnected in India has indeed been made possible by the forces of competition. Success in deepening that connectivity to broadband forms will also require adherence to the principle of competition and increased emphasis on its effective implementation. India has a far way to go to be able to fully exploit the potential of an internet economy.

Many millions of poor people are engaging in tasks normally associated with the Internet such as information retrieval, payments and remote computing using relatively simple mobiles. In China, for instance, Ovum predicts that there will be 325 million mobile broadband handset subscribers and 52.5 million mobile broadband laptop subscribers. However, policy and regulation is always in a catch up mode due to the fast change in the technology and most of the problems arise due to problems associated with legacy networks. Frequent revisions and lack of clarity in the licensing process sow uncertainty and confusion in the minds of industry players, so first and foremost market entry has to be made easy and not become a stranglehold of policy inertia.

Broadband wireless access may represent the most cost-effective way to bring broadband access to the masses. Notwithstanding the above discussion regarding the potential of mobile for internet access, further enabling the introduction of mobile broadband is likely to stimulate inter-platform competition in the broadband market in India, with the main different platforms likely to be public switched telephone network (PSTN) for digital subscriber line (DSL) access, fixed wireless (technologies such as WiMAX), and wireless (3G and 4G technologies). India is likely to enjoy the benefit of adopting 3G+ technology at a time when devices and applications relevant to enhancing the mobile broadband experience are entering a mature developmental phase. Network technology has changed, with the momentum, in terms of how people will access the functionalities currently associated with the Internet, shifting to EDGE and HSPA/HSDPA networks and away from ADSL and WiMAX in many developing-country markets. Policy makers and regulators must seek to understand and leverage the success that they have achieved in delivering voice by aiding a market driven model to achieve their policy objectives (Samarajiva, 2009).

Things are likely to change only if spectrum management policies of the government quickly accept the potential of mobile for fast speed internet. Removing artificial scarcity of spectrum and creating transparent mechanism for allocation will be the determining factors for the success of the potential of the technologies, as was done in the case of 3G and BWA spectrum allocation. After, the tumultuous experience with 2G allocation, it seems that the proposed NTP 2011 makes it mandatory that market based mechanisms for allocation of spectrum will be used. In the case of the broadband Rights of Way (RoW) is a major issue for deployment. TRAI has recommended that the Central Government may consider mandating the state governments to adopt uniform RoW procedures and streamline/ rationalise RoW cost, which may primarily be

[32] http://lirneasia.net/projects/2006-07/bbqos/

limited to cost of reinstatement only. RoW costs should be non-discriminatory, reasonable. RoW procedures should be transparent and publicly available.

Technological options like combination of WiFi & WiMAX or 3G will be very useful for extending Broadband to the rural areas. However, the cost of creating backhaul infrastructure in rural areas is substantial, which acts as a deterrent for a new operator. There is need to encourage new entrants in rural areas for installing their backhaul by providing incentives. TRAI in its recommendations on growth of Telecom services in Rural India dated 3rd October 2005 recommended that backbone sharing in rural area be mandated. With the incumbent refusing to share its existing backhaul infrastructure there may be a wasteful duplication of the same.

Some policy proposals that would contribute to the development of low-cost and high-quality telecom infrastructure for creating the next generation of Digital Capacity in India are as follows:

1. Providing Backhaul Connectivity:

→ Operators of backbone networks that constitute essential facilities should be required to give leased access at cost-oriented, non-discriminatory terms to other operators requesting access;

2. Universal service should be extended to provide support for providing backhaul between the BTSs and the BSC
3. Universal service subsidy should include subsidy for the backhaul from towers to the block headquarters to the entity installing the tower
4. Defray charges for spectrum used for providing microwave backhaul for rural BTS.
5. Bandwidth should be upgraded to STM-1 by USOF and BSNL should be mandated to share at least 2/3rd of the enhanced bandwidth with other service providers
6. Action should be taken to re-farm the 700 MHz band for use in wireless access networks expeditiously and to assign the cleared frequencies in minimum blocks of 15 MHz (coupled) by transparent means.
7. Universal Service policy should be only a facilitator and hence minimalist.
8. Reduction in Universal service levy

Last but not the least, it should be recognised that investment in mobile telecommunication networks requires complementary investment in education and other basic infrastructures. In order to drive productivity growth beyond the huge effects of simple access, how do these complementary investments in assets and skills boost the "bang for the buck" that mobile investment might provide requires demand side studies at the micro level (Waverman and Dasgupta 2009)

Annex 1: TRE Survey Methodology

Attempts were made to get 15 respondents each for each of the following categories:

1. Category 1: Stakeholders directly affected by telecom sector regulation, such as operators, Industry associations, equipment suppliers and re-sellers
2. Category 2: Stakeholders who analyze the sector with broader interest, such as those working for financial institutions, Telecom consultants, Law firms
3. Category 3: Stakeholders with an interest in improving the sector to help the public such as academics, research organizations, journalists, telecom user groups, civil society, former members of regulatory and other government agencies, donors.

Unlike the previous surveys many respondents chose the online survey mode. There were many respondents who wanted total anonymity in responding and gave e-mail responses only if anonymity and confidentiality is maintained. Eliciting responses was possible only on personal assurances from the principal author. Category 2 had very few responses on 2 accounts: First the category itself consists of far fewer stakeholders in comparison to category 1 and category 3. Second, there are not many law firms in India that have interests in the telecom sector. However, the responses are representative of the population of consultants and law firms. Financial institutions are not well represented.

Category 3 were the most enthusiastic respondents, especially the academics and the journalists. This group of stakeholders very keenly followed telecom as a sector as the last few years have been the most controversial with a huge political fallout.

Category 1 and Category 3 represent 37.5% of the respondents each and category 2 represent 25% of the respondents

Annex 2: Summary of Regulatory and Policy Events for India

Date	Key Regulatory Events – Jan. 2010 – Jan.2011
2010	
20 Jan	TRAI releases consultation paper on "Efficient Utilization of Numbering Resources". The consultation paper takes up the following important issues: Long term suitability of numbering plan Effective utilization of numbers Allocation and pricing of the numbers
23 Feb	The government announced mobile number portability (MNP) will be delayed by two months to the end of May 2010 due to security reasons.
17 Mar	TRAI releases consultation paper on "Collocation Charges". The consultation paper takes up the following important issues: Terms and conditions for collocation Measures to ensure transparent and non-discriminatory treatment in pricing and provisioning of collocation facilities Sharing of cost of collocation by the seeker and provider
09 April	Auctions started for India's third generation (3G) high-speed mobile licences.
11 May	TRAI issues Consultation Paper on Review of Telecom Unsolicited Commercial Communications Regulations. This consultation paper mainly reviews the regulatory framework and explores all possible alternatives including establishment of "Do Call Registry", which will address issue of growing dissatisfaction among consumers due to the problem of unsolicited commercial communications.
11 May	TRAI releases recommendations on "Spectrum Management and Licensing Framework".
10 June	TRAI issues Consultation Paper on 'National Broadband Plan'. The paper emphases need of urgent focus on creation of robust national BB infrastructure scalable to cater to future requirements not only in urban areas but also in villages.
11 June	The government rang a triumphant end to the auctions for high-speed, third-generation (3G) mobile and broadband licences, raising in excess of Rs1 trillion, more than three times the budgeted estimate.
02 Aug	TRAI issues Consultation Paper on "Review of measures to protect the interest of consumers in telecom sector"
20 Aug	TRAI releases recommendations on "Efficient Utilization of Numbering Resources in India". Among many recommendations TRAI has recommended that India should migrate to an integrated numbering scheme for fixed and mobile services by 31st December, 2011.
27 Sept	Adding a new twist to the 2G spectrum scam, the Comptroller and Auditor General (CAG) told the department of telecom (DoT) that a vast majority of the 126 licences controversially issued by the government in 2008 are illegal.
07 Oct	The telecom department (DoT), which oversees USO fund, has accepted in-principle a proposal by sector regulator TRAI to make the Universal Service Obligation Fund (USOF) an independent body.
13 Oct	TRAI issues Consultation Paper on "Certain Issues relating to Telecom Tariffs". In the context of representations from consumers and their representatives seeking further effective transparency measures, TRAI has formulated this Consultation Paper.
28 Oct	TRAI Issues Consultation Paper on "Quality of Service requirements for delivery of basic financial services using mobile phones"

02 Nov	TRAI Releases Consultation Paper on Issues relating to blocking of IMEI for lost/stolen Mobile handsets
03 Nov	TRAI Releases Consultation Paper on Revenue Sharing Arrangement for Intelligent Network Services Through the consultation paper TRAI aims to seek views of the stakeholders on the issue of sharing of revenue from IN based services among the interconnecting service providers to assist TRAI in arriving at a framework by which interconnecting service providers can be fairly compensated.
18 Nov	2G scam: Trai recommends cancellation of 62 licences The action also coincides with the Supreme Court hearing into the allocation of 2G spectrum in 2008 at 2001 prices
01 Dec	TRAI issues "The Telecom Commercial Communications Customer Preference Regulations, 2010" Unlike the previous Regulations which provided only for a Do Not Call Registry, these Regulations provide a wide choice to the customer. He may choose to be under the 'fully blocked' category which is akin to the Do Not Call Registry under the previous Regulations or he may choose the 'partially blocked' category, in which case he will receive SMSs in the category/categories chosen by him.
08 Dec	TRAI issues Recommendations on 'National Broadband Plan'. Highlights of the Plan: Establishment of national broadband network, which will be an open access optical fibre network. A National Optical Fibre Agency (NOFA) will be set up to establish this broadband network. A State Optical Fiber Agency (SOFA) would be formed in every State.
09 Dec.	The government set up a one-man committee of a former Supreme Court judge to examine the allocation of telecom licences and spectrum, some of which were granted at rock bottom prices, in one of the biggest corruption scandals to hit India this year.
14 Dec	TRAI issues "The Telecom Commercial Communications Customer Preference (Amendment) Regulations, 2010" The TRAI has found it necessary to re-determine the dates for implementation of the regulation "The Telecom Commercial Communications Customer Preference Regulations, 2010" issued on 1st December 2010. Accordingly, some of the relevant regulations have been amended so as to come into force, from dates as may be specified by the Authority, from time to time.
28 Dec	TRAI issues "The Telecom Commercial Communications Customer Preference (Second Amendment) Regulations, 2010" According to the provisions of these regulations, Telemarketers Registration shall commence from 15th January, 2011 and other provisions shall come into force from 1st February, 2011.
28 Dec	TRAI releases consultation paper on "Encouraging Telecom Equipment Manufacturing in India" The consultation paper takes up the following important issues: Promoting R&D and creation of intellectual property Promoting manufacture of telecom equipment in India Manufacture of electronic components in India
2011	
14 Jan	TRAI releases consultation paper on "Issues Related to Telecommunications Infrastructure Policy". The consultation paper takes up the following important issues: Telecom infrastructure classification and details with accent on policy issues that

	need to be consulted upon. Framework relating to Mobile Virtual Network Operators Setting up of National Internet Exchange Points Issues relating to telecom tower infrastructure Issues relating to Rural telephony
14 Jan	Telemarketer registration starts from 15th January 2011.
25 Jan	TRAI Issues Consultation Paper on "Issues arising out of Provisioning and Pricing of Services by Mobile Service Providers – in the context of Delivery of Basic Financial Services using Mobile Phones"
31 Jan	TRAI issued notice saying Consumer Preference Registration to stop Unsolicited Commercial Communication to start from 10th Feb 2011.
31 Jan	Former Supreme Court judge Shivraj V. Patil submitted his report on the procedures followed in awarding airwaves for second generation (2G) telecom services between 2001 and 2009, and identified some errant officials. The report came down heavily on the controversial First-Come, First-Serve (FCFS) policy in entertaining applications and has sought complete transparency in spectrum allocation and assignment.
02 Feb	Former Telecom Minister A Raja was arrested along with his two former associates in connection with the 2G spectrum scam.
03 Feb	TRAI releases consultation paper on "Green Telecommunications". The consultation paper takes up the following important issues: Estimation of the carbon footprint of the telecom sector in India. Need and framework of carbon credit policy for the Indian telecom sector Measures to reduce the telecom sector carbon footprint Promoting use of energy efficient devices and renewable sources of energy. Standards, testing and certification products and services as green. e-waste management
08 Feb	Review of Implementation of Mobile Number Portability by TRAI TRAI is constantly monitoring the implementation of MNP in the country. Based on the complaints and feedback received, TRAI has instructed the service providers to strictly comply with the provisions of MNP Regulations.
09 Feb	Four experts, appointed by TRAI have submitted their report on "The 2010 value of spectrum in 1800 MHz band" dated 30thJanuary, 2011.
10 Feb	The Telecom Regulatory Authority of India (Trai) submitted fresh recommendations on 2G spectrum pricing , steeply raising the estimated value of spectrum beyond 6.2MHz held by incumbent operators.

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