Background Paper submitted to the Committee
on India: Vision 2020

Telecom Sector in India: Vision 2020

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The views exposed in this paper are that of the authors not of the Planning Commission

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Introduction

The purpose of this paper is to construct a vision of Indian telecom sector for the year 2020, i.e., about two decades from now. Development being a continuous process, the choice of the year 2020 is just an arbitrary division of time, a pre-defined time horizon to take stock of what is likely to be achieved.

Pre-portrayal of a stage of development in future requires understanding of the process of change, the dynamics that set law of motion. In attempting to do so, the present paper deciphers the recent past.

Process of change is often volatile and responsive to intervention and global circumstances impacting it. In such an inherently dynamic situation it is convenient to assume that cross-country experiences incubate the most recent seeds of change. This is because countries at various stages of development encapsulate developmental experiences that occur with the passage of time.

The present paper isolates the agents of change based on international experiences and situates India in this development continuum. The agents of change, as observed from international perspective, have been broadly categorized into economic structure, competition policy and technology. Economic reforms and liberalization have driven telecom sector through several transmission channels of which these three categories are of major significance.

The paper, as it unfolds, is divided into six sections. Section 1 gives a brief account of the era of competition that was heralded in Indian telecom sector and the results achieved. Analysis of the results, particularly comparison with other major countries intrigued further discussions on economic structure, synergy between telecom and IT, competition policy and technology in sections 2,3.4 and 5 respectively. Logical extension of the arguments, as they developed, extended to a vision for 2020 in each of these sections. The paper concludes in section 6.

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The current policy configurations of India's telecom sector have been listed in the Appendix.

1. **Reforms and Performance**

India, like many other countries of the world, have adopted a gradual approach to telecom sector reform through selective privatization and managed competition in different segments of the telecom market. To begin with, India introduced private competition in value-added services in 1992 followed by opening up of cellular and basic services for local area to private competition. The Telecom Regulatory Authority of India (TRAI) was constituted in 1997 as an independent regulator in this sector. Competition was also introduced in national long distance (NLD) and international long distance (ILD) telephony at the start of the current decade[1].

The current policy stance affecting telecom sector in India is presented in the Appendix. Two state-owned public sector incumbents with a large existing subscriber base dominate the fixed line service. As on December 31, 2001, the two Public Sector Enterprises (PSEs), BSNL and MTNL[2] owned 34.73 million Direct Exchange Lines (DELs) against 0.45 million privately owned DELs. These two PSEs were allowed belated entry into the cellular segment in the beginning of the present decade. Consequently, their cellular subscriber base is tiny compared to the private operators. Out of 7.3 million cellular subscribers in the country in June 2002, they had only 0.2 million subscribers[3].

Despite asymmetry in initial market endowments between public sector incumbents and private operators, the act of opening up of the market unleashed dynamism that was hitherto latent in the sector. This is evident from a number of performance indicators. In terms of overall size of main telephone lines in operation, India ranked 14th in the world in 1995. The rank improved to 7th position in 2001 (Table 1).

Table 1: **Top 14 countries in the world in terms of number of main telephone lines in operation**

[1] Government divested 25 per cent strategic stake of Videsh Sanchar Nigam Limited (VSNL), a public sector monopoly incumbent in ILD telephony to Tata Group in the private sector out of 52.97 per cent equity held by the government. This was followed by opening up of ILD business to private players from April 1, 2002, terminating VSNL monopoly two years ahead of schedule, VSNL, *16th Annual Report, 2001-2002*, p.5.

[2] Till 1986 telecommunication was a public utility owned by the Government of India. Mahanagar Telephone Nigam Limited (MTNL) was created in 1986 as a PSE to take out telecommunication services from the Government entirely in the cities of Delhi and Mumbai. It was in the same year that VSNL was created in the ILD segment. Bharat Sanchar Nigam Limted (BSNL) was formed as a PSE on October 1, 2000 as a telecom service provider in all other places. Both these incumbents inherited the entire pre-existing subscriber base with the Government.

[3] *tele.net*, New Delhi, Vol.3, issue no.7, July 2002, pp. 54-55.

Country	**No. of lines in 1995** ('000)	**Ranks (1995)**	**No. of lines in 2001** ('000)	**Ranks (2001)**
USA	159,735.2	1	190,000.0	1
Japan	62,292.0	2	76,000.0	3
Germany	42,000.0	3	52,280.0	4
China	40,705.7	4	179,034.0	2
France	32,400	5	34,032.9	9
UK	29,411.4	6	34,710.0	8
Russia	25,018.9	7	35,700.0	6
Italy	24,845.0	8	27,303.0	10
Korea, Rep.	18,600.0	9	22,724.7	11
Canada	17,567.0	10	20,319.3	12
Spain	15,095.4	11	17,427.0	14
Brazil	13,263.0	12	37,430.8	5
Turkey	13,215.7	13	18,900.9	13
India	11,978.0	14	34,732.1	7

Source: World Telecommunication Development Report 2002, ITU

Network expansion in India was accompanied by an increase in productivity of telecom staff measured in terms of ratio of number of main telephone lines in operation to total number of full time telecom staff (Table 2).

One way of looking at the welfare gains to subscribers is to watch the trend in prices for telecom services, whether such prices came down in the competitive regime. What consumer ultimately pays includes rental as well as telecom tariffs. Because of complications involved in summarizing differential rates applicable to peak and non-peak hours, a convenient proxy for the change in telecom prices could be constructed in terms of observed trend in revenue earned from telephone services at constant prices expressed as a ratio of number of main telephone lines in operation. Table 2 shows a significant decline in this ratio since 1995 in Indian fixed line segment. It may be noted that the National Telecom Policy was announced in May 1994. Steps were intensified to introduce private competition in the basic and cellular services thereafter. The beginning of the declining trend in per line revenue at constant prices coincided with the period, which witnessed emergence of competitive pressure in the sector.

Table 2: **Trend in productivity and price**

Year	**Number of main telephone lines in operation per full-time telecom staff**	**Telephone service revenue at constant prices (CPI: 1995=100) per main telephone line in operation** (Rs. '000)
1991	15.58	9.13

1992	17.65	10.25
1993	20.32	11.04
1994	23.38	10.17
1995	28.45	9.23
1996	33.90	6.12
1997	41.89	5.62
1998	50.93	4.92
1999	62.97	4.24

Source: Computed from the data published in the Year book of Statistics: Telecommunication Services, 1991-2000, ITU

Table 3 shows the long run trend in supply and demand of DELs. The number of DELs in operation (i.e., main line in operation) has been taken as supply whereas demand has been computed by adding the number of subscribers in the waiting list to the number of DELs in operation. However, it needs to be kept in mind that the number in the waiting list, in certain cases, is unlikely to reflect potential demand for telecom services in the economy. The market potential may be much more than what is revealed through waiting list because the number in the waiting list reveals demand registered in those areas where telecommunication facilities are available and reasonable expectations exist for demand to be fulfilled. In the areas where telecom infrastructure is not adequate, demand may not get registered at all and remain suppressed.

Table 3: **DEL: Supply and demand**
(millions)

Year ending March 31	**Direct Exchange Lines** (DELs)	**Waiting List**	**Demand**
1981	2.15	0.45	2.6
1983	2.47	0.66	3.13
1985	2.90	0.84	3.74
1987	3.49	1.12	4.61
1989	4.17	1.42	5.59
1991	5.07	1.96	7.03
1993	6.80	2.85	9.65
1995	9.80	2.15	11.95
1997	14.54	2.89	17.43
1999	21.59	1.98	23.57
2001	32.44	2.92	35.36

Source: Indian Telecommunication Statistics 2002, Ministry of Communications, Government of India.

The figure below shows an interesting phenomenon. Total demand tends to exceed supply by a margin, which does not get narrowed down as supply expands. It shows that market for fixed line is supply constrained and demand

tends to increase as supply expands. The figure also reveals that there is significant growth in supply of DEL in the 90s, the eventful decade of sectoral reforms. The growth momentum is sustained in the current decade with a positive supply gap.

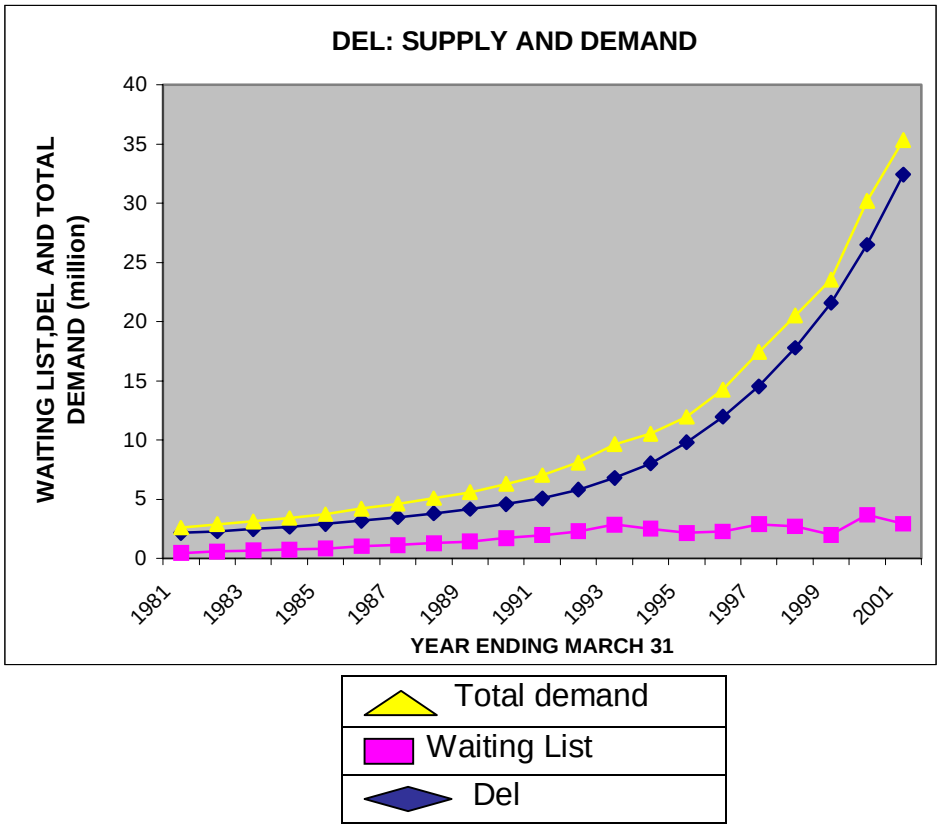

Table 4 indicates tele-density for the countries included in Table 1 as measured in terms of number of main lines per 100 inhabitants.

Table 4: **Number of main telephone lines per 100 inhabitants**

Country	**1995**	**2001**
USA	60.73	66.45
Japan	49.61	59.69
Germany	51.33	63.48
China	3.30	13.81
France	56.01	57.35
UK	50.18	57.78
Russia	16.91	24.33
Italy	43.33	47.06
Korea, Rep.	41.24	47.60

Canada	59.85	65.51
Spain	38.50	43.11
Brazil	8.51	21.69
Turkey	21.44	28.52
India	1.29	3.38

Source: World Telecommunication Development Report 2002, ITU

Above table indicates that despite phenomenal achievement in terms of network expansion, the size of the population is responsible for India's low tele-density[4]. A comparison between Table 1 and Table 4 reveals that countries with smaller network sizes than India are having much higher tele-densities. However, in terms of total tele-density, i.e., the sum of fixed-lines and mobile subscribers per 100 inhabitants, India's comparative ranking in the world improved from 160 in 1990 to 145 in 2000, an improvement by 15 positions[5]. Nevertheless, closing the digital divide in terms of tele-density remains a daunting task.

The present paper estimates that in order to attain the network size of USA in 2001 India has to expand its number of operational telephone lines at a compound annual growth rate (CAGR) of 23.44 per cent between 2002 and 2020. The corresponding growth rates to reach China and Japan's levels are 23.06 per cent and 17.63 per cent respectively. Even that is not going to mean much in terms of tele-densities in comparison to most of the countries cited in Table 4. Assuming no change in India's size of population (i.e., assuming population size to remain at 2001 level of 1.03 billion), India's tele-density will be 18.48 lines per 100 people even if India's network size reaches the level of USA. Considering the fact that India's DEL grew at a CAGR of 19.4 per cent during 1995-2000, significant effort would be needed to step up growth rate above 23 per cent.

Understanding telecom growth prospect would require understanding of the sources of growth --- what accounts for cross-country differences in growth experiences. Countries do differ among themselves in respect of their economic structure, sectoral policies and technological changes. Assuming these three to be key drivers of growth it can be said that 'Vision 2020' of Indian telecom sector will be shaped in an important way by the evolving economic structure, sectoral reforms including competition policy and technology trend.

2. **Economic Structure**

It has been observed that 'growth in the number of new telephone subscribers has far exceeded the growth in the global economy' in the last twenty years[6].

[4] It may be noted that tele-density being an average, does not throw light on the distribution of telephones across various income categories. If distribution is skewed, tele-density may not be an appropriate indicator of tele-accessibility of the poor.

[5] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.56.

[6] Ibid., p.1.

This shows that aggregate growth alone does not determine telecom expansion and there may be need to look at composition of growth as well. However, influence of economic structure on telecom expansion (or for that matter on achievable level of tele-density) does not find explicit consideration in today's literature on telecom economics as much as the other two factors, i.e., competition and technology. One plausible reason could be because of the importance that has been attached to income gap as a factor explaining digital divide. Moreover, income gap, by itself subsumes differences in certain structural characteristics and therefore diverts the focus of attention from structural gap to income gap[7]. Proponents of 'income determinism' may stop short of addressing structural factors because of their primary concern regarding income transfer between the developed to the developing countries as the only way to address the problems of digital divide. Structural issues, on the other hand, are more pertinent to the believers of 'leapfrogging' capabilities of the countries who are on the wrong side of the divide[8]. It is for them that the present paper goes on to prove that the effectiveness of direct promotion of telecommunications as a complementary policy to overall macroeconomic reforms will be determined in an important way by how structural issues in the economy are addressed.

In the first place, it is noteworthy that there are countries with per capita income less than that of India but with higher tele-density. As for instance, Bolivia had per capita income of US$ 2380 in 2000[9] compared to US$ 2390 for India. Bolivia's tele-density[10] was 6.05 in that year against 3.20 for India. Moldova had a tele-density of 13.33 with a per capita income of US$ 2240. Georgia, with a per capita income of US$ 2470 had a much higher tele-density of 13.86. Though Ecuador had a little higher per capita income of US$ 2920 compared to India, tele-density was significantly higher at 10.00. It was also noted that these countries had either more equitable income distribution than India (measured in terms of percentage of population living on less than $2 a day) or had a higher weightage of value added by the service sector in the Gross Domestic product (GDP) or both.

A comparative picture of India vis-à-vis these countries in respect of the two aforesaid characteristics are presented in Table 5.

Table 5: **Structural characteristics and tele-density, 2000**

[7] There is a two- way relationship between telecommunications and economic development. The relationship that operates through telecom expansion causing economic growth is known as Jipp's Law, after Professor A. Jipp, who was one of the first to write about it. The relationship is described in terms of a 'Jipp Curve', see for discussion, Ibid., p.64.

[8] See for instance, Negroponte, N., 'The Third Shall be First: The Net Leverages Latecomers in the Developing World', *Wired Magazine*, January 1998.

[9] PPP income, i.e., income measured in terms of Purchasing Power Parity.

[10] Number of main telephone lines in operation per 100 inhabitants.

Country	**Tele-density** (per 100 inhabitants)	**Per capita income** ($ PPP)	**Percentage of population living on less than $2 a day**	**Value added by the service sector in the Gross Domestic product (GDP)** (%)
Moldova	13.33	2240	38.4	53
Bolivia	6.05	2380	51.4	48
India	3.20	2390	41.4	46
Georgia	13.86	2470	Less than 2	52
Ecuador	10.00	2920	52.3	64

Source: (i) Year book of statistics, 1991-2000, ITU; (ii) World Development Report 2002.

In order to examine the generality with which such relationships manifest in a larger sample of countries, tele-density was regressed on percentage of population living on less than $2 a day and per capita income over a cross-section of 77 countries[11] for the year 2000 to yield the following results:

Tele-density = 9.63 – 0.1563** (Percentage of population living on less than $2 a day) + 0.0019**(Per capita income)

$R^2 = 0.82$;
** : Significant at 1%.

The result shows that income distribution has a much larger coefficient than per capita income and therefore emphasizes the fact that telecom development strategy should have substantial equity component built into it.

To assess the significance of service sector in telecom development, tele-density has been regressed on percentage contribution of value added by the service sector in GDP over a cross-section of 115 countries for the year 2000. The following result was obtained:

Tele-density = - 31.54 + 0.9267** (Percentage contribution of value added by the service sector in GDP)

$R^2 = 0.48$;
** : Significant at 1%.

[11] There were 77 countries, for which required data was available.

The result indicates a strong association between service sector growth and telecom development implying that future telecom expansion will depend significantly on the proliferation of services in the economy.

As a matter of strategy, it can be said that targeted intervention through access promotion can be potentially instrumental in delivering growth with equity. Access promotion means expansion of telecommunication and therefore will cause growth to occur[12]. Consequently, a broad based access promotion strategy would lead to more equitable growth.

The first step towards broad based access promotion in India was initiated in the eighties when Public Call Offices (PCOs) were given private franchises for both domestic and long distance services. Total number of PCOs grew from 0.2 million in 1993 to 0.9 million in 2001. The Eighth Plan (1992-97) targeted at provision of *Panchayat* [13]phones in 360,000 villages. Thrust on Universal Service Obligation (USO) as a part of broad based telecommunication development strategy[14] began with the National Telecom Policy of 1994 and was reinforced as one of the objectives of the New Telecom Policy 1999 (NTP-99). The licenses for the basic services, for which open tenders were invited in January 1995,contained an obligatory provision in the agreement for the private operators to provide 10 per cent of the DELs as Village Public Telephone (VPT). NTP-99 targeted complete rural coverage by the end of 2002 providing Village Public Telephones[15] in all the 0.6 million villages with emphasis on 'availability, accessibility and affordability'[16]. By the end of January 2001, 0.4 million villages have been covered. Share of rural areas in total number of DELs in the country stood at about 22.6 per cent in January 2002, increasing from 21.4 per cent in March 2001[17]. The trend is suggestive of potential scope of expansion of telecommunication in the rural sector.

Though USO is mandatory for the basic service operators, other service providers are also allowed to participate in it subject to technical feasibility. The subsidy element of the USO will be financed from a fund generated through Universal Service Levy (USL), i.e., levy of certain percentage of license fees charged from different service providers. As a follow up of NTP 99 and subsequent recommendations of the TRAI, The Universal Service Support Policy

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[12] It was empirically evident that countries having more than expected number of telephones or a higher tele-density (given their income levels) experienced higher growth than the countries with lower than expected number of telephones or tele-densities. See, The World Bank Group, *Information and Communication technologies: A World Bank Group Strategy*, Washington D.C., 2002, p.6. If more telephones equal growth, countries can leapfrog several percentage points growth through direct telecom promotion.

[13] Local self-government body consisting of elected representatives at village level.

[14] USO is now common in many countries seeking promotion of rural telephony. The modalities differ in matters of details.

[15] VPT is a community telephone facility.

[16] NTP 99 also envisaged provision of Internet access to all district headquarters by 2000.

[17] Government of India, Ministry of Communications & Information Technology, Department of Telecommunications, *Annual Report, 2001-2002.*

(USSP) came into effect from April 1, 2002 and the Department of Telecommunications (DOT) issued detailed guidelines for implementation[18]. Apart from expansion of VPTs, the guidelines also envisaged upgradation of VPTs to Public Telecom and Information Centers (PTICs) to provide data transmission facilities and installation of high speed PTICs (HPTICs) in the Short Distance Charging Areas (SDCAs) with broadband access. Allocation of subsidy will be to the bidder quoting lowest amount of subsidy, chosen through a multi-layered bidding process subject to a ceiling of the benchmark cost estimated by the DOT on the basis of efficiency criteria[19].

So far, the public sector incumbents have spearheaded expansion of rural telephony with very little contribution by the private sector. By the end of December 31, 2001, out of 0.4 million villages, the private operators covered only 718 villages and the rest was by the public sector.

Private sector presence is prolific in Public Call Offices (PCOs) and Internet Kiosks in the cities and towns[20]. However, there are certain pilot projects in the rural sector working to evolve cost effective wireless technological solutions in partnership with local service providers. Many such projects have developed applications based on local content and software in Indian languages and user-friendly icons for illiterate people[21].

Telecommunications have emerged as a springboard of ICT applications with economy-wide ramifications. There are plenty of anecdotal evidences[22] to show that telecom is improving life chances across the strata of the society tiding over the 'divide'. A whole range of information based industry and applications have

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[18] Department of telecommunications of the Ministry of Communications & Information Technology is the policy making arm of the Government of India in the area of telecom development.

[19] Chilean experience is a frequently quoted success story of leveraging US$ 40 million of private funding 'on the basis of just over US$ 2 million of public subsidy', see for discussion, The World Bank Group, *Information and Communication technologies: A World Bank Group Strategy*, Washington D.C., 2002, p.11 and Bjorn Wellenius, *Extending Telecommunications Service to Rural Areas – The Chilean Experience*, The World Bank Group, February 1997. Early pilot results showed that in output-based contracts for rural services Peru succeeded in mobilizing private investment equivalent to double the amount of subsidy provided, for details see Cannock Geoffrey, *Telecom Subsidies*, The World Bank Group, Private Sector and Infrastructure Network, June 2001.

[20] MTNL also commercially launched 25 Internet kiosks each in Delhi and Mumbai. Government of India, Ministry of Communications & Information Technology, Department of Telecommunications, *Annual Report, 2001-2002*, p. 64.

[21] CorDect is one such technology. See, Noronha, Frederic, *Internet for all: Indian villagers to get access at prices they can afford*, www.tenet.res.in ; also by the same author, *Web kiosks for India's villagers*, www.tenet.res.in ; 'Communications Revolution set to transform 1000 Tamil villages', *Infomy*, February 15, 2001; 'India Online', *Nature*, January 24, 2002. It has been reported that 'In Southern India, skilled Internet users download information about weather, agriculture and fishing and broadcast it over the radio'. ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, op.cit., p.34.

[22] See for example, *Life at Work in the Information Economy*, World Employment Report 2001, ILO, Geneva; Dasgupta, S., Somik Lall and David Wheeler, *Policy Reform, Economic Growth and the Digital Divide: An Econometric Analysis*, Working Paper No. 2567, World Bank, March, 28, 2001; Sood, Aditya Dev, 'How to Wire Rural India, Problems and Possibilities of Digital Development', *Economic and Political Weekly*, October 27, 2001.

come up creating new sources of employment and earning with welfare enhancing consequences for the wealthy and the poor. As a meta-technology, ICT has caused rapid innovations to occur in all other areas of material sciences. As a fabric of information society, ICT has improved access in the fields of education, healthcare, governance and all aspects of business services. It has also improved the abilities of the poor to manage risks and mitigate vulnerabilities through provision of timely information.

Vision 2020 is a vision of information society and knowledge economy built on the edifice of ICT. In India, the aggressive expansion of public sector telecommunications infrastructure in hitherto uncharted territories of geographically remote locations would unleash latent economic energies and market forces, which will erode the very foundation of perceived lack of profitability of rural investment among the private investors. Once this is achieved, Vision 2020 will be a vision of wealthier and more equal society full of creativity, innovation and competition.

3.**Telecom and IT**

The vision of telecommunications in 2020 is a vision of information society built on an edifice where IT and telecommunications merge. Rapid technological convergence has already implied a symbiotic overlap between the development strategies of IT and telecommunications. Part of today's IT is 'telecom writ large', it flourishes on the telecom-network and in turn permits modern day telecommunications to use sophisticated IT-software. Hardware is a common platform for both IT and telecom.

There is a legacy vision derived from export-success of India's software that has given rise to optimism regarding India's growing pre-eminence in global IT canvas. Such a vision builds on a much larger vision of all round development of IT that pervades wide cross-section of Indian economy and society. Deeper analysis shows that there is need for a comprehensive IT development strategy to ensure India's durable presence in the global software market. As discussion in the subsequent paragraphs will show, 'enclave' type development of software with exclusive focus on export can not bring about desired benefits if such a strategy ignores the linkages between export and the domestic market. Vision 2020, therefore, is a much larger vision.

First, it is to be appreciated that foreign exchange contribution of software export net of import of hardware is roughly fifty per cent[23]. Net foreign exchange contribution will increase if India is able to develop a strong base of hardware.

Second, scrutiny of the structure of India's software export vis-à-vis the emerging dynamics of the global market reveals that India has marginal presence in the

[23] Joseph K.J. and K.N. Harilal, 'Structure and Growth of India's IT Exports, Implications of an Export Oriented Growth Strategy', *Economic and Political Weekly*, August 25, 2001, p.3267.

fastest growing segment of the global IT market consisting of software packages and software products[24]. India's close competitors, on the other hand, have achieved greater success through diversification of exports with software packages[25]. There is, therefore, need for India to climb value chain with more innovative software products in the international market. This is possible when India is able to broad-base the development of IT with a strong and large domestic market supporting innovation and its diffusion along with the growth of component manufacturing base. Appropriate synergy between the domestic and export market will be key to enduring success of Indian IT sector in overseas market and development of state-of-the art telecom infrastructure is a prerequisite to both.

Finally, development of human resources through IT education, training and skill development is fundamental to the whole process.

Two important indicators of IT penetration in Indian market are Internet use and availability of Personal Computers (PCs). There has been significant expansion in both during the last decade (Table 6).

Table 6: **Growth in availability of Personal Computers and estimated number of Internet users**

Year	Estimated number of Internet users	Availability of Personal Computers
1992	1,000	410,000
1993	2,000	560,000
1994	10,000	800,000
1995	250,000	1,200,000
1996	450,000	1,500,000
1997	700,000	2,000,000
1998	1,400,000	2,700,000
1999	2,800,000	3,300,000
2000	5,00,0000	4,600,000

Note: Data for 1991 on Internet users is not available. The series start from 1992 because data on both is available from this year.
Source: Yearbook of statistics, 1991-2000, ITU

Despite impressive growth in the number of Internet users and availability of PCs, India remains on the wrong side of the divide (Table 7). Number of users of Internet is still a negligible fraction of India's total population. Per capita availability of PC is also very low.

[24] Ibid., p.3265.
[25] Chakraborty Chandana and C. Jayachandran, 'Software Sector: Trends and Constraints', *Economic and Political Weekly*, August 25, 2001, p.3258.

Table 7: **Internet penetration and PC availability, 2001**

Countries falling in different income categories	**Internet users per 10,000 inhabitants**	*PCs per 100 inhabitants*
Low income countries Of which	62.21	0.59
India	68.16	0.58
Lower middle income countries	264.94	2.45
Upper middle income countries	992.66	8.24
High income countries	3992.87	37.31

Source: ITU, World Telecommunication Development Report 2002

Internet kiosks, telekiosks, telecottages and cybercafes have emerged in important roles in expanding community access to ICT popularizing IT among the masses and promoting domestic market. However, their expansion crucially hinges on the growth of telecommunications infrastructure. In India, a spectrum of technologies has been unleashed to connect remote villages, which includes Wireless in Local Loop (WLL), wireless cum wired technology developed by C-DOT[26], radio systems, switching systems of different capacities integrated with underground cables, CorDect and medium capacity satellite systems. Besides, a number of small-scale ICT initiatives is already at work in different parts of the country (Box 1). It is envisaged that with the growth of telecom infrastructure such examples would multiply and create an information society in not so distant a future.

Box 1: **Harbingers of information society**

SARI: Sustainable Access in Rural India (SARI) is a joint initiative between MIT Media Lab, Center for International Development at Harvard, IIT Chennai and the I-Gyan Foundation. The project is located in northern Madurai district of Chennai. It seeks to provide voice and Internet connections in 1000 villages with the use of CorDect system. Apart from provision of a kiosk in each village, connections will be provided in schools, colleges and primary health centers. The project also provides for interest free loans and easy installments for purchase of computers and training support to technical personnel. Continuous evaluation of the socio economic impact of the project is a part of the initiative[27].

[26] The Government of India promoted center for the Development of Telematics (C-DOT) in 1984 to develop indigenous digital switches. C-DOT also designed 'Rural Automatic Exchange' (RAX) and manufactured small meters, which became popular with the PCOs. See Noronha Frederic, *Internet for all: Indian villagers to get access at prices they can afford*, www.tenet.res.in.

[27] 'Communications Revolution set to transform 1000 Tamil villages', *Infomy*, February 15, 2001 cited in www.tenet.res.in.

n-Logue: 'n-Logue' is a company incubated by a group of professionals in IIT Chennai under private initiative. The company offers wireless equipment, multimedia computer equipped with software in Indian language and other accessories to set up cost effective Internet kiosks in partnership with local service providers. Such kiosks are coming up in Madhya Pradesh, Rajasthan and Tamil Nadu[28].

M.S. Swaminathan Research Foundation: This project is located in Pondicherry of South India. Village Knowledge Centers have been established under this project with dedicated web sites of locally relevant information. The Foundation also disseminates knowledge and information through wireless radios to rural communities[29].

The Warana Wired Village Project: This is a collaborative project between the central and the state government, located on the banks of river Warana in Maharashtra. It operates distributive accounts system for the Warana sugarcane cooperative.

The Gyandoot Project: A joint initiative of the district collector of Dhar district of Madhya Pradesh and the District Rural Development Agency (DRDA). More than thirty Community Information Centers (known as 'Soochanalaya'), one for a group of villages, have been set up to provide information on market rates of agricultural products, land records, education, health, *Panchayat* related matters, governance issues, issue of certificates and registering complaints. E-mail facilities in Hindi are available. Majority of these Centers are own and run by the village communities with costs borne by the Panchayats. Others are privately run and bank financed[30].

Tarahaat.com: This is a commercial project promoted by a Delhi based NGO, 'Development Alternative'. The project provides online information centers for rural communities with interactive and graphic interface in some places at North India.

Hole-in-the wall initiative: A pilot project launched by the NIIT, a software company in urban slums by providing unmanned computers. Through continuous video monitoring it was found that despite language difficulties boys and girls from the neighbourhood developed access skills in web surfing and graphic designs even without formal training.

Indiagriline: This is an online network of trading, contract management, banking, retailing etc. promoted by EID Parry, a company dealing in food products[31].

[28] Noronha Frederic, *Web kiosks for India's villagers*, www.tenet.res.in.
[29] ILO, 2001, p.193.
[30] Kothari, Brij, Avinash Pandey and Amita Chudgar, 'Gyandoot: Can it be the harbinger of knowledge?' *India Infrastructure Report 2002, Governance issues for Commercialization*, 3i Network, OUP 2002, pp.198-205.
[31] www.indiagriline.com

School Net India: An initiative of the Infrastructure Leasing and Financial Services (IL&FS) to develop online multilingual content and CD-ROMs as supplementary teaching aid in classrooms.

SEWA: Self-Employed Women's Association (SEWA) is an NGO, which organizes poor and self-employed women. SEWA has promoted online global marketing of the products turned out by their members[32].

Source: Sood, 2001 and other sources.

The list of anecdotes included in the Box is by no means exhaustive. With progress of connectivity such examples will multiply bringing in its train benefits of an information economy and society. According to one estimate, 600,000 jobs have been created in cyberkiosks in India in addition to possible employment due to spillover effects[33].

Employment benefit of ICT occurs across wide range of skill spectrum. Apart from growth of employment and income at firm level due to ICT induced productivity growth in a large number of industries, a whole range of ICT enabled activities and services has started booming. Some such examples include operations like data entry, preparation and maintenance of database, revenue accounting, preparation of payroll, processing of insurance claims, human resource services, call center operations, running of customer support centers, medical transcription, content development and animation, web site services, software development, hardware repair and maintenance, systems engineering, systems design and integration etc. The process of job creation and productivity growth is expected to bring about market expansion supporting growth of domestic hardware and software industries broadening the base of ICT development. This, in turn, will induce R&D spontaneity enabling India to transit from the status of an importer of sub-assemblies of IT and telecom hardware to a higher state of development endowed with strong domestic manufacturing base of sophisticated hardware and software products booming from indigenous ideas, innovation and comparative advantage. A modern telecommunication infrastructure will accelerate this process through provision of high-speed communication links. In the global IT market India will be a major player at the higher end of value chain based on perfect synergy between the domestic and overseas market.

As in the past, state will play an important role in this development both as a proactive policy maker and also by taking a position in the market. Major policy trust of the government to promote IT was through provision of Technology Park, fiscal incentives, simplification of administrative rules and procedures, promotion of institutional finance including venture capital and liberalization of foreign equity

[32] ILO, 2001, p.195.
[33] Ibid., p.318.

participation. In the area of software, policies to encourage global presence included market support, overseas campaign for export promotion, quality certification, information security management and R&D support. Indian IT companies have been allowed to issue ADR/GDR linked stock options to employees under favourable tax treatment. Approval mechanism has been simplified under automatic route permitting overseas business acquisition through ADR/GDR route. The IT Action Plan on Hardware envisaged extending Export Oriented Unit (EOU) status to hardware manufacturing units and deemed export status to telecom manufacturers.

Traditionally, state has been the most important source of demand for IT industry[34] in India. The trend continues even today and government spending on IT is a key driver of domestic demand for IT products. One reason is that the government has significant market presence in many goods and services. The other reason is that the government is consciously promoting the use of IT in activities within its domain of activities. To undertake development of IT as a thrust area a separate 'Ministry of Information Technology' was formed in October 1999. Recently, Ministry of Communications and Ministry of IT have been merged to form a single 'Ministry of Communications & IT'.

Apart from encouraging use of IT in research and scientific areas, the government has also taken major initiative to computerize work of various ministries and departments. Ministries and departments have come up with their websites with all the relevant details. Though computerization of many more areas within the government are under implementation, significant results have already been achieved in computerization of railway reservation, allocation of Permanent Account Number (PAN) for income tax payers, processing of passport application, conduct of public examination, custom clearance, Regional Transport Offices, schemes under implementation by the NGOs, vigilance information, VSAT based money orders under the Department of Post, Supreme Court, land records, Parliament questions, debates and deliberations[35]. Different ministries have been advised to earmark 2 to 3 percent of the budget on IT.

Many state governments have also declared IT policies and computerized records, certificates, registration of deeds, issue of licences, various payments systems etc.

Computerisation is also spreading very fast in the field offices of the government, financial and educational institutions. According to one estimate, 12,000 out of 45,000 bank branches have implemented major computerization[36].

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[34] Evans, Peter B., 'Indian Informatics in the 1980s: The Changing Character of State Involvement', *World Development*, Vol.20, No.1, January 1992, p.2.

[35] These are only some examples. More details of computerization in the Central and the State Governments are available in the web site of the Ministry of Information Technology. See www.mit.gov.in.

[36] www.nasscom.org.

Legislative framework has been put in place with the enactment of the Information Technology Act 2000 recognising digital signature as means of authentication of government certificates. The act imparts legitimacy to contract through electronic means unless otherwise agreed. Indian Copyright Act of 1957 and its amendment in 1994 outlaw software piracy.

The foundation of digital democracy has been laid to usher in an era of e-governance, transparency and e-accountability. A recent study shows that the number of Indians using Internet for accessing government services and products as a proportion to total number of Internet users has increased from 22 percent last year to 31 percent this year[37].

Growing legitimacy of IT based transactions in government has started catalyzing the use of IT in private market and expanding the domain of e-business and e-commerce reducing transaction costs significantly and increasing productivity.

In time to come, the battle against digital divide will be won and ICT will be leveraged to benefit the poor. Apart from higher earnings associated with productivity gains and job creation, benefits for the poor will also result from risk mitigation and reduction in vulnerability due to timely availability of information on weather and market, guidance on improved farm practices and elimination of exploitation by the intermediaries. There will be general improvement in the quality of life of the poor through more responsive governance, improved delivery in the social sector programmes, better quality of public services and more effective public expenditure with more efficient targeting and monitoring. E-education and e-medicine will surmount all the access barriers to reach the remote and isolated locations.

There has been substantial depletion in the stock of IT personnel in India through migration into USA and Europe. There is need to replete this stock and plan for increased availability of skilled manpower to meet the future demand. Education, training and skill development will meet the demand for skilled manpower of the industry and at the same time keep the cost of IT education, servicing and maintenance within reasonable limit. Trained manpower will also be an important source of demand for IT products and services. The Government has taken steps to increase the teaching facilities to double the number of technology students and sponsored training institutes like Indian Institute of Information Technology and Management at Allahabad, Bangalore, Kolkata and Hyderabad in addition to Indian Institute of Technology and Management at Gwaliar. Initiative has also been launched to upgrade existing regional engineering colleges, give active support to the polytechnics and colleges and encourage private participation in training in the field of IT. A society[38] has been formed to extend accreditation to

[37] 'More Indians using Net to deal with Govt', *The Times of India*, November 9, 2002, p.1.
[38] Known as DOEACC

institutions at non-formal sector for certain courses and network services[39] have been launched to link academic and research communities.

Software in local languages is being increasingly available. Computers have also been specially designed for use in the mass market[40].

Vision 2020 is a vision of IT for the masses. All round development of digital literacy would put Indian society in complete command over the ICT tools. Available indications suggest that IT education is gaining popularity[41]. Perceived utility of ICT as enabler of business processes would continue to enhance market for IT education. Education will spur innovation, productivity and entrepreneurship. A knowledge society will be formed with participation from the rich and the poor, men and women, young and old, organized and unorganized, government and the governed.

4. **Competition Policy**

Countries often differed in pattern of sequencing and the speed of liberalization. Competition has been controlled within limit by state policy through licensing of limited number of market players in certain segments granting thereby a period of exclusivity to the operators. Heterogeneity of routes to sectoral reforms, as seen from the examples of some of the Asian countries, classified into different combination of policies and approaches to telecom reform, are presented below[42]:

1. *Competition in the fixed line segment with state owned incumbents: China, India and Korea.*
2. *Privatization of state owned incumbents but deferred competition through exclusivity granted to private investors: Hong Kong, Indonesia, Malaysia, Pakistan and Singapore.*
3. *Simultaneous introduction of privatization and competition: Japan and Sri Lanka.*
4. *Opening up of local market to competition first: Hong Kong, India and Singapore.*
5. *Opening up of competition in the international services first: Korea, Malaysia and the Philippines.*
6. *Introduction of second domestic long distance carrier first: China*

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[39] ERNET

[40] 'Simputer', a pocket book sized icon based computer is one such example.

[41] In a backward semi-arid sparsely populated district of Rajasthan, more than 100 computer-training centers have been opened under the franchise of popular brand names to operate on commercial basis. Despite total absence of reliable connectivity in the district, enrolment in these centers is high indicating popularity of IT courses. See, Sood, 2001.

[42] Taken from Fink Carsten, Mattoo Aditya and Randeep Rathindran, *Liberalising Basic Telecommunications: The Asian Experience*, The World Bank, Development Research Group, Washington, DC, November 2001.

7. *The sector ministry exercises regulatory functions: China, Indonesia, Japan, Korea, Malaysia, Taiwan and Thailand.*
8. *Separate regulator with the responsibility for interconnection lying with the dominant operator while regulator is responsible for arbitration of disputes: Hong Kong, Pakistan and Philippines.*

In most countries, restricting the number of licensees or imposing geographic limitations has limited competition. In India, for instance, competition in cellular telephony was allowed in a duopoly mode. This was gradually increased to licensing of four operators in each of the four metros and thirteen circles. Basic service in India is still limited to one private operator competing with state owned incumbents in the circles. Though private sector has been licensed and they are laying infrastructure, metros are still in the grip of public sector monopoly and it will take a while before private competition takes place. Differences in modes of privatization have been observed in other countries. In Thailand, private entry was allowed through Build Operate and Transfer (BOT) mode while the network was controlled by the state. In Vietnam, network was publicly managed with foreign operators participating in provision of training, equipment and supervision through Business Cooperation Contracts (BCCs). China did not allow private entry in the telecom sector and limited competition between state-owned entities of the ministries. Many countries in Asia restricted foreign equity participation. For example, China, India, Indonesia, Korea, Malaysia, the Philippines and Thailand limited foreign equity below fifty per cent[43].

It is interesting to note that competing technological standards have also limited competitions. Countries are divided in their technical options for mobile networks. While Europe predominantly opted for Global System for Mobile communications (GSM) technology and USA for Code Division Multiple Access (CDMA), within Asia, China, India, Indonesia and Malaysia have opted for GSM in cellular mobile network, whereas Hong Kong, Korea, the Philippines, Singapore and Thailand have opted for CDMA[44].

However, several countries are now opting for more than one standards. For example, in USA, 'Companies like AT&T and Cingular are increasingly moving to GSM'[45]. 'China is going with some CDMA as well.'[46] India is using CDMA in Wireless in Local Loop (WLL). Multiple technological standards fragment market rendering base stations purchased from one company unworkable with switches bought from another company potentially limiting the scope of exploitation of economies of scale that could accrue in a multi-vendor environment[47].

[43] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.5.
[44] Ibid., p.6. India has opted for CDMA in WLL.
[45] Interview with Ian Goetz, published in *tele.net*, Vol. No.3, issue no. 4, April 2002, p.32.
[46] Ibid., op.cit., p.31.
[47] Ibid., p.31.

The way multiple technological standards may confuse regulatory stance leading to market failures can be seen from the recent experiences of several vendors while trying to launch 3G in Europe. European Union has mandated a single technological standard called 'Wideband CDMA' (W-CDMA) for 3G coverage. Some of the companies that sought to launch 3G services in September 2002 (deadline stipulated in the licenses for the launch of services) faced the difficulties that networks and handsets of different vendors could not work with each other. 'CDMA2000', another standard for 3G, which is working successfully in Asia and USA could not be adopted in Europe because European operators did not have freedom to use 'CDMA2000' as per their licensing restrictions[48].

Which competition policies worked better than others? Literature cites certain developmental experiences to draw conclusions from 'before and after' and 'with or without' evaluations. The purpose here is to cite these references. In the absence of more detailed information, examination of the validity of such conclusions is not intended here.

Competition with privatization

World over, there is an observable trend of growing number of state owned telecom incumbents being privatized. In 2000, from among the member countries of the ITU, those with fully or partially privatized incumbents outnumbered countries with fully state-owned operators[49]. It has been observed that 'countries with a privately owned incumbent operator account for 85 per cent of the world market by revenue. Those with fully state-owned operators, in mobile as well as fixed lines, account for just two per cent.'[50]

It has been suggested that privatization with competition works better than privatization without competition. For example, Chile started privatization in 1988 but did not limit competition through grant of exclusivity period or licensing obligations. Argentina, on the other hand, privatized in 1990, but granted seven-year exclusivity period, which was subsequently extended by three years. Moreover, Argentina imposed licensing obligation in terms of stipulated growth rate of 6.5 per cent. In the decade following privatization, Chile far exceeded Argentina in terms of network growth. Moreover, starting with half of the tele-density, Chile surpassed Argentina in ten years' time[51].

The issue of granting a 'period of shared exclusivity' versus 'allowing more extensive market entry' has been discussed in the literature. Experience of UK has been cited in this context. Telecom expansion was reportedly much more rapid in the United Kingdom (i) after the expiry of exclusivity period from 1982-90, that was granted to Mercury, the second operator and (ii) after cable TV

[48] 3G telecoms: Let Europe's operators free, *The Economist*, September 28th – October 4th 2002, p.15.
[49] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.40.
[50] Ibid., p.2.
[51] Ibid., p.42.

operators were permitted to offer tele-services[52]. Therefore, it was concluded that open competition was better than duopoly. Both USA and Canada lost in terms of their mobile tele-density-rankings in the world in the 90s. Two reasons which have been cited for this are: (i) persistence with regional duopoly for too long, and (ii) slow transition from analog to digital systems[53].

Notwithstanding the merits of the above conclusions whatsoever, it can be argued that privatisation of existing state-owned incumbent operator is not the only way to promote private investment. Opening up of new services not preoccupied by state monopoly can attract private investors, provided regulatory policies do not inhibit growth of private markets in such areas. Growth of private mobile operators in India is a case in point. However, it is necessary for the regulatory authority to ensure that state incumbent does not inhibit growth of competition[54]. Operationalisation of these ideas is not without hazards. A conflict of common occurrence relates to interconnection issues. Interconnection between state-owned fixed line incumbent network and private mobile network has been a bone of contention in many countries. '…incumbent telecommunication operator, which often holds a monopoly…can set the price, typically at a high multiple of the actual cost'[55].

Independent regulator?

Sound regulation is a pre-requisite to healthy competition. Therefore, issue of competition cannot be divorced from the issue of regulation. The autonomy that a regulator enjoys from government control has often been given primacy over many other factors in determining a regulator's ability to discharge regulatory role in an impartial manner. In reality, however, it is difficult to perceive independent regulation as synonymous with impartial regulation. There are examples of effective regulation under regulatory functions being performed by the government departments. Similarly, there are instances of 'independent regulators that have been captured by market players'[56].

What about non-sector specific regulation? New Zealand experimented with non-sector specific regulation relying on Competition Commission of the country. This led to protracted litigations and disputes on interconnection and network access issues slowing down the progress of the sector. Finally, New Zealand enacted

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[52] Ibid., p.45.
[53] Ibid., pp.54-55.
[54] Dasgupta, et.al. find econometric evidence to support that 'difference in competition policies have much greater impact on Internet intensity than differences in income'. Here competition is measured in terms of World Bank's rating index, which captures to what extent state inhibits a competitive private sector. The results suggest positive impact of competition. The study also finds favourable impact of competition on mobile penetration. See, Dasgupta, S., Somik Lall and David Wheeler, *Policy Reform, Economic Growth and the Digital Divide: An Econometric Analysis*, Working Paper No. 2567, World Bank, March, 28, 2001.
[55] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, op. cit., p. 29.
[56] Ibid., op.cit., p.49.

'Telecommunication Act' in December 2000 and created a Telecommunication Commission within the Competition Commission[57].

In India, TRAI Act was amended in January 2000, to remove some of the shortcomings observed earlier. The legislation aimed at, *inter alia*, protection of interests of service providers and consumers of telecom sector. With this amendment, recommendatory functions were separated from enforcement functions. A separate Telecom Disputes Settlement and Appellate Tribunal (TDSAT) was set up with both original and appellate jurisdiction. It became mandatory for the central government to seek prior recommendations of the TRAI before introduction of new services. TRAI's power to issue directions was restricted to only its enforcement functions. Direct appeal to the Supreme Court of India against an order of TRAI was provided for. Thus, neutrality of Indian telecom regulatory regime was ensured through reliance on multiple agencies for conflict resolution[58]. TRAI had a proven record of maintaining neutrality. It had challenged several decisions of the Government of India[59].

In tune with the international development and evolution of technology, The Communication Convergence Bill 2001 was introduced in the Parliament and is under consideration of the Standing Committee of Parliament on Telecom and IT. 'The Bill aims at promoting, facilitating and developing, in an orderly manner, the carriage and content of communications (including broadcasting, telecommunications and multimedia), to facilitate development of a national infrastructure for an information based society, and to enable access thereto. It also seeks to provide a choice of services to the people with a view to promoting plurality of news, views and information'[60]. Thus, regulatory regime in 2020 will be overarching, based on convergence, which apart from paving the way to a full-grown information society will enhance growth and productivity of telecommunications and IT through exploitation of economies of scope and coverage.

Competition without privatization

Interestingly, there are other models of competition without privatization. China Telecom, one of the world's major Public Telecommunication Operators (PTOs) is still fully state-owned. Both China and Vietnam followed similar policies of competition without privatization. Competition has been allowed between ministries of the governments. Participation of foreign investors has been allowed through joint ventures. Both these countries have been very high achievers in

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[57] Ibid., p.50.
[58] Galal Ahmed and Bharat Nauriyal, *Regulation of Telecom in Developing Countries: Outcomes, Incentives and Commitment*, The World Bank, August 1995.
[59] See for such instances, *Sanctity of Contract and Rule of Law in Indian Power, Telecom and Infrastructure Sectors*, Conference document presented by Independent Power Producers Association of India, 12-13 September, 2001, New Delhi, pp. 175-177.
[60] Government of India, Ministry of Communications & Information Technology, Department of Telecommunications, *Annual Report, 2001-2002.*

terms of progress of telecom sector[61]. 'The key underlying factor is the will of the state to invest in, and prioritize, telecommunication development'.[62]

There have been instances of repeated market failures arising out of impudent investment decisions of the private operators. In Norway, license to provide 3G mobile services purchased for US$ 22 million was returned unused. Investment worth several billion dollars were sunk and lost in the Iridium Global Mobile Personal Communications by Satellite (GMPCS) network project. Global Crossing went bankrupt with debts over US$ 12 billion for a project of construction of 160,000 km fiber optic network[63]. One view is that too many competitors deciding 'to build enormous networks for which there was little demand' were responsible for such crashes[64]. Market failures of such magnitudes create backlash in the industry and can potentially risk a global crisis. Such failures, if not avoided, would prove too costly in terms of lost investment in a country like India. A calibrated approach through managed competition holds assurances for the investors of a reasonable time period for consolidation and therefore, seems to be a wiser strategy to follow.

Despite differences in competition regimes across the countries, the global trend is towards growing privatization and competition. India, with her commitment to reforms is already a part of this process. From the perspective of business organisation, as the global experience suggests, this process is likely to undergo an alternate cycle of differentiation and convergence. Convergent nature of technology may, by itself dictate mergers and acquisitions between companies in certain cases. Network operators and service providers will have to merge with content developers to add value to their services. This is likely to create temporary oligopoly in the market till competition intensifies with the emergence of more firms offering multiple services[65]. India in 2020 will see competition

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[61] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.52.
[62] Ibid., op.cit., p.53.
[63] Ibid., p.59.
[64] The great telecoms crash, *The Economist*, July 20th – 26th 2002, p.11.
[65] There can be horizontal mergers like mergers between telecom operators and cable operators. Similarly, there can be vertical mergers between mobile telecom operators and content providers. Mergers and acquisitions can also occur with the aim of reaping the benefits of economies of scale. In Indian telecom sector, there are instances of mergers between operators in contiguous license territories. It has been indicated that in 2001, only 7 groups were controlling nearly 90 per cent of the market shares in terms of cellular subscribers against 20 players, who were awarded licenses in 1995-96. See for details, Garg, Lokesh and Venu Madhav, Mergers and Acquisitions in the Indian Telecom Sector, *India Infrastructure Report 2002: Governance Issues for Commercialisation*, 3i Network, Oxford, 2002. A number of examples on U.S. market can be found in Balaji, N., *The Indian Telecom Sector: Basic Telecom & Cellular Services*, Indian Institute of Management, Lucknow, available at file://c:\windows\temp\Indian telecom experience - IIML study.htm. In the context of recent telecom crash in the world market a view has been expressed that such crisis may 'cause the pendulum to swing back too far in favour of the former monopolies. In the short term, they are likely to attract investment, to pick up the assets of bankrupt rivals, and to lead the way in consolidating the industry. This will provide some welcome stability. But it would be wrong to grant the former monopolies any regulatory concessions now that would protect them from competitors in future.' The great telecoms crash, *The Economist*, July 20th – 26th 2002, op. cit., p.11. Hence, mergers and acquisitions are also likely occur in the process of market consolidation.

among big firms offering innovative value-added services to capture market through creation of new digital needs and priorities. Regulatory environment will mature to allow maximum flexibility and freedoms to encourage innovation and expansion, consistent with this process of evolution.

5. **Technology trend**

Broadly speaking, technologies of mobile telecommunications and Internet are going to set the contours of further technological progress in the current decade and the next. The most recent initiative aims at convergence of voice and data received from multiple sources, both web based and real time video streams, in mobile handheld devices. Global satellite systems, mobile handsets and calling cards have made virtual presence possible almost everywhere and anywhere overcoming the barriers of distance, topography and remoteness.

There has been phenomenal growth in mobile subscribers in the world in the nineties, increasing from 11 million in 1990 to 941 million by the end of 2001. In 1991, less than one per cent of the world population had a mobile phone. The proportion has grown to the vicinity of one phone per every six people by the end of 2001. Similarly, one-third of the total number of countries of the world had cellular network in 1991. The ratio rose to over 90 per cent by end-2001[66]. Considering that the fixed telephone lines numbered just over a billion in this year, it is likely that mobile phones would surpass fixed line in 2002. It is interesting to observe that China has surpassed USA to become the largest mobile market of the world. In Africa, mobile subscribers outnumber fixed line subscribers in more than half the countries[67]. Mobile telephony has emerged as the major growth driver in this sector. But for expansion in mobile network, there would have been hardly any growth in telecommunications in many countries. In developed countries, mobile phones have complemented fixed lines whereas in many developing countries with low-level fixed line penetration, mobile has already surpassed fixed lines[68] filling up supply gaps created due to inadequate growth in the latter. It has been observed that 'the ability of a country to grow its mobile network to the point where it overtakes the fixed-line network is not a function of its wealth…the crossover point can come as low as a fixed teledensity of 0.4 (for instance, in Malwai) to as high as 75 (the case of Luxembourg) and at any point in between'[69].

There are three important economic implications of mobile explosion for the developing countries. First, by offering a viable techno-economic alternative it is helping in improving telecom penetration bypassing shortages of fixed lines. Consequently, it is bringing along with it all concomitant economic benefits of enhanced telecom accessibility. Second, it is promoting a better entrepreneurial

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[66] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.13.
[67] Ibid., p.6.
[68] Ibid., p.7.
[69] ibid., op. cit., p.65.

culture and supporting employment generation through proliferation of kiosks[70]. Third, there has been a shift in investment burden from state to private sector and the consumers[71].

Cellular mobile telephones subscribers in India increased from 77 thousand in 1995 to 3.6 million in 2000. By March 2002, it has grown to 6.4 million. Cellular subscribers in proportion to total number of telephone subscribers (basic plus cellular) has increased from 0.6 percent in 1995 to 14.6 percent in 2002. This is still lower than the average of 24.6 percent achieved by the low-income countries in 2001. The corresponding ratio for lower middle-income countries is 41.8 percent, 52.8 percent for upper middle-income countries and 50.2 percent for high-income countries. India is yet to experience mobile explosion of the scale other countries have seen. One would expect a rapid growth in mobile telephony in coming decades. India has also achieved significant quality upgradation of its network in the 90s. Digital lines in proportion to total number of main telephone lines have increased from 87 per cent in 1995 to 99.8 percent in 1999.

Like mobile, the last decade witnessed phenomenal growth in Internet usage. In 2001, 95 per cent of the countries were connected to Internet compared to 15 per cent in 1990. There are about half a billion Internet users in the world in 2001with subscribers numbering an estimated 230 million[72]. It is also interesting to note that in 1995 Internet users in developed countries were seven times more than the number of Internet users in the developing countries. In 2001, this gap has narrowed down to less than four times.

Initial stance of technology supporting expansion of Internet dictated revenue model based on convergence between telecom and Internet. Internet is accessed predominantly through dial up in old telephone lines. This has resulted in unequal distribution of benefits between the dotcom operators and the telecom operators. It has been observed that while dotcom operators 'are failing to make money on the Internet, telecom operators are. The reason is that they control the pipes over which Internet traffic runs'[73]. 'Incumbent telecom operators tend to be among the largest Internet Service Providers (ISPs) in their countries'[74]. There are three important implications of this development. First, it inhibits growth of content development as an independent specialized activity because revenue-share of the content developers depends on the first claim on revenue by the infrastructure providers. Second, technical capabilities of telephone lines constrain development of Internet infrastructure and conditions speed of download. Third, developing countries are faced with major bottlenecks in the spread of Internet due to shortage of telephone lines and high telephone charges. Technological answers to these problems have already emerged in the

[70] Ibid., p.15.
[71] Mobile telecom expansion does not need to wait for state to lay copper lines. While private service providers lay the base station, consumers purchase mobile stations, i.e., handsets. Ibid., p.15.
[72] Ibid., p.7.
[73] Ibid., p.7.
[74] Ibid., p.8.

forms of Integrated Services Digital Networks (ISDN), wireless solutions and upgraded cable television networks enabling high-speed Internet access without clogging telephone lines. Use of VSAT technology for Internet connectivity can also greatly enhance the speed of data transmission[75]. In the present decade and the next, one would hope to see faster expansion and consolidation of these technologies ushering in Internet revolution. Broadband access technologies, which include Digital Subscriber Lines (DSL) and cable modem, permit faster download and graphic-intensive Internet applications. However, diffusion of this technology is so far minimal, particularly in the developing countries. Commercial exploitation of Internet crucially hinges on the spread of broadband technology. The issue that confronts developing world is how to create demand for broadband applications at the first instance. At the early stage, government can play an important role to promote broadband usage in e-education, e-governance, e-medicine to stimulate its demand[76].

Another convergent trend that has emerged is the use of Internet as carriers of voice. Consequently, 'increasing share of voice traffic shifted to the Internet, to be carried as Voice over IP (VoIP)'[77].

At the uppermost end of the convergent technology spectrum have already emerged Third Generation (3G) mobile devices with the capability of access to mobile data and voice[78]. More than US$ 100 billion have been spent by the industry since 2000 to acquire 3G license and spectrum. However, a full-grown market is yet to develop to assure investors' return. Technical and commercial consolidation is expected to take quite some time. By 2020, one would expect 3G to be within reach of wider section of Indian population.

The pace at which 3G is going to proliferate in India will depend upon, *inter alia*, the market demand for higher bandwidth data. There is a view that perhaps the present demand for high speed data (greater than 64 kbps) can be met cost effectively with General Packet Radio Service (GPRS). While pent up demand for emerging data-needs can be met by using 2G systems like Short Message Service (SMS), GPRS etc., the drive for 3G in Indian market can come from 'corporate roaming traffic via international visitors'[79].

Substantial work needs to be done in developing 3G relevant contents so as to expand its market. Initiative has already been launched in these areas. For example, Sonera (formerly Telecom Finland) has already launched information

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[75] VSAT stands for 'Very Small Aparture Terminals', which 'are miniature earth stations, used for transmission of data, video, or voice via satellite'. The Nepalese Government has allowed ISPs to use VSATs for establishing their own connectivity leading to remarkable gain in speed from 320 kbps to over 5 mbps within six months. Ibid., p.30.

[76] Ibid., p.31.

[77] Ibid., op.cit., p.46.

[78] Data-like applications on mobile devices have already started taking off in developed and developing countries. Ibid., p.9.

[79] Interview with Ian Goetz, published in *tele.net*, Vol. No.3, issue no. 4, April 2002, pp.30 - 31.

portal for mobile phones including Internet localisation services[80]. Future work in this area will be in the form of adding more value to the new services.

Advanced plans are necessary to develop vibrant industries for 3G applications. This may call for investments. A synchronized growth of user industry and 3G technologies would ensure that pay-off period in investment is minimized. Developing knowledge based industry to provide mobile applications would reduce uncertainties regarding return from private investment in 3G technologies.

As a preparatory groundwork to usher in 3G, it is essential to demarcate areas where massive harmonization efforts would be needed. This would entail upgrading hardware and software for high bandwidth multimedia services. Harmonization would also be needed between the two emerging varieties of CDMA, i.e., wideband CDMA that also supports fixed network and CDMA – 2000. Since it is likely that both these solutions would ultimately support fixed and mobile applications, a marriage of the two would prevent technological fragmentation of the market.

There is need to develop deeper understanding of the evolution of new end-users in the market for the mobile multimedia services. Multimedia service providers will emerge as important shareholders in the network value chain. Countries should envision new partners, new entities, and new stakeholders in the business models. Multimedia portals will be important components of such business models.

There is need for further work to match regulatory perspectives emerging as a part of the convergence regime with the requirements of 3G. Another important area of work will involve further thought over efficient billing model ---- a transition from time dependent billing model to content dependent billing[81].

The revenue model in the telecommunications sector is going to change significantly in times to come. In many cases PTOs have started offering free Internet to augment revenue from telephone lines[82]. In the Philippines, a global leader in SMS use in mobile handsets, revenue from SMS contributed a growing share of mobile revenue. SMS proved to be much cheaper than voice call [83].

6. **Conclusions**

LDCs are experiencing fastest growth in telecom network. In the mid-90s, growth in total telephone subscribers per 100 inhabitants of the LDCs surpassed that of

[80] Such services give information like 'which gas stations are nearby'. Finland is a pioneer in cellular telephony. ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.19.
[81] For detailed discussions see various reports of UMTS Forum, London.
[82] ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.11.
[83] Ibid., p.10.

the developed countries. In 2001, LDCs surpassed emerging countries achieving the distinction of fastest among the three[84]. Given the relationship between telecom expansion and growth, there is hope for narrowing down of digital-divide, provided, LDCs are able to sustain growth momentum in the long run. The vision is no doubt optimistic. It has been cited that some twenty years ago Tokyo had more telephones than the whole of African continent whereas today Africa has more than twice the number of main telephone lines than that of Tokyo[85]. It is but natural that markets in high-income countries saturate while expansion in developing countries continues unabated.

One notable break with the past is that with opening up of the developing economies and widespread sectoral reforms, catching up process has become faster. Developing countries with liberal policies have much better opportunity to leapfrog than before. Mobile experience of the low-income countries bears testimony to this process. India is a participant in this global process. There is tremendous appetite to absorb new technology. At the higher end of the market, India will mimic the most sophisticated telecom technology of the world and face all types of uncertainties that are associated with any new technology anywhere in the world. It will take time for the market for new technologies to consolidate. 'Market maturing' will be a continuous process at some of the segments of telecom sector. This holds good even today. Today's market does not guarantee 'reliable revenue stream' to investors in new technology like VoIP, bradband and 3G since they lack an existing client base[86]. Side by side, a process of diffusion will continue unhindered in respect of established technology in the mass market.

What will be the telecom scenario in India in 2020?

To look forward, from now on, the growth momentum in the expansion of fixed line network is likely to be sustained. This is the current phase of expansion developing countries are passing through. In 2000, three out of four fixed lines were installed in developing countries. China alone installed more fixed lines in 2000 (35 million) than the entire developed world in 1999 and 2000[87].

Once fixed line market is matured, mobile will crossover fixed line market. India is still much below the crossover point even by the standard of the low-income countries. A mobile revolution is in the offing in India.

The next points of crossover will be between data and voice[88], and between mobile and fixed-line Internet[89]. This is going to take some time because this is

[84] ITU classification of LDCs, emerging countries and developed countries has been referred to. Ibid., p.17.
[85] Ibid., p.17.
[86] Ibid., p.59.
[87] Ibid., p. 68.
[88] Increasing demand for data should not lead to a conclusion that voice services will not attract innovation any longer. It has been held that in a miniature handheld device, information can be received only in the form of voice. Lot of developments is in the offing in the area of voice recognition, integration between

yet to occur even in high-income countries. The process of technical consolidation and system integration of different competing standards in a single platform will by itself take some time. The process of commercial consolidation will start thereafter.

In order to guess the time frame over which such technological and commercial cycles may run their courses in future it may be of interest to look at the past experiences. Going by the history, commercialisation of cellular mobile telecommunication services began in late seventies, when Japan took the lead in 1979. Many developed countries have reached saturation point only now though developing countries are far from it. Similarly, market for Internet in the developing countries is yet to mature though the service commenced in late 1960s, when USA took the lead in 1969. As rightly observed, 'But for both these innovations, the full extent of their impact on businesses and consumers is probably still to come. E-commerce, for instance, is still in relative infancy and is expected to boom in coming years as "old economy" firms re-orient their business processes around it. Similarly, the true potential of a mobile phone, as an integrated communications, entertainment and positioning device, is only beginning to be realized'[90].

If past trend were any guide, it would be reasonable to hope that by 2020 India would complete transition into digital switching and transmission, VoIP, broadband and 3G. Though there would be always a small niche market in India, which would catch up with the cutting age of the technology, consolidation and expansion of evolving technologies across the length and the breadth of the country will follow with a lag.

Future vision of telecom is a vision of IT. Telecom will be the springboard of future expansion of IT heralding in an information society. ICT will spread among the masses and will spur innovation, entrepreneurship and growth. An expanding domestic market will deepen the synergy between the domestic and the export market and strengthen India's presence in the high-value segment of the global trade and investment. ICT benefits will spread among all, the rich and the poor, the young and the old, the men and the women, the organized and the unorganized and the government and the governed.

Appendix

Indian Telecom Sector: Recent Policies

1. All the villages shall be covered by telecom facility by the end of 2002.

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voice and text and vice versa. See, Interview with Ian Goetz, published in *tele.net*, Vol. No.3, issue no. 4, April 2002, p. 32.

[89] This point has already been reached in Japan. ITU, *World Telecommunication Development Report 2002*, Geneva, 2002, p.73.

[90] Ibid., op.cit., p.72.

2. The Communication Convergence Bill 2001introduced in the Parliament on August 31, 2001 is presently before the Standing Committee of Parliament on Telecom and IT.
3. National Long Distance Service (NLD) is opened for unrestricted entry.
4. The International Long Distance Services (ILDS) have been opened to competition.
5. The basic services are open to competition.
6. In addition to the existing three, fourth cellular operator, one each in four metros and thirteen circles, has been permitted. The cellular operators have been permitted to provide all types of mobile services including voice and non-voice messages, data services and PCOs utilizing any type of network equipment, including circuit and/or package switches that meet certain required standards.
7. Policies allowing private participation have been announced as per the New Telecom Policy (NTP), 1999 in several new services, which include Global Mobile Personal Communication by Satellite (GMPCS) Service, digital Public Mobile Radio Trunked Service (PMRTS), Voice Mail/ Audiotex/ Unified Messaging Service.
8. Wireless in Local Loop (WLL) has been introduced for providing telephone connections in urban, semi-urban and rural areas promptly.
9. Two telecom PSUs, VSNL and HTL have been disinvested.
10. Steps are being taken to fulfill Universal Service Obligation (USO), its funding and administration.
11. A decision to permit Mobile Community Phone Service has been announced.
12. Multiple Fixed Service Providers (FSPs) licensing guidelines were announced.
13. Internet Service Providers (ISPs) have been allowed to set up International Internet Gateways, both Satellite and Landing stations for submarine optical fiber cables.
14. Two categories of infrastructure providers have been allowed to provide end-to-end bandwidth and dark fiber, right of way, towers, duct space etc.
15. Guidelines have been issued by the Government to open up Internet telephony (IP).

Investment Policy Framework

1. Foreign Direct Investment of up to 100 percent permitted for the following:
   - Manufacturing of telecom equipment
   - Internet service (not providing international gateways)
   - Infrastructure providers (Category I)
   - E-mail service
   - Voice mail service
   - Call Centers and IT enabled services

2. Foreign Direct Investment of up to 74 percent permitted for the following:
   - Internet service (providing international gateways)
   - Infrastructure providers (Category II)
   - Radio paging services

3. Foreign Direct Investment of up to 49 percent permitted for the following:
   - National long distance service
   - Basic telephone service
   - Cellular mobile service
   - Other value added service

4. Additional foreign investment through holding/investment company

5. Automatic approval for technology fee up to US$ 2 million, royalty up to 5 percent for domestic sales and 8 percent for exports in telecom manufacturing (higher amount through specific approvals)

6. Full repatriability of dividend income and capital invested in the telecom sector

7. Fiscal incentives and concessions for the telecom sector:
   - Amortization of license fee
   - Tax holiday
   - Rebate on subscription to shares/debentures
   - Scope for tax exemption on financing through venture capital
   - Import duty rates reduced for various telecom equipment

Source: (i) Annual Report, 2001-2002 and (ii) Indian Telecommunication Statistics 2002 (Policy Framework, Status and Trends), both published by the Department of Telecommunications, Ministry of Communications & IT, Government of India.