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Reforms and Advances in Telecommunications in India

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The telecom sector in India was traditionally controlled by the Government. Teledensity was low, infrastructure growth was slow, and the lack of reforms restricted investments and adoption of new technologies. The existing legislative and regulatory environment needed major changes to facilitate growth in the sector.

The Government started a massive process of reforms by defining five-year National Telecom Policies (NTP) in 1994 and 1999. The policies opened the gates of liberalization in the sector. The sector was opened to private sector and foreign investments. This resulted in significant advancements in the telecom infrastructure. A large number of private operators started operating in the basic/mobile telephony and Internet domains. Teledensity has increased, mobile telephony has established a large base, the number of Internet users has seen a steep growth, large bandwidth has been made available for software exports and IT-enabled services, and the tariffs for international and domestic links have seen significant reductions. We share these experiences here.

A brief look at the telecom infrastructure in India was presented in the February issue of *GCN* [8]. The focus in that article was on IT strategies, growth in telecom manufacturing and R&D sectors, and growth in basic telephony infrastructure of India. The focus of the current article is a detailed look at the strategies that fueled growth in telecom in India, with detailed focus on growth in cellular telephony, the Internet, ILD, bandwidth for software exports, and so on.

Telecommunications Organizations in India

The Indian Government has a single unified Ministry for Information Technology and Communications with three separate Departments (under separate Secretaries) for IT (http://www.mit.gov.in), Telecom (www.dotindia.com) and Postal Services.

The Department of Telecommunications (DOT) is the nodal regulatory and legislative agency. DOT has its role in policy making, licensing, and coordination matters relating to telegraphs, telephones, wireless, data, fascimile and telematic services, and so on. DOT has traditionally also been a services provider organization and is responsible for the large domestic telecom infrastructure.

The overseas communications needs are handled by the international telecommunication service provider of India, called Videsh Sanchar Nigam Limited (VSNL: http://www.vsnl.com). The company operates a network of earth stations, switches, submarine cable systems, and value-added service nodes to provide a range of basic and value added services. VSNL is also a major domestic Internet service provider (ISP) and also provides international gateways to other private ISPs.

India has a significant focus of software exports and IT-enabled services. The Government has a dedicated organization to cater to the international telecom links and services requirements for this exports sector. The agency is called Software Technology Parks of India (http://www.stpi.soft.net).

Telecommunications Initiatives

The Government has taken a number of initiatives in the past few years to promote the telecom sector in India.

National Telecom Policies

The new economic policy of the Government aimed to improving India's competitiveness in the global market and rapid growth of exports. The Government also wanted to attract Foreign Direct Investment (FDI) and stimulate domestic investment. In 1994, the Government realized that Telecom Service of international quality is necessary for the success of this policy. Thus, the National Telecom Policy (NTP) 1994 [1] was formulated to give high priority to the development of telecom services.

The objectives of the NTP were defined to be:

- Telephones to be made available on demand
- All villages to be covered by telephone services
- All internationally available value added services to be introduced in India
- One public call office (PCO) to be provided per 500 population

It was calculated that to meet such objectives, the additional resources required would be above US$5 billion. This was beyond the capacity of Government funding and internal generation of resources. Hence it was decided to promote private investments and FDI. A whole range of services like basic telephony, cellular mobile telephony, radio paging, email, voice mail, data services, audio text services, video text services, and videoconferencing were opened to private investment and FDI.

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The Government decided to auction licenses for major cities cellular telephony services to potential operators. This resulted in cellular operators ending up paying large license

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fees. However, the corresponding revenues were not forthcoming since the mobile telephone users segment was only beginning to grow. These large overheads for the operators could have resulted in higher subscription fees and tariffs for the subscribers, leading to an even lesser demand and a reduced subscriber base. The Government, taking note of this situation, decided to change the license fee model to a percentage of the revenue share of the operators, instead of a fixed license fee. This initiative has eased the financial burden on the operators, improved competition, lowered tariffs, and increased the subscriber base. It should be noted that last year we observed a similar problem in Europe, where 3G licenses have been auctioned for large amounts, draining the operators of their financial resources. The Indian experience in this regard could be a good learning experience for Europe to correct the situation.

The five-year period after NTP 1994 saw significant growth in infrastructure in India. This was followed by a number of major initiatives announced in NTP 1999 [2] and the subsequent Government decisions. The policies for growth of basic telephony and vllage telephony have already been covered in [8], so we detail the other aspects of the policy:

The Government has formulated its major telecom policies in consultation with experts in the domain. Decisions on such issues have been made after forming Expert Committees with representatives from the Government, industry, and academic sectors.

- License period for all providers to be 20 years, extendable by 10 years
- Providers to pay an entry fee only, and the license fee to be paid as a percentage of revenue share
- The national long distance telephony opened to the private sector
- Basic and cellular operators able to set up their own long distance services in the licensed service area
- International long distance telephony, which was being controlled only by VSNL, to be opened by April 2002
- Limited mobility (wireless in the local loop) for basic telephony services allowed
- Private ISPs able to establish international gateways for Internet traffic
- ISPs allowed to take bandwidth directly from foreign satellites coordinated over India
- Cable service providers allowed to provide direct connectivity with any other service provider in their area and allowed to share infrastructure with them; provisions made to allow operators to provide two-way communication (voice, data, and information service) instead of the usual one-way broadcast entertainment service
- Indian companies able to establish commercial satellites; companies with FDI equity till 74 percent can own and operate satellite
- 49 percent foreign equity allowed in telecom services
- 100 percent foreign equity allowed in IT, manufacturing, voice mail, and audiotex services

Restructuring and Corporatization of Telecom Bodies

The growth of telecom demanded more flexibility in controls, easy access to authorities, and faster response from the Government. It was also important to separate the regulatory arm from the services arm to facilitate requisite investment in the latter through privatization. The Government met these objectives by restructuring and corporatizing major telecom bodies. DOT created an autonomous Telecommunications Regulatory Authority of India (TRAI) to provide an effective regulatory framework and a corporatized telecom services operator, Bharat Sanchar Nigam Limited (BSNL) [8].

The Government has also decided to corporatize VSNL. This would facilitate it in being able to get large investments to acquire higher bandwidths on international links, which is very critical for the growth of Indian telecom.

The Role of Expert Committees

The Government has formulated its major telecom policies in consultation with experts in the domain. Decisions on such issues have been made after forming Expert Committees with representatives from the Government, industry, and academic sectors. The Government has favorably considered the recommendations of these committees and, in most cases, has accepted almost all their recommendations without any changes.

One example of an expert committee was the Task Force on Information Technology [3]. The committee of Government officials and Industry experts was formed in 1998 and made 108 recommendations. The Government accepted almost all the recommendations, which included the suggestion to remove the monopoly of VSNL on international Internet gateways. Currently an expert committee on VoIP was set up to study the potential and policies for implementing Internet telephony, which would start in India in April 2002. Another panel has been set up on 3G services to suggest how these services would be rolled out in the near future.

It was also observed that the industry itself has proactively taken initiatives to make the Government actively consider formulating strategies to promote the telecom infrastructure. A specific case is the consortium of Indian software companies, "National Association of Software and Service Companies" (NASSCOM: http://www.nasscom.org), which initiated a study of future requirements for bandwidth for software exports and domestic Internet use. The study has prompted the Government to constitute an expert committee on operation bandwidth. The initiatives taken aree discussed in the next section.

Telecommunications Growth

The initiatives taken by the Government have resulted in remarkable growth in telecom infrastructure in the past few years [4,5]. Detailed figures on the current status of and future projections for telecom and Internet infrastructure were given in the February issue of *GCN* [8]. Since that issue also discussed the basic telephony sector in detail, we will cover other aspects of telecommunications and Internet growth.

Cellular Telephony

India has seen a significant growth in mobile telephony (GSM) subscribers within a short time of rolling out these services in 1995. This has been possible due to large investments made by the private operators and the flexible licensing policies extended by the Government. Some of the favourable policies have been a license fee being a percentage of revenue share, operators being allowed to set up their own long distance services, and permission to direct connectivity between a cellular operator and any other type of service provider in the area.

Subsequent to NTP 1994, cellular operator licenses were awarded to 8 private operators in four metropolitan cities and 14 private operators in 18 states of India. Large private invest-

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ment has significantly boosted the subscriber base. Notably, 0.8 million subscribers have been added in the past year itself, increasing the subscriber base to 3.45 million. The number of operators in each sector has now been increased to four each, leading to significant competition and reduction of tariffs.

Internet Infrastructure

Internet services started in August 1995 and were traditionally offered only by VSNL. The decisions made in the NTPs resulted in the participation of a large number of private ISPs; this has significantly fueled the growth of Internet usage. Some of these policies were removing the restriction on the number of service providers, no license fee till October 2003, permission for 100 percent FDI, permission to set up international gateways, and lease bandwidth from foreign satellites.

Since the advent of private operators in 1998, the small population of 0.17 million Internet subscribers has now increased to a manifold figure of 3 million. It is projected that this subscriber base will grow to 10 million by the year 2003.

International Telecommunications Links

VSNL is responsible for providing international telecom links. High-capacity international links have been provided to support large voice and Internet traffic requirements [6]. Besides the basic telephony and Internet back-end support, the company also provides services in the area of dedicated international leased lines for business customers, videoconferencing, television relay services, and so on.

The international links are provided through satellite and fiber optic cables. The satellite capacity is received from two international satellite systems, Intelsat and Inmarsat. VSNL gateways at eight locations provide access points for satellite services. Intelsat is an international consortium that owns and operates satellite communication systems. Inmarsat is a consortium of 88 countries providing satellite mobile communication services in the air, on land, and at sea.

VSNL uses a number of submarine optical cables for its operation. The VSNL gateway at Bombay is connected to the fiber SEA-ME-WE-2, which extends from Singapore to France. The cable connects 13 countries. The VSNL gateway is also connected to UAE through the Gulf cable, which has a capacity of 1380 circuits. The cable primarily handles Gulf region traffic. The VSNL gateway at Madras is connected to Malaysia through the IOCOM cable with a capacity of 480 circuits.

The Fiber Optic Link Around the Globe (FLAG) links Europe and the Far East through the Indian Ocean. Besides India, this has landing points in the United Kingdom, Spain, Italy, Egypt, Saudi Arabia, UAE, Thailand, Malaysia, Indonesia, Hong Kong, Korea, and Japan.

The SEA-ME-WE-3 is another high-capacity cable connecting India to Singapore in the east and to France in the west. The cable connects 33 countries. VSNL is also a signatory for the SAFE cable project for international connectivity to the African subcontinent. Besides Kochi in India, the other landing points of the cable include South Africa, Mauritius, and Malaysia. VSNL got 600 2 Mbyte circuits from the project by December 2001.

VSNL provides connectivity to 237 international destinations for basic telephony services. It also provides point-to-point international leased lines to users. Corporate users can also set up earth stations for fully digital streams of 64 kb/s to many megabit-per-second rates for functions like voice/data communication, LAN interconnections, and videoconferencing. These facilities are provided for linking to more than 60 countries.

VSNL has been proactively acting on the requirements for telecom growth in India. It has taken initiatives to significantly reduce tariffs and enhance bandwidth. In 2000, the Internet leased line and international private leased circuit (IPLC) tariffs were reduced to almost 30 percent of their original value. The current tariffs are shown in Table 1.

Speed	Internet leased line (1:4 compression) tariff (US$1000s p.a.)	IPLC (half circuit) tariff (US$1000s p.a.)
64 kb/s	4.3	7.7
128 kb/s	6.4	13.9
256 kb/s	8.5	24.0
512 kb/s	10.6	37.2
1024 kb/s	15.0	61.9
2048 kb/s	26.6	85.1
8 Mb/s	106.4	308.5
34 Mb/s	425.5	1170.2
45 Mb/s	553.2	1542.6
155 Mb/s	1649.0	4468.1

Table 1. *Tariffs for international links.*

Realizing that the fast growth of Internet usage requires large international link bandwidth, VSNL took major initiatives in 2000. It procured large amounts of bandwidth from optical cables and satellite links, increasing the capacity from 331 Mb/s to 800 Mb/s in less than a year. Initiatives have been taken to further increase the bandwidth so that it continuously matches the demand in coming years, as discussed in the "Operation Bandwidth" section.

National Internet Backbone

The large growth in Internet usage has necessitated a high-bandwidth domestic backbone infrastructure. The BSNL has taken major steps in this direction through its National Internet Backbone (NIB) project. This multiphase project envisages to create high-speed Internet backbone linking more than 400 cities. Phase I of the project has provided 2.5 Gb/s covering 17,000 route km and 33 cities. Currently 45 nodes have been installed for commercial use, and the core network links to international gateways at six locations provided by VSNL. Phase II would cover 150 cities using 36,000 route km of fiber using 32 rings of STM-16. Subsequent plans included realizing 40 Gb/s DWDM routes covering 10,000 route km during 2001–2002.

Telecom Infrastructure for Software Exports and IT-Enabled Services

India has displayed tremendous growth in the area of software exports and IT-enabled services. Last year 266 of the Fortune 1000 companies outsourced their software requirements to India. India is exporting software to about 100 countries. Indian software exports were worth US$6.24 billion in 2000–2001. The long-term projections are that software and IT-enabled services exports would gross US$50 billion in 2008.

This growth in software and IT-enabled services exports has been made possible by a number of factors. Besides reasons such as the availability of a large pool of English speaking pro-

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fessionals, strong mathematical ability of Indians, high software quality at low cost benefits, and tax exemptions and other promotional policies of Government, a major contributing factor has been the availability of high-speed data communication international links for off-shore software development. The STPI takes care of the needs of these exporters [7].

STPI has the objectives of establishing and managing infrastructural resources for software exporters, such as data communication facilities, built-up space, and core computer facilities. Software technology parks (STPs) are built-up complexes within which the software companies are located. There are currently 12 cities that have STPs with high-speed data communication (HSDC) links. HSDCs are international links through dedicated earth stations that act as international gateways at each location. IPLCs ranging from 64 kb/s to 2 Mb/s are provided through Intelsat satellites. These are single-hop networks, and the other end of the international line terminates at the respective international carrier. STPI has arrangements with these carriers for these circuits to be distributed to the ultimate clients' premises in that country. Some of the international carriers include IDB, SPRINT, AT&T, BT, France Telecom, GE Spacenet, Korea Telecom, and Telstra.

The units inside the complex are linked to the gateway through LANs, and those outside the complex are linked through line-of-sight point-to-multipoint TDMA microwave links (some software exporters outside the STPs also useVSNL links for international access). As of December 31, 2000, there were more than 1200 high-speed leased circuits in use by software exporting companies. STPI also provides options for connection to IP networks and videoconferencing facilities.

This availability of HSDC links has made India an attractive location for multinational companies setting up their software development centers. A large number of international IT majors are operating in STPs, with HSDC links linking their centers to their parent companies outside India. The STPI is currently providing bandwidth on demand to new companies wishing to set up such centers in India.

Operation Bandwidth

Bandwidth requirements are growing in India due to the large growth of Internet users, and the demands of software and IT-enabled services exporters. This has prompted the Government to launch a set of initiatives called Operation Bandwidth.

The set of initiatives, some of which are detailed in previous sections, promises bandwidth on demand for users. The initiative of opening the international links to private Internet operators has seen a number of private operators acquiring bandwidth on international cables. The expected bandwidth availability would be in the range of terabits on completion of these projects. VSNL already has more than 30 Gb/s bandwidth available through its existing optical cables, and can acquire (buy) this bandwidth on demand of users. STPs are making high bandwidth available to software exporters. Thus, international bandwidth is available on demand for users. In the domestic sector, the NIB initiative has made available large bandwidth to ISPs in different cities as discussed earlier.

Conclusion

The reform process of the Indian Government has resulted in significant growth of the telecom infrastructure in India. Such measures as opening the telecom sector to the private sector and flexible licensing policies have facilitated large investments from private operators and foreign investors. Significant growth has been observed in fixed line and mobile telephony teledensity. Internet users have shown exponential growth, and a large number of ISPs are operating. Technologies have been deployed that have resulted in large increases in bandwidth, with reduced tariffs for both international links and domestic Internet use. The Operation Bandwidth initiative has resulted in availability of bandwidth on demand for software and IT-enabled services exporters, commercial establishments, and Internet users. These achievements have given a significant boost to the Indian economy.

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