



**Stanford**  
Center for International  
Development

**Working Paper No. 434**

**An Assessment of Indian Telecommunications Reform**

by

**Roger G. Noll**

**Scott J. Wallsten**

**March 2011**



Stanford University  
John A. and Cynthia Fry Gunn Building, 366 Galvez Street  
Stanford, CA 94305-6015

# **An Assessment of Indian Telecommunications Reform**

**Roger G. Noll and Scott J. Wallsten\***

**March 2011**

## **Abstract**

Indian telecommunications reform began in the early 1980s. The performance of the industry at that time was poor. The Government of India eventually developed and implemented effective reforms that caused dramatic improvements in the quality and quantity of service. In early 2010 India passed an important milestone when the number of subscriber lines passed 600 million and telephone penetration rose above 50 percent of the population. Notwithstanding the recent success, the Indian telecommunications industry still has a few significant inefficiencies, and some unsolved policy problems must be solved if the industry is to achieve its potential, especially in the area of data services and internet use. This paper assesses the state of the Indian telecommunications industry and the policies that have shaped the improvement of its performance during the past three decades. We briefly set forth the underlying economics of telecommunications and the conclusions of the policy-research literature concerning “best practice” policies for telecommunications. We then review the recent performance of the main components of telecommunications service in India, and compare the existing policy environment with best practices. Followed by a review of the most troubling feature of the current regulatory system, which is the approach to increasing Internet usage. We then provide some conclusions about future policy actions.

**Keywords:** Telecommunications reform, Internet usage, Data services, Policy research, Government regulations, Best policy, India.

**JEL Classification No.:** O17, O21, O38, O53.

---

\* Stanford Center for International Development and The Technology Policy Institute, respectively. The authors thank Anita Alves, Katrina Kosec and Rohit Malik for excellent research assistance, Suman Bery, Ashok Desai, Gajendra Haldea, Payal Malik, S. K. N. Nair and the entire NCAER staff for their hospitality and advice during our visits to India, Deepak Maheshwari of Sify and B. N. Satpathy of BSNL for providing information about the telecommunications industry, and Rakesh Mohan and T. N. Srinivasan for insightful comments.

## **AN ASSESSMENT OF INDIAN TELECOMMUNICATIONS REFORM**

By Roger G. Noll and Scott J. Wallsten<sup>\*</sup>

Indian telecommunications reform began in the early 1980s. The performance of the industry at that time was poor. After twenty years of fits and starts, between 1999 and 2001 the Government of India eventually developed and implemented effective reforms that caused dramatic improvements in the quality and quantity of service. Since then growth in service has been explosive, largely due to substantial entry into all segments of the industry, pro-competitive interconnection regulation, and cost-based price caps, all of which caused India's wireless telephone industry to become among the most successful in the world. In early 2010 India passed an important milestone when the number of subscriber lines passed 600 million and telephone penetration rose above 50 percent of the population (Telecommunications Regulatory Authority of India [henceforth TRAI], 2010b).

This chapter assesses the state of the Indian telecommunications industry and the policies that have shaped the improvement of its performance during the past three decades. Improved performance is traced first to a series of incremental policy decisions beginning in the mid-1980s that led to extensive private participation in the industry, first permitting private investment and then removing significant restrictions on private operators, especially wireless carriers.

Notwithstanding the recent success, the Indian telecommunications industry still has a

---

<sup>\*</sup> Stanford Center for International Development and The Technology Policy Institute, respectively. The authors thank Anita Alves, Katrina Kosec and Rohit Malik for excellent research assistance, Suman Bery, Ashok Desai, Gajendra Haldea, Payal Malik, S. K. N. Nair and the entire NCAER staff for their hospitality and advice during our visits to India, Deepak Maheshwari of Sify and B. N. Satpathy of BSNL for providing information about the telecommunications industry, and Rakesh Mohan and T. N. Srinivasan for insightful comments.

few significant inefficiencies, and some unsolved policy problems must be solved if the industry is to achieve its potential, especially in the area of data services and Internet use. If these reforms are consolidated and expanded, the industry will continue to grow. The main remaining weakness in the industry is the underdeveloped state of Internet use and data services. For the industry to achieve its full potential as a crucial input to business services and as a conduit for highly valued consumer services, further reforms are required. Most of the remaining problems center around the same fundamental issues: the government's protective attitude towards the former monopoly and still dominant state-owned enterprises (SOEs).

The structure of this essay is as follows. First, we briefly set forth the underlying economics of telecommunications and the conclusions of the policy-research literature concerning "best practice" policies for telecommunications. Second, we review the recent performance of the main components of telecommunications service in India, and compare the existing policy environment with best practices. Third, we review in detail the most troubling feature of the current regulatory system, which is the approach to increasing Internet usage. We then provide some conclusions about future policy actions.

### **A Primer on Telecommunications Economics and Policy**

The most important fact about telecommunications is the revolutionary technological change in the industry since the widespread adoption of digital technology in the 1980s. Most of the assumptions that guided telecommunications policy throughout the world before 1980 were hopelessly out of date by 1990. Unfortunately, many policies throughout the world are still misinformed by these outdated assumptions.

## *Technology and Optimal Pricing*

The old technology for telecommunications had three basic components.<sup>1</sup> The foundation was copper wire cables in which each telephone was connected to a dedicated pair of copper wires, stretching on average two miles from the telephone to the local switch.<sup>2</sup> The switch was an electro-mechanical device that physically connected two telephones in the same local network or a telephone on the local network and the system that connected all local switches. The network connecting local switches consisted of high-capacity trunks – coaxial cable, microwave links, fiber-optic cable, or satellite links. Sometimes adjacent local switches in a local network were directly connected by a trunk, but for the most part these trunks connected local switches to a second network of trunks and switches for routing calls over long distances.

The old technology caused the network to exhibit several economic features that strongly influenced both industry structure and policy. First, the local network exhibited strong economies of scale because stringing lines through a local area has a significant fixed cost. Second, switches typically were designed to have a maximum capacity far below the capacity that would enable all telephones to be in use simultaneously. Unlike the loops connecting telephones to switches, the switch itself did not have significant scale economies. Local networks were designed to have a low but non-zero probability that the switch was used at full capacity, in which case an additional user would not be able to make or receive a call. Third, the capacity of domestic and international long-distance facilities was based on a similar calculation of the number of people who would be expected to place a long-distance call.

---

<sup>1</sup> For a more complete discussion of the basic technology and economics of telephone systems, see Mitchell and Vogelsang (1991) and Laffont and Tirole (2000).

<sup>2</sup> In densely populated areas, copper wire pairs sometimes connect to concentrators, which combine circuits from many copper wire pairs into a coaxial or fiber optic cable for part of the distance to the switch, but this detail does not affect the underlying economics of the traditional industry.

Another feature of telephone service, both in the past and today, arises from the network externality of service. The value of a telephone to a user is increasing in the number of other users who are connected to the system. This network effect extends across national boundaries. All telephone users place a higher value on their telephones if the number of other users throughout the world rises. Consequently, an important characteristic of a local network is the ease with which its users can make connections to other users of other local networks. Thus, inexpensive, efficient interconnection is a continuing policy concern, and will be as long as the entire world-wide telephone system is not operated by a single, ubiquitous entity.

The underlying technology of the telephone system determines its optimal pricing structure. First-best optimal pricing requires that prices equal the marginal cost of service. For telephones, this means that the combination of installation fee and fixed monthly cost covers the incremental cost of adding one more circuit to the local loop. Because the cost of a local wire-line loop exhibits economies of scale, the incremental cost of access and so the optimal price is higher in areas with low population density, such as rural communities.

In addition to fixed charges, optimal pricing in the old technology requires that telephone subscribers pay usage charges for local calls that include the cost of maintaining a live circuit plus the probability that the call would fill the switch to capacity times the incremental cost of switching one more call. Similarly, the optimal usage charge for long-distance calls covers the incremental cost of local connections at both ends of the call, plus the incremental cost of long-distance transmission, where both include the probability of filling capacity times the incremental cost of capacity.

The probability of fully utilizing the capacity of either the switch or the connection to the long-distance system is fairly easily estimated from the pattern of calling through the day, week

and year. This probability is virtually zero late at night, but much higher in periods of peak use during the day. Other than capacity costs, the incremental operating cost of placing a call and maintaining the connection is extremely low. Hence, the optimal pricing system in the old technology is to impose a significant usage charges during peak periods and low use charges during the rest of the day. Indeed, because measuring and billing usage is itself costly, the most efficient price of off-peak usage frequently is zero because the efficiency gains from setting a price equal to the incremental cost of usage is more than offset by billing costs.

A first blush, the network externality seems to imply a subsidy for access; however, on average each person creates an externality that approximately equals the external benefit that user receives from other subscribers, so for a given subscriber the optimal outgoing and incoming subsidies roughly cancel. Only in the case of people who have a low willingness to pay to connect with others is the externality that they create likely to be substantially larger than the externality that they enjoy from others, in which case optimal pricing requires that their service be subsidized. Since the willingness to pay for subscription externalities enjoyed from others is likely to be positively related to income, the network effect theoretically could support targeted subsidies to induce low-income users to subscribe, raised primarily from users with higher incomes. Thus, some sort of “universal service” policy that is well targeted toward people who otherwise would not subscribe because their incomes are low may be justified; however, one must bear in mind that the primary beneficiaries of the subsidy are not the people who receive it, but the (wealthier) people who derive benefit from being able to communicate with subsidized subscribers. A cash payment to low-income users that is equal to the subsidy that is required to induce them to purchase access would be extremely unlikely to be spent on telephone service. If the monetary value of the sum of all subsidies to the poor is fixed, the poor

are likely to be much better off receiving income support, food supplements, subsidized health care, and subsidized education than subsidized telephone service.

As mentioned above, the costs of service are often much higher in rural areas. Subsidizing rural areas simply because they have high costs is not implied by optimal pricing unless rural customers generate a much greater subscription externality than do urban subscribers. Most nations subsidize rural telephony, although in developing countries rural telephone penetration is far lower than in urban areas. The presence of some rural subsidies, but not enough to bring penetration to the level of urban areas, is likely to reflect a subtle constellation of political forces. Residents of rural households most likely would rather have a cash subsidy than a subsidized telephone or other infrastructure service; however, since the former is not available, the latter is better than nothing. Likewise, the incumbent telephone operator benefits from having some subsidized customers because services that lose money provide a political rationale for protecting profitable services from competition.

Even in the absence of subsidized service, economies of scale in wireline local loops may cause the optimal pricing structure not to generate enough revenue to cover all costs of service. In this case, second-best optimal pricing requires so-called Ramsey prices: the excess of price over incremental cost must create the minimum possible distortion (Baumol and Bradford 1970). A distortion arises when a customer who values a service at more than its incremental cost of production is nonetheless dissuaded from purchasing it because the price exceeds this cost.

Second-best pricing has two features. First, the extra revenues from covering costs must be raised from as broad a basket of commodities as possible to minimize the extent to which the entire price system of the economy departs from incremental costs. Second, the departure of price from incremental cost should be largest for services with inelastic demand – that is,



services for which an increase in price causes a very small change in the quantity that is sold. In general, the price-elasticity of demand for the first business or residential line is very low compared to the price-elasticity of demand for usage. Thus, to the extent that departures of price from incremental cost are necessary for covering the total cost of service, most of the additional revenues should be raised from the access fees, not usage charges.

In the modern digital network, the optimal pricing structure differs from optimal prices under the old technology because incremental usage costs have become even lower for all but full mobility wireless services. Digital technology allows multiple telephone calls to use the same transmission medium (wire, cable, off-air). Modern digital switches are computers for which the cost per unit of capacity also is low. Likewise, wireless calls with no or limited mobility have very low incremental costs.<sup>3</sup> Cellular systems are more expensive to operate because calls must be maintained as they make use of a sequence of transmitter/receiver stations as the user travels, but even here the transition from analog to digital systems has made the marginal cost of capacity much lower than in the past. Finally, long-distance transmission in digital networks also has a very low incremental cost of calling.

Because the marginal cost of usage capacity in digital networks is very low, many carriers have eliminated most usage charges for telephone calls. A carrier that does not impose

---

<sup>3</sup> Wireless telephone service comes in three varieties. In descending order of cost, these are as follows. (1) Mobile cellular wireless telephones connect to the nearest transmitter/receiver in the network, and the call connection can be maintained as the user moves from one transmitter/receiver to another. The capability for seamless switching of calls between cell sites as the user travels is a major component of the costs of mobile cellular systems. (2) Limited mobility wireless does not permit connections to be handed off from one transmitter/receiver to another, but the user has mobility within the area in which a connection can be maintained with the same transmitter/receiver. (3) Fixed wireless involves installing a stationary wireless transmitter/receiver on the premises of a customer, and connects the telephone to the transmitter either by inside wire or by low-power wireless (cordless) transmission. Limited mobility wireless is more expensive than fixed service because the former requires a telephone with a battery that can power a portable transmission system and an omni-directional transmission/reception capability (that is, the customer's receiver must be able to detect transmissions from all directions), while the power source for fixed wireless need not be portable (it can be ordinary electric current) and the connection between the telephone and the transmitter/receiver station can be a unidirectional point-to-point transmission.

usage charges avoids the costs of metering and documenting calls. Thus, in many countries consumers can now pay a fairly high fixed rate per month (US\$40-60) but have free calling, including long-distance and international.<sup>4</sup>

The cost structure of the new technology has caused the optimal price structure to move more towards fixed fees – installation charges or basic monthly tariffs – and away from usage charges. In the absence of policy intervention, the market will tend to converge on zero usage charges for local service and charges of a few cents per minute for cellular calls and for domestic and international long-distance calls. Of course, policy does intervene, typically by imposing usage-based interconnection fees on one carrier for delivering a call to another carrier. In the absence of regulatory intervention or cartelization, these charges would be very small, and perhaps would disappear entirely.

An important feature of a modern digital telecommunications network is that the fall in usage costs has made high-speed data services sufficiently inexpensive that, even in a developing nation, a large fraction of users can afford them. Whereas a telephone call uses a tiny amount of bandwidth and can be implemented at very slow data speeds, the use of the telecommunications system to access large data files (lengthy text, still pictures, audiovisual entertainment) requires a data speed that is between ten and one-hundred times the transmission rate that is needed for voice telephony. Today in advanced, industrialized nations, high-speed data services account for nearly all uses of network capacity, due to rapid innovation in both consumer and business Internet services. In rapidly growing developing nations such as India, by far the most important source of the growth in demand for network usage already is accounted for by data services. As a result, the optimal price for high-speed data use during peak periods is not zero, although it is

---

<sup>4</sup> The fixed rate can be even lower for long-distance Internet (VoIP) services, such as Vonage, which offers US customers unlimited long-distance and international calling to 60 countries for \$25 per month.

still remarkably low (a few cents per minute).

### *Best Practice Policies*

As implied by the preceding section, best-practice policy in telecommunications requires cost-based prices, and cost-based prices imply that nearly all revenue will be collected from installation and fixed monthly charges, with significant other revenue from on-peak usage of high-speed data services. By pushing telephone usage charges and off-peak data service charges toward zero and keeping the on-peak data usage charge at marginal cost, policy encourages not only ordinary voice telephony, but also the widespread diffusion of new value-added data services for both business and consumers. To the extent that subsidies are justified to encourage service to low-income users, the best source of revenues for subsidies is a tax on fixed fees (not usage charges) that are paid by unsubsidized users. The task of policy makers is to set up an industry structure and governance institutions that support an efficient pricing structure. Because the technology of the industry is advancing rapidly, a second feature of best-practice policy is to facilitate the adoption of new technology, especially in data services. Because competition generally performs well in achieving both goals, another feature of best-practice policy is to eliminate franchise monopolies and to encourage competition wherever it emerges.

Since the 1980s, most nations have fundamentally reformed their policies regarding the governance of the telecommunications sector. Circa 1980, almost all nations relied upon a monopoly SOE for providing service, and even those that did not typically relied upon a private monopoly that was subject to comprehensive regulation of prices and service quality. By 1990, most countries had begun the process of liberalization: allowing private firms to enter all or part of the industry, privatizing all or part of the state-owned monopoly, encouraging competition,

and placing greater reliance on market forces to drive prices, service quality, and the types of services that are offered.

The history of telecommunications before and after these reforms provides insight into why government ownership and control of the industry leads to inefficiencies.<sup>5</sup> The fundamental cause of problems in telecommunications and most other infrastructure industries as well is that they create opportunities for achieving short-term political gains that also cause large long-term economic and political costs – but costs that are the responsibility of later political leaders. These opportunities arise from the cost structure of the industry, the common experience and interest of the middle class in the operation of the industry, and the differential political mobilization of the incumbent monopolist in comparison with potential entrants.

In the telecommunications industry, like rails, power, and water, a very large proportion of long-run average costs are accounted for by capital investments with a very long life. As a result, if prices are sufficient to recover total costs, a very large fraction of revenue will simply recover capital costs – which means it will accrue as profits to equity holders (perhaps the government), interest to debt holders (again, possibly the government), and depreciation reserves. Revenue-starved governments often look to capital-intensive infrastructure industries as a quick source of cash. Funneling a large share of the excess of revenues over operating costs into public coffers has little short-term effect on the operation of the industry. Although diverting the cash flow curtails maintenance and investment, several years will pass by before a large number of users experience inadequate service due to inadequate maintenance and investment. Thus, telecommunications and other infrastructure industries present opportunities for revenue diversion that does not entail much immediate political or economic harm. In

---

<sup>5</sup> For more details, see Noll (2000).

today's environment, revenue diversion implies that the telecommunications network will not be upgraded to accommodate new services that require high-speed transfer of large data files, and so vastly slows, if not eliminates, the diffusion of new services to both business and consumers. Just as twenty years ago poor service led to privatization and reform, so, too, would extensive revenue diversion today lead to deteriorating data service, damage to firms that supply new services and their customers, and renewed political pressure to make improvements. But within an electoral cycle, an incumbent government has an incentive to divert revenues today and leave to its successor the problem of dealing with the consequences.

The second politically salient feature of telecommunications in developing countries is that it is ubiquitous among the middle class but almost nonexistent among the poor. As a result, an informed and influential part of the population has a common experience in the price of telephone service. On the one hand, short-term political benefits may be obtained from cutting service prices, and the most visible commonly experienced price is the monthly basic service fee. Hence, governments are prone to make these charges too low compared to the optimal structure, while charging too much for usage and, frequently, generating insufficient revenues to cover total long-run costs. Eventually deteriorating service due to inadequate revenues can be politically costly. Here the least politically costly strategy is to collect more revenues from foreigners in the form of very high interconnection prices. Most developing countries receive far more international calls than they originate, so high interconnection charges transfer costs to foreigners. Likewise, because domestic usage is not distributed uniformly across all users, a tax on usage generally creates less political resistance than a higher basic monthly access charge. Of course, high prices discourage use, and high prices for foreign connections that deliver data services discourage use of an especially attractive feature of the Internet, which is enabling

access to distant data sources at virtually no cost. Part of the harm from taxing usage in general and foreign connections in particular is suffered by the domestic customer who receives fewer calls and data files from relatives abroad and less business from foreign associates.

The third feature of government policies in a regime of monopoly, whether full or partial, is that governments tend to protect the monopolist when demand, technological change or simply incumbent inefficiency attracts competition. Even when woefully underdeveloped, telecommunications is always a huge industry – one to three percent of gross domestic product. If a single firm controls so much of the economy, it is likely to be extremely powerful politically. A government action that encourages competition threatens all who are employed by the incumbent whereas only a few (at the beginning) will be employed by the entrant. Thus, the balance of political pressure strongly favors the incumbent. Yet all research on the performance of the industry shows that performance is substantially improved by competition. Hence, the political incentives to protect the incumbent usually lead to ever-mounting efficiency losses.

### *Designing Effective Governance of Telecommunications*

No nation has succeeded in transforming every component of the telecommunications industry from a legally protected monopoly to robust competition. Hence, telecommunications reform requires governance that simultaneously encourages competition, limits the exercise of monopoly power in any segment of the industry in which competition is not robust, and provides firms in both monopoly and competitive markets proper incentives to make investments to increase the quantity and quality of service. Because competition is unlikely to be pervasive in all aspects of the industry, government inevitably will be called upon to regulate certain aspects of the industry. Experience indicates that effective regulation is far from easy to implement, and

requires certain best-practice features. This section briefly summarizes the key features of best-practice regulation.<sup>6</sup>

The cornerstone of an effective regulatory system is a statute that clearly specifies the objectives and powers of the regulator. A best-practice mandate promotes competition, requires interconnection among all carriers, regulates prices where competition is inadequate to prevent monopoly abuses, and promulgates technical standards. Statutes are the best mechanism for empowering regulators for two reasons. First, statutes, because they are durable and difficult to change, are an especially effective way to create policies that are consistent over time and are politically responsive while protecting against non-transparent political intervention on specific regulatory decisions. Because telecommunications investments last a very long time, a private company will be more willing to make investments if the long-term policies in the industry are stable, transparent, and free of political micro-management. Second, statutes are an effective way for making regulators accountable without exposing them to short-term political pressures. If the mandate of the regulator is clearly specified in statutes, the task of assuring political accountability can be delegated to the judicial system, which can review decisions of the regulatory agency for conformance with the statute's political mandate.

In addition to a clear statutory mandate, effective regulation is enhanced by creating independent regulators. Independence does not mean freedom for politics. Independence means that the decisions of regulators do not require the approval of elected political officials, and that a regulator can not be removed from office solely because a decision is unpopular with a minister or the legislature. Independence is created by giving regulators multi-year fixed terms of office, by granting regulators the authority to conduct investigations and compel information, and by

---

<sup>6</sup> For a more thorough discussion of best-practice regulation, see Kessides (2004), Chapter Two.

making their decisions final, subject to judicial review or to formal legislative reversal in a statute. Independence also is enhanced if the budget of the regulatory authority is secure, either by an earmarked tax or through multi-year appropriations.

Another characteristic of best-practice regulation is transparency. The concept of transparency refers to both the regulations of the agency and to the process by which these regulations are developed and enforced. Transparency of policies means that the actual rules and regulations are clearly stated in public documents. Transparency of process means that the procedures of the agency for issuing regulations are publicly available, that policies are developed in an open process in which all parties can participate, and that anyone can gain access to the information on which decisions will be based. Transparency contributes to policy stability and predictability, and protects against a particular interest gaining undue influence.

Effective regulation inevitably depends upon analyzing information about technology, costs, demand, and the qualitative aspects of service. To regulate effectively, therefore, requires that regulatory authorities have a sufficiently large and capable staff to process this information. Adequate professional staff also contributes to independence by making regulators less dependent on analysis that is provided by others, whether players in the industry or a ministry, and to policy stability by more closely tying regulations to technical analysis.

### **Indian Telecommunications Reform**

During the 1980s, India began the process of telecommunications reform, but until 2001 it struggled to find reforms that would cause the performance of the industry to improve at a satisfactory rate. While talk of reform dragged on for years before, actual reform began in the mid 1980s when telecommunications was separated from postal services and some SOEs in



telephone service were reorganized into limited liability corporations. Corporatization usually is the first step towards privatization, and indeed the state-owned international long-distance carrier has been mostly privatized, but India still has not begun to privatize the principal state-owned wire-line access and domestic long-distance carrier nor the state-owned equipment manufacturer, retains controlling interest in the second state-owned wire-line access provider, and was slow to allow private participation in all facilities-based services.

### *Historical Overview of Reform*

Figure 1 shows the penetration of telephone service in India since 1982. As is apparent from the Figure, the number of telephone subscribers has grown substantially for the past 25 years, but growth has been especially strong since 2002. Moreover, since 2002 all of the growth is accounted for by the boom in wireless service that is provided by private companies.

The era of Indian telecommunications reform divides into five periods, each of which began with a major telecommunications policy initiative: 1981-1986, 1986-91, 1991-96, 1996-2001, and 2001-2010 (and hopefully beyond). These periods correspond to different approaches and commitments to policy reform, with the trend being gradually to increase the extent of competition, reduce regulatory distortions in prices, and enhance the role of private entities in providing service. The number of telephones in service has grown in all periods, but has accelerated from each period to the next as policy improved.

At the beginning of the period covered in Figure 1, telecommunications services were provided exclusively by a monopoly SOE in the Ministry of Posts and Telegraphs. The state telephone monopoly performed poorly, with low service quality, low penetration, and roughly a four-year wait for new service (Desai, 2006, p. 42). The SOE was profitable, but most of the net

operating revenue was used to subsidize postal service rather than to expand and improve telephone service. In response to this poor performance, a parliamentary inquiry into the telecommunications system was commenced in 1981. In 1982-86, under the shadow of this inquiry, the performance of the SOE began to improve. The annual growth in access lines in this period was about seven percent, but the waiting list changed little as improved performance led to more requests for new service.

The first significant steps in reform occurred as the parliamentary inquiry drew to a close. In 1985, the Ministry of Communications was separated from the Ministry of Posts and Telegraphs, ending the practice of managing the telephone system to benefit the postal system. In 1986 the state-owned telecommunications provider was divided into three parts. Local service in Delhi and Mumbai was given to a new corporatized SOE, Mahanagar Telephone Nigam Limited (MTNL). Another new corporate SOE, Videsh Sanchar Nigam Limited (VSNL), was created to provide international telephone service. Domestic long-distance service and the rest of local service remained an unincorporated SOE. Management of the last entity and oversight of the government's ownership in MTNL and VSNL were placed in the Department of Telecommunications (DoT) within the Ministry of Communications. All three entities continued to be monopolies and privately owned facilities-based carriers continued to be prohibited. After these changes, the growth in telephone lines improved to slightly less than ten percent per year, but the long waiting list actually grew, reaching a peak of 49 months in 1991 (Desai 2006, p. 42).

In 1991, the Government of India announced the New Economic Policy (NEP), which was a comprehensive review and reform of policies affecting India's economic performance. One element of the NEP was a reformulation of industrial policy, including the scope of SOEs (Ministry of Industry 1991). The NEP stated that the role of SOEs would be redirected "to focus

on strategic, high-tech and essential infrastructure,” but even here “there would be no bar for areas of exclusivity to be opened up to the private sector selectively.”<sup>7</sup> The NEP also announced a plan of partial privatization, stating that ownership shares in SOEs “would be offered to mutual funds, financial institutions, general public and workers.”<sup>8</sup> Finally, the NEP contained a list of industries that continued to be reserved for the public sector, and the list did not include telecommunications.

In the process that produced the NEP, the Ministry of Communications favored continued state-owned monopoly of all facilities-based services, while other ministries – notably, Finance – favored greater participation of the private sector, including privatization of the SOEs (Desai 2006, pp. 44-7). Shortly after the NEP was issued, partial privatization of MTNL and VSNL was begun, although at a very gradual pace. As of 2010 the Government of India still owned 56 percent of MTNL and 26 percent of VSNL (DoT, 2009a). Since 2008 VSNL has been known as Tata Communications because the Tata industrial group owns controlling interest. In 2001, the state-owned provider of domestic long-distance service and local wire-line access everywhere except Delhi and Mumbai was incorporated as Bharat Sanchar Nigam Limited (BSNL).<sup>9</sup> Despite periodic announcements that privatization is imminent, in 2010 BSNL remained wholly state-owned.

The most important consequence of the NEP was that it announced a policy to allow the private sector to participate in sectors that previously had been reserved for the state. Although telecommunications was not mentioned in the NEP, in July 1992 the government announced that

---

<sup>7</sup> “Statement on Industrial Policy,” Ministry of Industry (1991), Section 39Di.

<sup>8</sup> *Ibid*, Section 39Diii.

<sup>9</sup> To avoid confusion between DoT as a policy making department and as an owner/operator of telecommunications service providers, henceforth we refer to DoT’s unincorporated telecommunications services branch as BSNL, even though this name was created by the incorporation of the SOE in 2001.

it would allow private firms to provide both fixed and mobile wireless services (Desai 2006, p. 47). In 1994, these policies were embodied in the National Telecom Policy (NTP94) (DoT, 1994). NTP94 sought to eliminate waiting lists for service by 1997, to improve the penetration of telephone service, and to accelerate the introduction of new telecommunications services in India. Because the financial requirements for achieving these policy goals exceeded the government's resources, the NTP94 stated that private firms would be permitted to enter all aspects of the industry, including fixed wire-line access. After procedures for granting private licenses were developed and implemented, private operators entered the four largest cities in the second half of 1995 and several more metropolitan areas in 1997.

During the 1991-1995 period BSNL and MTNL still were monopolies, but expected to face competition in the near future. VSNL did not face an immediate threat of competition, but the new policy implied that entrants loomed on the horizon. In addition, the partial privatization of MTNL and VSNL had commenced, and seemed to loom on the horizon for BSNL, although very little privatization was accomplished in this period. Once again, performance improved. The number of lines more than doubled in five years, and the waiting list finally began to fall, reaching two years when the cellular licenses were put out to bid (Desai 2006, p. 42).

Between late 1995 and 1997, wireless carriers entered and an independent regulator, TRAI, was created. From the beginning, TRAI has been a model independent regulator. TRAI is composed of three full-time and two part-time commissioners. The part-time appointees are selected from among experts in engineering and economics in universities or think tanks. The agency has a sufficient budget for professional staff and consultants that it can produce a regular stream of white papers, called a consulting document, analyzing the policy issues before it, and detailed explanations of its regulations, called an explanatory memorandum. The process of the

agency is open and transparent, with many entities submitting comments on consulting papers and proposed regulations, and the agency extensively discussing these comments in its decisions.

Initially wireless entry and the presence of a high-quality independent regulator had very little effect because the reforms adopted in the prior period were incomplete. The initial lack of success of the entrants is examined in greater detail elsewhere in this chapter, but briefly the problems were as follows. First, very few private entrants were licensed. Second, DoT, which controlled the licensing process, imposed conditions on licensees that limited their ability to compete with the SOEs. Third, the NTP94 did not address interconnection between carriers. BSNL and VSNL retained their monopolies in domestic and international long distance, while BSNL and MTNL accounted for nearly all subscribers and hence the other end of calls to or from wireless telephones. The incumbent SOEs were allowed to charge monopoly prices for connecting with their networks that, when combined with the regulated ceiling prices for service, made the entrants so unprofitable that they could not pay their license fees. Fourth, the court with jurisdiction over TRAI opposed reform and overturned TRAI's attempts to reverse DoT's license restrictions and to control the prices of the SOEs.

By 1999 India's attempt to introduce private wireless services appeared doomed. As a result of the impediments to successful competition that had been created by DoT and the SOEs, nearly all growth in telephone penetration continued to be wire-line service from the SOEs. Between 1996 and 2001, penetration nearly tripled and the waiting list was eliminated, but after 20 years of reform, penetration still stood at less than five percent of the population.

India's commitment to telecommunications reform deepened substantially between 1999 and 2001. The crises in wireless services led to another searching policy re-evaluation, resulting in the 1999 New Telecom Policy (NTP99) (DoT 1999). TRAI's capability was enhanced by

giving it rate-making authority over the SOEs and by transferring judicial review of its decisions to a new, reform-friendly court. Each wireless carrier was automatically given a license to provide long-distance service within its licensed service territory and to interconnect directly with all other carriers, rather than only through the SOEs, enabling the entrants to avoid the SOEs entirely for interconnecting among themselves and for providing long-distance service. BSNL and MTNL received licenses to provide wireless services, thereby creating a third competitor in each circle. BSNL's monopoly in domestic long distance and VSNL's monopoly in international long distance were ended and the first private entrants were licensed. Controlling interest in VSNL was sold to the Tata group, thereby reducing, although not eliminating, DoT's conflicting interest in promoting competition and profiting from VSNL's dominant position in international long distance.

The reforms initiated by NTP99 and implemented in the ensuing two years finally removed the barriers to rapid improvements in telecommunications services. From early 2002 to early 2010, telephone penetration in India increased more than tenfold, from about 50 million to 600 million subscribers (TRAI 2010b), leaving India second only to China in total telephone lines in service.

### ***TRAI's Approach to Regulation***

Soon after TRAI was created, the process of developing comprehensive tariff regulations began. The first step was a set of guiding principles for regulating the industry that were set forth in its second consultation paper on tariffs (TRAI 1998). Although this document set forth proposals for the first set of regulated prices for the industry, its main purpose was to make the process and underlying policies of TRAI transparent to the industry and its customer, thereby

enabling those who were directly affected by TRAI's regulations to have realistic expectations about the future course of regulation. To this end, the 1998 Consultation Paper and the first tariff notification in the following year (TRAI 1999) set forth the principles that TRAI would apply in setting tariffs. Among these principles were to promote competition, to forbear regulating prices of competitive services, to set ceiling prices but to allow carriers to set prices below the ceiling, to require that prices be non-discriminatory, and to base regulated prices on costs.

At the time that TRAI was created, no component of facilities-based services was structurally competitive. The SOEs enjoyed near monopolies in fixed access service, facing entrants in fixed wireless in only a few cities, and full monopolies in domestic and international long distance. The first mobile wireless licenses created only a duopoly in each market. Moreover, as discussed elsewhere in this chapter, both fixed and mobile wireless carriers suffered from restrictions imposed by DoT that protected the incumbents against effective competition. Hence, the initial TRAI tariff adopted forbearance of price regulation only for fixed wireless access service because its prices adequately would be constrained by the regulated prices of the SOE wire-line access providers.

TRAI initiated price regulation in a system in which DoT's policy was to price basic access subscriptions substantially below cost, especially for residential users, and to price usage substantially above cost, especially long distance. This price structure emanated from a policy goal that was common among many nations at the time, which is to measure progress in telecommunications primarily by the number of people who subscribe and largely to ignore the extent to which the service is used or the quality of service that is offered. Given this formulation of the policy goal, rebalancing tariffs raised two policy concerns: whether higher fixed costs of service – installation charge and monthly service charge – would reduce

subscriptions, and whether rate rebalancing would make the SOE wire-line access providers financially unviable. TRAI concluded that because the SOEs were highly profitable, lower usage charges could be imposed immediately without requiring substantial increases in fixed charges without sacrificing either penetration or the financial health of the SOEs (TRAI 1998, 1999a). Hence, in 1999 TRAI began what became a decade-long process to bring rates more in line with costs and, as competition intensified, to rely increasingly on competition, rather than regulation, to set rates (TRAI 1999a, 1999b).

The adoption of nondiscriminatory cost-based prices led to other changes in the tariff structure beyond substituting fixed charges for usage charges. TRAI understood that costs varied by time of use, so it set cost-based ceiling prices on usage only for on-peak calls. Carriers were allowed to set prices at the ceiling for eleven hours per day during the business week, but were required to offer separate off-peak rates for other time periods. TRAI adopted a policy of forbearance for off-peak rates and for the selection of the hours that the carrier classified as peak. TRAI also determined that the gradations of established long-distance tariffs on the basis of distance were substantially greater than differences in terms of cost, so TRAI reduced the extent of distance sensitivity in prices and simplified the tariff structure to have fewer break points. TRAI also expanded the definition of local calls, which were capped by the much lower local usage charge instead of the long-distance tariff for the shortest distance interval.

Because TRAI inherited a situation in which the incumbent SOEs were highly profitable, the politics of increasing the efficiency of the rate structure were favorable. In particular, long distance charges could be cut substantially without requiring a substantial increase in fixed charges for wire-line access providers to offset the revenue loss. But TRAI could not fully adopt a system of cost-based rates immediately because of the policy commitment to the Indian version



of universal service. India's goal was not just to increase the number of subscribers to the telephone network, but was defined in terms that excluded mobile wireless service. Beginning with the NTP99, for several years the quantitative target of telecommunications policy was to achieve 15 percent penetration of basic access service, which implied that the number of wire-line access customers would have to increase by at least five-fold.

The impediment to achieving this goal was thought to be the inability of customers to pay cost-based fixed charges, so the policy solution was a subsidy. As in nearly all other nations, initially the subsidy was financed by cross-subsidizing access service with high usage charges. Rate balancing threatened this system. As explained in the section on universal service, TRAI embarked on a decade-long policy that gradually switched the source of the subsidy from a tax on usage to a broader tax on all services. By 2010, the tariff structure had made the transition to a largely cost-driven set of ceiling prices for the services that remain subject to price regulation.

One important area of continued tariff regulation is caps on terminating access charges. The regulation of terminating access charges is an element of a broader policy on responsibility for paying usage charges for terminating calls. The issue arises when a call originates on an access line of one carrier and terminates on an access line of a different carrier. All calls have either two or three distinct components: the local network of the calling party, the local network of the receiving party, and if the two local network access providers do not connect directly, transmission over another carrier that connects the two local access networks. For international calls the three carriers are almost always different entities, but even for domestic long-distance and local calls, two or more carriers are involved more often than not if the industry is competitive, as is now the case in most of India.

Responsibility for paying for usage charges can be divided in three distinct ways:

calling-party pays (that is, the originator of the call pays for both origination and termination), receiving-party pays (the person being called pays both charges), and bill and keep (each carrier charges its customers for originating and terminating calls, with the calling party and the receiving party each paying for the part of the call that uses their access network). How rate-paying responsibility is divided has important consequences for rate regulation. If either the originator or the receiver of the call is responsible for paying all charges, competition among access providers is not sufficient to guarantee reasonable rates for each component of the call. In the case of calling party pays, the access provider that terminates the call is a monopolist in terminating to any of its customers. Because its subscribers do not pay termination charges, they have no incentive to take these charges into account in shopping among carriers for local access service. Hence, a potentially profitable business strategy for an access provider is to set low charges for origination, attract many customers who will be called by subscribers of other access providers, and set a high terminating access charge. In fact, prices are significantly lower in countries that make the receiving party responsible for paying terminating usage charges and the calling party responsible for origination and transmission charges (Littlechild 2006).

TRAI adopted calling party pays (TRAI 1999a, 1999c), and as a result is committed to regulating termination charges because competition cannot be relied upon to lower these charges. Because TRAI is committed to cost-based prices, terminating access charges have fallen substantially. By 2010, the terminating access charge for inter-carrier local and domestic long-distance calls, regardless of the technology of the local network, was Rs. 0.2 per minute, or about US\$0.004<sup>10</sup> (TRAI 2009, p. 13). The terminating access charge for international calls is double

---

<sup>10</sup> In recent years the rupee-dollar exchange rate has fluctuated between between \$0.020 and 0.025 US\$ per rupee. Until the 1980s, India regulated international trade and capital flows far more stringently than it does today. These restrictions gradually were weakened over the next two decades. Thus, in the early 1980s the rupee-dollar exchange rate was about \$0.12, fell to about \$0.06 during the 1980s, and commenced to fall to the current range by 1997.

this rate, making this charge above cost and discriminatory. TRAI introduced this discrimination against international calls only in 2009. The context of this decision is that in 2008, TRAI eliminated another usage-based fee, Access Deficit Charges, discussed in detail below. The ADC for incoming international long distance calls was Rs. 4.25 in 2003, Rs. 1.60 in 2006, Rs. 0.5 in March 2008, and finally zero in September 2008 (TRAI 2003a, 2006, 2008). Notwithstanding the increase in terminating usage charges, the overall trend is continuing reduction in the cross-subsidization from international termination to local access.

### ***Reform of Long-Distance***

The 1986 restructuring separated international and domestic long-distance service, giving the former to VSNL and the latter to the entity that eventually became BSNL. When BSNL was incorporated in 2001, it lost its monopoly in domestic long-distance service. In late 2001 the first private carrier, Bharti, was granted a license to offer domestic long-distance service.<sup>11</sup> In early 2002, Reliance (another private carrier) and VSNL also were licensed. Additional entry did not occur until May 2006, but then a flood of applicants were granted licenses. By 2009 a total of 29 domestic long-distance carriers were licensed (DoT, 2009b). Local access carriers are required to grant interconnection to any licensed long-distance carrier and to allow access customers to choose their domestic long-distance provider (DoT 2002a).

The government began its protracted process of privatizing VSNL in 1992, a process that still is not complete. Initially minority interests were sold to various investors, primarily financial institutions. The key events occurred in 2001-2. A large stake in the company was

---

Throughout this paper we express rupee prices in US dollars using the more recent, market driven rate of roughly US\$0.02 per rupee.

<sup>11</sup> See <http://www.dot.gov.in/nld/nldindex.htm> for a synopsis of India's domestic long-distance history and policies.

sold to Tata, India's most important industrial group.<sup>12</sup> In a series of transactions the Government of India reduced its ownership stake to 26 percent, where it remains today. In January 2008 the name of VSNL was changed to Tata Communications.

VSNL lost its monopoly position in international long distance in 2002 when three private carriers were granted licenses. By 2009, 24 carriers had been licensed to offer international services (DoT, 2009c). In addition, a major restriction on international carriers was lifted in 2009. Until then international carriers were not allowed to sell calling service directly to customers. Instead, international service licensees were "carrier's carriers," selling carriage to access providers that resold international calling to customers. In August 2009, the DoT changed the licenses of international long distance carriers to enable them to sell directly to consumers, although direct sales were limited to the use of calling cards (DoT, 2009d).

### *The Tortured History of Wireless*

In late 1995 wireless telephony was introduced in India and the SOE access providers faced competition for the first time. Wireless services initially grew slowly. By 2001 fixed wireless accounted for only three percent of lines and mobile telephony accounted for about ten percent. During this period, the SOEs roughly tripled their number of lines in service and so still accounted for about 80 percent of the growth in penetration.

Since 2002, virtually all of the growth in penetration has been accounted for by mobile telephony. Between April 2003 and April 2004, the number of fixed lines grew by 1.4 million to about 40 million, while the number of cellular lines grew by 21 million (TRAI, 2004e). Since then, the number of wire-line subscribers has fallen, while wireless lines now top 600 million.

---

<sup>12</sup> The history of the privatization of VSNL is summarized in its annual reports (Form 20-F) to the U. S. Securities and Exchange Commission, available at [http://www.secinfo.com/\\$/SEC/Registrant.asp?CIK=1116134](http://www.secinfo.com/$/SEC/Registrant.asp?CIK=1116134).

In fixed line service private companies have taken business from the SOEs. As of December 2003, the SOEs had 40.17 million wire-line subscribers and private fixed wireless carriers served 1.92 million; however, between March and December of 2003 the number of fixed lines served by BSNL and MTNL actually declined by about 370,000, while private companies grew by about 1 million (TRAI 2004a), more than doubling their number of customers. Because fixed wireless licensees now offer limited mobility, the government no longer distinguishes between fixed and mobile wireless; however, private carriers also have entered the wire-line access business, and taken substantial market share from the SOEs. In February 2010, the number of wire-line subscribers had fallen below 37 million, and the two SOEs accounted for less than 32 million (85 percent) of wire-line subscribers (TRAI, 2010b). Thus, in seven years BSNL and MTNL have lost roughly 8 million wire-line subscribers, while private carriers have gained nearly 6 million.

While the SOEs provide mobile as well as wire-line service, most of the growth in mobile lines is accounted for by the private sector. As of early 2010 less than 13 percent of wireless subscribers are accounted for by the SOEs (TRAI 2010b). Thus, the recent success of Indian telecommunications is due primarily to the growth of service from private companies.

India decided to permit wireless telephones and to open the market to private enterprise in 1992.<sup>13</sup> DoT successfully resisted privatization and competition in the core services of wire access, domestic long distance, and international, but it agreed to permit private entry into “value-added” services that did not directly compete with its monopoly. Like most telephone monopolists of the era, DoT incorrectly concluded that wireless was a value-added service, not a potential competitor (Desai, 2006). In January 1992, the government announced a plan to issue

---

<sup>13</sup> For an entertaining detailed history of India’s reforms, see Uppal (2003).

one license for fixed wireless service (a competitor for basic access) and two licenses for cellular services in all parts of the nation. Controversy and litigation about how to license wireless delayed implementation until 1994.

The government's wireless licensing plan divided the nation into four large metropolitan areas (Chennai, Delhi, Kolkata, and Mumbai) and originally 21 (eventually 23) smaller circles, separated into three groups (A, B, C) according to the expected value of licenses.<sup>14</sup> SOEs were barred from participating in all auctions on the grounds that wireless investments should come from private sources and license fees should not substitute for other investments by the SOEs.

The metro cellular licensing process was completed quickly, with licenses awarded to two carriers in each of the four cities in November 1994. After announcing an auction for the remaining wireless licenses in January 1995, the process was delayed and changed several times. For mobile services, the process was not completed until December 1995, when 34 licenses were granted in 18 circles. For fixed wireless, the initial auction seemed to be a big success, with 81 bids received for 20 circles. But DoT then changed the terms of the original offer, most importantly by announcing new reservation prices, and reopened the bidding. On the second round, a small company won the bid for nine circles by submitting a bid that was over 500 times the company's net worth. DoT again changed the terms, limiting to three the number of A and B circle licenses that any company could hold and inviting new bids for 13 circles. The next two rounds of the auction then generated bids for only six circles that were above the reservation prices, primarily because the reservation prices were unrealistically high.

---

<sup>14</sup> Most of the circles correspond to states, although states play no role in telecommunications policy. The five A circles are Andhra Pradesh, Gujarat, Karnataka, Maharashtra and Tamil Nadu. The ten B circles are Chhattisgarh, Haryana, Kerala, Madhya Pradesh, Punjab, Rajasthan, Uttaranchal, Uttar Pradesh East, Uttar Pradesh West and West Bengal. The eight C circles are Andman and Nicobar Islands, Assam, Bihar, Himachal Pradesh, Jammu and Kashmir, Jharkand, North East (several small states) and Orissa. As of 2010, cellular service is available in all circles except Chhattisgarh, Jharkand and Uttaranchal (TRAI 2010b). The service for Andman and Nicobar Islands, which have no fixed line service, has been integrated into the West Bengal circle for two carriers.

As discussed in the previous section, a fundamental problem with large SOEs is that their employees typically are an extremely powerful political force, partly because the entity provides a large cash flow to the government and partly because the employees want to protect their jobs. In India, between fiscal 1997 and fiscal 2000, the entity that became BSNL had an average annual surplus of revenues over expenditures of about Rs 70 billion (US\$ 1.5 billion), more than 40 percent of revenues, and had nearly a half-million employees (DoT 2003). Part of the income of these employees was derived from side payments from customers to initiate or to repair service in a timely fashion (Desai 2006). Given these realities, the DoT could not realistically be expected to be an enthusiast for introducing competition into telecommunications. Thus, reform had to be imposed from elsewhere – a committed government, a strong, politically independent regulator, and/or a politically independent judiciary that respects the rule of law.

Regardless of the government's intent, the effect of the auction procedure was to delay competition against the SOEs. By August 1995, mobile service was available in the four metro areas, but additional mobile licensees were not formally awarded until October 1996 and did not come on line until 1997, while the original six fixed wireless carriers did not come on line until 1998 or 1999. The slow development of wireless service was mainly the result of the failure to develop consistent pro-competitive policies.

After the auction but before signing the licenses DoT set maximum monthly service fees on cellular licensees of Rs 3000 for the deposit (roughly US\$65), Rs 156 (US\$3.50) for the monthly charge, Rs 16.8 (US\$0.37) for peak-period calls, and Rs 8.4 (US\$ .18) for standard calls. The underlying theory of the price structure was to price access (the initial deposit plus the monthly charge) substantially below cost and to set usage prices far above cost. But the latter

prices were so high that usage was too small to offset the low access fees, so the wireless carriers were unprofitable.

Another problem arose from interconnection arrangements. DoT did not order the incumbent SOEs to interconnect with wireless providers until September 1996, and when they did the interconnection fee was Rs 1.40 (about three cents US) per minute, compared to a maximum of Rs 1 (about two cents US) for local calls originating and terminating in their own networks. Moreover, DoT decreed that all calls from one wireless carrier to another had to be interconnected through the SOEs, so only calls within the same network could avoid the interconnection charge.

In October 1996, MTNL unilaterally announced that it was offering wireless services in Delhi and Mumbai, and DoT decided that both BSNL and MTNL could acquire wireless licenses without paying for them or being subject to regulation. The decision to allow the SOEs into wireless service without having to pay a license fee or interconnection charges gave the government entity an insurmountable competitive advantage. At the same time DoT also raised the interconnection charge for mobile services to Rs 10 (about US\$.22) per minute, which was higher than the maximum price that mobile carriers could charge for off-peak calls (US\$.18). The pricing action made cellular calls that interconnected with the fixed wire-line network ridiculously expensive for the carriers.

DoT's actions initiated a two-year long battle between DoT and the new independent regulator, TRAI. From its inception, TRAI sought "rate balancing" – bringing the service prices more in line with cost. This policy requires increasing fixed charges (installation fees and/or basic monthly service tariffs) and lowering usage charges. TRAI asserted that it had jurisdiction over interconnection prices and an advisory roll in licensing new carriers. In April 1997 TRAI



ordered DoT to rescind the increase in interconnection charges. But TRAI lost both battles as the High Court ruled that it lacked authority to regulate the government. In 1999 TRAI also attempted to introduce “calling party pays” for interconnections from fixed to wireless so that wireless customers would discontinue the practice of not answering their phones but observing the calling number and then returning the call over wire-line telephones. DoT sued TRAI again, and again TRAI lost.

Another major battle concerning wireless carriers ensued because most were unable to pay the government license fee. The government blamed the operators for over-bidding for licenses and for being badly managed businesses. The carriers argued that the bids from the auction process were too high because they relied on the government’s claim that it wanted to encourage private investment in wireless services, and so expected the government to adopt pricing rules that made wireless services commercially viable. The government refused to budge, and DoT began to withdraw interconnection from the wireless operators that were delinquent in their payments to the government. By early 1999, the wireless carriers owed the government Rs. 27 billion (US\$600 million) in unpaid license fees (Desai 2006).

In early 1999 Indian telecommunications reform was verging on disaster. The High Court had declared that the independent regulator had no authority over the SOEs, and DoT had made a series of decisions that were bankrupting the entrants and re-monopolizing the industry. Fortunately, the government changed course and announced the New Telecommunications Policy in March 1999 (DoT 1999). The key features of the plan were that the annual license payments would be replaced by a fee based on share of revenues, that TRAI would have the authority to regulate the prices charged by SOEs and to adjudicate disputes between SOEs and private carriers, that BSNL would be corporatized, and that any two carriers could interconnect

(they did not need to go through BSNL). DoT retained the authority to determine which operators were permitted in which markets.

Entities unhappy with the new policy appealed to the courts, and in late 1999 the High Court vacated the elements of the NTP99 that gave TRAI authority over DoT and the SOEs, thereby vitiating not only the new wireless policies by all elements of TRAI's comprehensive tariff regulations (TRAI 1999a, 1999b). Finally, in January 2000, the government adopted an ordinance that removed authority over telecommunications policy from the High Court, giving it to a new body, the Telecommunications Disputes Settlement Appellate Tribunal. Thus, the court that had stopped TRAI from regulating the SOEs and preventing anticompetitive policies by DoT no longer had jurisdiction. The government and TRAI then proceeded to implement regulations and policies that would take a major step towards leveling the field between the SOEs and private wireless carriers. By the spring of 2000, private operators finally could expect that future policies regarding interconnection rules and prices would be more favorable, although another year passed before these expectations were realized.

In December 2001, the newly reinvigorated and empowered TRAI began the process of harmonizing regulation among the various forms of access carriers. Fixed wireless carriers were allowed to provide limited mobility service, and as a result eleven of the 27 service areas had four mobile competitors. While interconnection prices remained far above cost due to the "universal service" plan, discussed elsewhere, the new regulatory regime at least eliminated much of the unnecessary complexity and unfairness. Although final interconnection rules were not adopted until 2003 (TRAI 2003a, 2003b, 2003c), their general form was known by early 2002, and explains the subsequent boom in wireless networks.

Wireless telephony has exploded since 2001. Figure 3 shows the growth of wireless

penetration nationally for each carrier. Once the NTP99 had been reasonably securely implemented through regulations that would not be overturned by the court, the wireless operators began a vast expansion of their networks. Mobile lines roughly doubled each year after 2000. Fixed wireless, now part of networks that also can offer limited mobility, also grew.

The ordinance that removed jurisdiction from the High Court certainly made reform possible and in so doing triggered massive growth in service, but not without cost to TRAI. The ordinance also empowered the government to remove TRAI commissioners with three months notice. After the ordinance was adopted, the government removed all but one of the sitting TRAI commissioners. Thus, some of TRAI's independence was lost, and Indian telecommunications policy remains vulnerable to frequent changes in policy that reflect short-term political pressures.

As a result of the incomplete institutionalization of reform, the future of local competition is not secure. The government still is accountable for the half-million employees of the SOEs, and still receives a large annual cash flow from them. The independence of TRAI is tenuous. Although the ordinance of 2000 was favorable to competition and reform, it was not fully committed to it – as revealed by the failure to privatize BSNL, a controlling interest in MTNL, and more than a quarter of VSNL/Tata. The ease with which policy, TRAI membership, and judicial oversight were dramatically shifted shows the fragility of liberalization, regardless of the formalities. Like the government in power in 2000-1, a future government can change policy and the distribution of authority among DoT, TRAI, the High Court, and the Dispute Settlement Tribunal with a stroke of the pen.

On the positive side, the private carriers are now bigger and more important to consumers than the SOEs, so that doing serious damage to the private carriers would not be easy politically. The main threat to reform no longer is indirect expropriation of the investments of the private

entrants through Draconian regulations, as tried by DoT in 1996-99. Instead, the primary danger is regulatory capture, in which a competitive regime (in which some firms inevitably do not make money and even fail) evolves into a cartelized regime in which prices are set to protect all parties. Fortunately, all of the governments since 1999 have embraced the new policies, and as the rapid growth of wireless subscribers continues the likelihood of political reversal diminishes.

### *Internet Services*

Internet service is important to India's economic development for reasons beyond the benefits that users derive from access to information, e-commerce and entertainment that is available on the Internet. In addition, India has a vibrant information technology sector that effectively competes on the world market. The future growth of this sector depends on whether the domestic demand for its products, which is likely to be driven by the growth in Internet services, will expand. A nation that does not have a healthy domestic telecommunications sector, including a vibrant Internet services industry, is seriously handicapped in being a world class provider of the hardware and software that is used to provide Internet services.

India recognizes the importance of expanding Internet use, and in 2004 TRAI recommended two goals: 40 million Internet subscribers and 20 million broadband subscribers by 2010 (TRAI 2006b). The actual performance has fallen far short of these goals.

According to estimates by the International Telecommunications Union (ITU), India had just over 4 Internet users per 100 people in 2008, which is about average for low-income countries and much higher than neighboring Bangladesh, but lower than Pakistan, which had 11 users per hundred people, and much lower than China, which had 22 users per 100 (Figure 4). More generally, the Indian population does not appear to be adopting the Internet as rapidly as

other countries.

Data on the number of Internet subscribers shows faster growth than does the ITU data, but the number of subscribers is still quite small and not growing very fast. In the third quarter of 2009, India had only 14.6 million Internet subscribers, or just over 1 subscriber per 100 people. While Internet subscriptions were growing at about 20 percent per year (TRAI, 2010a), the goal of 40 million by 2010 was not in site. In February of 2010, the number of broadband connections was only 8.6 million (TRAI 2010b), again far below the goal of 20 million. The problem in Internet service is apparent in the Internet Service Provider (ISP) industry. Initially the number of ISP subscribers grew rapidly when private ISPs were first allowed to enter, but growth soon began to slow.

#### *Dial-up Internet Service and the ISP Industry*

In developing countries, the predominant method of accessing the Internet is dial-up connections over ordinary telephone lines because broadband connections are beyond the means of most potential customers. VSNL began providing dial-up Internet access in August 1995, and was the monopoly provider until 1998, when other ISPs were allowed to enter the market. Entry barriers were largely removed, with low license fees and no limit on the number of ISPs that could obtain a license. As of the end of 2009, 376 ISP licenses had been granted, including the state-owned wire-line access providers, BSNL and MTNL (DoT 2010, p. 20). But the ISP industry is concentrated, and growing more so. The ISPs of BSNL and MTNL accounted for over 70 percent of Internet services subscribers in 2009, up from 62 percent in 2006 (TRAI 2010a, 2006b). More generally, over 90 percent of the ISP market is accounted for by six affiliates of facilities-based carriers (TRAI 2010a).

Initially, the number of Internet subscribers, like the number of ISPs, grew rapidly.

Figure 5 shows that from the time entry was allowed in 1998 through 2001 the number of ISP subscribers increased from around 140,000 to more than 3 million, an average growth rate of nearly 200 percent a year. In 2001, growth abruptly slowed, as Figure 5 shows. From 2001 through the third quarter of 2009 the number of subscribers increased to about 14.6 million (TRAI 2010a). Nearly all of the growth has been by ISPs owned by the state-owned carriers, while private ISPs that are not affiliated with a large access provider have barely added any subscribers. Even VSNL/Tata now accounts for only two percent of the ISP market.

These data raise two questions: what is suppressing growth in the number of subscribers, and why are independent private ISPs losing out to the facilities-based carriers, especially the state-owned incumbents? The two most important factors are the expense of Internet service and the licensing regime, which advantages basic access providers.

The affordability of Internet service is affected by the cost of connect time, which until recently has been high. DoT regards cost, including the cost of a computer, as the main cause of low penetration (DoT 2010). Despite TRAI's policy to bring tariffs in line with costs, Indian fixed line telephone prices still are characterized by low access charges and high usage charges, which makes time-intensive uses of dial-up connections for Internet use expensive (TRAI 2006b). In order to log on through a dialup connection (still the most common method of access, though all growth is in broadband) a customer must dial through the public telephone network to connect to an ISP. Local calls in India are metered according to the number of three-minute pulses per call, and the price of local calls using the fixed line network varies according to pricing plans. Consumers who pay a higher access charge receive a larger number of free calls and a larger discount on additional calls up to a ceiling of 360 pulses per month. For example, an urban user who pays an installation charge of Rs. 500 (about US\$10, the lowest available) and

Rs. 120 (US\$2.40) per month obtains 50 free pulses per month, is charged Rs. 1.0 per pulse for the next 300 pulses, and Rs. 1.20 for each additional pulse.<sup>15</sup> Higher monthly access charges reduce the usage charge to Rs. 1.0. In addition, a customer must pay an additional fee per minute of Internet connection, with the charge proportional to the speed of the connection (Rs. 0.1 for ordinary telephone lines which are about 28kbps, Rs. 0.2 for 64kbps, Rs. 0.4 for 128kbps, and Rs. 0.8 for 256kbps). Thus, a dial-up customer who expects to spend an hour per day on the Internet faces a marginal cost of an hour of use Rs. 30. Assuming that free use is accounted for by ordinary telephone calls, the monthly cost of using the Internet an hour per day is about Rs. 750 (US\$15).

The pricing structure of local calls gives the incumbent two advantages over their ISP competitors. The incumbent wire-line carriers benefit from calls made to any ISP. At the calling rates listed above the incumbent collects nearly three-fourths of total revenues from a consumer dialing a private ISP. The incumbent is not currently required to share revenues from the call with the ISP, as it would if the call terminated on a mobile network.<sup>16</sup> To the extent that local calling charges are above marginal cost, the incumbent can reduce its prices for ISP use below the price of competitors and capture the part of the fee that otherwise would go to the ISP. Because the marginal cost of ISP usage is small, this portion of the ISP fee also is priced above marginal cost. Thus, the incumbent can gain financially by sacrificing a small fraction of the calling charge, reducing its ISP fee below that of the competition, and increasing its market share

---

<sup>15</sup> BSNL's tariffs for usage and Internet connections are posted at <http://www.bsnl.co.in/service/tnc/basic tariff.htm> and [http://www.bsnl.co.in/service/internet\\_tariff.htm](http://www.bsnl.co.in/service/internet_tariff.htm).

<sup>16</sup> The private ISPs argue that they should be considered telecommunications service providers and thus entitled to a share of dialup revenues under India's interconnection regulations. BSNL claims that ISPs are simply users of the network and therefore not entitled to share in telephone revenues generated by consumers calling into the network (Nair 2003). In addition, private ISPs must lease circuits from the incumbent to interconnect their networks, providing the incumbents with additional revenues. At the end of 2003, TRAI capped the incumbents' rates for ISP connections (TRAI 2003c).

and the excess of revenues over variable costs in its ISP division.<sup>17</sup>

In addition to the issue of local calling charges, private ISPs complain vociferously about difficulties their customers face in simply connecting to a private ISP. In general, access service providers have a financial incentive to favor their unregulated affiliates because their local access and usage tariffs are regulated. If regulated tariffs are set below the monopoly profit-maximizing rate, an access provider has a financial incentive to use its monopoly power in local service to transfer market power to an unregulated affiliate (Joskow and Noll 1999). In particular, because the prices of ISPs are not regulated, the ISP affiliate can use this incremental market power to earn greater profits. Thus, the high and growing market shares of BSNL and MTNL in ISP services should be regarded as something of a red flag that the ISP affiliates of the SOE wire-line providers are being advantaged by a combination of the practices of the SOEs and the policies of their principal owner, DoT.

In a move intended to simplify Internet access, TRAI allocated telephone numbers starting with 172 for Internet access. The private ISPs have noted that their customers generally cannot access those numbers when they are outside of the service territory of the ISPs local access provider. Because BSNL has service in most of the country, BSNL's ISP subscribers can access their ISP more easily. Thus, in a submission to TRAI the private ISPs note: "subscribers of an ISP in Delhi can usually not access any service other than BSNL's when they are out of Delhi" (Nicol 2004). Alternative modes of accessing the 172 numbers are also generally not available. The private ISPs note that it is typically not possible to connect via mobile phones. That is, calls from mobile phones to the 172 numbers rarely connect, making it more difficult for consumers to bypass BSNL's network even if they can afford to do so (Nicol 2004).

---

<sup>17</sup> This strategy is profitable to the incumbent as long as the reduction in the calling fee is small compared to the increase in ISP sales arising from the lower ISP price.



Another potential source of access to the Internet is via mobile wireless networks, using either a “smart phone” or a wireless access card on a computer. As of September 2009, 127 million wireless customers subscribed to wireless data services, which gave them some access to value added services (TRAI 2010a). But in India, nearly all value added use of wireless networks is for services provided by the carrier such as texting, ringtones and ringback tones, but not for Internet services or even value added services provided by others (TRAI 2009c).

TRAI has studied the low use of Internet and other value-added services intensively over that past few years (TRAI 2006b, 2008b, 2008c, 2008d, 2009b, 2009c). In these documents TRAI’s diagnosis is that the sluggish growth in Internet use and other value added services arises from the policies and practices of DoT. TRAI has made many recommendations of changes to DoT’s policies. One recommendation is that DoT eliminate restrictions, vague provisions, and inconsistencies across technologies in the licenses of access providers to enable them to offer a greater variety of services. Another recommendation is that DoT allocate “short codes” for accessing value added services on a common, nationwide basis, rather than on the basis of a specific carrier, as is now the case. As of the spring of 2010 DoT had not implemented TRAI’s proposals.

### *Internet Cafés*

One reason for the low number of ISP subscribers is because average incomes in India are low and Internet use at home is not feasible for most people. As a result, as in most poor countries, Internet cafés are a very important part of ISP usage. TRAI (2004c) estimated that more than 10,000 cafés were operating as of March 2004, though others have estimated that number to be many times higher (e.g., Kumar 2003). A report by the Confederation of Indian

Industries (CII) estimated 180,000 cafes operating in 2008, representing 36 percent of all Internet access points.<sup>18</sup>

While the presence of many cafés is a bright spot in India’s Internet story, the number of cafés probably is higher than it otherwise would be because of the high costs of Internet access. High usage price discourage use, and thereby discourage investment in computers and ISP service in the home. Just as call centers were popular in developing countries when telephone service was costly and poor, Internet cafés also might be less prevalent if the price of accessing the Internet from home were lower.

While cafés have become an easy and popular means of accessing the Internet, local governments are threatening to increase government oversight in ways that could reduce demand and increase costs. In particular, in Mumbai the police, asserting security issues, have required café customers to present identification and to provide their home addresses if they want to access the Internet. In addition, the police want to require cafés to pay an annual license fee and to obtain several government permits.<sup>19</sup> These requirements increase costs substantially and are barriers to entry (Djankov, La Porta, Lopez-de-Silanes, and Shleifer 2002). The CII report credits these interventions with significantly reducing growth in the number of Internet cafes.

### *High-speed Access and Other Advanced Services*

High-speed Internet access has become available slowly in India (Figure 5).<sup>20</sup> High-speed access is more costly and requires better infrastructure than does a dial-up connection, so it

---

<sup>18</sup> As discussed here: <http://indiabb.blogspot.com/2008/07/growth-of-cyber-cafes-declining-sharply.html>.

<sup>19</sup> See Associated Press (2004).

<sup>20</sup> TRAI (2004c) defines “broadband” to be “always-on data connection that is able to support various interactive services, and has the capability of a minimum download speed of 256 Kbps.”

is not surprising to see slow adoption in poor countries. With about 0.7 broadband connections per hundred people India is somewhat better off than Pakistan, which had 0.09 broadband connections per hundred people in 2008, but much worse than China, which had 6.23.

In order to provide high-speed service, an ISP must solve the “last mile” problem: how to get a high-speed Internet connection into homes and Internet cafés. The most common high-speed access systems are asynchronous digital service lines (ADSL) over ordinary telephone lines or cable modem access that uses hybrid fiber-coaxial (HFC) cable television networks. Because in developing countries telephone service is far more widely available than cable TV and is provided by either a state-owned enterprise (SOE) or a highly regulated former SOE, in most countries ADSL is both more important than HFC and heavily regulated.

Many countries require that the monopoly or former monopoly incumbent telephone company – which almost always owns nearly all of the copper wires into homes – unbundle high-speed access. Unbundling requires that the incumbent sell high-speed access service separately from ISP service on a non-discriminatory basis, thereby giving customers the right to pick their ISP. In the absence of an unbundling requirement, high-speed access providers typically offer combined access and ISP service through their ISP affiliate.

The argument for an unbundling requirement is that it is necessary to make ISP service truly competitive. If bundling is allowed, incumbent wire-line carriers can use their monopoly power in access to monopolize Internet services (Umino 2004). The presence of economic regulation increases the incentive to engage in this behavior because historically economic regulation is far more vigorous in capping access prices than the prices of enhanced services that use the telecommunications network as an input. Indeed, in India all prices of wire-line access providers are capped, while prices for ISPs are unregulated. As a result, incumbents may

perceive themselves as able to obtain long-term excess profits only through Internet services, not access services.<sup>21</sup> The counter-argument is that because the economic viability of high-speed access is uncertain, and because incumbents expect that regulation will prevent them from capturing excess profits if high-speed access becomes extremely popular, forcing incumbents to accommodate ISP competitors reduces their incentive to invest in high-speed access. Hence, unbundling may delay diffusion of the technology (Crandall, Hahn, Litan and Wallsten, 2004). Nevertheless, the low penetration of high-speed access in India demonstrates that the presence of a monopoly that is protected by regulation does not necessarily lead to rapid diffusion of service.

Like most countries in the world, the Indian incumbents, BSNL and MSNL, own nearly all (almost 95 percent) of the existing copper network.<sup>22</sup> India does not currently require unbundling by the incumbent for high-speed access service. TRAI (2004a) recently recommended mandatory unbundling, but the DOT rejected that recommendation.<sup>23</sup> Until recently, regulation also prevented private ISPs from laying their own copper wires (Telecommunications Regulatory Authority of India 2004c). TRAI recently recommended allowing ISPs to lay copper, and the DOT agreed. The implication of this regulation and its repeal is unclear since extensive duplicate copper wiring is exceedingly uncommon anywhere.

Several other technologies also can be used to provide the infrastructure for high-speed access, such as WiFi, satellites, cable television, and third generation (3G) wireless technology.

---

<sup>21</sup> This argument is known as the “Bell Doctrine,” since it was the underlying economic theory of the U.S. antitrust complaint that led to the divestiture of the American Telephone and Telegraph Company. For a thorough explanation of the Bell Doctrine and its application to telecommunications reform in both developed and developing nations, see Joskow and Noll (1999).

<sup>22</sup> Arora (2004).

<sup>23</sup> See Gairola (2004).

Unfortunately, regulation makes it difficult to solve the “last-mile” problem through other technologies in India.

WiFi service is a low-power, limited range wireless service that is used for high-speed access to the Internet. In many countries WiFi is offered in parts of the electromagnetic spectrum where no operating license is required. In India, licensing requirements for WiFi were removed only in 2003, and then only for use “within the single contiguous campus of an individual, duly recognized organization/ institution.”<sup>24</sup> This regulation prevents WiFi from being used ubiquitously to provide high-speed access as a standard telecommunications service to all business and residences in a neighborhood.

Internet service over satellites has been similarly suppressed. Regulations mandate particular routings of Internet traffic that uses satellite connections, place size limits on antennae, cap transmission speed below available technical capabilities, and do not allow satellite TV operators to provide Internet download capacity (Telecommunications Regulatory Authority of India 2004c). TRAI recommended removing these restrictions, but both DOT and India’s Department of Space rejected the proposals.<sup>25</sup> Satellite services are generally not major providers of broadband, but the regulations and the quick initial rejection by other government agencies highlights general difficulties in promoting competition in this industry.

In most industrialized countries half or more of broadband consumers connect through cable modems, yet in India cable modem access is largely undeveloped. Cable TV penetration in India is quite high, with about 6 cable TV connections per hundred people, compared to 3.9 fixed

---

<sup>24</sup> See Ministry of Communications and Information Technology (2003).

<sup>25</sup> See Gairola (2004) and Thomas (2004).

telephone lines and 2.6 mobile phones (TRAI 2004e). Cable companies are free to offer high-speed access as well as other enhanced broadband services, but few do.

Several factors create barriers to the development of the service in India (TRAI 2004c). One factor is the fragmented nature of the Indian cable industry. Indian cable TV is comprised of a large number of small, localized firms, whereas in nations where cable modem access has become important large multi-system operators provide most service. Larger cable companies are advantaged in providing cable modem access because they can form an ISP that can be offered without negotiations and contracts to many customers in their entire system. By contrast, in a fragmented cable market cable companies have too small an installed base to justify creating their own ISP, and any ISP would face a long process of negotiating both business and technical terms for interconnecting with many cable systems.

In addition, private ISPs that seek to offer service to cable modem subscribers in many cable systems must interconnect to the telecommunications network through telephone companies. For ISP service to become widespread over cable systems, large numbers of cable companies would need to interconnect with the telephone network in order to provide access to the local access networks that support these ISPs. For the same reason that the incumbent telephone access providers have an incentive not to facilitate the growth of competing ISPs that are accessed by ADSL, they also have an incentive not to facilitate growth in cable modem access by providing high-quality, low-cost interconnection between ISPs and cable systems.

In the Indian context probably the most promising technology for delivering broadband access is wireless access networks. Advances in digital wireless technology, as embodied in 3G and 4G wireless networks, enable wireless access to be used for a variety of data-intensive services, including Internet access. Recently DoT observed that “wireless broadband is likely to

be the preferred route that many operators adopt in delivering broadband services to the masses of the country” (DoT 2010, p. 6). In 2008 DoT announced an auction of spectrum to be used for 3G wireless service and wireless broadband access (DoT 2009e) as a means for achieving the aforementioned goals of 20 million broadband subscribers and 40 million Internet subscribers in 2010 (DoT 2010, p. 6). But the amount of spectrum that DoT has made available for broadband services is small, and licenses have been reserved for BSNL and MTNL.

For broadband wireless access, three blocks of 20MHz have been made available, one of which is automatically allocated to either BSNL or MTNL (DoT 2009e, p. 9). In the short run, this spectrum can accommodate a substantial expansion of broadband service, but in the long run more will be needed if wireless broadband is to become the major mechanism for accessing the Internet and other value added services.

A key question is why DoT continues to issue licenses that fragment spectrum use among types of wireless services. In the same auction, DoT also will auction spectrum that is separately stipulated for 3G use (DoT 2009e, p. 7). The total spectrum to be awarded varies from 25 MHz in 15 service areas to nothing for Rajasthan, 5 MHz in the North East circle, and 10 MHz for West Bengal. This spectrum is further subdivided into 5MHz blocks, with one block automatically given to BSNL or MTNL, leaving between zero and four small blocks for other carriers. The varying number of licenses guarantees that only BSNL/MTNL will be able to offer an integrated service to almost the entire nation. The alternative approach is to relax restrictions on all spectrum that is allocated for wireless telephone service, including existing licenses that are now used for 2G mobile telecommunications, and to let each carrier work out how it will make the transition to advanced wireless technology and the provision of broadband access.

As has often been the case, DoT's wireless broadband policies are a compromise between facilitating competition in the provision of data services and protecting the position of the flagship SOEs. DoT's policies assure that BSNL and MTNL will continue to have a dominant share of Internet services.

### *Summary*

Indian Internet services and usage, after a promising start, have become stalled. The cause of the problem is regulatory barriers to the growth of Internet services, which for the most part arise from the unwillingness of the government to threaten the protected monopoly position of the incumbent SOEs. Whereas TRAI has made several attempts to push the government and the monopoly access providers in directions that would facilitate greater growth in Internet services, it has been thwarted by reluctant incumbents and DoT.

### **Universal Service Policy**

Nearly every country in the world has established "universal service" policies for telecommunications. These policies generally start with the goal that all residents of a country should have access to telecommunications services at affordable prices, though definitions of "access," "telecommunications services," and "affordable" are debated across and within countries. Services can be beyond the means of most people for either of two reasons: low income, or high cost. Whereas the poor reside in communities of all sizes, rural areas generally have much lower telephone penetration because costs are also high where population density is low (Figure 2).

To achieve universal service goals, governments commonly subsidize basic local access



service (and increasingly data services, as well) for all customers in high-cost rural areas and for urban residential customers with relatively little attempt to target the subsidies on those who cannot afford service. Most of the subsidy arises through price discrimination between business and residential customers and across geographic areas without regard to the ability to pay of customers who face either high or low prices. Overall deficits in providing local access service typically are paid primarily from excess profits in other services, notably long-distance and international calling, but more recently, with the boom in radio telephony, from usage charges on mobile telephone service.

Economists have long argued that the case for extensive cross-subsidization is weak on several grounds (e.g., Rosston and Wimmer, 2000, and Clarke and Wallsten, 2002). Among the arguments are the following:

- (1) Cross-subsidization systems tend to be very inefficient in that the amount of money transferred among services and households is very large compared to the net subsidies for low-income consumers;
- (2) the cross-subsidy system has almost no effect on the penetration of telephone service because it taxes usage services, which have a relatively high price-elasticity of demand, in order to subsidize access, which has a very low price-elasticity of demand;
- (3) poor households, if given the choice, would far prefer a cash transfer that was not earmarked to a subsidized price for telephone service; and
- (4) especially in developing countries, almost no low-income households subscribe to access service while many make calls from pay telephones or call centers, so that taxing usage to subsidize access transfers income from the poor to the middle class.

In developing countries, the case for cross-subsidization is further undermined because

state-owned monopolies generally offer little service in poor urban areas and no service in poor rural areas. Indeed, in the era of state-owned monopolies in developing countries, the telecom provider faced little or no incentive to invest in any telecommunications services, as witnessed by the appalling long waiting period to obtain connections and the poor quality of service was connections were installed. As a result, telephone penetration and utilization were low, even considering developing countries' low incomes, and service to poor and rural areas was horrible (see Figure 1). Nonetheless, some observers have worried that if reforms increase efficiency and improve average consumer coverage, they would hurt rural residents and the poor by making cross subsidies difficult to maintain. As a result, telecommunications reforms have typically included schemes meant to subsidize service to rural areas or to poor consumers.

India has been no exception to any of these tendencies. Telephone service stagnated under state ownership, and despite DoT's (later BSNL's) mandate to provide service in rural areas, relatively few villages had even a public telephone, let alone residential telephones. In 1995 approximately 185,000 villages out of more than 600,000 had a public telephone (Jain and Das 2001). As late as 1998, only 2.6 percent of rural households had telephone service.<sup>26</sup> And, as Das and Srinivasan (1999) note, that number exaggerates the true state of telecommunications in rural areas since village surveys "revealed that more than 60 percent of ... VPTs [village public telephones] were faulty. Of the remaining, a high percentage were disconnected due to non-payment of dues, so that in effect, very few are in actual use." Clearly, prior to recent reforms the SOE did a poor job of providing services to rural areas.

### *Universal Service Policies in India*

---

<sup>26</sup> DHS surveys.

India's first official universal service program arose as part of NTP94, which defined universal service as the availability of certain "basic telecom services at affordable and reasonable prices" to all citizens (DoT 1994). This policy was revised and made more detailed under NTP99, which made providing telecom services in remote rural areas a higher priority.<sup>27</sup>

Among other goals, the NTP99 aimed to:

- Provide voice and low-speed data services to 290,000 villages with no service by 2002;
- Provide Internet access to all district headquarters by 2000; and
- Achieve telephone on demand by 2002 (DoT 1999).

Policymakers hoped to increase rural teledensity from 0.4 telephones per hundred people in 2000 to 4 by 2010 (Telecommunications Regulatory Authority of India, 2000). NTP99 states that universal service objectives will be funded through a universal service levy. While the 2002 goals were not met, the DoT (2002c) issued clarifying guidelines on how universal service activities should proceed. It directed two objectives: first, providing public telecom services in villages, and second, providing household telephones in rural areas. It made the first objective a higher priority, and all efforts to date have been directed towards it.

The universal service fund is based on the assumption that carriers will not provide service in rural areas without subsidies. Subsidies were financed in two ways. The first is the universal service levy (USL), which is a tax of five percent of adjusted gross revenues on all telecommunications providers except "pure value added service providers" such as ISPs. These funds go to the DoT, which distributes them as discussed below. The second method is "access

---

<sup>27</sup> According to DoT (2002b), "The New Telecom Policy'99 envisaged provision of access to basic telecom services to all at affordable and reasonable prices. The resources for meeting the Universal Service Obligation (USO) shall be generated through a Universal Service Levy (USL), at a prescribed percentage of the revenue earned by the operators holding different type of licenses. Further, NTP'99 envisaged implementation of Universal Service Obligation for rural and remote areas through all Basic service providers who will be reimbursed from the funds collected by way of USL. Other service providers shall also be allowed to participate in USO provisioning subject to technical feasibility and shall be similarly reimbursed out of the funds of USL."

deficit charges” (ADCs), which are interconnection usage charges that are paid directly to fixed access providers (mostly BSNL), in order to compensate them for providing below-cost service. While collecting the USL is simple, distributing the funds so that they actually help meet universal service objectives is far more difficult. The ADC, meanwhile, was intensely controversial, and was phased out in 2008.

#### *Allocating the USF: Auctioning Subsidies*

The USF is intended to reimburse the net cost (defined as cost minus revenues) of providing telecom services in rural areas. A carrier can be reimbursed for all net costs (including capital expenditures) for public telephones installed after January 1, 2002, replacement of telephones installed prior to that date, and operating expenses of all public phones. To allocate the funds, the DoT divided the country into 20 telecom “circles” (which loosely follow the circles for wireless licenses). The subsidy for each area is determined through an auction that was proposed by Dr. Rakesh Mohan, then a member of TRAI, in a dissent from TRAI’s recommendation on how to implement universal service. In the auction, telecommunications firms submit bids for providing service. The firm willing to provide service with the lowest subsidy, subject to the bid being no higher than a predetermined benchmark, receives the right to be reimbursed from the fund. Any firm with a license to provide basic or cellular service in the relevant service area is allowed to bid (DoT, 2002c). The winner receives the subsidy for seven years, subject to review after three years.

Auctioning subsidies has been used elsewhere in the world with some success. In a fair bidding process with multiple bidders, firms should bid the smallest subsidy necessary for them to provide service. Chile and Peru were among the first to implement this method, giving licenses to the operators that agreed to serve areas for the smallest subsidy (Cannock 2001). In

Chile, the average winning subsidy from 1995-1999 was about half the maximum subsidy offered, while in Peru it was only about one-quarter the subsidy offered (Intven and Tetraolt 2000). These experiences reveal that auctions are feasible and that the subsidies required were far less than the incumbents had previously led policymakers to believe were necessary.

The Indian subsidy auctions yielded a different result. In 19 of the 20 circles only one firm bid for the subsidies, the incumbent BSNL (Ghosh 2004). Not surprisingly, given the thin market, BSNL bid exactly the benchmark amount, which was the maximum subsidy DoT was prepared to provide.

The failure of the auction to create genuine competition for rural public service plausibly arose from at least three problems. First, the calculations for the benchmark subsidy probably were not on the appropriate standard, which is the incremental cost of public telephone service. While the benchmark was calculated by a disinterested third party, cost data for the calculations were provided by BSNL. DoT officials insist that the incumbent could not have manipulated the data, but others note that BSNL's accounts are aggregated in a way that makes it impossible to separate costs for different operations (e.g., Ramachandran 2003), which in turn makes incremental cost calculations impossible. Second, BSNL receives large ADC subsidies, which also are based on the estimated cost of service. Consequently, the incumbent has potential gains from manipulating how cost information is aggregated across service categories and across high-cost and low-cost areas. If some ambiguous cost elements are allocated to subsidized areas, the effect will be to increase both the public telephone subsidy and the ADC subsidy. Third, bidding was open only to basic service operators already operating in the service area. BSNL, even though it historically has not served many villages, owns some facilities in these areas; however, few other firms had entered these markets as of the auction date, in part because only recently

(between 2000 and 2002) were the impediments to their operations that were imposed by DoT effectively removed by TRAI and in part because disputes about the terms and condition of interconnection with BSNL remained unresolved. Firms not yet operating could bid for the public telephone subsidy only if no other bids were received or if the bids by others exceeded the benchmark (Intelecon Research and Consultancy Ltd. 2002). By precluding firms that were not already present, the subsidy scheme explicitly was designed not to encourage either entry or innovation in rural services.

The auction procedure that was set up advantaged the incumbent while providing no incentive to improve efficiency of service. In particular, if only a single firm can qualify for the subsidy and if that firm is then reimbursed the difference between its revenues and its costs, the subsidized firm has no incentive to reduce its costs unless it can do so in ways that can be hidden from the DoT. Moreover, with only one subsidized firm in the entire nation, even benchmark competition (whereby differences between monopolies in different areas are used to evaluate performance and adjust the subsidy) is impossible, while the subsidies themselves make it impossible for non-subsidized firms to enter the market.

The subsidy scheme for encouraging investment in VPTs is only the first part of what eventually will be a two-part universal service policy. The second step is to distribute funds for connecting individual households. Neither the DoT nor TRAI have issued guidelines on how this objective will be accomplished, though the administrator of the universal service fund expects it to be quite controversial (Ghosh 2004).

The second step is potentially far more important than the first. Many more telephone lines are at stake in devising a plan for implementing extensive residential access than for providing more public telephones. Indeed, while even in the best of circumstances firms might

not have found subsidies for a relatively small number of public telephones an attractive basis for entering rural areas, subsidies for a much larger number of residential lines clearly are more attractive. Thus, a failure to correct the problems with the auction system that was used for public telephones could unnecessarily doom India to an inefficient rural telephone system that is a drain on all other telephone services for decades to come.

### *Access Deficit Charges*

Between 2003 and 2008, India imposed a second method to pay for universal service, access deficit charges. In an earlier article (Noll and Wallsten 2006) we provided an extensive critique of this system. Two years later TRAI abolished ADCs. We briefly summarize the system here because it has historical interest by providing another window into how India favors its SOEs.

TRAI adopted ADCs on the premise that SOEs have unprofitable service obligations and should therefore be compensated for them by entrants who are free to provide service only to profitable customers (TRAI 2003a). The magnitude of the revenue deficit was not trivial. TRAI originally estimated the annual “access deficit” at Rs 13,000 crore (nearly \$3 billion), but then reduced its estimate to Rs 5,340 crore (approximately \$1.1 billion) (TRAI 2003b).

The deficits presumably arose because TRAI’s price ceilings on basic monthly access charges were below the cost of service for a large number of customers. As one DoT official put it, “private operators started services from creamy areas, so they have a clear advantage over BSNL. The state-owned operator has to provide services in rural areas at a subsidised rate, which reduces its ability to compete with private operators in the creamy areas” (Intelecon Research and Consultancy Ltd. 2004).

ADC charges were imposed only on some calls. Table 1 shows the complex system of ADC charges as of 2003. No ADC charge was imposed on local calls originating and terminating in access networks of the same type in the same local service area – that is, between two fixed wire-line access networks or between two fixed wireless access networks, regardless of whether fixed or mobile. All other local calls and intra-circle long-distance calls paid Rs .3 per minute (about US\$ 0.006). Domestic inter-circle long-distance calls paid between Rs .3 and Rs .8 per minute, depending on distance. International calls paid Rs 4.25 per minute. For calls originating in a wire-line access network, the ADC was paid to the originating local network. In all other cases, the ADC was paid to BSNL, even if no part of the call was carried by BSNL (TRAI 2005a).

The ADC fee structure was highly inefficient for three reasons.

First, the price-elasticity of demand is much greater for usage than for access. Hence, taxing usage to finance access substantially distorts the former to obtain very little gain in the latter. This distortion increases as the usage of the telecommunications network for wireless data service grows.

Second, the application of the tax to only some calls created another distortion. A user who called mostly people on one type of network (wire-line or wireless) had a financial incentive to acquire access service using the same type of network. This incentive was not trivial: users who place five three-minute calls per day could save Rs 135 per month (about \$3 US) by using the same type of network for access as the people they are most likely to call.

Third, differential charges for long-distance calls created still another distortion. A call over a distance of 225 km between adjacent states was taxed nearly three times as much as a call of the same distance within a state. Again, the difference was not trivial – Rs .5 (about one cent)



per minute. This particular form of price discrimination has no plausible basis in efficiency, vertical equity (by income group), or horizontal equity (e.g., rural versus urban).

The magnitude of the ADC fee was the same for all fixed carriers, regardless of their actual costs of service. Thus, access carriers with high usage received a larger subsidy than carriers for which usage was low. Like most goods, telephone usage has a positive income elasticity of demand; hence, the reimbursement scheme provided a greater cross-subsidy from usage to access service in richer parts of India. Moreover, because rural areas generally have lower average income but higher costs per user, the magnitude of the subsidy probably was inversely proportional to a community's ability to pay for service. In short, the largest subsidies flowed from mobile carriers to fixed carriers in the highest income urban areas. Fixed access carriers in low-income rural areas with no mobile service received the smallest subsidy. Even within BSNL, which received most ADC payments, the incentive created by this system was to extend access service in rich urban areas before providing service to low-income and rural areas.

Because ADCs were a charge per minute of calling, the revenues that were collected grew enormously as wireless penetration escalated. As a result, TRAI quickly concluded that the rates had to be adjusted downward as wireless calling grew, and substantially reduced the rates early in 2005 (TRAI 2005a). But ADCs were controversial for many reasons other than the fact that they provided a growing windfall to the SOEs. In addition to the three sources of distortions listed above, TRAI also observed that expenditures from the Universal Service Fund were far below collections, which implied that the two taxes on other services were substantially higher than the amount that was actually spent to achieve universal service goals. Consequently, TRAI undertook a review of ADCs that led to a consulting paper (TRAI 2005b) and a series of adjustments to ADCs that culminated in their elimination in 2008 (TRAI 2006a, 2008a).

## **Conclusions**

No one can seriously challenge the proposition that Indian telecommunications policy has been an outstanding success in the 21<sup>st</sup> Century. Nevertheless, the path to successful reform was long and grueling, and the many pitfalls provide several important lessons. Obviously, the establishment of a strong regulator was an important element of reform. But to give TRAI the strength to implement pro-competitive, efficiency-enhancing reform required three bites at the apple: its original creation in 1997, the NTP99, and the ordinance removing the jurisdiction of the High Court.

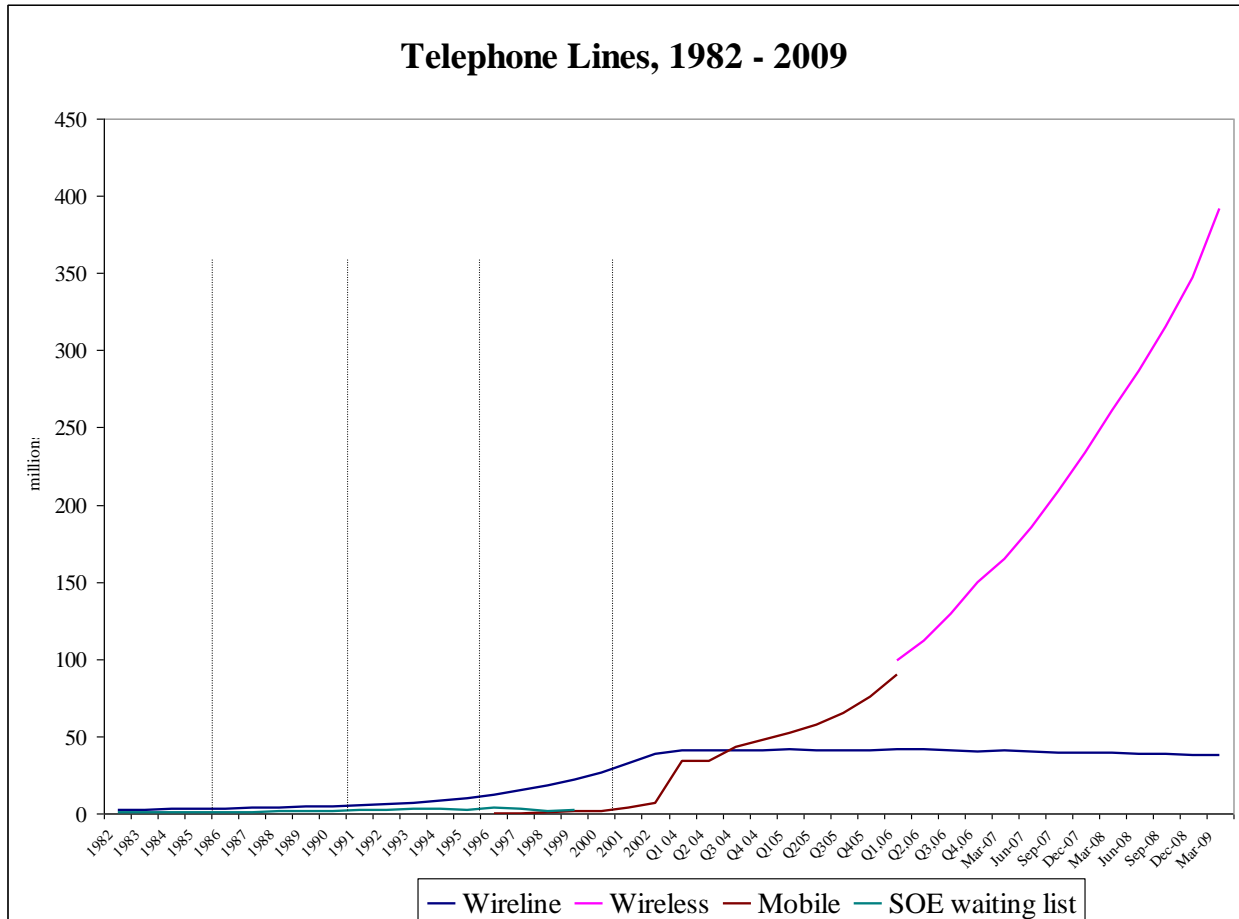
DoT is now generally an enthusiast for private participation in the industry. But DoT also continues to favor the interests of the SOEs that provide access service, as witnessed by its spectrum allocation for 3G and wireless broadband and its licenses for other carriers that advantage BSNL and MTNL in providing Internet service. To assure that broadband access is competitively supplied, DoT needs to end its protective stance towards BSNL and MTNL. Only then can TRAI implement effective pro-competitive regulation in the provision of high-speed data services.

TRAI has an exemplary track record in implementing reform, but its quality and independence are not yet secure. The problem is the independence that was sacrificed in the ordinance that removed the jurisdiction of the High Court. Truly a revolutionary change in the economic ideology of the government would be needed before a new government plausibly would seek to put an end to private participation in the industry. The success of the private entrants is simply too great to imagine that a future government would seek to undermine them. The vulnerability now is cartelization – having TRAI set price floors, rather than price ceilings,

and break the connection between cost and price in order better to reward political friends.

While there is no magic bullet to guarantee TRAI's continued high-quality contribution to Indian telecommunications policy, an important next step would be to grant TRAI commissioners greater security of office and more authority over the licensing process.

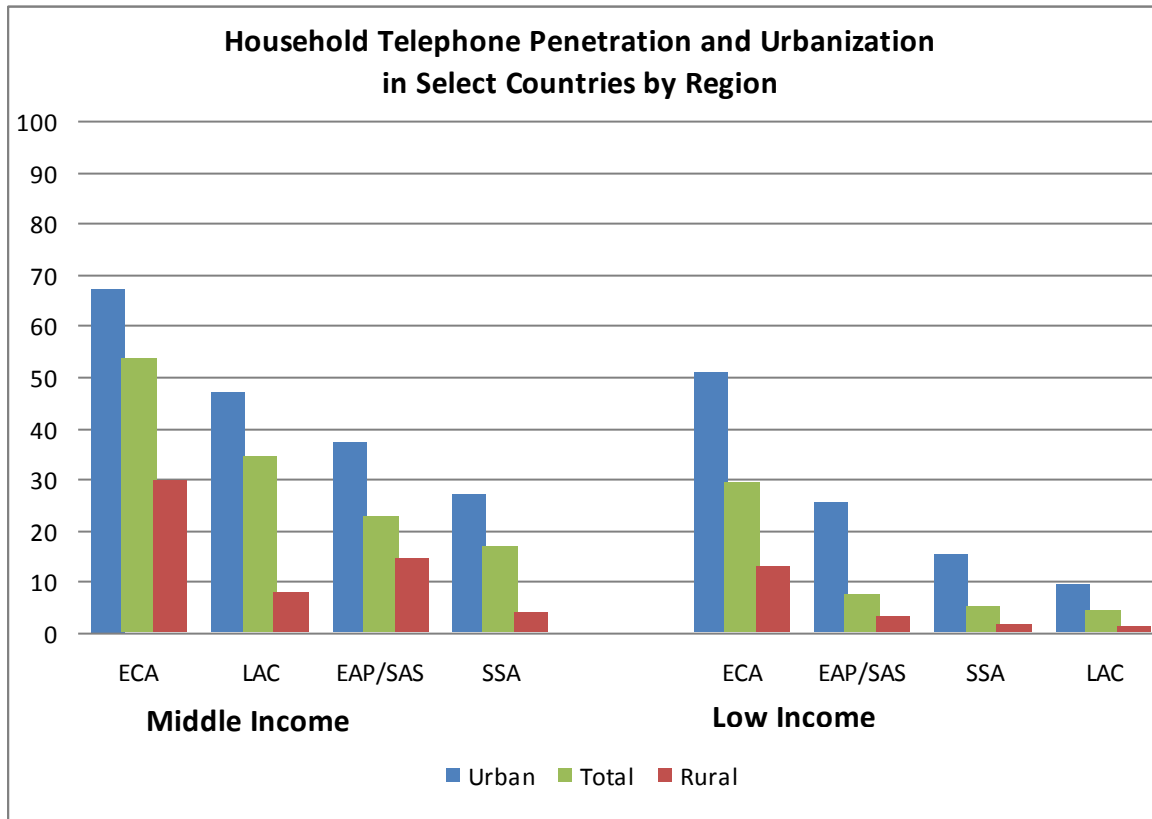
Figure 1



Sources: Department of Telecommunications (2003, 2009), Desai (2004), TRAI (2004a, b), TRAI Performance Indicators.

“Wireline” is basic wired service, “mobile” indicates cellular (GSM and CDMA) and mobile WLL; “wireless” includes cellular (GSM and CDMA), mobile WLL, and fixed WLL.

Figure 2



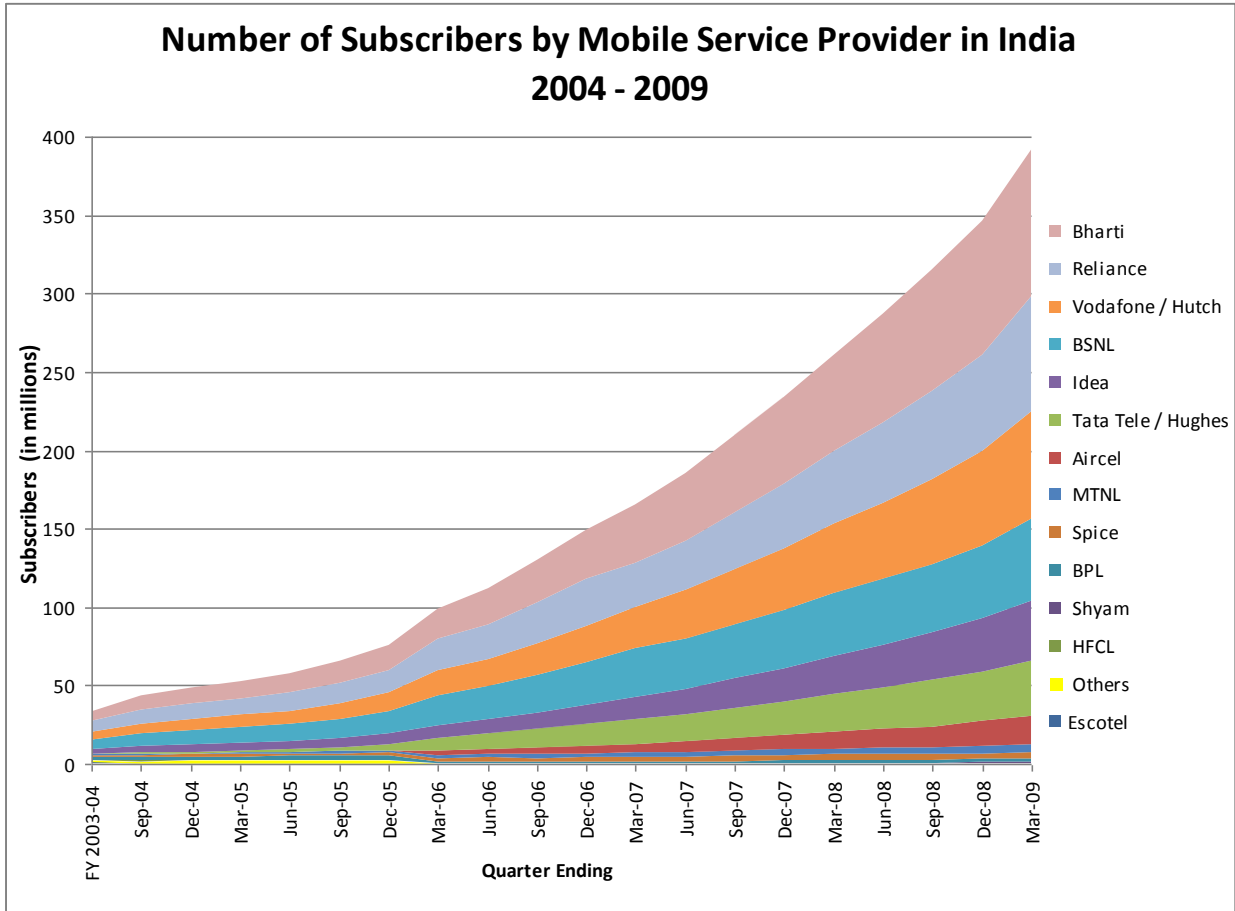
Source: MEASURE DHS+ Demographic and Health Surveys.<sup>28</sup>

<sup>28</sup> LAC = Latin America & Caribbean; EAP= East Asia & Pacific; SAS = South Asia; ECA = Europe & Central Asia; SSA= Sub-Saharan Africa

Telephone penetration rates are from most recent Measure DHS survey of each country (categories are not complete) Income designations adopted from World Bank (July 2009), ignoring the distinction between upper and lower middle income. Weighted by mid-2005 populations as estimated by UN Region designations adopted from World Bank, combined East Asia & Pacific with South Asia

Most of the surveys (46 out of 55) were conducted in 2003 or later, but the ECA Low Income group (made up of 2 surveys from 1996 and 1997) is the only with disproportionately early results.

Figure 3



Sources: TRAI, The Indian Telecom Service Performance Indicators 2005-2009:

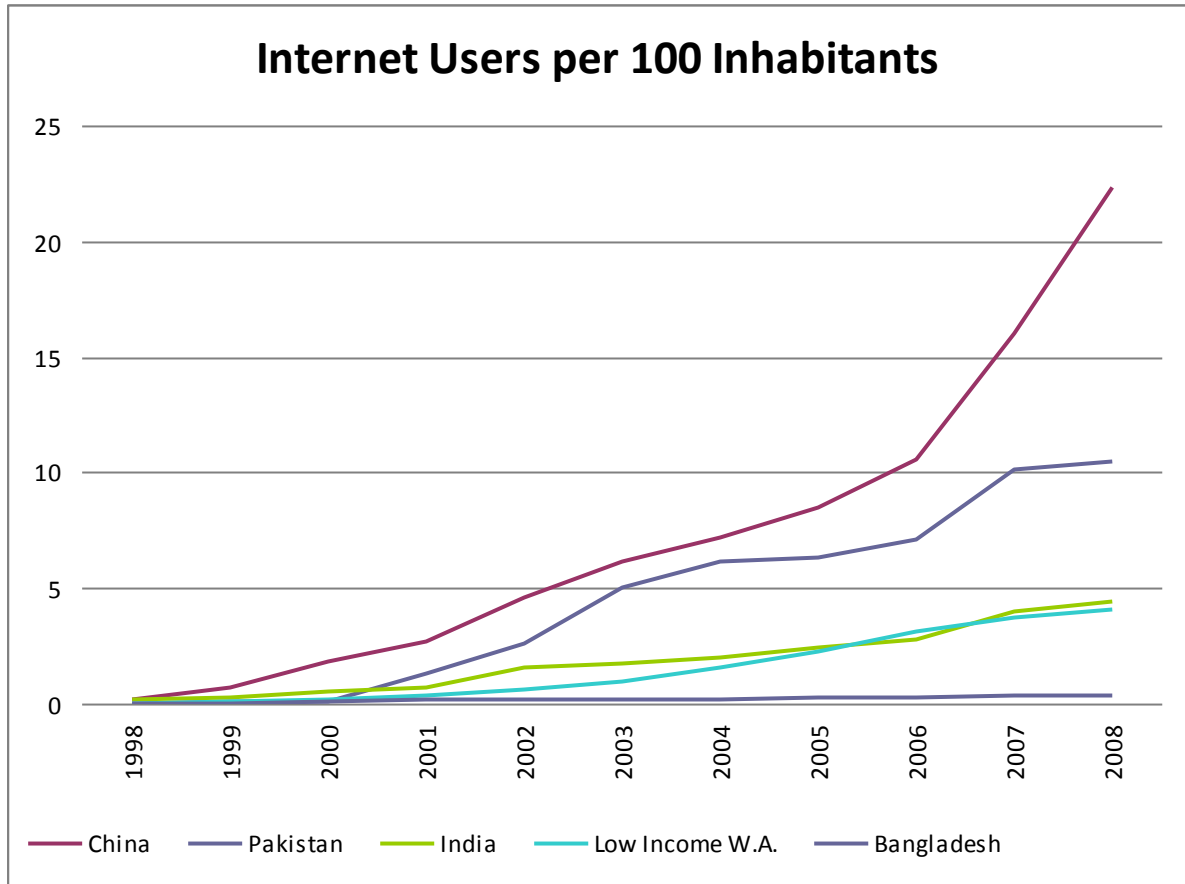
<http://www.trai.gov.in/WriteReadData/trai/upload/Reports/8/reports17jun05.pdf>

<http://www.trai.gov.in/WriteReadData/trai/upload/Reports/26/Report%20QE%20Mar-06%20Part%20I.pdf>

<http://www.trai.gov.in/trai/upload/Reports/36/report1.pdf>

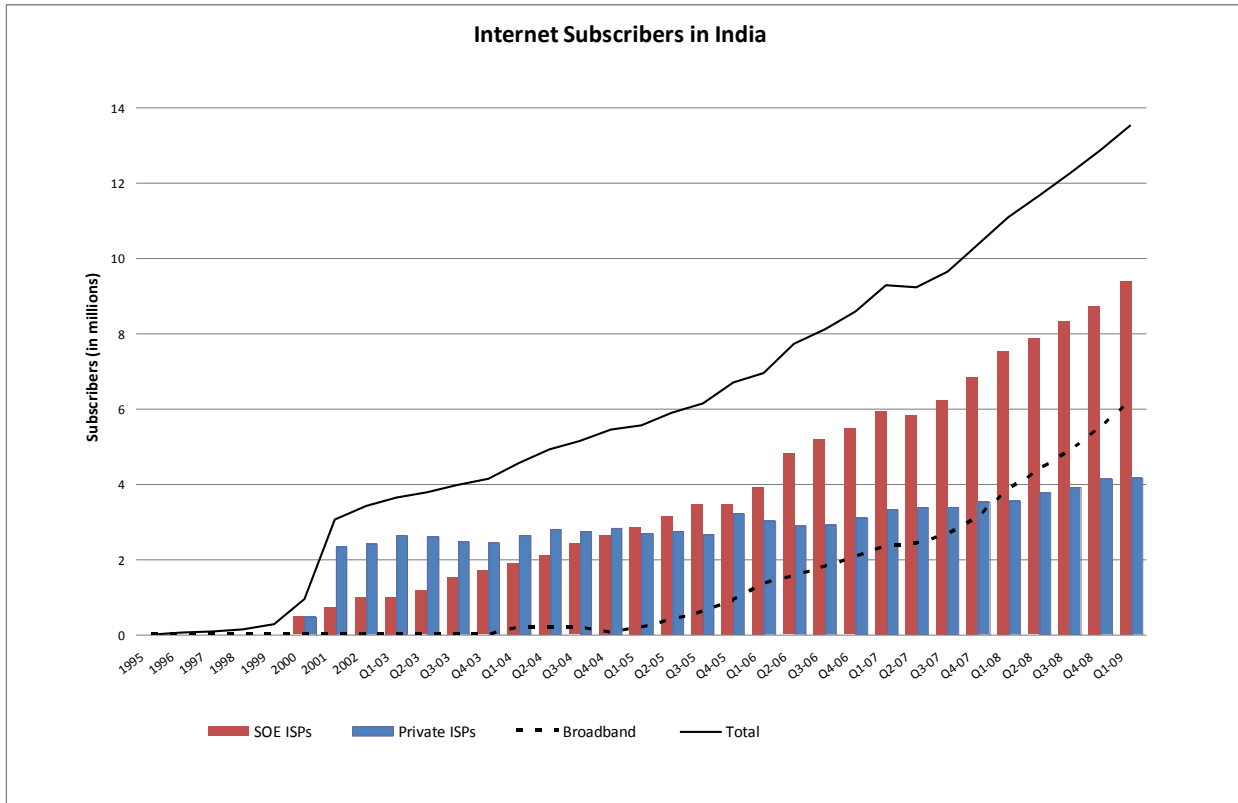
<http://www.trai.gov.in/WriteReadData/trai/upload/Reports/42/reportQE3july08.pdf>

Figure 4



Source: ITU.

Figure 5



Sources: TRAI Performance Indicators.



**Table 1**  
**Access Deficit Charges**

Access Deficit Charges in Rs per minute	Local	Intra circle calls		Inter Circle calls			ILD
	local	0-50 kms	>50 kms	0-50 kms	50-200 kms	>200 kms	ILD
Fixed - Fixed	0	0	0.3	0.3	0.5	0.8	
Fixed - WLL(M)	0.3	0.3	0.3	0.3	0.5	0.8	
Fixed - Cellular	0.3	0.3	0.3	0.3	0.5	0.8	4.25
WLL(M) - Fixed	0.3	0.3	0.3	0.3	0.5	0.8	
WLL(M) - WLL(M)	0	0	0	0.3	0.5	0.8	
WLL(M) - Cellular	0	0	0	0.3	0.5	0.8	4.25
Cellular - Fixed	0.3	0.3	0.3	0.3	0.5	0.8	
Cellular - WLL(M)	0	0	0	0.3	0.5	0.8	
Cellular - Cellular	0	0	0	0.3	0.5	0.8	4.25

Source: TRAI (2003c)

## References

Associated Press. 2004. "India Cracks Down on Cyber Cafes." *CBSNEWS.com*, January 19: New Delhi.

Cannock, Geoffrey. 2001. "Telecom Subsidies: Output-Based Contracts for Rural Services in Peru." The World Bank: Washington, D.C.

Clarke, George and Scott Wallsten. 2002. "Universal(ly Bad) Service: Providing Infrastructure Services to Rural and Poor Urban Consumers." *World Bank Policy Research Working Paper Series*: Washington, D.C.

Crandall, Robert W., and Leonard Waverman. 2000. *Who Pays for Universal Service? When Telephone Subsidies Become Transparent*. Brookings Institution: Washington, D.C.

Crandall, Robert W., Robert W. Hahn, Robert E. Litan and Scott Wallsten. 2004. "Universal Broadband Access: Implementing President Bush's Vision." AEI-Brookings Joint Center for Regulatory Reform, Regulatory Analysis 04-01: Washington, D.C..

Das, Pinaki and P. V. Srinivasan. 1999. "Welfare Implications of Telecom Tariff Reform." *Economic and Political Weekly*, 34, pp. 672-75.

Department of Telecommunications. 1994. "National Telecom Policy." Available at <http://www.dot.gov.in/ntp/ntp1994.htm>.

Department of Telecommunications. 1999. "New Telecom Policy." Available at <http://www.dot.gov.in/ntp/ntp1999.htm>.

Department of Telecommunications. 2002a. "License Agreement for National Long Distance Service." October 18. Available at <http://www.dot.gov.in/nld/nldindex.htm>.

Department of Telecommunications. 2002b. "Draft Tender Document: Subsidy Disbursement Towards Capital Recovery for Replacement of MARR VPTS Installed before 1.4.2002 and Expenses towards Their Maintenance and Operation under Universal Service Obligation Stream-1." Reference No. 30-107/2002: New Delhi.

Department of Telecommunications. 2002c. "Guidelines for Implementation of Universal Service Support." Government of India, Ministry of Communications and Information Technology: New Delhi, available at [www.dotindia.com/uso.doc](http://www.dotindia.com/uso.doc).

Department of Telecommunications. 2003. *Annual Report 2002-2003*. Government of India, Ministry of Communications and Information Technology: New Delhi.

Department of Telecommunications. 2009a. *Annual Report 2008-2009*. Ministry of Communications and Information Technology: New Delhi.

Department of Telecommunications. 2009b. "List of MLD Licensees." July 14, 2009, available at <http://www.dot.gov.in/nld/nldindex.htm>.

Department of Telecommunications. 2009c. "List of ILD Licensees." July 14, 2009. Available at <http://www.dot.gov.in/ild/ildindex.htm>.

Department of Telecommunications. 2009d. "Amendment of ILD License Agreement." Ministry of Communications and Information Technology, August 21: New Delhi.

Department of Telecommunications. 2009e. "Auction of 3G and BWA Spectrum: Revised Information Memorandum." Ministry of Communications and Information Technology, October 23: New Delhi.

Department of Telecommunications. 2010. *Annual Report*. Ministry of Communications and Information Technology: New Delhi.

Desai, Ashok. 2003. "India's telecommunications Industry: Emerging Industry Structure." National Council on Applied Economic Research: New Delhi.

Desai, Ashok. 2006. *India's Telecommunications Industry: History, Analysis, Diagnosis*. Sage Publications: New Delhi.

Djankov, Simeon, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer. 2002. "The Regulation of Entry." *Quarterly Journal of Economics*, 117:1, pp. 1-37.

Fink, Carsten, Aaditya Mattoo and Randeep Rathindran. 2002. "An Assessment of Telecommunications reform in Developing Countries." Policy Research Working Paper 2909, World Bank: Washington, D.C.

Gairola, Manoj. 2004. "MoF Doesn't Sing to TRAI's Broadband Tune." *The Economic Times*, August 17: New Delhi.

Ghosh, Shyamal. 2004. Personal Communication.

Intelecon Research and Consultancy Ltd. 2002. "India: Universal Service Fund May Fail to Lift off." *regulateonline.org*, April 3, available at [www.regulateonline.org/intelecon/2002/April/A-India-020403.htm](http://www.regulateonline.org/intelecon/2002/April/A-India-020403.htm).

Intelecon Research and Consultancy Ltd. 2004. "India: Continued Strife over Access Deficit Charge." *regulateonline.org*, April 19, available at [www.regulateonline.org/intelecon/2004/April/A-India-040419.htm](http://www.regulateonline.org/intelecon/2004/April/A-India-040419.htm).

Internet Service Providers Association of India. 2004. "Internet Services Industry - An Overview." New Delhi, available at [www.ispai.com/overview.html](http://www.ispai.com/overview.html).

Intven, Hank and McCarthy Tetrault. 2000. *Telecommunications Regulation Handbook*. World Bank: Washington, D.C.

Jain, Rekha and Pinaki Das. 2001. "A Framework for Assessing Universal Service Obligations: A developing Country Perspective." Presented at *Telecommunications Policy Research Conference*: Washington, D.C., available at [arxiv.org/abs/cs.CY/0109050](http://arxiv.org/abs/cs.CY/0109050).

Joskow, Paul W., and Roger G. Noll, "The Bell Doctrine: Applications in Telecommunications, Electricity, and Other Network Industries." *Stanford Law Review* Vol. 51, No. 5 (1999): pp. 1249-1315.

Kessides, Ioannis. 2004. *Reforming Infrastructure: Privatization, Regulation, and Competition*. Oxford University Press and World Bank: New York.

Kumar, Ashu. 2003. "Cyber Cafe Market Doubles in Two Years: IMRB." *Financial Express*: April 1: New Delhi, available at [www.financialexpress.com/fearchive\\_frame.php](http://www.financialexpress.com/fearchive_frame.php).

Laffont, Jean-Jacques, and Jean Tirole. 2000. *Competition in Telecommunications*. MIT Press: Cambridge, Massachusetts.

Li, Wei, and Lixin Colin Xu. 2002. "The Impact of Privatization and Competition in the Telecommunications Sector around the World." Working Paper No. 02-13, Darden Graduate School of Business Administration, University of Virginia: Charlottesville, Virginia.

Littlechild, S. C. 2006. "Mobile Termination Charges: Calling Party Pays Versus Receiving Party Pays," *Telecommunications Policy* Vol. 30, No. 5-6 (June-July), pp. 242-77.

Meggison, William L. and Jeffery M. Netter. 2001. "From State to Market: A Survey of Empirical Studies on Privatization." *Journal of Economic Literature* 34:2 (June), pp. 321-89.

Ministry of Communications and Information Technology. 2003. "Gazette of India - Notification." Wireless Planning and Coordination Wing, April 8: New Delhi.

Mitchell, Bridger M., and Ingo Vogelsang. 1991. *Telecommunications Pricing: Theory and Practice*. Cambridge University Press: Cambridge, United Kingdom.

Nair, Vipin. 2003. "TRAI Debating Service Provider Status: ISPs' Claim for Revenue Share Suffers Setback." *The Hindu Business Line*, February 13: New Delhi.

Nicol, Chris. 2004. "Regulatory Strategy for Facilitating Dialup Access to the Internet in India." Internet Service Provider Association of India: New Delhi.

Noll, Roger G. 2000. "Telecommunications Reform in Developing Countries." In Anne O. Krueger (ed.), *Economic Policy Reform: The Second Stage*. University of Chicago Press, Chicago, Illinois.

Noll, Roger G., and Scott J. Wallsten. 2006. "Universal Telecommunications Service in India." In *India Policy Forum 2005-06*, Suman Bery, Barry Bosworth and Arvind Pamagariya, eds. Brookings Institution, 2006.

OECD Directorate for Science, Technology, and Industry. 2003. "Broadband Access in OECD Countries per 100 Inhabitants, December 2003." Organization for Economic Cooperation and Development: Paris, available at [www.oecd.org/document/31/0,2340,en\\_2649\\_34225\\_32248351\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/31/0,2340,en_2649_34225_32248351_1_1_1_1,00.html)

Ramachandran, T. V. 2003. "TRAI Consultation Paper on IUC Issues: Concerns on the Calculation of Access Deficit." Cellular Operator's Association of India: New Delhi.

Rosston, Gregory L., and Bradley S. Wimmer. 2000. "The 'State' of Universal Service." *Information Economics and Policy* 12, pp. 261-83.

Telecommunications Regulatory Authority of India. 1998. "Consultation Paper on Tariffs," Consultation Paper 98/3. New Delhi.

Telecommunications Regulatory Authority of India. 1999a. "The Telecommunications Tariff Order 1999." March 9: New Delhi.

Telecommunications Regulatory Authority of India. 1999b. "The Telecommunication Interconnection (Charges and Revenue Sharing) Regulation of 1999." May 28: New Delhi.

Telecommunications Regulatory Authority of India. 1999c. "Consultation Paper on Certain Aspects of Calling Party Pays (CPP) for Cellular Regime." August 31: New Delhi.

Telecommunications Regulatory Authority of India. 2000. "Consultation Paper on Universal Service Obligations," July 3: New Delhi.

Telecommunications Regulatory Authority of India. 2001. "Recommendations on the Opening of the International Long Distance Service Market," November 12: New Delhi.

Telecommunications Regulatory Authority of India. 2002a. "Recommendations of the TRAI on Universal Service Obligations," May 9: New Delhi.

Telecommunications Regulatory Authority of India. 2002b. "Report of the Task Force on Growth of Internet in the Country," August: New Delhi.

Telecommunications Regulatory Authority of India. 2003a. "The Telecommunication Interconnection Usage Charges Regulation." January 24: New Delhi.

Telecommunications Regulatory Authority of India. 2003b. "TRAI Finalises the Results of the IUC Review," April 19: New Delhi.

Telecommunications Regulatory Authority of India. 2003c. "The Telecommunication Interconnection Usage Charges Regulation, 2003 (4 of 2003)." October 29: New Delhi.

Telecommunications Regulatory Authority of India. 2003d. "The Telecommunication Tariff (Twenty-Ninth Amendment) Order," December 3, New Delhi.

Telecommunications Regulatory Authority of India. 2004a. "The Indian Telecom Services Performance Indicators Oct-Dec '03," March: New Delhi.

Telecommunications Regulatory Authority of India. 2004b. "Unprecedented Growth in telecom Services during Financial Year 2003-4." Press Release - No . 26, April 7: New Delhi.

Telecommunications Regulatory Authority of India. 2004c. "Broadband India: Recommendations on Accelerating Growth of Internet and Broadband Penetration," April 29, New Delhi.

Telecommunications Regulatory Authority of India. 2004d. "Growth in Telephony Continues in April 2004. Subscriber Base Touches 78 Million." Press Release - No. 32/2004, May 8: New Delhi.

Telecommunications Regulatory Authority of India. 2004e. "The Indian Telecommunication Industry Performance Indicators for FY 2003-2004," July: New Delhi.

Telecommunications Regulatory Authority of India. 2005a. "The Telecommunication Interconnection Usage Charges (Fourth Amendment) Regulation." January 6: New Delhi.

Telecommunications Regulatory Authority of India. 2005b. "Consultation Paper on Interconnection Usage Charge Review." March 17: New Delhi.

Telecommunications Regulatory Authority of India. 2006a. "Telecommunication Interconnection Usage Charges (Sixth Amendment) Regulation." February 23: New Delhi.

Telecommunications Regulatory Authority of India. 2006b. "Study Paper on Analysis of Internet & Broadband Tariffs in India." November 28: New Delhi.

Telecommunications Regulatory Authority of India. 2008a. "The Telecommunication Interconnection Usage Charges (Ninth Amendment) Regulation." March 27<sup>th</sup>: New Delhi.

Telecommunications Regulatory Authority of India. 2008b. "Consultation Paper on Issues Related to Internet Telephony." May: New Delhi.

Telecommunications Regulatory Authority of India. 2008c. "Consultation Paper on Growth of Value Added Services and Regulatory Issues." May 28: New Delhi.

Telecommunications Regulatory Authority of India. 2008d. "Recommendations on Issues Related to Internet Telephony." August 18: New Delhi.

Telecommunications Regulatory Authority of India. 2009a. *Annual Report 2008-2009*. New Delhi.

Telecommunications Regulatory Authority of India. 2009b. "Consultation Paper on Bandwidth Required for ISPs for Better Connectivity and Improved Quality of Service." January 15: New Delhi.

Telecommunications Regulatory Authority of India. 2009c. "Recommendations on Growth of Value Added Services and Regulatory Issues." February 13: New Delhi.

Telecommunications Regulatory Authority of India. 2010a. "The Indian Telecommunications Performance Indicators: July-September 2009," January 7, New Delhi.

Telecommunications Regulatory Authority of India. 2010b. "Telecommunication Subscription Data as on 28<sup>th</sup> February 2010," March 29, New Delhi.

Thomas, Thomas K. 2004. "DoT Shoots down TRAI Plan to Slash VSAT Licence Fee." *The Hindu Business Line*: New Delhi (July 12).

Umino, Atsushi. 2004. "Developments in Local Loop Unbundling." *Working Party on Telecommunications and Information Services Policies*, Organization for Economic Cooperation and Development: Paris.

Uppal, Mahesh. 2003. "India's Telecom Reform Exercise: A Chronological Account." National Commission on Applied Economic Research: Delhi.

Wallsten, Scott. 2001. "An Econometric Analysis of Telecom Competition, Privatization, and Regulation in Africa and Latin America," *Journal of Industrial Economics* 49:1, pp. 1-20.

World Bank. 2002. *World Development Report 2002: Building Institutions for Markets*. Washington DC: World Bank.

World Trade Organization. 1997. *India: Schedule of Specific Commitments -- Supplement 3*, GATS/SC/42/Suppl.3, April 17, 1997.