

THE DIFFUSION OF THE INTERNET IN THE ISLAMIC REPUBLIC OF PAKISTAN

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The Diffusion of the Internet in The Islamic Republic of Pakistan

Introduction

OVERVIEW OF PAKISTAN

History

The Islamic Republic of Pakistan, shown in Figure 1, was formed in 1947 by the partitioning of British India into India and Pakistan. The partition line was drawn through the formerly unified Punjab, with portions of Jammu and Kashmir in each new country. Immediately following partition, 12-14 million refugees crossed the dividing line, seeking safety with their co-religionists. In 1947 and 1948, efforts by the Muslim leader of the predominantly Hindu Junagadh and the Hindu ruler of the predominantly Muslim Kashmir to join Pakistan and India respectively led to the first war between these two states. An inability to resolve the dispute over the Kashmir region led to a second war in 1965, and a third armed conflict in May/June, 1999. The conflict with India has been one of the defining features of Pakistan's modern history, affecting Pakistan's foreign policy and economy.



Figure 1The Islamic Republic of Pakistan

In addition to conflicts with India, Pakistan suffered a brutal civil war in 1971 which preceded the independence of Bangladesh, formerly East Pakistan. A secessionist leader, Sheikh Mujibur Rahman, had won a landslide election in East Pakistan in 1970 and pressed for virtual independence from West Pakistan. Following failed negotiations with West Pakistan, he was arrested, and West Pakistan troops went into action against his followers. The following struggle,

in which millions of refugees fled to India and West Pakistan, ended only after the intervention of the Indian army in 1971.

While war and continuing conflict with India has been one defining quality of modern Pakistan, political instability has been a second. With the end of the civil war, the military ruler of Pakistan, General Agha Muhammad Yahya Khan, turned power over to Zulfikar Ali Bhutto, a foreign minister under a previous regime. Bhutto nationalized the basic industries, insurance companies, domestically owned banks, and schools and colleges. He also instituted land reforms that benefited tenants and middle-class farmers.

Against a backdrop of claims of election fraud, General Muhammad Zia Ul-Haq staged a successful coup on July 5, 1977. Zia was the first leader to turn the country away from secularism. He supplanted the civil code with Islamic law, the *sharia*, and started the trend toward orthodoxy. Following his death in a plane crash in 1988, Benazir Bhutto, daughter of the former Prime Minister, was appointed Prime Minister after her party, the Pakistan People's Party (PPP) won a general election in November. She was dismissed on corruption charges in 1990, and re-elected in 1993. The Bhutto government was again dismissed on charges of corruption in 1996. Elections in February, 1997, brought to power Nawaz Sharif and his Pakistan Muslim League. Sharif himself was ousted in a coup in October, 1999.

Politics

Pakistan is a democratic Islamic republic with a parliamentary system of government. The bicameral Parliament of Majlis-e-Shoora consists of the Senate (87 seats; members indirectly elected by provincial assemblies to serve six-year terms) and the National Assembly (217 seats, of which 10 represent non-Muslims. Members are elected by popular vote to serve five-year terms.) The president is elected by Parliament for a five-year term [58].

When the Minister Mohammed Nawaz Sharif became Prime Minister in 1997, he combined measures designed to bring economic liberalization, stability, and growth with those to solidify his own position. Among his first measures was the Pakistan 2010 Programme (described below). This program laid out a number of measures designed to cure some of the fundamental ailments of Pakistan and its economy: corruption, a depressed economy, low per capita income, low investment, violence, and political instability. Some early measures included broad reforms of the tax and tariffs laws reducing and streamlining them in an effort to stimulate economic growth [10].

On the political side, he weakened the presidency with a constitutional amendment that stripped the president of his power to dismiss the National Assembly, ousted a chief justice of the Supreme Court, and reversed the traditional balance of power between the military and civilian government. He carried out a campaign of intimidation against the press, and sought (unsuccessfully) to push through Parliament a bill making Islamic Law the supreme authority in Pakistan. In an article in *The Economist*, one writer wrote [89]:

Pakistan has been run by such dreadful governments for so long that it seems barely worth remarking on any deterioration. But whereas previous governments were chaotic in their awfulness, this one has turned out to be systematic. Over the past two years Nawaz Sharif, the prime minister, has been picking off individuals

and institutions that he believes pose any threat to his own power. He has seen off a president and the chief of the army staff, and is now trying to push through a constitutional amendment that would give him sweeping powers to ignore Pakistan's legislature and provincial governments in the name of Islamisation.

Sharif was not able to deliver on his promises, or hold onto his control. While the explosions of nuclear weapons in May, 1998 provided a morale boost to much of the country, it did nothing to address structural weaknesses and, in light of world reaction, ultimately harmed the economy. Reports of political, legislative, judicial, and financial crises quickly sapped the enthusiasm over Pakistan's response to Indian tests. Murders and other forms of lawlessness in Karachi and elsewhere created a climate little conducive to investment and trade [92]. In May, 1999, Pakistan-backed guerrillas invaded Indian Kashmir, only to retreat a few weeks later. The dissolution of a battlefield victory into a diplomatic loss left many in the army and the country disillusioned with Sharif [88]. Given the history of Pakistan's Prime Ministers, his ouster in a coup in October, 1999 was not particularly startling.

Economy

Since Pakistan was founded in 1947, the economy has been characterized by periods of relative hopefulness and growth that are usually overshadowed by longer periods of stagnation or decline precipitated by economic shocks and sustained by systemic weaknesses. The 1960s were years of considerable growth. The real GDP grew by an average of 6.8% per year at a time when major advances taking place in the agricultural and industrial sectors. During these years Pakistan pursued an import-substitution, highly protectionist policy. The Green Revolution fueled the growth of the agricultural sector.

During the 1970s, Pakistan experienced a series of disruptions to its economy. The country engaged in a Civil war which drew in India intervention in 1971; land reforms created considerable uncertainty; instability was a dominant characteristic of the political scene; a cotton virus severely impacted Pakistan's largest export commodity; nationalization in 1972 shattered investor confidence; oil prices increased five-fold in 1973. These and other factors contributed to a prolonged recession for most of the decade.

During the 1980s, policy changes favoring gradual decontrol, deregulation, and denationalization began to pay dividends, and, with the improving global economic, Pakistan experienced growth rates comparable to those of the 1960s. However, most of this growth was due to increases in factor inputs (labor and capital) rather than from improvements in productivity [18]. The real GDP grew at an annual rate of 6.5% helped by 4.1% growth in agriculture and 8.2% growth in large-scale manufacturing.

During the 1990s, the economy again has experienced substantial deceleration. Between 1991-1997, the real GDP growth rate declined to 4.7% per annum. According to the Pakistan 2010 Programme, the factors that have been most responsible for the worsening economic landscape are: political instability (between 1988-1996 Pakistan saw the dismissal of three elected governments and four caretaker regimes), worsening of law and order in major growth poles of the country; setbacks to the cotton crop and consequential increases in cotton prices which adversely affected textile and related industries; inadequate power supply along with frequent

breakdowns of power units around industrial areas; emergence of significant infrastructural bottlenecks in power, transport, and other sectors, and insufficient industrial investment [18].

<i>Metric</i>	<i>Value</i>	<i>Remarks</i>
Population	139 million	January, 1998 est. [16]
	130.6	1998 est. [31]
Population growth rate	2.7-3.0%	July 1999 est.
GDP	\$65 billion	1998 est.
GDP per capita	\$457	1998 est.
Inflation rate	13.9%	
Literacy	37.8%	
Telephones	3.2 million	1997 est.
	4 million	1999 (est.)
Teledensity	1.78	1997 per 100 people [30]
	2.25	1999 Per 100 people
	3.49	2000 (est.) per 100 people

Table 1 Pakistan in Statistics. Source: [8,16,58]

Geography and demographics

Pakistan is a country of the Southern Asian littoral of 803,940 km² on the northeastern tip of the Northern Arabian Sea. It has 1,046 km of coastline and shares land borders with Iran (909 km) to the west, Afghanistan (2,430 km) to the north, China (523 km) to the northeast, and India (2,912 km) to the east.

The climate and terrain of Pakistan are both varied and difficult. In the east is the flat Indus plain, and there are mountains in the north and northwest, tapering off to the Balochistan plateau in the west. As a result the climate is mostly hot, dry desert, with a more temperate climate in the northwest and arctic conditions in the Hindu Kush and Karakoram mountains of the north.

Pakistan's nature resources include extensive natural gas reserves, limited petroleum, poor quality coal, iron ore, copper, salt, and limestone. About 23 percent of the country's land is arable, and agricultural enterprise occupies about 46 percent of the 36 million-strong labor force. Frequent natural disasters, principally earthquakes and flooding along the Indus River after heavy rains, hamper the government's attempts to develop a sustainable infrastructure.

The capital of Pakistan is Islamabad. The country is divided into four provinces, the Autonomous Tribal Areas territory, the Islamabad Capital Territory, and two federally Administered Regions. The Pakistani-administered portion of the disputed Jammu and Kashmir region is known as Azad Jammu and Kashmir is officially "independent," according to Pakistani government policy that does not recognize the 1947 UN partition of Kashmir.

According to 1999 estimates, the population of Pakistan is about 138 million people, with an annual growth rate of 2.18%. The major ethnic groups in Pakistan include Punjabi, Sindhi, Pashtun (Pathan), Baloch, and Muhajir (Muslim immigrants from India at the time of partition in 1947 and their descendents). Although the official language is Urdu, it is considered their first language by only about 7 percent of the population. English is the second official language, and is the *lingua franca* of Pakistani elite and most government ministries. Other languages widely used include Punjabi (64%), Sindhi (12%), Pashtu (8%), and Balochi. The population is 97% Muslim (Sunni 77%, Shi'a 20%); the remainder is predominantly Christian or Hindu. About 33 percent of the population is literate.

KEY ORGANIZATIONS

Telecommunications Service Providers

Pakistan Telecommunication Company, Ltd. (PTCL). The PTCL is a private company wholly owned by the government of Pakistan, established by the Pakistan Telecommunication Act, 1996 to provide domestic and international telecommunications services to Pakistan [62]. The PCTL has an exclusive license to provide basic telephone service through the year 2003. Basic telephone services include (i) two-way live voice telephone service, digital or otherwise, (ii) real-time fax transmission over the PSTN, (iii) international telephony services, (iv) the lease of circuits for the provision of such services [62].

National Telecommunication Corporation (NTC). The National Telecommunication Corporation was created by the Pakistan Telecommunication Act, 1996 to provide telecommunication services within Pakistan only to the armed forces, defense projects, Federal Government, Provincial Governments other government agencies determined by the Federal Government.

Government organizations

Ministry of Communications. The Ministry is responsible for policy-setting and oversight for the telecommunications sector, including licensing of data network operators and oversight of public sector data networking projects. Up until 1990, all telecommunications services were provided by the Ministry's Telephone and Telegraph Department. In 1990, the department was spun off from the Ministry as the Pakistan Telecommunication Corporation (PTC). The Ministry retains broad policy making powers, which are exercised principally via the Pakistan Telecommunications Authority.

Pakistan Telecommunication Authority. Formed under the Pakistan Telecommunication Act, 1996, the Pakistan Telecommunication Authority (PTA) is the regulatory body for all telecommunications services in Pakistan. Among its aims are a liberalized environment for telecommunications equipment and services, the creation of a backbone for reliable connectivity, promotion of the Internet, and maximization of economic impact of value-added services [70]. It is, in particular, responsible for licensing ISPs and setting rates for international telecommunication connections [57].

Information Technology Commission. Formed in July, 1997, the Technology Commission consisted of 10 members from academia, the private sector, and federal and provincial government who were tasked with addressing such issues as: (i) the speedy introduction and promotion of information technology in all spheres of the Federal, Provincial, and local governments; (ii) identification of areas of taxation, licensing/registration, of Federal/Provincial/Local Governments, and Autonomous Bodies for outsourcing appropriate activities; (iii) assisting Provincial governments in outsourcing appropriate activities, (iv) creation of important databases for the national economy; (v) strengthening and expanding training and educational facilities in the area of information technology [4,91]. The commission has sunk somewhat in prominence, and is now called the IT Working Group and meets at the Sustainable Development Policy Institute [49].

Academic organizations

Unlike in many other countries, the academic sector has not been a major force in the development of the Internet in Pakistan. Lahore University of Management Sciences (LUMS) has been the most active in this area. A faculty member of LUMS, Dr. Syed Zahoore Hassan, has been a member of the Information Technology Commission, and has conducted studies on the state of telecommunications and the software industry in Pakistan [27].

Other

Internet Service Providers Association of Pakistan (ISPAK). ISPAK was founded in 1998 as an association between 11 Pakistani ISPs (Asia Online, BrainNet, CompuNet, COMSATS, CyberAccess, CyberNet, Digicom, Fascom, GlobalNet, IBM, SuperNet). The association has a broad slate of aims, including [7]:

- Present a united forum for presenting the Issues and points of view of the ISPs and their users to the Government, PTA and PTCL.
- Present a joint forum for getting optimal pricing and technical solutions from PTCL regarding domestic leased fiber capacity, local dial-in lines, delivery of International circuit and any other areas requiring interface with PTCL.
- Evaluate new protocols and standards e.g. RSVP, IPV6, Internet commerce related issues, security, etc for standardized implementation in the Networks.
- Co-operate in all technical, administrative and financial aspects to work toward creating local interconnect between all the ISPs of the country.
- Private Peering arrangements will be made in order to provide for alternate routes in case of failures so that the end users of the member ISPs do not suffer because of individual link failures.
- The ISPAK will come up with a complete plan for implementing a true Pakistani Internet backbone in the private sector. This will include the administration of the Pakistan TLD in Pakistan via a neutral body.

Internet Association of Pakistan. Internet Association of Pakistan (IAP) established in 1997, is a non-profit organization whose principal aim has been to promote the Internet and Internet literacy in Pakistan. The main claim to fame of the association appears to have been the role it played in convincing the Government of Pakistan to exempt phone calls for Internet users from the practice of multi-metering (discussed below) [29].

Networks in Pakistan

A BRIEF HISTORY OF TELECOMMUNICATIONS

Until 1990, telecommunication services in Pakistan were provided by the Telephone & Telegraph (T&T) Department of the Ministry of Communications, which oversaw on the order of 800,000 telephone lines throughout the country. Like many such providers in other countries, the TT had limited autonomy to plan, execute, and finance expansion of telecommunications services or networks.

During the 1980s, global trends towards deregulation, privatization, and open markets combined with substantial technological innovations in telecommunications and data networks to push the issue of telecommunications infrastructure to the forefront of many countries' policy-making efforts. These trends, coupled with the often not-so-subtle encouragement of international financial institutions, led policy makers in many developing countries to consider the importance of a sound telecommunications infrastructure to the future health and growth of their economies.

Pakistani policy-makers realized the value of an expanded and competitive telecommunications sector, and in 1991 passed the Pakistan Telecommunications Corporation Act, 1991. This act restructured the T&T Department into a state-owned corporation, the Pakistan Telecommunications Corporation, with operational and financial autonomy. Some of the stated goals of the measure were [8]:

- promotion and rapid development, modernization, and diversification of telecommunications services;
- improvement in performance quality of service and operational efficiency of the telecommunications sector, especially with regard to basic services;
- privatization of the PTC to help inject private sector capital and skills into its operation;
- encouragement of increasing private sector participation in telecommunication development;
- facilitation of new investment and competition in telecommunications by enabling legal and regulatory framework;
- redefinition of the role of government from an operator to that of a regulator.

One of the very significant results of this reform was the introduction of private operators to provide value-added services. Between 1991 and 1996, the year of the next major restructuring of the telecommunications market, a number of private companies received licenses for a number of services, including data communications. In 1994, fifteen companies were given licenses to operate domestic data networks, with international links through PTC, servicing primarily the business, industry, education, and government sectors.

Concurrently, the Pakistani government carried out a huge expansion of the telecommunications system by PTC, which quadrupled the number of lines (to 3.2 million) by 1997 [8].

In 1996, the Pakistan Telecommunication (Re-organization) Act, 1996 (PTA 1996) introduced a new telecommunications regime through the creation of the Pakistan Telecommunication Authority, two new corporations out of the Pakistan Telecommunication Corporation, and a Frequency Allocation Board [62].

The functions of the Pakistan Telecommunication Authority were [62]:

- to regulate the establishment, operation, and maintenance of telecommunication systems and the provision of telecommunication services in Pakistan;
- to receive and expeditiously dispose of applications for the use of radio-frequency spectrum;
- to promote and protect the interests of users of telecommunication services in Pakistan;
- to promote the availability of a wide range of high quality, efficient, cost effective and competitive telecommunication services throughout Pakistan;

-
- to promote rapid modernization of telecommunication systems and telecommunication services;
 - to investigate and adjudicate on complaints and other claims made against licensees arising out of alleged contraventions of the provisions of [the PTA 1996], the rules made and the licenses issued thereunder and take action accordingly;
 - to make recommendations to the Federal Government on policies with respect to international telecommunications, provision of support for participation in international meetings and agreements to be executed in relation to the routing of international traffic and accounting settlements;
 - to perform such functions as the Federal Government may, from time to time, assign to it.

The PTA 1996 also broke the Pakistan Telecommunication Corporation into two companies. The new Pakistan Telecommunication Company Limited (PTCL) received 95% of PTC's infrastructure, assets, resources, and employees. PTCL received a license from the PTA to provide 'basic telephone service', which the PTA 1996 defined as

1. two-way live voice telephone service, in digital form or otherwise, over any public fixed switched network or between base stations or switches or modes of any public mobile switched network;
2. real-time transmission or reception of facsimile images over a public fixed switched network,
3. international telephony service,
4. the lease of circuits for the provision of the services specified in (1), (2), and (3).

A second company, the National Telecommunication Corporation (NTC) received 5% of PTC's infrastructure, assets, resources, and employees, and received a license from PTA to provide "telecommunications services within Pakistan on a non-exclusive basis only to the armed forces, defense projects, Federal Government, provincial Governments, or such other Governmental agencies or Governmental institutions as the Federal Government may determine; and ...the National Telecommunication Corporation shall not sell its capacity on the telecommunication system to any person other than such Government agencies or the [PTCL]" [62].

The licensing of PTCL to be the sole provider of basic telephone service, and the creation of the PTA as the licensing authority with a clear mandate to encourage provision of non-basic telephone services opened the door for the creation of the Internet Service Provider (ISP) market.

Growth of telephone subscriber lines

By 1999, 32 of the largest cities in Pakistan were connected by a fiber optic/digital cross connect system. A second high capacity fiber optic link, catering to 20 cities, was commissioned in 1998 [48]. This OC-12 (622 Mbps) fiber optic cable runs from Peshawar through to Karachi [68].

In spite of a poor economy, Pakistan has continued to make telecommunications a high priority for government spending. The Public Sector Development Programme (PSDP) for 1999-2000 prioritized infrastructure development and the telecommunications sector, to the tune of Rs 110 billion through 2000. Overall, the growth of telecommunications lines and services has been a rather bright spot in a dreary economic landscape [41]. By June, 1998, Pakistan had an estimated

2.75 million phone lines. By mid-1999, the number of telephone lines in Pakistan was expected to reach nearly 4 million [68,79].

We list below a number of recent initiatives impacting the expansion of telecommunications services in Pakistan.

In April, 1998, China Wan Bao Engineering Corporation was the low bidder for a \$27 million contract from PTCL to install nearly 190,000 new lines and nearly 80,000 replacement lines in various parts of Pakistan. The switching center proposed by the Chinese would bring the total number of switching systems to five. The other four were installed by NEC, Ericsson, Siemens, and Alcatel [12]. In October, 1998, PTCL formally awarded the contract to China Wan Bao. At the time of contract award, Wan Bao intended to set up three exchanges on a trial basis in Karachi, Lahore, and Islamabad and eventually expand to 40 country-wide. The \$95 million contract specifies the installation of a total of 266,000 new and replacement lines over a two year period [14].

In July, 1998, PTCL issued a letter of intent to the Pakistani company Telecard for a \$200 million project to set up a wireless local loop (WLL) system to provide 160,000 telephone lines. Thirty percent of the lines would be in areas where PTCL has no lines [2,14]. Funding for the project would come from the United Nations backed WorldTel (\$96 million), and the remainder raised through a loan, possible through an Islamic facility. When it was signed, the contract called for 150,000 lines at approximately \$1000 per line. The development could be worth up to \$175 million [14].

In August, 1998, PTCL approved a \$280 million annual development plan to enhance Pakistan's telecommunications infrastructure.

THE ORIGIN OF THE INTERNET IN PAKISTAN

In 1991, two Pakistani computer enthusiasts established an UUCP e-mail connection to the global Internet from the IMRAN.AR.PK host. Located in New York City, this node would batch e-mail traffic and, through an international phone call to Lahore, exchange e-mail with domestic servers [51].

Following the introduction of the Mosaic Web browser in 1993, the Internet in the United States surged in size and popularity, with the commercial sector experiencing the greatest rates of growth. By 1995, Pakistani policy makers had begun to appreciate the potential of the medium for economic development. The IMRAN service proved sufficiently useful that in 1995 the Pakistani government solicited proposal for establishing a public e-mail service [51]. Sixteen companies were awarded licenses for e-mail and Internet services in February, 1996.

THE EMERGENCE OF INTERNET SERVICE PROVIDERS

Some of the licensees began offering service even before the regulatory regime and their licenses were finalized. Digicom launched the first on-line Internet service, in Karachi, in 1995. This service was connected to the global Internet by a 64 Kbps line. In 1996, the PakNet data network, operated by PCTL was upgraded to provide Internet services as well. PakNet was connected to the global internet via total of 512 Kbps. By mid-1997, nine ISPs were operational, offering services in five cities to approximately 25,000 subscribers [8,40]. PTCL also offered Internet service in 10 cities to approximately 8,500 subscribers.

A multitude of Internet Service Providers emerged quickly following the introduction of Internet service in 1995. The Pakistan Telecommunication Act, 1996 stated that "No licenses to provide basic telephone service shall be issued by the [Pakistan Telecommunication] Authority for a period of seven years from the effective date referred to in section 35 [Oct. 13, 1996] vesting property in the [Pakistan Telecommunication] Company other than to the National Telecommunication Corporation and the [Pakistan Telecommunication] Company" (Chapter IV (39)(3) [62]. While it makes no direct mention of the Internet, the Pakistan Telecommunication Act, 1996 does not prohibit the licensing of private companies to provide a host of value added services, including Internet services.

In mid-1998, PTCL obtained a license for the establishment of the Paknet Internet service. PTCL planned to provide 100,000 new connections [13]. Equipment is provided through a consortium led by Germany's Siemens, which includes the American company, Bay Networks, Inc. In the Spring of 1999, PTCL shareholders decided to invest \$1 million in its Paknet Ltd. subsidiary [83].

By mid-1999, licenses to provide Internet service had been issued to approximately 100 organizations, of which 50 were operating [48]. NetMag, an on-line magazine devoted to the Internet in Pakistan (<http://netmag.com.pk>) listed 27 ISPs in its May-June, 1999 issue. In its Sept-Oct, 1999 issue, it listed 40, a 50% increase in four months.

INTERNET INFRASTRUCTURE PROJECT

The most significant technical development affecting the Internet in Pakistan has been the Internet Infrastructure Project, initiated in 1998. This project, phased over three years (1998-2000) and costing Rs 700 million is designed to accommodate 500,000 customers in 90 cities, including all district towns [48].

In August, 1998, the board of directors of PTCL approved the investment of over Rs 3 billion (US\$ 56 million) for an expansion program of a number of telecommunications services, including the Internet. The plan involved the creation of three wholly-owned subsidiaries, one of which, Pak Internet Limited, was developed exclusively to the provision of Internet services. Rs 1 billion would be spent on creating the three subsidiaries, and Rs 2 billion would be used to provide 750,000 new telephone lines over an 18 month period ending in February or March 2000 [65].

In April, 1999, the Planning Commission announced that the Public Sector Development Programm (PSDP) for 1999-2000 would include provisions for adding 300,000 new Internet connections [56].

Phase 1 of the project was completed in August, 1999, with testing carrying through the end of September [66]. This phase involved the addition of 50,000 Internet connections [67], Internet Service Providers and dialup users in Karachi, Lahore and Rawalpindi/Islamabad were connected to the new infrastructure in August, and those in Peshawar and Quetta were connected in September.

Government Initiatives Impacting the Internet

PAKISTAN 2010 PROGRAMME

The Pakistan 2010 Programme is a program established by Prime Minister Mohammed Nawaz Sharif in 1997 to bring about "the Quaid's glorious vision." The vision is based on four goals [3]:

1. Justice for all Pakistanis, including women, minorities and other vulnerable groups;
2. Tolerance of opinion, belief, custom, values, behavior, life style and knowledge;
3. Knowledge for production and competition and for its own sake; and
4. Entrepreneurship, not in the send of an ability to exploit others, but rather as a behaviour that innovates, produces and serves society.

Economic prosperity is essential to this vision. Good governance is essential to economic prosperity. Therefore, the principal goals of the Pakistan 2010 Programme were to establish good governance, double per capita income and ensure equitable access to economic opportunity and quality social services.

According to policy-makers, economic prosperity also could not be built on the "old paradigm" of infrastructure creation, but had to be built on the new paradigm of "knowledge creation and its utilization." Among the major Pakistan 2010 goals is the promotion of science and technology [46]. The Pakistan 2010 Programme places the shift from material-based to knowledge-based production as one of the six key steps that define the programme's Action Plan [5]:

A second shift is from material-based towards knowledge-based production. The international context has changed dramatically over the last fifty years, and comparative advantage has shifted from those with access to raw material to those with access to knowledge. Pakistan must be prepared to operate in the new scenario. To this end, policy must guide investment into high-tech areas, through support for information technology, technical education, incentives for knowledge production, provision of free and open access to information, opening up credit markets to knowledge industries, and generally creating and enabling environment for research and technology development.

Accordingly, Pakistan 2010 includes a concerted programme for upgrading the science and technology infrastructure in the country.

The multiple objectives are intertwined. The shift to knowledge-based production requires investment. Investment requires the creation of a positive investment climate. A positive investment climate requires the development of "a sound and credible financial system, adequate ready credit availability, a simple and transparent regulatory system (through autonomous statutory bodies wherever possible), a transparent and effective tax and tariff system, a stable policy regime, a reliable certification system, a planning system oriented towards indicative planning to assist investors in forecasting future economic trends, collaborative policy making, and revamped SROs" [5].

PRIVATIZATION OF PAKISTANT TELECOMMUNICATION COMPANY LTD.

In 1991, the Pakistani government established the Privatization Commission with the goals of reducing the government's debt, and generating resources to reduce loan liabilities. In 1994, a decision was made to privatize PTCL by selling a 26% stake in the company [11]. But 1997, the company still was not privatized, but the government borrowed Rs. 250 million against the company's future earnings through the sale of bonds [6]. The Government of Pakistan continued to be unable to find a suitable investor. In May, 1997, privatization was postponed [75]. A few

weeks later, Prime Minister Sharif mandated the sale of the company within a year [52]. No investor was forthcoming. Government changeovers, differing views on how to sell the companies assets, and financial crises in the international markets have all be identified as factors contributing to the delay. By early 1999, the deadline for a sale had been pushed back to July, 1999 [74]. Goldman Sachs was hired to formulate a strategy for privatizing PTCL, including a plan for road shows and seminars for the sale of the 26% [24,60]. Following a visit to Pakistan in early 1999, Goldman Sachs set a new deadline of February, 2000 for the sale of the company [55].

The prolonged effort to privatize PTCL revealed a conflict between privatization and the goal of encouraging a fledgling Internet services. In order to make PTCL attractive to investors and minimize the government's budget deficit, the regulatory authorities in 1998 gave approval for a number of measures to enhance PTCL's revenue stream [92]. These included the right to increase the telephone tariffs by Rs. 55 per month, and limit local calls to 5 minutes. While the announcement of these rate increases was accompanied by an announcement of a 15% reduction of nationwide calls and decreased connection charges and, the latter were more than offset by a Central Excise Duty of 15%. Each of these measures increased the cost burden on users of local telephone service. Typical Internet access is characterized by much longer than average local telephone calls.

Analysis Framework Dimension

In the last six years, the Internet has not only taken root in Turkey, but has begun to flourish. In this section we present the quantitative aspects of this evolution, captured in six analytic dimensions of an analytic framework for studying the diffusion of the Internet, shown in Figure 2. The following section, a discussion of the Determinants, provides a deeper analysis of why the Internet has the metrics it does, and how it might be changing in the future.

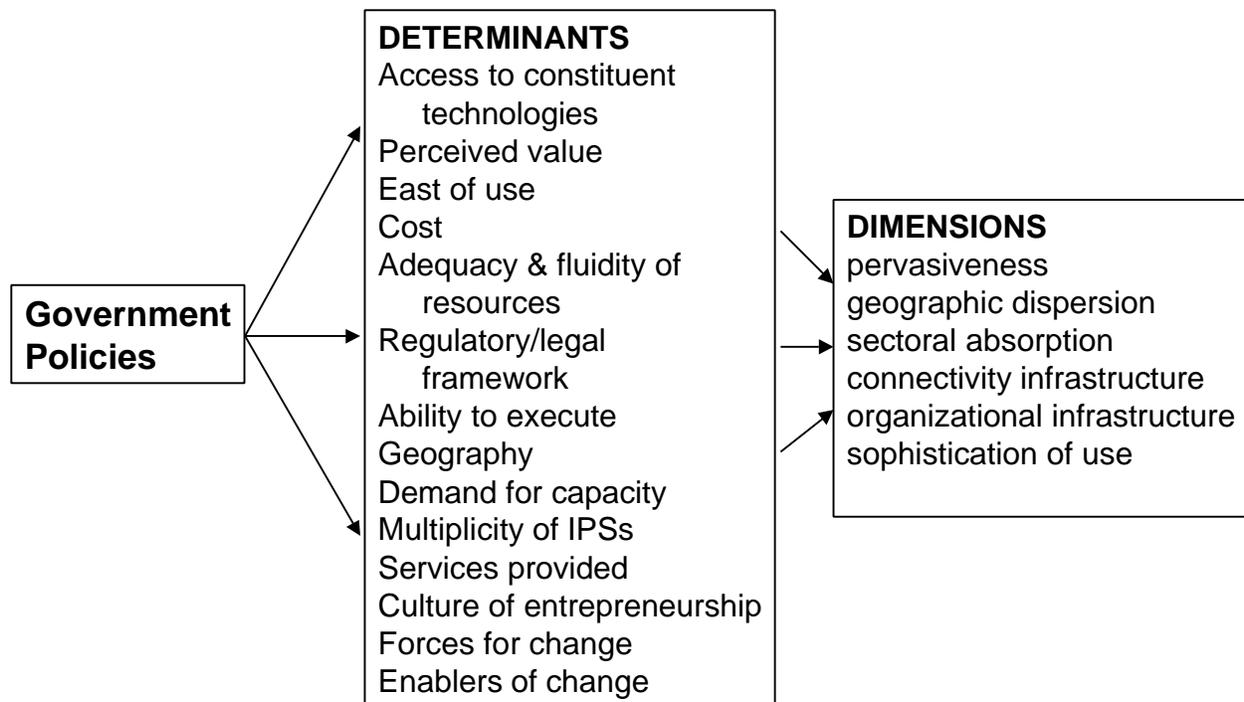


Figure 2 An Analytic Framework for the Diffusion of the Internet

PERVASIVENESS

Pervasiveness is a function principally of the number of subscribers and hosts per capita. It differs from commonly used Internet growth metrics only in that the final measure of pervasiveness is not an absolute number, but a ranking of that number in one of five levels. The intent is to depict the fraction of a population that uses the Internet regularly. A determination of the number of users of the Internet is always problematic. A basic difficulty is the confusion between Internet users and Internet subscribers. The latter are those who have an account with an Internet Service Provider. While individual ISPs may have precise data on the number of accounts they have, they may not publish accurate figures. Furthermore, in some contexts, such as at Universities and at Internet Cafes, the concept of a "subscriber" may have little direct correspondence with the number of individuals accessing the Internet through the provider. Even in the case where an identifiable individual subscribes to an ISP's service, that individual may share his or her account with a number of friends or members of the family.

Nevertheless, tracing the numbers which are available over time provides clear indications of the trends. The order of magnitude difference between dimension levels within the analytic framework means that in most cases differences of a factor of two or three are unlikely to result in different dimension values.

The Internet user community in Pakistan has grown steadily since service was first offered in 1995. The following table illustrates the growth in Internet subscribers and users. Khan estimates that the number of users is approximately four times the number of subscribers [45].

Date	Number of subscribers	Number of users	Source
1995	1500 (.001%)		[47]

1997	2,000-3,000 per ISP (18-27,000) (.013-.02%)		[40]
November, 1997	25,000 (ISPs) + 8,500 (PTCL) (.024%)		[8]
November, 1997		45,000 (.032%)	[76]
December, 1997	20,000-40,000 (.014-.029%)	Approx. 120,000+ (.087%)	[45]
August, 1998	50,000 (.035%)		[79]
September, 1998	50,000 (.035%)		[78]
1998	70,000 (.049%)		[47]
February, 1999	60,000 (.045%)		[96]
August, 1999	80,000 (.042%)		[48]
November, 1999	250,000 (.17%)		[47]
2003 (est.)	400,000 (.25%)		[79]

Table 2 Number of Internet Subscribers and Users in Pakistan

If Khan's estimate is correct, and the percent of the population using the Internet is four times greater than the percentages shown above, then Pakistan passed from Level 1 (*Embryonic*, <.1% users) to Level 2 (*Established* >.1% users) in late 1997 at the earliest. If estimates that the number of Internet subscribers will increase by a factor of five by 2003 are correct, then it is possible that Pakistan could reach Level 3 (*Common*, >1% users) by that year. In conversations held in November, 1999, representatives of ZoocomNet stated that the number of subscribers had grown from 70,000 in 1998 to 250,000 in the fourth quarter of 1999 [47]. While it would not be surprising if these figures are inflated, they point to very rapid growth of the user base in Pakistan at present, with some possibility that Pakistan could reach Level 3 (*Common*) as early as the year 2000.

Level 0	<i>Non-existent:</i> The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country. There may be some Internet users in the country; however, they obtain a connection via an international telephone call to a foreign ISP.
Level 1	<i>Embryonic:</i> The ratio of users per capita is on the order of magnitude of less than one in a thousand (less than 0.1%).
Level 2	<i>Established:</i> The ratio of Internet users per capita is on the order of magnitude of at least one in a thousand (0.1% or greater).
Level 3	<i>Common:</i> The ratio of Internet users per capita is on the order of magnitude of at least one in a hundred (1% or greater).
Level 4	<i>Pervasive:</i> The Internet is pervasive. The ratio of Internet users per capita is

on the order of magnitude of at least one in 10 (10% or greater).

Table 3 Pervasiveness of the Internet in Pakistan

GEOGRAPHIC DISPERSION

Geographic Dispersion describes the physical dispersion of the Internet within a country, there being benefits to having multiple points-of-presence, redundant transmission paths, and multiple international access points. As currently defined in the analytic framework, geographic dispersion is a function of the fraction of first-tier political subdivisions with an Internet point-of-presence. Pakistan is divided into four provinces (Balochistan, North-West Frontier, Punjab, Sindh), one territory (Administered Tribal Area), and one capital territory (Islamabad Capital Territory). A review of ISP web sites during the summer and fall of 1999 showed advertised presence as shown Table 4. The numbers are not exact; a number of ISPs did not indicate the cities in which they had POPs; others may not have provided complete listings. According to some sources, thirty cities in Pakistan now have ISP points of presence [48].

<i>City</i>	<i>No. ISPs</i>	<i>Province</i>
Karachi	21	Sind
Lahore	15	Punjab
Islamabad	8	Islamabad Capital Territory
Rawalpindi	4	Punjab
Hyderabad	4	Sind
Sialkot	3	Punjab
Faisalabad	3	Punjab
Peshawar	3	Northwest Frontier
Gujranwala	2	Punjab
Multan	2	Punjab
Rahim Yar Khan	2	Punjab
Bahawalpur	1	Punjab
Sukkur	1	Sind
Gujrat	1	Punjab
Sahiwal	1	Punjab
Sheikhupura	1	Punjab
Mardan	1	Northwest Frontier
Quetta	1	Baluchistan

Table 4 ISP Concentration in Pakistani Cities

A geographic representation of this data is shown in Figure 3. This figure illustrates two important points. First, ISPs generally lie along the route taken by Pakistan's major fiber optic backbone cables. The backbone was laid in two stages. The first stage connected Karachi and Rawalpindi with 2,036 km of fiber via thirteen cities including Karachi, Hyderabad, Sukkur, Rahimyar Khan, Multan, Sahiwal, Gujranwala, Lahore, Faisalabad, Sargodha, Kharian, and Jhelum. This 565 Mbps SDH cable was funded by a World Bank loan and completed in 1993 [28]. The second stage, completed in mid-1994, consisted of two segments. The first segment connected Peshawar to Rawalpindi; the second segment connected Peshawar and Karachi. The latter has terminal stations in Hyderabad, Dadu, Larkana, Shikarpur, Dera Ghazi Khan, Muzaffargarh, and Dera Ismail Khan [77]. Interestingly, none of the ISPs advertise POPs in any of the cities connected by the second segment.

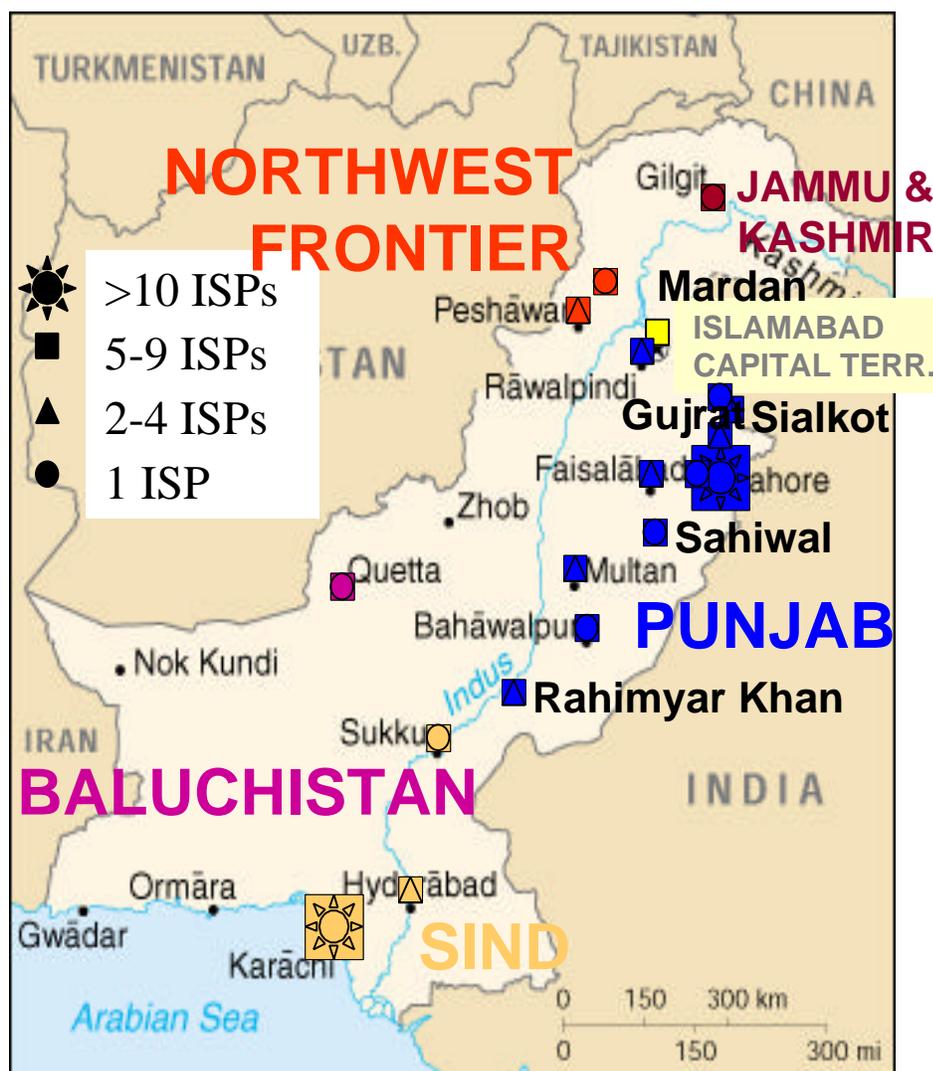


Figure 3 ISP Concentration in Pakistani Cities

The second major point illustrated in Figure 3 is that POPs are now found in all four Pakistani Provinces. The location of ISPs reflects the underlying geographic influence that shapes not only the geographic dispersion of the Internet, but the socio-economic structure of the country itself.

Most of Pakistan's people, industry, and power lie within the Indus River valley and the fertile basin of its tributaries rather than in the mountains and plateaus of the Western and Northeastern portions of the country. Although Internet points of presence are found in all provinces, rural access is by no means publicly and commonly available. As a result, Pakistan cannot have a rating higher than 3 (*Highly Dispersed*) for Geographic Distribution, as indicated in Table 5.

Level 0	<i>Non-existent.</i> The Internet does not exist in a viable form in this country. No computers with international IP connections are located within the country.
Level 1	<i>Single location:</i> Internet points-of-presence are confined to one major population center.
Level 2	<i>Moderately dispersed:</i> Internet points-of-presence are located in at least half of the first-tier political subdivisions of the country.
Level 3	<i>Highly dispersed:</i> Internet points-of-presence are located in at least three-quarters of the first-tier political subdivisions of the country.
Level 4	<i>Nationwide:</i> Internet points-of-presence are located in all first-tier political sub-divisions of the country. Rural access is publicly and commonly available.

Table 5 Geographic Dispersion of the Internet in Pakistan

SECTORAL ABSORPTION

Sectoral Absorption recognizes the differing impacts of the degrees to which four major Internet-using sectors of society have taken up the technology: the academic, commercial, health, and public (government) sectors. The sectoral absorption of the Internet in a country is determined by first evaluating the absorption of the Internet in four principal segments of the country's economy, as shown in Table 6. Based on these ratings, an aggregate score is given, assigning one point for each sector that rates at *rare*, two points for each *moderate* sector, and three points for each *common* sector. The ratings shown give Pakistan a score of Level 1 (*Rare*) for sectoral absorption, but should any single sector move into the Moderate column, Pakistan would reach a Level 2 (*Moderate*). The estimations are quite speculative, and there currently exist a number of plans which, if brought to fruition, will change the sectoral absorption substantially. It is likely that Pakistan will reach Level 2 in the near future, if it hasn't already.

<i>Sector</i>	<i>Rare</i>	<i>Moderate</i>	<i>Common</i>
Academic - primary and secondary schools, universities	>0-10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	>90% have leased-line Internet connectivity
Commercial-businesses with more than 100 employees	>0-10% have Internet servers	10-90% have Internet servers	>90% have Internet servers
Health-hospitals and clinics	>0-10% have leased-line Internet connectivity	10-90% have leased-line Internet connectivity	>90% have leased-line Internet connectivity

Public-top and second tier government entities	>0-10% have Internet servers	10-90% have Internet servers	>90% have Internet servers
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Table 6 Absorption of the Internet in Sectors of the Pakistan Economy

Sectoral point total	Absorption dimension rating	
0	Level 0	<i>Non-existent</i>
1-4	Level 1	<i>Rare</i>
5-7	Level 2	<i>Moderate</i>
8-9	Level 3	<i>Common</i>
10-12	Level 4	<i>Widely used</i>

Table 7 Sectoral Absorption of the Internet in Pakistan

Education

While most colleges have dial-up access, according to one source less than 0.5% have leased line connectivity [47]. Connectivity among K-12 schools is very low. However, this may change. Mr. Ahsan Iqbal, Deputy Chief Planning Commission, told a workshop on Private Sector Reforms in Islamabad on June 9, 1999, that by the year 2005 every high school student in Pakistan would have a computer [73].

Health Care

The PTA web site lists only five health-care facilities. According to representatives of ZoocomNet, only the Aga Khan Hospital in Karachi has leased-line connectivity [47]. While this is enough to establish that at least one health care facility has Internet connectivity, it is a vanishingly small percentage of the health-care facilities that service the country.

Commercial

The commercial sector is difficult to evaluate. While the PTA web site listed 115 Commercial organizations evaluated for the survey of sophistication of use, the actual number of commercial organizations using the Internet is larger. We do not, however, have a precise count of the number of .com.pk domains have been registered. The Internet Software Consortium July 1999 Internet Domain Survey (formerly done by Network Wizards) counts 523 level 2 domains under the .pk domain (e.g. netmag.com.pk). If the collection of organizations on the PTA web site has the same distribution of organizations among the .com, .gov, etc. domains (certainly not guaranteed), then one would conclude that 58% of the Pakistani domains are commercial. If that is the case, then approximately 300 commercial organizations have their own domain names under the .pk domain.

The specific numbers here are probably incorrect, being based on some shaky assumptions. However, even if all 523 hosts were commercial, this still probably does not represent 10% of the Pakistani companies with more than 100 employees.

What makes Pakistan a bit unusual, however, is that according to Hassan, most businesses are jointly owned by families, but managed individually. As families grow, they spin off new business units to give to the younger generation rather than allowing businesses to grow. In addition, Pakistani laws have, to an extent, favored small firms over large [27]. As a result, the number of large companies relative is likely to be much smaller relative to the population than would be the case in developed countries. Representatives of ZoooomNet claim that over 50% of Pakistani companies with more than 100 employees have leased-line Internet connectivity [47]. Additional research is required to reconcile this figure with the Network Wizards data. However, it is likely that sectoral absorption among commercial organizations will cross the 10% boundary soon, if it hasn't already.

Public

According to some observers, most central government ministries do have leased line connectivity to the Internet. Moreover, there are indicators that the usage of computer networks could increase substantially in the near future. These indicators include plans not only for new installations of networks, but also, and perhaps more significantly, for the expanded use and dissemination of government information by electronic means.

On March 19, 1999, the Interior Minister of Pakistan unveiled plans to link all district headquarters with provincial capitals and the federal capital networks. Part of this plan included the creation of a computer-based national registration system that would support the issuance of identity cards, new passports and residency cards for overseas Pakistanis [59]. According to Mr. Ahsan Iqbal, Deputy Chief Planning Commission, the Pakistani Federal Government will spend \$20 million on computerization in the 12 month period from July, 1999 to July, 2000 [73].

The Central Board of Revenue announced plans to make regular use of the Internet for calculating the day to day pricing of import consignments and to discourage the mis-declaration of value [98]. This body has also placed on the Internet the Federal Budget of Pakistan at www.cbr.gov.pk.

In September, 1999, a proposal was made to the Prime Minister's cabinet to fund a project to link 1300 police stations in Pakistan through a network. The proposal came out of the Group on Police Reforms, chaired by Mr. Ahsan Iqbal, Deputy Chairman of the Planning Commission [1].

Perhaps the provinces most actively pursuing computerization are Punjab and Sind. In 1999 each of them established IT Promotion Boards to formulate and implement strategies to maximize the use of computers in every provincial government department [84,95]. Punjab has been working on a Web site on which to make available to the populace the laws and rules and regulations of all provincial departments as well as any updates [85]. The province also plans to spend over \$8 million in the year 1999-2000 to computerize land records in all the 34 revenue districts of Punjab [86]. In September, 1999, plans were announced to link all of the departments. A pilot project, already underway, is linking the Governor House, the Chief Minister House, and all provincial department heads [94].

CONNECTIVITY INFRASTRUCTURE

Connectivity infrastructure comprises four components: the aggregate bandwidth of the domestic backbone(s), the aggregate bandwidth of the international IP links, the number and type of inter-connection exchanges, and the type and sophistication of local access methods being used. Table 8 depicts how these factors are related to the assessment of the infrastructure's level of development, with Level 0 assigned to a country with no Internet presence (and hence, no infrastructure) and Level 4 assigned to a country with a robust domestic infrastructure, multiple high-speed international links, many bilateral ("peering") and open Internet exchanges--facilities where two or more IP networks exchange traffic, and a variety of access methods in use.

		<i>Domestic backbone</i>	<i>International Links</i>	<i>Internet Exchanges</i>	<i>Access Methods</i>
Level 0	<i>Non-existent</i>	None	None	None	None
Level 1	<i>Thin</i>	≤ 2 Mbps	= 128 Kbps	None	Modem
Level 2	<i>Expanded</i>	>2 -- 200 Mbps	>128 Kbps -- 45 Mbps	1	Modem 64 Kbps leased lines
Level 3	<i>Broad</i>	>200 Mbps -- 100 Gbps	>45 Mbps -- 10 Gbps	More than 1; Bilateral or Open	Modem > 64 Kbps leased lines
Level 4	<i>Immense</i>	> 100 Gbps	> 10 Gbps	Many; Both Bilateral and Open	< 90% modem > 64 Kbps leased lines

Table 8 Connectivity Infrastructure of the Internet in Pakistan

International connectivity

Pakistani ISPs must currently connect to the global internet through an international leased line to a global carrier, typically UUNET, Teleglobe, or SINGNET, as shown in Table 9. Some other ISPs use MCI or Sprint. These carriers do not have a Network Access Point (NAP) within Pakistan, so connections must be made via two half-circuits, with the Pakistani half-circuit provided by [9,53]. Of the international circuits, 70% terminate in Karachi, and 30% terminate in Islamabad [47].

Due to the high cost of international bandwidth, ISPs typically have no more than a 2 Mbps (E1) connection, and most have less than 1 Mbps [57]. While the total international bandwidth to and from Pakistan was estimated (July 1998) to be approximately 620 Mbps not including bandwidth PTCL leased on See-Me-We 3 [90], the ISPs use only a fraction of this, perhaps 5%. According to ZoomNet representatives in November, 1999, the total international IP bandwidth from Pakistan is 32 Mbps [47].

One exception to the small international pipes appears to be Pakistan Online. One of its web pages boasts two OC-3 (155 Mbps) connections with Verio, plus an additional DS3 (45 Mbps) connection to Sprint [34]. More research is required to verify this claim.

According to one report, Dr. Jawed Ghani, Chairman of the Pakistani Information Technology Board, was quoted on August 23, 1999 as saying that the country's international data traffic is not more than "12 Megabytes" [64]. It is not clear whether this is really 12 Mbps, or 96 Mbps, or whether this refers to capacity or actual traffic.

<i>Provider</i>	<i>Network</i>	<i>Range</i>	<i>Upstream Provider</i>	<i>Circuit Type</i>
Brain Net	203.128.0.0	203.128.0.0- 203.128.7.0	SINGNET	Frame Relay
COMSATS	210.56.0.0	210.56.0.0- 210.56.32.0	Teleglobe	Point-to-Point
NexLinx	208.240.62.0	208.240.62.0- 208.240.62.255	UUNET	Frame Relay
Pakistan Online	206.82.143.0	206.82.143.0- 206.82.143.255	Teleglobe	Point-to-Point
SHOA	208.232.94.0	208.232.94.0- 208.232.94.255	UUNET	Frame Relay
Space Net	208.228.87.0	208.228.87.0- 208.228.87.255	UUNET	Frame Relay
World Online	208.242.128.0	208.242.128.0- 208.242.128.255	UUNET	Frame Relay

Table 9 IP Addresses and Upstream Providers for ISPs.

Source: [35]

Domestic backbone

There does not exist a proper Internet backbone in Pakistan. Since there does not exist even a Network Access Point of the international carriers, traffic from one ISP to another must leave the country, usually to the United States or Canada, and return [9,53]. The creation of such a backbone was a strong recommendation in a study by Shah [90].

In 1997, one of the larger ISPs, Supernet, was offering its data networking infrastructure, built on PTCL links, to other ISPs as a form of backbone. It also offered bulk data communications facilities on the domestic VSAT network [40].

According to some observers, one of the reasons for the lack of a domestic backbone has been the lack of an organizational entity around which to arrange it. The Internet Service Providers Association of Pakistan (ISPAK) was supposed to have played a role in providing a unified voice for Internet Service Providers in their negotiations with the Pakistan Telecommunications Authority. However, this objective has not, apparently, been realized.

One of the more enigmatic developments has been the announcement by PTCL of a major effort to establish such a backbone. Press reports of the last year have reported the completion of the first phase of a large Internet expansion project called the National Internet Backbone (NIBB) [64,66,67,78]. The objective is to provide a total of 300,000 new Internet connections, with 50,000 becoming available by September/October 1999.

The most detailed information discovered by this author is that PTCL has laid additional fiber cable on both sides of the Indus River, which runs through the midpoint between Islamabad and Peshawar and empties into the Arabian Sea just east of Karachi. The fibers are each capable of OC3 traffic (155 Mbps). According to ZoomNet representatives, there are a total of 18 pairs, only 1/4 of one pair being devoted to Internet traffic [47]. Of the fibers laid, twelve are unutilized and only "one would be sufficient for the nation's needs" [64].

When asked about this project, the editor of the leading Internet magazine in Pakistan, NetMag, replied, "You know how things work here in Pakistan, we have heard that PTCL is putting something of that sort together but how and when it is going to do that is still a mystery to me too" [43].

While there does not exist a domestic backbone shared by multiple ISPs, the aggregate capacity of the links between Karachi and Islamabad of those ISPs with POPs in those cities is almost certainly more than 2 Mbps.

The ISPs that do have POPs in more than one city employ a topology that runs from one city to the next along the backbone of the Indus River Valley [47].

Internet exchanges

There are currently no Internet Exchange Points in Pakistan. While the Internet Service Providers Association of Pakistan has been serving as a forum for such discussions, and plans for the creation of an internet exchange point are underway, these plans have not yet resulted in the creation of IXP. According to ZoomNet representatives, a project has been awarded to Napcom, but details on when it will be available are not yet ready [47].

Access methods

The access methods available to subscribers in Pakistan are shown in Table 10. As the table shows, subscribers who do not have a continuous connection to an Internet Service Provider almost always use dial-up connections; high-speed Internet access is available in only very limited forms.

Modems up to 33.3 Kbps offer 22-25 Kbps access Pakistani telephone lines. 56 Kbps modems are of little additional benefit because the quality of telephone lines is low, and the international lines of the ISPs have such limited capacity that they are the bottleneck, rather than the local loop. Furthermore, ISPs typically oversubscribe their networks [57].

<i>Service</i>	<i>Availability</i>	<i>Performance</i>	<i>Pros</i>	<i>Cons</i>
Dial-up	Wherever there are telephone lines	56/33.6/19.2/9.6 Kbps	Cheap, easy to install, and available in most places	Quality of lines reduces data rates well below theoretical
ISDN	Very limited	128 Kbps - basic rate.	Enhanced capacity and functionality	Costly, relatively slow
Satellite	Nationwide	400 Kbps downstream/33.6	Good downstream speed. Available	Discouraged by PTCL. Costly

		Kbps upstream	to anyone with clear view of southern sky.	compared with alternatives
Cable	Not available	1-5 Mbps downstream/ 33.6-2.5 Mbps upstream		
xDSL	Extremely limited	144 Kbps-8 Kbps/64 Kbps-8 Mbps	Fast connect that does not tie up a phone line	Almost non-existent in Pakistan. Costly

Table 10 Internet Access Methods in Pakistan. Source: [90]

Companies in Pakistan also favor dial-up connections. In a survey conducted in 1998, Shah found that 58% of companies responding used dial-up connections; 28% used a 64 Kbps shared channel; 7% used a 64 Kbps clear channel; and 7% leased a 256 Kbps clear channel [90]. Although they have a low call completion rate and bandwidth effectively restricted to 32 Kbps, dial-up connections are found by most companies to be more cost effective than the alternatives. Overall, the bottleneck in connecting to the Internet is not the local loop. Increasing bandwidth at the user end is lot likely to improve performance until the capacity of the backbone increases [47]. Only one ISP, Cybernet, currently offers ISDN access [47].

ORGANIZATIONAL INFRASTRUCTURE

Just as the connectivity infrastructure assessed the extent and robustness of the physical structure of the network, organizational infrastructure, derived from the number of ISPs and the competitive environment, assesses the robustness of the market and services themselves.

Regulatory Regime

Under the Telecommunication (Reorganization) Act of 1996 continued the monopoly over basic domestic and international telecommunications services that had been put in place earlier. Internet service providers must obtain their domestic leased lines and the international half-circuit to a foreign carrier from PTCL.

The Government of Pakistan has deregulated and privatized the provision of certain telecommunications services and the manufacture of certain telecommunications equipment. Table 11 lists the services, the number of licensees and related data, presumably as of early 1999. Of the 45 licensees of data network services, 18 are providers of data network services who are also licensed to offer Internet services, and 27 are licenses as Electronic Information Service providers.

Service	Licensees (PCTL web page)	Licensees (PTA web page)
Data Network Operation		
▪ Data	▪ 18	▪ 29
▪ Information		

Services	■ 27	■ 88
Cellular Mobile phone system	3	4
Radio paging system	1 ⁸	3
Trunked radio	11	11
Card pay phone	7	10
Satellite Services		3
Telephony services		2 ⁹

Table 11 Privatized and deregulated telecommunications services in Pakistan.
Source: [20,69]

The data network operation figures of Table 11 were obtained from the PTCL and PTA web pages in October, 1999. Aside from pointing out that the PTCL has not done a good job of keeping its web site updated, the data also show the rapid growth in data network operation services, especially within Electronic Information Services/Email (Internet Services). Although less than half of the companies granted licenses are offering services, the 40 active ISPs (Oct. 1999) have created a very competitive market. According to some industry observers, 150 licenses have been granted, 30 more are being processed [47].

The ISP market has become highly competitive, fuel in no small part by measures such as an ongoing ISP Survey conducted by NetMag Magazine, one of the leading Internet-focused periodicals in Pakistan. This survey (<http://www.netmag.com.pk/>) not only posts data regarding connection prices and locations, but also solicits input from readers regarding the quality of the ISPs and tabulates and posts this information on its web site. User comments themselves are included, for example [36]:

On Zoooom Net: "Speed is good, mail server is the worst, problems in changing network password, very frequent disconnection, dial up negotiating problem, round the clock poor support, every time ask for envelope ID. Disconnect for remaining idle for few minutes, difficult to connect at first try, no usage logs facility."

On COMSATS: "Comsats is OK as far as the service is concerned, but they should really think about dropping there [sic] rates. The service was quite good a few months back by now it seems like they have more users than they can actually account for. The result is poor surfing and waste of customer's time and money."

⁸ Eleven other licensees are unable to begin offering radio paging service because of litigation.

⁹ The two licensees for telephony services are the PTCL and the National Telecommunication Corporation,

On Asia Online: "The connectivity is very good and speed is also very good and customer service is also very good."

While the survey is certainly not scientific and, in all likelihood, does not prevent ISPs from seeding the survey with positive comments about themselves or negative comments about their competitors, the existence of the survey indicates a heated competition among what is likely more ISPs than the existing market can support.

Industry Associations

The Internet Association of Pakistan (IAP) is a non-profit organization devoted to promoting Internet technology in Pakistan [33].

The Internet Service Providers Association of Pakistan (ISPAK) was founded in 1998 to act "as a catalyst for opening newer and better avenues for growth of Internet in Pakistan" [72]. Among its aims (<http://www.ispak.net.pk/aims.htm>) are:

- Present a united forum for presenting the Issues and points of view of the ISPs and their users to the Government, PTA and PTCL. For this purpose, ISPAK will hold meetings to arrive at a consensus on different issues.
- Present a joint forum for getting optimal pricing and technical solutions from PTCL regarding domestic leased fiber capacity, local dial-in lines, delivery of International circuit and any other areas requiring interface with PTCL
- Co-operate in all technical, administrative and financial aspects to work towards creating local interconnect between all the ISPs of the country. Currently, any transaction of data that takes place between any two ISPs is routed to the International service provider of the sender and then to that of the intended recipient.
- Private Peering arrangements will be made in order to provide for alternate routes in case of failures so that the end users of the member ISPs do not suffer because of individual link failures.
- The ISPAK will come up with a complete plan for implementing a true Pakistani Internet backbone in the private sector. This will include the administration of the Pakistan TLD in Pakistan via a neutral body.

While these points and the others that appear in the organization's aims and objectives appear to be very sound and worthwhile, in the nearly two years after it was created it is not clear that the organization has come very close to achieving these goals. While it did play a significant role in getting the charges for local phone access to ISPs changed (discussed below under Costs), it has clearly not been successful in establishing a national backbone, or evening internet exchange points between its members. Most curiously, the ISPAK web site has not been updated in over a year. Thus, while the industry associations which are part of a Level 4 organizational structure exist, it appears that they have not been very effective.

Organizational Infrastructure

In light of the discussion above, we rate Pakistan at a Level 2 (*Controlled*) on the organizational infrastructure. While there are more than a few ISPs at present, the monopoly control over

domestic and international basic telecommunications services prevents the rating from rising to a Level 3 (*Competitive*).

Level 0	<i>None</i> : The Internet is not present in this country.
Level 1	<i>Single</i> : A single ISP has a monopoly in the Internet service provision market. This ISP is generally owned or significantly controlled by the government.
Level 2	<i>Controlled</i> : There are only a few ISPs because the market is closely controlled through maintenance of high barriers to entry. All ISPs connect to the international Internet through a monopoly telecommunications service provider. The provision of domestic infrastructure is also a monopoly.
Level 3	<i>Competitive</i> : The Internet market is competitive and there are many ISPs due to the existence of low barrier to market entry. The provision of international links is a monopoly, but the provision of domestic infrastructure is open to competition, or vice versa.
Level 4	<i>Robust</i> : There is a rich service provision infrastructure. There are many ISPs and low barriers to market entry. The provision of international links and domestic infrastructure are open to competition. There are collaborative organizations and arrangements such as public exchanges, industry associations, and emergency response teams.

Table 12 Organizational Infrastructure in Pakistan.

SOPHISTICATION OF USE

To truly understand the Internet capability of a country, it is necessary to understand not only how many and where people use the services, but also how the Internet is employed. Of particular interest is the "elbow" reached when the service is mature enough to attract interest and use outside the narrow community of technicians. A second major milestone is reached when the user community transitions from only using the Internet to creating new applications, sometimes eventually having an impact on the Internet elsewhere.

A preliminary assessment of the sophistication of use by Pakistani organizations was undertaken during September, 1999. Not a statistically robust survey, the study provides results which would have to be verified through a more stringent methodology. Nevertheless, for the purposes of this, initial, country study, it may provide some baseline data.

The Pakistan Telecommunication Authority web site contains links to over 200 organizations' web sites. These organizations cover a broad spectrum of sectors of the Pakistani economy. We grouped them into five categories: Health, Education, Government, Commercial, and Other. The Other category includes a number of non-profit organizations with religious or national orientation. The web sites of each of these organizations was evaluated against the five levels of sophistication of use, shown in Table 13.

<i>Level</i>	<i>Organizational Use</i>
Level 0 <i>None</i>	No use of the Internet

Level 1 <i>Minimal</i>	E-mail is available, but is not used as an alternative to traditional inter-personal communications (memos, telephone, meetings). Web sites consist of a small number of static pages reflecting a "minimalist brochure."
Level 2 <i>Conventional</i>	E-mail is widely used for both official and unofficial communication. Listservs or their equivalent are used to disseminate information or solicit feedback. Web sites are largely static, but are extensive and provide customers with in-depth information about products and services, utilization of those services, comparative information, etc. The content is more than just advertisement.
Level 3 <i>Transforming</i>	Web sites are dynamic, becoming an alternative distribution channel. On-line ordering is possible. Customer service functions expand to permit customers to conduct transactions that formerly involved employees (e.g. home banking, FedEx package tracking, etc.) International companies use the Internet as a substitute for business trips, enabling round-the-clock collaborative product development. E-Commerce has taken hold.
Level 4 <i>Innovating</i>	The fundamental structure of organizations and their external relations with other organizations is altered. Examples include Egghead Software, which no longer has a bricks-and-mortar presence, and Amazon.com, the on-line bookseller. Companies pioneer new uses of the Internet, such as IP Telephony, data mining of Web customers' "click-histories".

Table 13 Levels of Sophistication of Use

Table 13 Shows examples of uses of the Internet that would be typical of a ranking at the level indicated. It is not necessary, however, for an organization to exhibit *all* of the uses before being ranked in that category. Indeed, one of the limitations of the survey is that all the information is drawn from a company's web page. It is possible that there exist companies with rather unsophisticated public web sites that may make more sophisticated use of the Internet internally.

Figure 4 contains the results of the survey. By definition, there were no Level 0 organizations included in the survey since such organizations do not have web sites. In most sectors, most organizations are at Level 1, meaning that their Web site is little more than an electronic "shingle" providing the most basic information about the organization. Interestingly, the Education and Government sectors appears to have fewer Level 1 organizations than Level 2 organizations. At level 2, organizations are providing more than basic identifying information. Often they are using the Web site as a mechanism for information dissemination. The fact that Education and Government organizations have relatively more organizations in this category than in level 1 may reflect the fact that information dissemination is closer to the core mission of such organizations than it is of organizations in the Commercial and Healthcare sectors. Alternatively, the Commercial sector may be experiencing a rapid increase in the use of the Web. The high proportion of companies with level 1 sophistication of use may reflect a large number of "newbies." The educational and government organizations may simply have been using the Web for a longer period of time. We lack the historical data to determine this.

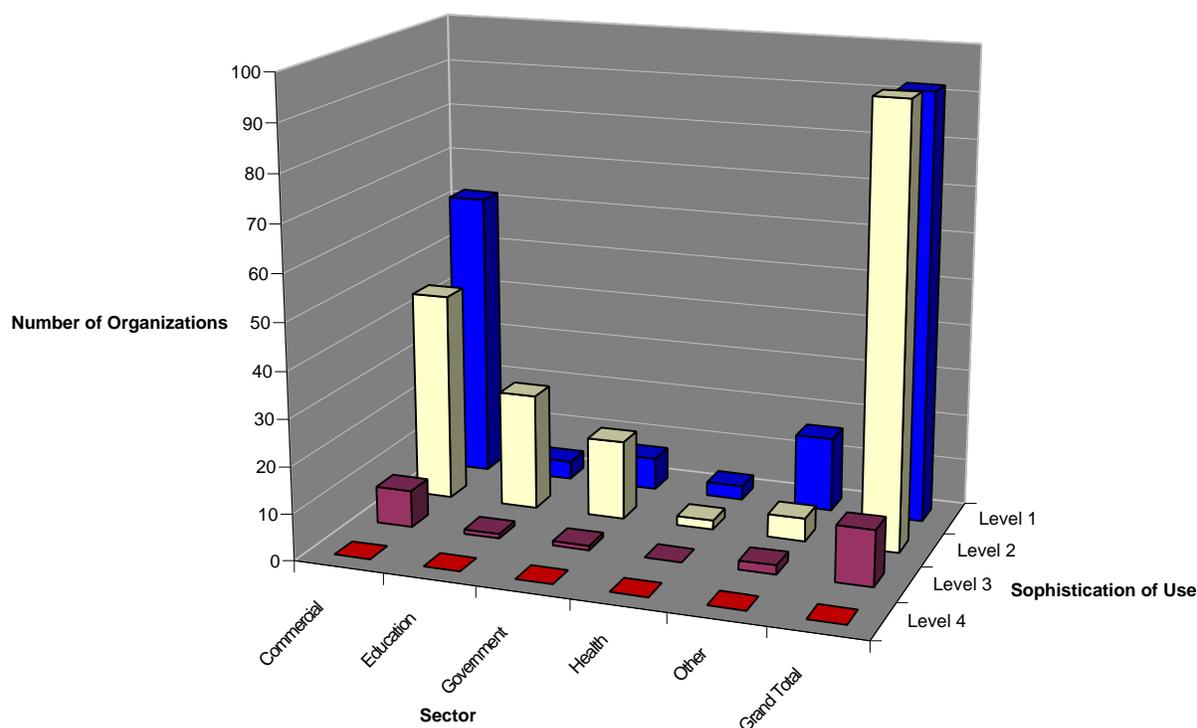


Figure 4 Sophistication of Use of Pakistani Organizations

The small number of organizations at level 3 sophistication of use indicates that, among other things, electronic commerce (at least, the business-to-customer variety) is not widely supported in Pakistan. Of the twelve organizations ranked at level 3, one was a government institution (the Pakistan Telecommunication Company, Ltd), one was an educational institution (the National College of Business Administration & Economics, which has an on-line registration system), two were from the Other category, and eight were Commercial organizations. Of the latter, a number were Internet Service Providers. The other category of most sophisticated users is the newspaper industry. The Business Recorder, Pakistan's national financial daily publication use the Internet not only to disseminate news, but also to sell classified advertisements. IMRAMM-NEWS and Information Times boast on-line auctions, site search engines, and so forth.

We did not find in this sample any companies at level 4. Level 4 companies must be engaged uses that are innovative, not just new to a particular company or industry.

Overall, we place Sophistication of Use in Pakistan at a level 2 in the analytic framework. It is likely that the number of level 3 organizations will increase substantially in the near future. If electronic commerce becomes an accepted way of conducting business in Pakistan, the number will grow dramatically. If electronic commerce does not, it will grow much more slowly.

The data presented here should be interpreted with caution, however. First, there is no guarantee that the Pakistan Telecommunication Authority populates its web site with all, or even a representative sampling of organizations in Pakistan with a presence in Cyberspace. The results

of our survey may not apply to the country as a whole. Second, the evaluation of an organizations sophistication of use is at best an educated guess, based on what is observed on web sites.

Voice over Internet is prohibited in Pakistan [71]. While ISPs inform their customers of this, they typically do not close the ports that permit such transmission. Consequently, voice over Internet is, in practice, popular [57]. The PTA has tried to enforce this restriction. During 1999, ZoocomNet and AK Net were (temporarily) shut down for violations [44].

ANALYTIC FRAMEWORK DIMENSIONS

The discussion of the analytic framework dimensions is summarized in the following table and associated graph.

<i>Dimension</i>	<i>Level</i>	<i>Explanation</i>
Pervasiveness	2	As of August, 1999, there are approximately 80,000 subscribers to the Internet (0.6% of the population). If the ration of users to subscribers is 4:1, as some estimate, then over 0.1%, but less than 1.0% of the population uses the Internet.
Geographic Dispersion	3	ISP points of presence are found in three of the four provinces, absent only in Baluchistan. Access is limited to major metropolitan centers, located in the Indus River valley.
Sectoral Absorption	1->2	Absorption into all four sectors identified in the framework is less than 10%. However, Pakistan could rise to a level 2 if just one of the four sectors exceeds 10% absorption.
Connectivity Infrastructure	1	Pakistan does not fall cleanly into one level. Access is at level 3, but the lack of a domestic backbone and peering arrangements between ISPs are at level 0
Organizational Infrastructure	2	While provision of basic domestic and international telecommunications services is a monopoly, the ISP market is quite vibrant.
Sophistication of Use	2	Sophistication of use varies from organization to organization, but Pakistan is strongly concentrated in the first two levels. Isolated examples of Level 3 sophistication of use exist, but we have not discovered evidence of level 4 usage.

Table 14 Current Values of Internet Dimensions in Pakistan.

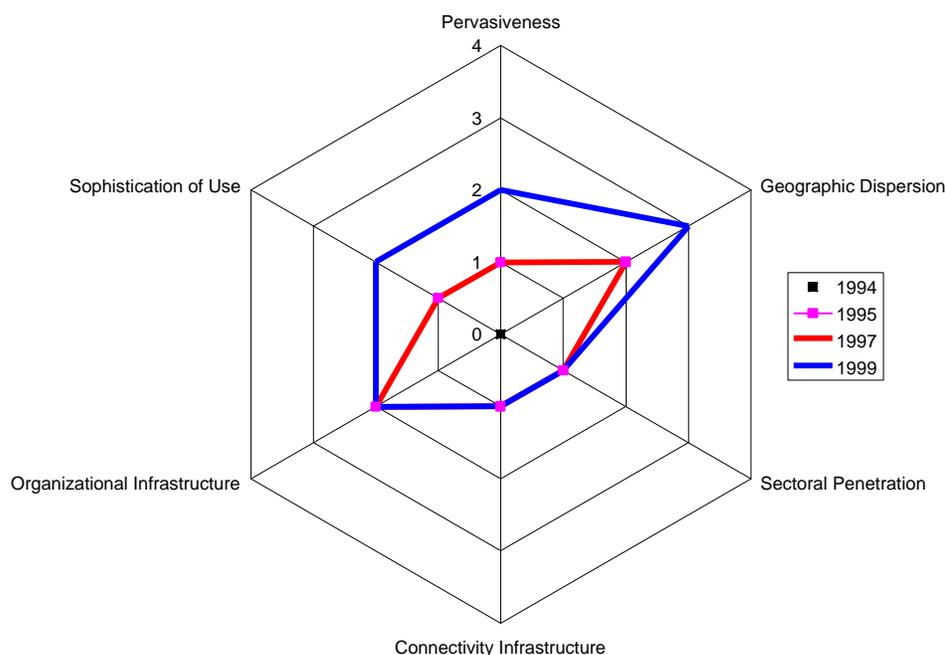


Figure 5 Internet Diffusion Dimensions in Pakistan

Analysis Framework Determinants

In the current section we will examine a number of key factors that have emerged as particularly strong determinants of the extent and nature of growth of the Internet within a country. These determinants were introduced in the previous chapter. Not only will the determinants provide insight into why the Internet in Pakistan has evolved as it has, they can also yield insights into the factors that offer the greatest leverage for policy-makers who wish to promote (or discourage) Internet development.

We will step through each of the determinants. Table 15 shows the relationships of the determinants to the dimensions. In the next section, we integrate the discussion of dimensions with that of determinants to better understand the prospects for the Internet in Pakistan and the measures policy makers might take to promote it.

	Dimensions

Determinants	Dimensions					
	Pervasiveness	Geographic Dispersion	Sectoral Absorption	Connectivity Infrastructure	Organizational Infrastructure	Sophistication of Use
<i>Access to Internet</i>	X	X	X		X	X
<i>Perceived value</i>	X	X	X	X	X	X
<i>Ease of Use of the Internet</i>	X		X		X	X
<i>Cost of Internet Access</i>	X		X	X	X	
<i>Adequacy & fluidity of resources</i>		X	X	X	X	X
<i>Regulatory/ legal framework</i>		X	X	X	X	X
<i>Ability to Execute</i>		X		X		
<i>Geography</i>		X				
<i>Demand for capacity</i>				X		
<i>Multiplicity of ISPs</i>				X		
<i>Services provided</i>				X		
<i>Culture of entrepreneurship</i>						X
<i>Forces for change</i>	X	X	X	X	X	X
<i>Enablers of change</i>	X		X		X	X

Table 15 Integration of Internet Dimensions and Determinants

ACCESS TO THE INTERNET

Individual Access to the Internet

Today in Pakistan, subscribers have local access to the Internet in at least 17, and perhaps as many as 30 of Pakistan's largest cities.

Since 1998, access to personal computers has improved. In July, 1998, the Government of Pakistan removed all import duties on personal computers. As a result, the legal prices came much more in line with international prices so that the gray market for PCs had shrunk to the point where it was not perceived to be a significant problem. The head of the Karachi chapter of the Computer Society of Pakistan has reportedly estimated that Pakistan's PC market is growing between 20-40% per year [87].

ISP access to the Internet backbone

There is no Internet backbone in Pakistan, other than the lines that individual ISPs lease from PTCL to carry their own traffic. To connect to the global Internet, ISPs lease rather pricey international circuits with the half-circuit terminating in Pakistan provided by PTCL. Getting such

a leased line might not take place as quickly as some would like, but does not seem to be a fundamental barrier to the creation of ISPs.

COST OF INTERNET ACCESS

Cost to subscribers

Subscribers of Internet service must pay a number of separate charges. First, PTCL charges a monthly service fee for a telephone line and a connection fee when service is established. Second, users pay a metered charge for each telephone call. Third, an excise tax is levied on telephone services. Fourth, users must pay often (but not always) pay a start-up fee or a deposit or both when signing up for Internet Service. Fifth, Internet subscribers pay either a monthly fee or an hourly fee for Internet usage.

Traditionally, telephone service in Pakistan has been viewed not as a basic necessity but as a luxury, and has had a tariff structure reflecting this philosophy. Initial installation costs have been high. Local telephone calls are metered.

While some officials have made statements that the telephone is now viewed as a basic necessity, the track record of the tariff structure is mixed. One of the first measures of the Sharif administration was a broad set of reforms in the tax laws. In the area of telecommunications, the reforms included a reduction in the excise duty on telephone services from 40 to 15 percent [10]. Apparently the central excise duty was later increased again to 25%, because on July 1, 1999, the central excise tax was again reduced to 15% [19]. In a meeting in July, 1997, the Cabinet of Prime Minister Sharif approved a measure to reduce the tariff on inter-city calls by 20%, and extended the local call tariff area to small towns within a 25 kilometer range. The latter measure was estimated to benefit 200,000 consumers [91].

In 1998, PTCL proposed the multi-metering of local calls. Under such an arrangement, calls would be subject to a five-minute limit before they are again billed as a new call. In other words, a fifteen minute telephone call would be billed as three separate five-minute phone calls. The new metering would also be accompanied by a tone that, while an annoyance to voice conversation, could cause a data line to drop. The multi-metering would have resulted in an extra Rs. 24 per hour for connect charges. The outcry from the Internet community was strong and swift. The Internet Service Providers Association of Pakistan (ISPAK) and the Internet Association of Pakistan (IAP) both served as focal points for the reaction and eventually played a role in having multi-metering of Internet calls dropped [22,29,37,82].

On July 1, 1999, long distance domestic call rates were reduced by 26% on major direct dialed routes; operator assisted long distance calls were also reduced. However, at the same time PTCL raised the local call charges by 60% and installation charges by 6%. Local telephone calls now cost Rs. 2.10 (\$0.04); monthly line rent costs Rs. 235 (\$4.55), and installation costs Rs. 4390 (\$85) [81].

Most Internet service subscription fees in Pakistan were, and continue to be based on usage. In 1997, average ISP charges were approximately \$1.80 per hour during daytime hours, and \$.80 per hour for off-peak periods. An early exception to metered charges was IBM Pakistan, which offered in 1997 a flat rate of \$38. Per month [40]. At the time of this writing (November, 1999), the Internet Service Providers are competing intensively on price, but a fixed rate for unlimited access is *not* universal. Of the nearly 30 ISPs posting rates on the Web, nine offered unlimited

access at rates ranging from Rs. 1500 to 2500 per month (\$30-48/month). All ISPs offered a variety of tariff packages based on hourly rates. Hourly rates ranged from Rs. 20-65/hour (approx. \$0.38-\$1.26/hour); the greater the number of hours in the "package" the lower the hourly rate.

In the last two years subscription costs have dropped significantly, but not to levels that are the norm in many other countries (including Turkey), approximately \$20/month or less for unlimited usage. While in many countries the subscription cost is the only cost beyond basic monthly charges for the telephone line for accessing the Internet, in Pakistan the subscription cost along does not reflect the total cost to a user. The following table shows estimated total costs for users connected for various lengths of time. At 100 hours of usage, the table assumes the user to have subscribed under the unlimited access package.

<i>Hours</i>	<i>Hourly ISP charge</i>	<i>Total ISP charge</i>	<i>Telephone charge</i>	<i>Excise Tax</i>	<i>Total Cost (Rs.)</i>	<i>Total Cost (US\$)</i>
10	40	400	252	37.8	689.8	\$ 13.37
20	40	800	504	75.6	1379.6	\$ 26.73
50	35	1750	1260	189	3199	\$ 61.98
100	N/A	1500	2520	378	4398	\$ 85.22

Table 16 Typical Cost of Internet Access in Pakistan (estimate).

Table 16 shows that while it is possible to use the Internet minimally at a modest cost (although not necessarily modest to the average Pakistani household), costs rapidly escalate as usage increases to the point where only the wealthy can afford to be connected for long hours.

Some changes have been made to how users connect to their ISPs. The PCTL can give to an organization, such as an ISP, a Universal Access Number (UAN) which gives a single, usually 9-digit, number with which an individual can contact the organization regardless of the number of geographic offices the organization has. While this reduces the number of telephone numbers an individual might have to keep track of, the billing for UAN access is high. However, it appears that now PTCL is permitting calls to ISPs to not be subject to such multi-metering.

In June, 1998, PTCL announced a special Tariff Re-Balancing Package for 1998-1999 to promote information technology, the Internet, and software export from Pakistan. Under this package, all research and education institutions working for the promotion of information technology would be given a 50% reduction in rates, as well as 20 free hours per month. This same package proposed allowing registered Internet users to be allowed unlimited calls for Rs 2,000, excluding the central excise duty (CED) [48,61].

The Internet Welfare Society of Pakistan (IWSP) is a non profit organization whose mission is to provide Internet facilities to those who cannot afford it. As of mid-1999, their efforts consistent of arranging for free e-mail service (in Karachi only) through MAGS Computers <http://www.mags.net.pk>.

Cost to ISPs

The cost to ISPs includes the cost of obtaining a license from the PTA, the hardware and software necessary to support ISP functions, and the leasing of lines to connect to an upstream provider.

Unlike Turkey in which ISPs need only a domestic leased line to connect to the global Internet through the national backbone, Pakistani ISPs need to lease an international line to connect. In each of these areas, costs have improved in 1999 in particular.

In early 1999, the Pakistan Telecommunication Authority invited applications for the provision of Electronic Information Services (Internet, E-mail, and website) in three license categories. The license rates are [50]:

1. Big Citywide Service (Karachi, Lahore, Faisalabad, each district area of Rawalpindi/Islamabad): Rs. 300,000 (\$5800.)
2. Small Citywide Service Rs. 100,000 (\$1900.)
3. Nationwide Rs. 500,000 (\$9700.)

Also in 1999, the government reduced customs duties on telecommunications and Internet equipment [48].

Bandwidth in Pakistan is expensive, when compared with other countries in the world. Rates for international lines are set by the Pakistan Telecommunications Authority (PTA) [57]. As Shah puts it, "Data communication rates in Pakistan are two to three times that of other countries like Malaysia, Singapore, etc. PTCL charges five to six times more than what it costs PTCL. Since PTCL is the only backbone Internet service provider, these high tariffs have a high adverse spillover effect on the information technology sector in Pakistan" [90].

The following table shows the rates for software companies, accredited universities, educational institutions, and teaching hospitals for clear pipe domestic leased lines [80]:

	1999
64 Kbps	\$ 3,208
128 Kbps	\$ 6,000
256 Kbps	\$ 10,333
512 Kbps	\$ 16,000
1024 Kbps	\$ 25,000
2048 Kbps	\$ 33,750

Table 17 PTCL Leased Data Circuit Rates

Not only are the costs are high, but PTCL policies levy in addition a 25% sales tax, and forbid the use of compression. Voice over data networks is strongly prohibited [42].

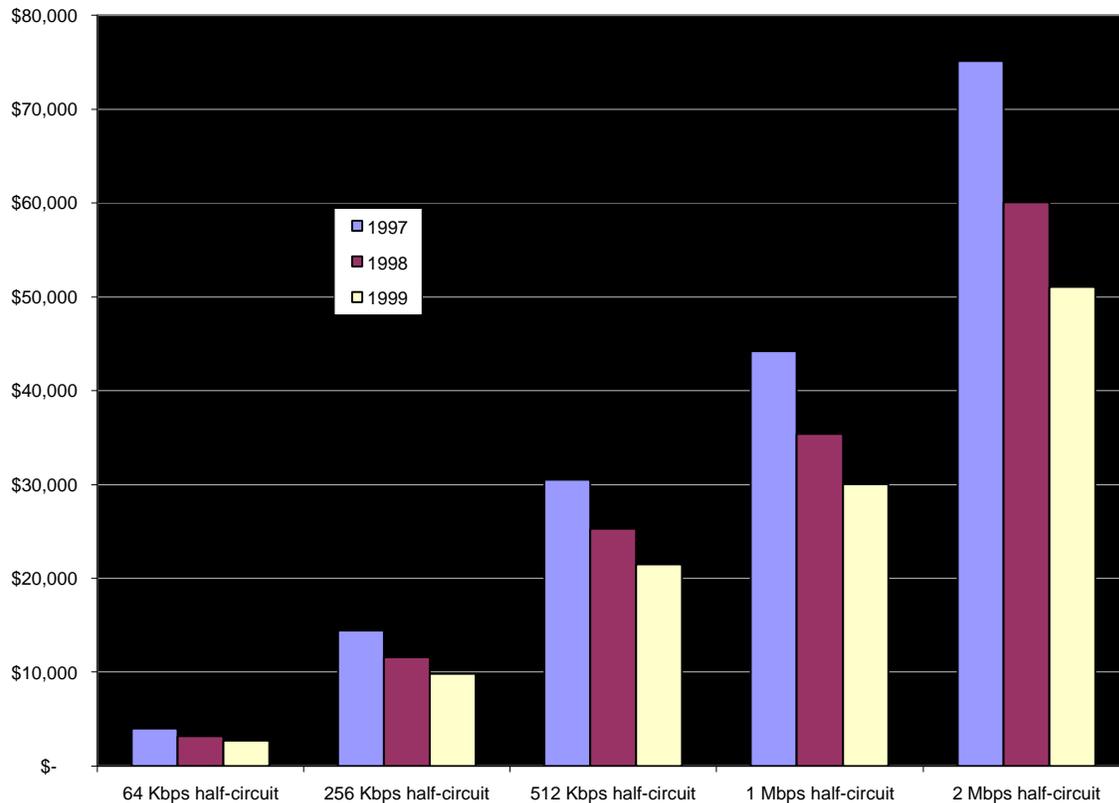
Costs for international leased lines are also high. The following break-down of costs in 1998 for a 512 Kbps international circuit is given in [21]. What has agitated the ISPs the most is the huge profit margin that PTCL is able to extract.

Foreign operator charges (e.g. MCI, Sprint)	\$10,500/month
PTCL charges	\$25,300/month

Total	\$35,800/month
Cost to PTCL of providing circuit	\$2500/month

Table 18 Cost of International 512 Kbps Leased Circuit (1998).

However, while PTCL is still earning a huge profit off of international circuits, prices are falling, as illustrated in Figure 6. Prices dropped by 20% in 1998, and another reduction of 15% went into effect on July 1, 1999. [81].



**Figure 6 Cost of International Leased Circuit in Pakistan (some values estimated).
Sources: [21,42,81]**

EASE OF USE

Pakistan has a relatively low rate of literacy, less than 30%. Of these, two thirds read only Urdu and one third can read English (although most prefer Urdu) [45]. Figures like these make it difficult to understand the projections of individuals such as Maj. Gen. Zahid Ihsan, Director General of the National Database Organizations, that by the year 2006 or 2007, Pakistan would achieve 100% computer literacy [59]. Nevertheless, such statements at least show an expectation of a trend towards broader and broader computer usage within the country.

PERCEIVED VALUE OF THE INTERNET

Perceived value by individuals

One of the most popular applications of the Internet in Pakistan is Internet chat. According to one source, nearly 90% of Pakistani users consider using Internet chat to be their primary motivation for using the Internet [63]. Not surprisingly, e-mail and Web surfing are other very popular uses. Needless to say, given the level of poverty and poor state of the economy, the Internet is of little interest to most of Pakistan's populace. For those who do use the Internet, however, it has become an important vehicle of expression and contact with those inside and outside of Pakistan.

The Internet has also become an important source of information about Pakistan to the global community (especially Pakistanis living abroad) and about the global community to Pakistanis within Pakistan. The Internet played a particularly important role in this regard during the October, 1999 coup. Reportedly, on October 13, 1999, the web site of Dawn, a leading Pakistani periodical, was accessed by nearly 124,000 distinct individuals. In contrast, only 75,000 accessed the Web site 18 months earlier during the nuclear tests [49].

Perceived value by organizational users

While overall awareness of the Internet among Pakistani organizations is probably low, awareness is being heightened through the marketing efforts of individual ISPs, and through events such as national IT summits and international conferences. On October 16-17, 1999, an international conference on "E-Commerce: Preparing for the Challenges" was organized in Karachi [32].

Perceived value by government entities

There is no great unified attitude towards the Internet among government entities, although overall the attitude is generally positive. In 1997, the Ministry of Commerce began arrangements for using the Internet to promote trade and business. At the urging of former Finance Minister Sartaj Aziz, the Ministry of Commerce, through the Export Promotion Bureau, began work on establishing web sites for displaying Pakistani products [17].

Interest in promoting the Internet is moderate to high at the highest levels of Pakistani government. Farooq Leghari, President of Pakistan through 1997, was personally interested in information technology issues, including the Internet, and appointed a presidential commission to study the issue in the mid 1990s. His successor, President Muhammad Rafiq Tarar has not been as interested, but the Prime Minister, Muhammad Nawaz Sharif, and other ministers have continued to support the Internet's expansion [41]. In a statement made on Communications Technology Day (June 12, 1999), Sharif underscored his view of the importance of the communications infrastructure [93]:

I envision Pakistan as a country where an overall progress will be doubly enhanced with effective and modern means of communications. We already have made great advances in roads by spreading a network of Motorways in the country supported with a modern and reliable telecommunication network. The Ports & Shipping day and night are serving the economic needs of the

country. Today and tomorrow's progress hinges on the E-Commerce and Information Technology.

While concerns about pornography and other socially objectionable content exist, the government has not actively tried to control access to content [41].

Strong telecommunications has been seen as a necessary condition for a strong software export and IT industry, which in turn has consistently been a priority of the national government. We have mentioned a variety of measures including tariff reduction on leased lines that favor companies involved in such industries.

At the provincial level, the administrations of the Punjab and Sind provinces in particular have indicated very positive views of the information technologies, reflected in their creation of IT boards and ambitious plans to established a much more computerized, open means of handling and disseminating government information.

Perceived value by telecommunications service providers

The perceived value of the Internet by PTCL must be inferred from its actions. Overall, PTCL appears to view the Internet as an encroachment on its traditional activities, rather than as an opportunity to be embraced. This attitude arises from at least four quarters. First, the telecommunications acts of the 1990s establish PTCL as the exclusive provider of basic telecommunications services to non-governmental entities within Pakistan. Although the Internet is not considered a basic service, some aspects of Internet use--voice over Internet in particular--are and establish a point of direct contention between the PTCL and the ISPs. Second, PTCL behaves towards its customer base in a manner typical of monopolies throughout the world. It is sluggish, has a poor attitude towards customer service, and is not quick to embrace change. Third, PTCL is undergoing a protracted effort to privatize the corporation. Fourth, PTCL has had a strong interest in building the infrastructure necessary to support provision of basic services. These investments are seen both as a means of improving the company's position in the eyes of foreign investors and as a necessary condition for the support of Pakistan's software industry.

The impact on the Internet community has been mixed. While ISPs certainly benefit from the fiber optic cables and telephone lines that have been installed over the last decade, PTCL's effort to maximize its short term revenue through high tariffs has not benefited the industry. The Tariff Re-Balancing Package for 1998-99, announced in June, 1998, provides an example the mixed impact. While this package had elements that benefited the IT industry, the education system that supports it, and the software export industry, the multi-metering components would have had a rather negative effect on the subscriber base of the internet market [38,61].

The PTCL announced in 1998 a development plan that would devote \$380 million per year to infrastructure development, including a fiber optic link, the creation of an Internet infrastructure, and a submarine cable project [78]. In 1999, PTCL announced the completion of the first phase of the new Internet backbone, but did not reveal details [64,66,67,78].

Balance of Interests

In the balance, the perceived value of the Internet is positive. There is little organized opposition that we know of, and certainly no strong opposition. Most lack of support is a result of lack of

awareness, or of conflicting priorities (e.g. privatization) that create conditions that are not the most conducive to the Internet's growth.

RESOURCES

Technological Resources

PTCL and the Internet Service Providers regularly purchase technology from the world's leading vendors of communications technology. Consequently, the computing devices supporting the Internet are quite contemporary.

Human Resources

The IT industry as a whole suffers from a shortage of skill IT professionals. According to Hassan, this state of affairs is a result not only of a failure of government to provide sufficient education (since most technical institutions are run by the government) but also a lack of interest and understanding by the private sector [27]. Furthermore, due to the rapid growth of demand for skilled IT professionals in other countries, the United States in particular, experienced IT professionals are migrating away from Pakistan [27].

The Private Software Export Board (PSEB) was established in 1995 to promote software exports from Pakistan. This organization has launched the ALCoE (Action Learning Center of Excellence) Program to encourage private sector investment and participation in technical education [27]. There are some reports of substantially expanded IT education in Pakistan which is helping address the need.

Financial Resources

In spite of the poor state of Pakistan's economy throughout the 1990s, the Pakistani government has consistently placed priority on funding for the telecommunications infrastructure. In addition, PTCL has invited private sector investment for the expansion of the fixed line network (under a build-lease-transfer arrangement), and expansion in rural areas, wireless local loop, and card payphone projects [8].

However, the economic climate has had a negative impact. The suffering financial sector is burdened with many non-performing loans. Reduced business activity has dragged down PTCL revenues. Economic downturns have resulted in lower tariff and taxes revenue than would otherwise be the case.

The demographics of Pakistani industry may also play a role. According to Hassan, most businesses are jointly owned by families, but managed individually. As families grow, they spin off new business units to give to the younger generation rather than allowing businesses to grow. Pakistani laws have, to an extent, favored small firms over large. As a consequence, most companies are not large enough to be able to afford significant, long-term investment in information technologies [27].

Direct foreign investment is another potential source of financial resources. Since the late 1980s, Pakistan has taken great strides to improve the climate for foreign investment, at least on paper. Pakistan's legal framework does not discriminate against foreign investors. The Foreign Private Investment (Promotion and Protection) Act, 1976, states explicitly that foreign investment shall not be subject to more taxation on income than investment made in similar circumstances by

Pakistani citizens. Prior to 1997, however, direct foreign investment was limited to the manufacturing sector. A new investment policy, announced in November, 1997, opened the agriculture, services, infrastructure, and social sectors to foreign investment as well. In addition, particular benefits were given to investments in valued-added or export industries, high technology, priority industries, and agro-based industries [26]. In general, foreign investment enjoys the following benefits among others [15]:

- Relaxation of foreign exchange controls, and a general policy of permitting foreign investors to participate in local projects on a 100% equity basis;
- Allowing of foreign companies registered in Pakistan to undertake export and import trade;
- Provision of full safeguards to protect foreign investment;
- Withdrawal of work permit restrictions on expatriate managers and technical personnel working in an industrial undertaking and easing of remittance restrictions;
- Abolition of the ceiling on payments of royalties and technical fees;
- Exemptions or relief from import duties on imported plant and machinery not manufactured locally in high-technology and other industries

In spite of these legal benefits, however, foreign investment in Pakistan has been relatively low. Total foreign private direct investment reached a high-water mark in 1995/96 with \$1.1 billion. This figure dropped to \$699 million in 1996/97, and to \$547 million for the ten months July-April, 1997/98 [16]. Possible reasons include inadequate infrastructure, perceptions of political instability, law and order difficulties, policy inconsistencies, resistance to the open economic environment by bureaucrats, the lack of effective protection of intellectual property rights, endemic corruption [15]. Another factor inhibiting investment in Pakistan is the lack of a legal and fiscal framework for the creation of venture capital funds [27]. Following Pakistan's nuclear tests in May, 1998, foreign investors withdrew \$175 million [23].

Material Resources

One of the few material resources on which the Internet depends is electrical power. In many countries electrical power is sufficiently stable and universally available that it ceases to be an issue. This is not the case in Pakistan. In 1997, only 31% of households had electricity [5]. Unstable power sources in major industrial areas has been identified as a contributing factor in the economic deceleration of the 1990s [18].

LEGAL AND REGULATORY FRAMEWORK

IP Address and Domain Name allocation

Since 1992, before the first Internet connection to Pakistan was established, the Pakistan Network Information Center has had responsibility for the maintenance and administration of the registry service for .PK domains. The organization is also responsible for the technical operation and maintenance of the root services for the .PK domain DNS [72].

PKNIC does not provide IP address allocations. These are provided by ISPs, or directly to an organization through INTERNIC or APNIC.

PKNIC is based in Lahore.

Provision of Telecommunications Services

The Pakistan Telecommunication (Re-organization) Act, 1996 established that the Pakistan Telecommunications Authority should be the authority regulating telecommunications services in Pakistan. This body was required by the Act to provide a license for basic telecommunications services to the Pakistan Telecommunication Company Limited and the National Telecommunication Corporation. Individual citizens and private sector companies, including ISPs, must rely on PTCL for the leased, data, and dial-up lines on which the Internet depends.

Licensing of ISPs

The Pakistan Telecommunications Authority is the licensing authority for Internet services. Two kinds of companies could (in 1997) offer Internet service. Companies that already had a license to operate a data network were permitted to offer Internet service as well. In addition, companies wanting to offer only Internet access could obtain an Electronic Information Service license [40].

Information-related legislation

During August, 1999, an IT Summit was held in Pakistan, presided over by President Muhammad Rafique Tarar. A working group recommended that new legislation on freedom of information at the federal and provincial levels be passed as a top priority to enable "e-government" and good [25,39].

ABILITY TO EXECUTE

General

The introduction to the Pakistan 2010 Programme makes a telling commentary on Pakistan's general ability to execute [3]:

To achieve [the goals of the Programme] requires a broader definition of development not as "catching up" (which focuses almost exclusively on physical capital), but as "making things work" with a primary, though not exclusive, emphasis on social and human capital. Pakistan remained under developed not because the endowment of physical capital was low, but because we had a low capacity to operate and maintain that capital effectively; not for want of institutions, but by a dearth of standards of behavior that enable institutions perform (sic) effectively; not because we did not have sound policies, but because we lacked the ability to implement those policies effectively; not for want of laws, but because of the absence of norms of conduct that prevent the misuse of laws.

In light of this general difficulty with "making things work," the Pakistan Programme 2010 placed a good deal of emphasis on establishing good governance. The Sharif government did little, however, to establish "good governance."

Pakistan Telecommunication Company Ltd.

PTCL's ability to execute appears to be neither excellent nor dismal. While customers of PTCL experience many of the same difficulties dealing with the companies as do customers of monopoly

PTTs in other countries, PTCL has made steady progress in expanding its infrastructure and services.

Pakistani Government

Economic management in Pakistan has been characterized by instability and corruption. By some estimates, 30% to 40% of the original cost of projects ends up in the pockets of contractors and officials in the shape of kickbacks and commissions [15]. While the October 1999 coup illustrated that the Shariff government had not succeeded in reversing these qualities, Sharif did, at some level, recognize the problem. "In the past, governments introduced minute and unanticipated changes in tax and tariff rates, exemptions, controlled prices, or credit variables, frequently and at will. The result was that on the one hand the unpredictability discouraged long term investment, and on the other hand the policy stance encouraged diversion of private sector resources into lobbying and influence peddling" [5].

Internet Service Providers

The number of ISPs has grown significantly in recent years, and many of them have succeeded in expanding service beyond one or two cities. One reason to question their ability to execute is the lack of peering agreements or an Internet exchange point among ISPs. The Internet Service Providers Association of Pakistan was formed in part to facilitate the creation of such IXP or peering arrangements, but has apparently been unsuccessful. It is not clear to what extent the fault lies with the ISPs themselves, or with factors beyond ISPs' control.

GEOGRAPHY

The Indus River runs from north to south nearly the entire length of Pakistan. Within its river valley lie most of the people, power, and, correspondingly, telecommunications infrastructure. The ISPs also have their POPs within the major cities of this valley. In contrast, the rest of Pakistan, to the west and to the northeast, is filled with inhospitable mountains or desert plateaus.

DEMAND FOR CAPACITY

The current bottleneck of the Pakistani Internet is not the local loop, but the domestic and international leased circuits that connect an ISP's POPs, or connect it to the global Internet. Currently, demand on these circuits exceeds capacity [49].

MULTIPLICITY OF ISPS

The number of ISPs in Pakistan has grown rapidly in recent years. In 1999 alone, the number of ISPs grew from 27 to 40. The number continues to grow, even though the Internet market probably cannot support this many.

SERVICES PROVIDED

Backbone Services

As discussed above, Pakistan does not have an Internet backbone. Individual ISPs lease domestic and international connections, but do not have peering arrangements with other ISPs.

End User Connection Services

Very few ISPs offer high-speed Internet service. Out of 40 ISPs, only about 10% advertise ISDN on their Web pages (and, according to one source, only CyberNet actually offers the service [49]), and none advertises DSL service. Leased lines of 1 or 2 Mbps are available from ISPs.

CULTURE OF ENTREPRENEURSHIP

According to Hassan, the Pakistani economy is characterized by many, many small, family-owned companies, and policies favoring small businesses [27]. As a result, a greater percentage of the Pakistani population is likely to have experience managing their own business than in other countries with comparable demographics. The proliferation of ISPs reflects no shortage of individuals and organizations willing to enter a new market. However, the financial structures needed to support a truly vibrant entrepreneurial culture, venture capital markets in particular, appear to be lacking [27].

FORCES FOR CHANGE

Agents of Change

While the Information Technology Commission was created in 1997 with high expectations, its Web site www.itcomm.gov.pk is not inspiring. The following quote illustrates a good intention [97]:

Information Technology is the fastest growing area in today's world and the Government of Pakistan has prioritized its energy and resources towards ensuring that the Government is fully equipped with all the relevant IT tools required to enter the 21st Century. This web site has been developed in the same spirit.

However, the Web site does not appear to have been significantly updated or added to since its creation. There are few indications of any concrete results of the Commission's efforts. According to one source, the IT Commission has been renamed the IT Working Group and is currently based at the Sustainable Development Policy Institute, a victim of the frequent changes in the ruling party [49].

Competitive Forces

Under the current economic climate, the use of the Internet as a point of competitive advantage makes little sense for most Pakistani businesses, except, perhaps, those in the software business. The vast majority of the Pakistani populace is unfamiliar with the Internet. Given the current political and economic climate in Pakistan, most organizations probably have greater concerns than how the Internet might assist their marketing efforts. However, for those organizations that have dealings with the global community, the Internet is much more likely to be an essential business tool.

External Mandates

There have been no national-level mandates for organizations, public or private, to be connected to the Internet. However, there have been programs designed to bring government entities on-

line. At the provincial level, Sind and Punjab have programs to bring all provincial government agencies on-line.

ENABLERS OF CHANGE

Enablers of change are those elements that help a change take hold in a community. While forces for change push change into a community, the enablers of change are those conditions that enable a community to embrace the change and that affect that rate of change. One of the more significant enablers include what Nelson calls the 'National Innovation Systems,' which encompasses the educational system and organizations involved in research and development [54]. Other factors may include historical strengths (e.g. Israeli expertise in security issues), the legal framework for creating of new companies, and cultural elements that may influence a society's willingness to embrace new technologies.

In Pakistan, there are few distinctive enablers of change that would make Pakistani society particularly receptive (to this author's knowledge). The educational system has pockets of excellence (e.g. Lahore University of Management Science (LUMS)), but lacks the breadth and depth to produce the quality and volume of graduates needed for broad-based adoption of the Internet. Pakistan has few inherent technology strengths, although the software industry has been growing. While creating new company is not difficult, companies of all kinds may struggle at times with bureaucracy and political change.

Government Policy and the Determinants of Internet Diffusion

The most important determinant, government policy, belongs in a category by itself, since the policies of government overlay all other determinants, affecting both their nature and their effectiveness, based upon a government's ability to exercise coercive power. The policies created by a government are generally intended to achieve the fulfillment of that government's goals, which may be more or less closely related to the goals of those governed, depending upon the form of government. The government's policies may also appear to be more or less rational, depending upon how well the policy reflects the realities of its milieu, but governments can--and all too often do--create policies that reflect a lack of awareness or understanding of its environment, or an excessive optimism regarding the government's ability to overcome obstacles to its policies. The most important levers are:

1. passage of legislation and directives that shape the legal environment within which a society functions;
2. enforcement of laws and the wishes of those in control of security forces;
3. taxation, fees and other forms of revenue generation;
4. allocation of resources: financial, informational, technical, human, and material.

Governments' ability to apply the levers of power to shape determinants is by no means uniform across determinants. Some determinants, e.g. geography, are, for the most part, outside the realm of influence of the government. Other determinants, e.g. resources and legal/regulatory environment, lie firmly within the reach of governments' levers of power. Still other determinants lie somewhere in-between. While governments may over time work to create an entrepreneurial culture within a country, for example, this is usually a slow and uncertain process.

The following table illustrates some of the ways in which Pakistani government policy has influenced the determinants discussed above. The table also can be used to suggest ways in which the government can impact the development of the Internet in Pakistan. Each of measures can be classified according to whether it is likely to be a high impact or a low impact measure. High impact measures are those that are likely to have a strong and relatively quick impact on one or more of the Internet dimensions. Each measure can also be classified according to whether it is easy or difficult to implement. Spending a lump sum of money is easy; bringing about a shift in popular opinion is more difficult; changing the geography of a country is practically impossible.

<i>Determinant</i>	<i>Measures taken</i>	<i>Measures that might be taken</i>	<i>Impact/Difficulty</i>
<i>Access</i>	Building of fiber cables; reduction of import duties on PCs	Construction of true national backbone; provision of hardware / software to educational institutions	Moderate / Easy - Difficult
<i>Perceived value</i>	Promotion of use of Internet in government by federal and provincial governments	Promotion of openness and transparency of the governance process.	Moderate / Difficult
<i>Ease of Use of the Internet</i>		Literacy programs. Promotion of non-English language content.	Moderate / Moderate
<i>Cost of Internet Access</i>	Reduction in leased line charges; exception of Internet access from multimetering	Reduction in leased line charges, especially International.	High / Easy
<i>Adequacy & fluidity of resources</i>	Investment in telecommunications infrastructure; Expansion of IT training in schools;	Improvement of investment climate; Creation of financial system supporting of venture capital; Expanded and more stable power grid	High / Moderate-Difficult
<i>Regulatory/ legal framework</i>	PTA, 1996 Licensing of ISPs	Passage of E-Commerce legislation; Opening up of domestic & international basic services to competition; removal of prohibition on voice over Internet.	High / Moderate
<i>Ability to Execute</i>		Stabilization of government and economy.	Moderate / Difficult
<i>Geography</i>			Low / Difficult
<i>Demand for capacity</i>			Moderate / Moderate
<i>Multiplicity of ISPs</i>	Liberal licensing of ISPs		High / Easy

<i>Services provided</i>		Expansion of telecom. Services provided; improve quality of switches & local loop	High / Moderate
<i>Culture of entrepreneurship</i>		Improvement of investment climate; legislation more conducive to venture capital	Moderate / Moderate-Difficult
<i>Forces for change</i>	Creation of IT Commission, etc.; programs to connect governmental departments	Continuity of champions of Internet, technology	Moderate / Moderate
<i>Enablers of change</i>	Expansion of IT education	Continued expansion of IT education; promotion of benefits of technology	High / Moderate

Table 19 Selected Internet-Enhancing Options for Government Policy Makers

Table 19 shows a number of measures taken by the Pakistani government have had a positive impact on the growth of the Internet in Pakistan. Most prominent among these are the liberal licensing of ISPs and the investments made in telecommunications infrastructure over the last two decades. But a good deal more could be done. The most likely candidates are those that are relatively easy to implement, yet which are likely to have a large impact on the Pakistani Internet. As shown in the table, a reduction of tariffs, both domestic and international, for IP traffic is very important. Of slightly greater difficulty, given the numerous interest groups involved in the issue of privatization of PTCL, would opening up of the domestic and international basic services and infrastructure creation markets to competition. In the long term, the Internet would benefit tremendously if Pakistan were able to get its economic and political house in order. This is perhaps the most difficult task of all, and one which is well beyond the scope of this study. It is not inconceivable, however, that the Internet, as another medium for integrating Pakistani society and business into the global fabric, could play a small role in bring such change about.

References

- [1] 1300 Police Stations in Pakistan to be Linked Through Net, *IT Pakistan*, Vol. 1, No. 16, Sep 16, 1999, p. 1.
- [2] \$200 million expansion for telecom network, *Middle East Economic Digest*, Jul 17, 1998, p. 26.
- [3] 2010 in Brief - Pakistan 2010 Programme, <<http://www.pak2010.gov.pk/2010%20in%20brief.htm>> (Oct. 16, 1999).
- [4] About Information Technology Commission, 1997. <<http://www.itcomm.gov.pk/about.htm>> (Oct. 16, 1999).
- [5] Action Plan - Pakistan 2010 Programme, <<http://www.pak2010.gov.pk/action%20plan.htm>> (Oct. 16, 1999).
- [6] Ahmed, S., "The Multiple Risks of Frantic Borrowings," *karachi Dawn*, Sep 29, 1997.
- [7] Aims & Objectives, Internet Service Providers Association of Pakistan. <<http://www.ispak.net.pk/aims.htm>> (Nov. 6, 1999).
- [8] Ali, M., "Pakistan: Telecommunications & Politics," *Middle East Communications*, Nov, 1997, pp. 13-18.
- [9] Bhai, T., E-mail communication, 23 Aug, 1999.
- [10] The Budget, *Business Recorder*, Jun 14, 1997, p. 2.
- [11] Chief of ARY Group File Charges Against MCB, *The Nation (Islamabad)*, Jan 20, 1997, pp. 1,11.
- [12] China bids low for telecoms expansion, *Middle East Economic Digest*, May 1, 1998, p. 23.
- [13] China Wan Bao selected for telecoms expansion, *Middle East Economic Digest*, Oct 16, 1998, p. 18.

- [14] Contracts signed for telecoms expansion, *Middle East Economic Digest*, Oct 30, 1998, p. 19.
- [15] Country Commercial Guides FY 1999: Pakistan, U.S. Department of State.
<<http://www.state.gov/www/aboutstate/business/comguides/1999/sa/pakistan9907.htm>>
(Oct. 16, 1999).
- [16] Country Commercial Guides FY 1999: Pakistan, U.S. Department of State.
<<http://www.state.gov/www/aboutstate/business/comguides/1999/sa/pakistan9910.htm>>
(Oct. 16, 1999).
- [17] E-Commerce Gets State Patronage, *South Asian Business Analyst*, Aug 31, 1997.
- [18] Economic Overview - Pakistan 2010 Programme,
<<http://www.pak2010.gov.pk/economic%20overview.htm>> (Oct. 16, 1999).
- [19] Excise Duty on Phone Calls to be Reduced, *IT Pakistan*, Vol. 1, No. 11, Jun 25, 1999, p. 1.
- [20] Existing Private Sector Licensed Services, Pakistan Telecommunications Corporation.
<<http://www.ptc.pk/invst1.html>> (May 26, 1999).
- [21] Flash Report Number 2: International Connection costs to Provide Internet,
<<http://www.millat.com/interests/it/ispuserinfo.htm>> (Sept., 1999).
- [22] Flash Reports, Internet Service Providers Association of Pakistan.
<<http://www.ispak.net.pk/ispak-1.htm>> (Nov. 5, 1999).
- [23] Foreign Investors Withdraw \$175 Million From Pakistan, *Islamabad The News*, Sep 7, 1998.
- [24] Goldman Sachs to Assist Privatisation of Pakistan Telecom, *Asia Pulse*, Jan 15, 1999.
- [25] Haq, I., "Pakistan IT Summit Recommendations," *Bytes for All*, Vol. 2, Sept/Oct, 1999.
- [26] Haque, I., "Pakistan's New Investment Policy Detailed," *karachi Dawn*, Nov 22, 1997.
- [27] Hassan, S. Z., A Framework for IT Industry Development: A Case Study of Pakistan, Working Paper, Lahore University of Management Sciences.

-
- [28] Hunter, T. C., "Pakistan Telecommunications," *Global Communications*, Vol. 16, July/August, 1994, pp. 16-19.
- [29] Husain, E., IAP Rescues Internet in Pakistan, Internet Association of Pakistan. <<http://www.iap.org.pk/pm.htm>> (June 2, 1999).
- [30] In Brief: Pakistan, *Middle East Communications*, Jul, 1997, p. 8.
- [31] India and Pakistan: Not Cricket, *The Economist*, May 22, 1999, pp. 3-5.
- [32] Institute of Business Administration to Hold International Conference on E-Commerce, *IT Pakistan*, Vol. 1, No. 17, Sep 17, 1999, p. 1.
- [33] Internet Association of Pakistan, <<http://www.iap.org.pk/iap.htm>>.
- [34] Internet Connectivity Comparison, <<http://www.pol.net.pk/compare/connectivity.htm>> (Nov. 2, 1999).
- [35] IP Address Space Allocation of ISPs, *NetMag*, No. 7, May-June, 1999.
- [36] ISP Survey Results. User Comments, *NetMag*, Vol. 1, No. 7, May-June, 1999 (<<http://netmag.com.pk/isps/Survey%20Results/isp7.htm>>).
- [37] The ISPAK Flash Report #4, Internet Service Providers Association of Pakistan, June 18, 1998. <<http://www.ispak.net.pk/ispak-4.htm>> (Oct. 14, 1999).
- [38] It Is Not Appropriate To Invite New Crises, *Rawalpindi Jang*, Jun 18, 1998 (FBIS-NES-98-171).
- [39] IT Summit Recommends law for E-Government, *IT Pakistan*, Vol. 1, No. 14, Aug 25, 1999, p. 1.
- [40] Jalal, S., "Competition hots (sic) up in pakistan's Internet market," *Middle East Communications*, June, 1997, p. 10.
- [41] Karamat, J., The Internet in Pakistan, Communication with S.E. Goodman. May 21, 1999.
- [42] Khan, F., "Can You Top This?," *Feedback*, Vol. 2, No. 12, Nov, 1997, p. 11.

- [43] Khan, F., E-Mail Communication, Nov. 3, 1999.
- [44] Khan, F., E-mail Communication, Nov. 4, 1999.
- [45] Khan, U. A., The ?? of Business on the Internet, December.
<<http://wavetec.com/talk/sld001.htm>> (June 2, 1999).
- [46] Major Goals - Pakistan 2010 Programme,
<<http://www.pak2010.gov.pk/major%20goals.htm>> (Oct. 16, 1999).
- [47] Mehta, A., Communication with ZooomNet representative, November, 1999.
- [48] Mehta, A., The Internet in Pakistan, E-mail Communication. Sept. 2, 1999.
- [49] Mehta, A., Personal Communication, Nov. 15, 1999.
- [50] More EIS Licenses Offered, *IT Pakistan*, Vol. 1, No. 3, Mar 5, 1999.
- [51] Nasrullah, J., "Entrepreneurs provide e-mail to Pakistan," *The Institute (IEEE)*, Oct, 1995, p. 4.
- [52] Nawaz Orders Privatization of Public Sector Units Expedited, *karachi Dawn*, May 24, 1997.
- [53] Nazeer, A. H., E-Mail Communication, 28 Aug.
- [54] Nelson, R. R., Ed., *National Innovation Systems: A Comparative Analysis*, Oxford University Press, New York, 1993.
- [55] New Deadline for Privatization of Pakistan Telcoms Co, *Asia Pulse*, Feb 5, 1999.
- [56] New Pakistan Public Sector Program to Prioritise Telecoms, *Asia Pulse*, Apr 30, 1999.
- [57] Nexlinx Member Services, Nexlinx, Inc. <<http://nexlinx.net.pk/faq/isp.html>> (May 26, 1999).

-
- [58] Pakistan, CIA -- The World Factbook.
<<http://www.odci.gov/cia/publications/factbook/pk.htm>> (Oct. 16, 1999).
- [59] Pakistan Government To Fully Computerize Its Functioning, *IT Pakistan*, Vol. 1, No. 4, Apr 2, 1999, p. 1.
- [60] Pakistan Plans Roadshows in April for Telecoms Sale, *Asia Pulse*, Feb 1, 1999.
- [61] Pakistan Telecom Corp. Plans Special Package for 1998-1999, *Asia Pulse*, Jun 23, 1998.
- [62] Pakistan Telecommunication Act, 1996, Act No. XVII of 1996, Oct. 17, 1996.
<<http://www.pta.gov.pk/>>.
- [63] Pakistan, Past Picks. DesiChat. Apr. 8, 1999.
<<http://www.pakistan.com/psite/past/yr99/Apr/p0408.htm>> (June 2, 1999).
- [64] Pakistan's Internet Backbone, *Bytes for All*, Vol. 2, Sept/Oct, 1999
(<<http://www.bytesforall.org/>> (Oct. 13, 1999)).
- [65] Pakistan's PTCL Approves \$56 Mln Expansion Programme, *Asia Pulse*, Aug 7, 1998.
- [66] Pakistan's PTCL Completes Phase 1 of Internet Expansion, *Asia Pulse*, Aug 18, 1999.
- [67] Pakistan's PTCL Installs Internet Infrastructure, *Asia Pulse*, Sep 16, 1999.
- [68] Pakistan's Teledensity Set to Double by June 2003, *IT Pakistan*, Vol. 1, No. 3, Mar 5, 1999.
- [69] Pakistan Telecommunication Authority, List of licensees,
<<http://www.pta.gov.pk/industry/pta%20costumers.htm>> (Oct. 16, 1999).
- [70] Pakistan Telecommunication Authority, Policy Framework,
<<http://www.pta.gov.pk/authority/pf.htm>> (Oct. 16, 1999).
- [71] Pakistan Telecommunication Authority, Public Notice,
<<http://www.pta.gov.pk/publicnotice2.html>> (Oct. 16, 1999).
- [72] PKNIC Services, <<http://pknice.net.pk/services.htm>> (June 2, 1999).

- [73] Planning Chief's Vision for IT in Schools, *IT Pakistan*, Vol. 1, No. 10, Jun 14, 1999, p. 1.
- [74] Privatisation of Pakistan State Telco to be Delayed, *Asia Pulse*, Jan 11, 1999.
- [75] Privatization of Telecom Sector Postponed, *The Nation (Islamabad)*, May 3, 1997 (FBIS-NES-97-123).
- [76] PTA Chairman: Fiber Optic Link with CARS Planned, *Islamabad The News*, Nov 9, 1997, p. 8 (FBIS-NES-97-313).
- [77] PTC & Olex, *Middle East Communications*, Vol. 10, Nov, 1995, p. 4.
- [78] PTC pledges further investment, *Middle East Communications*, Sep, 1998, p. 6.
- [79] PTC to invest \$280 million a year in new lines, *Middle East Economic Digest*, Aug 21, 1998, pp. 27-28.
- [80] PTCL Leased Data Circuit Rates, *NetMag*, No. 5, Jan-Feb, 1999.
- [81] PTCL Lowers Connectivity Charges, *IT Pakistan*, Vol. 1, No. 12, Jul 9, 1999, p. 1.
- [82] PTCL seeks to tax internet users further, *Dawn*, May 24, 1998 (<<http://www.apnic.net/mailling-lists/s-asia-it/9806/msg00011.html>> (Oct. 14, 1999)).
- [83] PTCL to Invest Rs. 1.2 billion (US\$ 24 Million), *IT Pakistan*, Vol. 1, No. 7, Apr 30, 1999.
- [84] Punjab and Sind Provinces Set Up IT Boards, *IT Pakistan*, Vol. 1, No. 6, Apr 17, 1999.
- [85] Punjab Government to Launch Its Own Web Page, *IT Pakistan*, Vol. 1, No. 7, Apr 30, 1999, p. 1.
- [86] Punjab to Computerize Land Records, *IT Pakistan*, Vol. 1, No. 9, May 28, 1999, p. 1.
- [87] Removal of Import Duties on PCs has Choked Grey Market, *IT Pakistan*, Vol. 1, No. 4, Apr 2, 1999, p. 1.
- [88] Retreat, *The Economist*, Jul 17, 1999, p. 37.

-
- [89] The Rot in Pakistan, *The Economist*, May 22, 1999, p. 18.
- [90] Shah, S. I. A., Data Communication Services: Their Impact on the Pakistani Software Industry, Abridged Version of the report on "Data Communications Services: Their Impact on the Pakistani Software Industry" A Small and Medium Enterprise Development Authority Funded Report.
- [91] Shaikh, S., "Armed Forces to Monitor First National Census in 16 Years," *The News*, Jul 17, 1997, p. 1.
- [92] Sharif government Rapped Over 'Crisis', *Rawalpindi Jang*, Jun 18, 1998, p. 10.
- [93] Sharif, M. N., "Communications Technology Day: Message from Muhammad Nawaz Sharif: Prime Minister of Pakistan," *Business Recorder*, Jun 12, 1999.
- [94] Sind Government to Use IT at All Levels, *IT Pakistan*, Vol. 1, No. 17, Sep 17, 1999, p. 1.
- [95] Sind to Have Its Own IT Board, *IT Pakistan*, Vol. 1, No. 16, Sep 16, 1999, p. 1.
- [96] State Telecom PTCL to Provide 140,000 New Internet Connections by May 1999, *IT Pakistan*, Vol. 1, No. 2, Feb 19, 1999 (<<http://www.parep.org.sg/ITPAK.htm>> (Nov. 2, 1999)).
- [97] Text for IT, Information Technology Commission. Government of Pakistan. 1997. <<http://www.itcomm.gov.pk.htm>> (Oct. 16, 1999).
- [98] Trade Malpractice to be Checked Thru Internet, *IT Pakistan*, Vol. 1, No. 8, May 17, 1999, p. 1.

Appendix A Internet Service Providers in Pakistan¹⁰

<i>ISP</i>	<i>URL</i>	<i>Cities</i>
Acsys	Unknown	Unknown
AKNET	http://www.ak.net.pk	Lahore
Apollo Online	http://www.apollo.net.pk	Unknown
Asia Online	http://www.aol.net.pk	Karachi
Aster Net	http://www.aster.com.pk	Lahore
Brain Net	http://www.brain.net.pk	Faisalabad, Gujranwala, Islamabad, Karachi, Lahore, Mardan, Multan, Peshawar, Rahim Yar Khan, Rawalpindi, Sahiwal, Sheikhpura, Sialkot
Breeze Net	http://www.breeze.net.pk	Karachi
BRIT.NET	http://www.brit.net.pk	Karachi
CompuNet Online	http://www.compol.com	Hyderabad, Islamabad, Karachi
COMSATS	http://www.comsats.net.pk	Faisalabad, Gilgit, Islamabad, Karachi, Lahore, Peshawar, Sialkot
Cube XS	http://www.cubexs.net.pk	Karachi
CyberAccess	http://www.cyberaccess.com.pk	Unknown
CyberNet	http://www.cyber.net.pk	Karachi
Digicom	http://www.digicom.net.pk	Unknown
EZE Net	Unknown ¹¹	Unknown
Fascom	http://fascom.com	Karachi
Gerry's Net	http://www.gerrys.net	Karachi
GlobalNet	http://www.global.net.pk	Karachi, Lahore
Hermes Online	Unknown	Unknown
IBM	http://www.ibm.net	Karachi
ICNS	http://www.icns.com.pk	Unknown
Infonet	http://www.inet.com.pk	Unknown
LOGON Net	http://www.logone.net	Karachi
Meganet	http://www.meganet.com.pk	Rawalpindi

¹⁰ The URLs and cities shown were collected from ISP web pages. This list is not guaranteed to be complete.

¹¹ A number of ISPs were listed without a URL on the NetMag ISP listing <http://netmag.com.pk/isps/ispwathc.htm>

MSNet	http://www.ms.net.pk	Lahore
Net 21	Unknown	Unknown
NetAccess	http://www.netxs.com.pk	Unknown
NetAsia	http://www.netasia.com.pk	Hyderabad, Karachi
Nexlinx	http://www.nexlinx.net.pk	Lahore
One Net	Unknown	Unknown
Orbit	Unknown	Unknown
Pakistan Online	http://www.pol.com	Gujranwala, Islamabad, Lahore, Rawalpindi
Paknet	http://www4.ptc.pk	Faisalabad, Islamabad, Karachi, Lahore, Peshawar, Quetta, Rawalpindi
PakNet	http://www.ptc.pk	Unknown
Pienet Global	http://www.pienet.net	Karachi
Sat.net	http://www.sat.net.pk	Islamabad, Karachi, Lahore
SHOA	http://www.shoa.net	Islamabad, Karachi, Lahore
Space Net	http://www.space.net.pk	Gujrat, Lahore, Sialkot
Supernet	http://www.super.net.pk	Islamabad, Karachi, Lahore
The Flash Net	http://www.theflash.net	Lahore
VisionNet	http://www.vision.net.pk	Hyderabad, Karachi
World Online	http://www.wol.net.pk	Unknown
Zooom Net	http://www.zooom.net	Bahawalpur, Hyderabad, Karachi, Lahore, Multan, Rahim Yar Khan, Sukkur

Glossary

ALCoE	Action Learning Center of Excellence
APNIC	Asia-Pacific Network Information Center
IAP	Internet Association of Pakistan
INTERNIC	Internet Network Information Center
ISP	Internet service provicer
ISPAK	Internet Service Providers Association of Pakistan
IWSP	Internet Welfare Society of Pakistan
LUMS	Lahore University of Management Sciences
NTC	National Telecommunication Corporation
PKNIC	Pakistan Network Information Center
POP	Point of Presence
PSDP	Public Sector Development Program
PSEB	Private Software Export Board
PTA	Pakistan Telecommunication Authority
PTC	Pakistan Telecommunication Corporation
PTCL	Pakistan Telecommunication Company Ltd.
TLD	Top Level Domain
UAN	Universal Access Number
UUCP	Unix-to-Unix Copy
WLL	Wireless local loop