



# **Broadband Policy for Pakistan**

**Nov 2004**

**Ministry of Information Technology**  
IT & Telecommunications Division  
Government of Pakistan  
[www.moitt.gov.pk](http://www.moitt.gov.pk)

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## 1.0 INTRODUCTION:

### 1.1 What is broadband?

The definition of 'Broadband' varies from country to country, but it is generally accepted as high speed, 'always on' Internet connection. Various organizations like the ITU, OECD and international regulators specify the minimum download speed of a broadband connection ranging from 128 Kbps to 2 Mbps or higher. The 'Always On' facility as opposed to the 'dial up' (10s of KBps) means that the user has access to the net as soon as he switches his internet browser on and does not need to dial the ISP number for a connection. As illustrated in Figure 1<sup>1</sup>, most applications can be adequately supported if the minimum user speed is around 128kbps.

Speed, kbps	28	128	512	1,024	2,048	4,096	10,000
Transaction Processing	A	A	A	A	A	A	A
Messaging / Text Apps	A	A	A	A	A	A	A
Voice	A	A	A	A	A	A	A
Still Image Transfers	N	A	A	A	A	A	A
Internet / VPN Access	N	A	A	A	A	A	A
Database Access	N	A	A	A	A	A	A
Enhanced Web Surfing	N	A	A	A	A	A	A
Low quality Video	N	A	A	A	A	A	A
Hi - Fi Audio	N	A	A	A	A	A	A
Large File Transfer	P	A	A	A	A	A	A
Moderate Video	P	N	A	A	A	A	A
Interactive Entertainment	P	N	N	A	A	A	A
High Quality Video	P	P	N	N	A	A	A

A = Acceptable  
P = Poor Quality  
N = Not Acceptable

**Figure 1 – Broadband Applications & download speeds**

(Source – Broadband Strategy for Egypt 2004-2007)

### 1.2 Broadband Benefits

Broadband access is widely recognized as a catalyst for the economic and social development of a country. Broadband roll-out has a more powerful impact than the spread of basic telephony. For it not only allows people to communicate, but also to do business more efficiently over longer distances, be better educated, have access to better health services, benefit from better governance, and have enhanced entertainment services. A major part of the expected increase in GDP and economic uplift due to broadband access will come from the benefits that high speed data networks and internet access will have on corporate efficiency and success. Whether transacting between a business and a consumer, or between two businesses, the success of e-commerce transactions severely decreases with

lower speeds. This is driven by the longer time taken to access and act upon information.

A broadband connection can also be used for two way applications that would not be viable with a slow and unreliable 'dial up' service such as online classrooms and health clinics where the teacher and student and the Doctor and his patient can see and talk to each other through their computers.

### **1.3 Broadband lessons from the world markets-**

Countries with high penetration of broadband users such as South Korea, Japan and Canada have all implemented conscious policies for the growth of broadband in their countries. These policies have included growth enablers such as price reductions for the use of infrastructure, unified licensing for service providers, government's setting of strict annual broadband penetration targets, content and e-commerce development incentives and lowering of the price and tax barriers on the broadband terminal equipment. The resultant growth and high penetration of broadband has contributed significantly to the social and economic standing of these countries. Realising the social and economic benefits of broadband, other countries such as India and Egypt have also recently issued similar strategies for the growth of broadband in their countries.

## **1.4 Broadband in Pakistan**

### **1.4.1 Global standing of Pakistan**

Even with tremendous growth in the information technology sector over the past five years with the internet reaching almost 2000 towns and villages and the international bandwidth rates dropping by almost 90% (from USD 30,000 in year 2000 to USD 3,950 in 2004), overall ICT usage and penetration in Pakistan is still below international averages and shows a significant room for improvement. (See table 1- Annex B). Although the availability of broadband infrastructure in itself will not necessarily result in the spread of broadband services in Pakistan, the price of broadband access will play a significant role.

### **1.4.2 Broadband market dynamics in Pakistan**

- According to various market surveys and estimates carried out in Pakistan, Pakistan had approximately 2.5 million Internet users by the end of June 2004. First Broadband connection in Pakistan was given in 2002. By June 2004 there were approximately 40000 (91% cable, 8% DSL and less than 1 % satellite and wireless) broadband subscribers in Pakistan, i.e. a penetration of 1.6 %. All broadband subscribers are in the three main cities of Karachi, Lahore and Islamabad.

- Even though copper access network still dominates the cable / HFC network (less than 100,000 connections compared to over 4.5 million copper connections), broadband, in particular DSL, penetration is low because:

International IP bandwidth cost for a 2 Mbps connectivity, despite significant reductions, is a constraint at \$US 3995 in mid Aug 2004, and as a result the customer is charged a minimum of Rs 3500 for unlimited volume of shared 128 kbps of DSL broadband connectivity per month, plus the installation (Rs 2500) and CPE costs (Rs 3500). These tariffs<sup>1</sup> have kept the demand at a very low level.

- Approximately 3000 DSL subscribers (by June 2004) belonged to four private sector companies namely Micronet Broadband Pakistan, Multinet Pakistan, Dancom Pakistan and Habib Rafiq Pakistan, who lease PTCL's access network on an Operation & Maintenance contract basis. These four DSL service providers had very little existing ISP presence/customer base when they started their DSL service. Hence their broadband customer acquisition costs were also high.

#### **1.4.3 Barriers to broadband growth in Pakistan:**

##### Price:

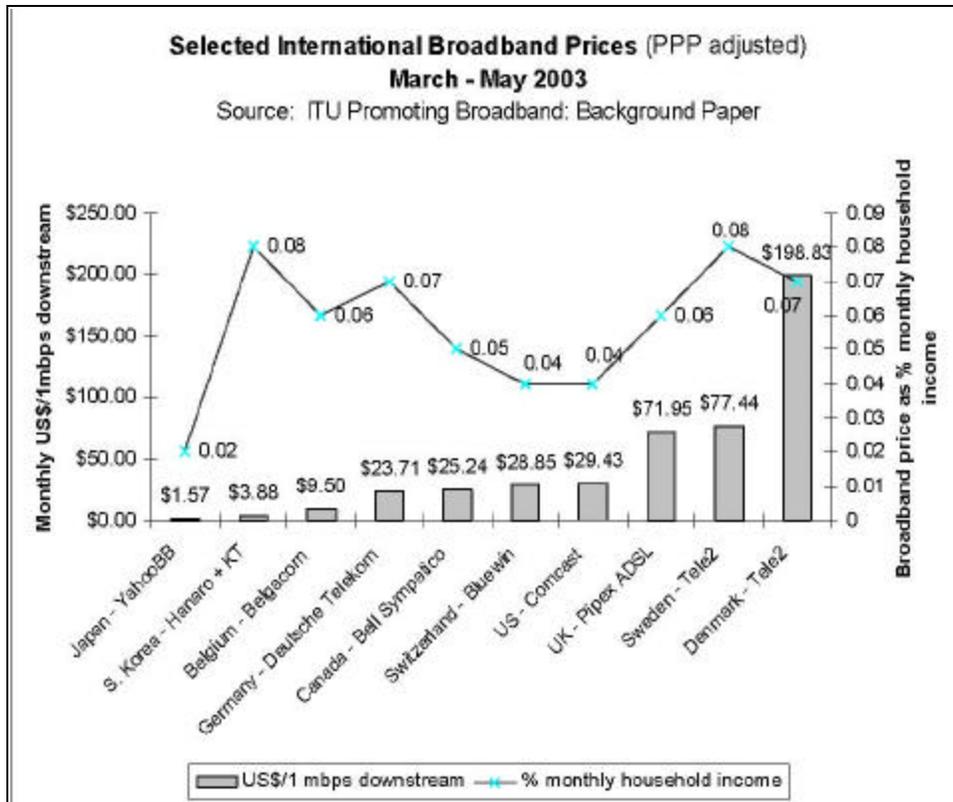
–The subscription prices for broadband in Pakistan are 60 times higher than in Korea, as the price of 100 KBps in Korea is US\$ 0.25/m, as compared to the minimum of US\$ 15/m in Pakistan<sup>2</sup>. However considering the respective purchasing powers of the two economies<sup>3</sup>, this translates to 1600 times higher prices in Pakistan.

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<sup>1</sup> These were the minimum tariffs for unlimited (non volume based), shared 128kbps usage, installation and CPE for broadband DSL in Pakistan in Oct 2004.

<sup>2</sup> In Oct 2004, the minimum monthly tariff for a 128kbps volume based broadband connection in Pakistan was Rs 1170.

<sup>3</sup> In June 2004, the per capita GDP in Korea was US\$ 17,700 as compared to US\$ 652 in Pakistan (source: Ministry of Finance, Pakistan and Ministry of Finance & Economy, ROK)



**Figure 3- International broadband prices**  
 (Source - ITU Promoting Broadband: Background Paper)

Last Mile Access

- Low quality and small scaled HFC networks
- Quality issues with the copper beyond 1.5 km from the exchange
- Allocation and availability of frequency bands for BWA according to the ITU standards.

Content:

- Lack of locally located and local language content
- Lack of content and applications
- e.g. online stock market, online content in local languages, online education, e-government, e-commerce, home shopping, on-line games etc.

**1.4.4 Broadband enabling steps required in Pakistan.**

While other countries, like Japan and South Korea, are aiming at delivering “universal, affordable access to broadband” for all of their citizens, Pakistan needs to quickly create the environment for stimulating explosive initial growth. Without the right interventions, the current market offerings – dial-up connectivity of 50 hours per month for Rs. 500, or unlimited broadband

connection at more than Rs. 3500 per month<sup>4</sup>, with high installation and CPE costs, and low reliability and quality of service – will continue to prevail with benefits realized by only a few. Steps need to be taken in the Broadband sector in order to escalate the growth of users and in turn the GDP of the country.

In Pakistan the mobile users have already overtaken the fixed line users in Pakistan. However only until the year 2000, this figure stood at less than half a million. The government then introduced CPP (Calling Party Pays) regime in the mobile sector in Pakistan. Within four years the cellular penetration grew by more than a 1000% reaching 6.2 million by September 2004. One policy initiative changed the entire growth of the cellular sector in the country. Today the six mobile operators are each looking to add more than 1 million connections in a year. Similar if not higher growth rates are expected in the fixed line sector after the recent removal of the monopoly in fixed line service provision. The ‘open’ fixed line deregulation policy has resulted in 12 LDI (Long Distance International) operators and 73 Local loop service providers<sup>5</sup>. Open regulatory steps in the policy have resulted in such interest, which no doubt will contribute to a reduction of tariffs and accelerated growth of the fixed line services into the far flung areas of the country.

#### **1.4.5 Way forward – A broadband enabling policy**

In order for the above success to be replicated in the broadband sector of Pakistan, a broadband policy for Pakistan is required- A policy that aims at setting goals for broadband services in the country. This will include investment in urban networks, domestic and international backhaul, content delivery mechanisms, content and application development, and rural build-out. The content and applications would include a full menu of services including education, health, governance, locally located content, local language web content, and new broadband-based entertainment like games and videos. For this magnitude of investment to occur, the appropriate regulatory environment and policies need to be established. Once this happens, only then will there be successful growth and business models in broadband services.

### **1.5 Policy Objectives**

The Broadband policy is designed to achieve the following objectives:

- 1. Spreading of an affordable, ‘always on,’ broadband high speed internet service in the corporate and residential sectors across Pakistan.**
- 2. Encourage the entry and growth of new service providers while stimulating the growth of the existing ones at the same time.**

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<sup>4</sup> The non volume based (unlimited) 128kbps broadband connection tariff in Pakistan in June 2004.

<sup>5</sup> Sept 2004 figures from PTA website.

### **3. Encourage private sector investment in local content generation and broadband service provision.**

The policy proposes the following strategy for the achievement of the above objectives:

- a. Removing the existing technical, commercial, operational and legal barriers to the growth of broadband in Pakistan.
- b. Increasing the choice of broadband technologies (DSL, Cable & FTTx, Wireless, Satellite) available to the consumer at affordable prices.
- c. Encourage the development and hosting of local content so as to reduce reliance on the expensive international bandwidth.
- d. Promoting the sale of terminal equipment (PCs, CPEs).
- e. Obligating a pro-active and facilitating role by the largest infrastructure provider PTCL for the growth of Broadband in Pakistan.

#### **1.6 Broadband Targets:**

**1.6.1 Broadband in Pakistan will be defined as “Always on Internet connection with a download speed of at least 128kbps in case of shared connectivity and at least 256kbps in case of volume based connectivity”. These download speed targets will be subject to an increase as the bandwidth prices reduce, local content becomes available and there is a general increase in awareness of broadband.**

**Based on the independent broadband market surveys of Pakistan in 2004, it is estimated that at least 70% of Internet dial up users will switch over to a broadband service if offered at a monthly tariff of up to Rs 1000. However keeping in view the fact that a majority of those users are paying less than Rs 500 per month for a dial up connection (and would only switch if broadband tariffs are kept under the same rate as well) and do not pay any fixed costs either such as the costs of CPE and installation associated with broadband connection, it is estimated that with the enablers given in this policy and the resultant monthly tariffs dropping below Rs 1000, at least 5 % of the internet users will be connected to broadband. i.e 200,000<sup>6</sup> broadband users in Pakistan within two years of implementing the policy. In line with the continuous reduction in international and domestic Internet and broadband tariffs and the expected availability of local content and broadband**

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<sup>6</sup> Assumes 4 million dial up Internet users by the end of 2005.

**awareness facilitated through this policy, it is forecasted that the number of broadband users in Pakistan will reach at least half a million within five years, with higher levels of penetrations with further reductions in the tariffs.**

However despite all the contributions projected from different parties, we should not expect the broadband services, especially those newly proposed, to turn profitable immediately. Looking at success stories of other developed countries, new services become profitable typically in 3 years. Broadband service providers in Pakistan should take that risk in order to stimulate usage and hence create much higher revenue streams in the future. The penetration levels envisaged in this policy will be achieved and further enhanced when the availability of local content and lucrative e-business models become widespread in Pakistan, when the legal framework fully supports the spread of such business models and when the cost of providing broadband services becomes as low as the levels seen in the broadband rich countries such as Japan, Korea and the US. The policy only aims to facilitate all of the above factors, but the actual growth will depend on the initiatives taken by the other stakeholders too, such as the service and content providers both abroad and in Pakistan to capitalize on these facilitations and help creating and meeting the demand rather than just meeting it.

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## 2.0 Policy Structure:

This policy document aims at separating the broadband value chain into four components and creating growth enablers in each component (Fig 4). The four links of the broadband value chain that will cover all the enabling aspects of the broadband services are

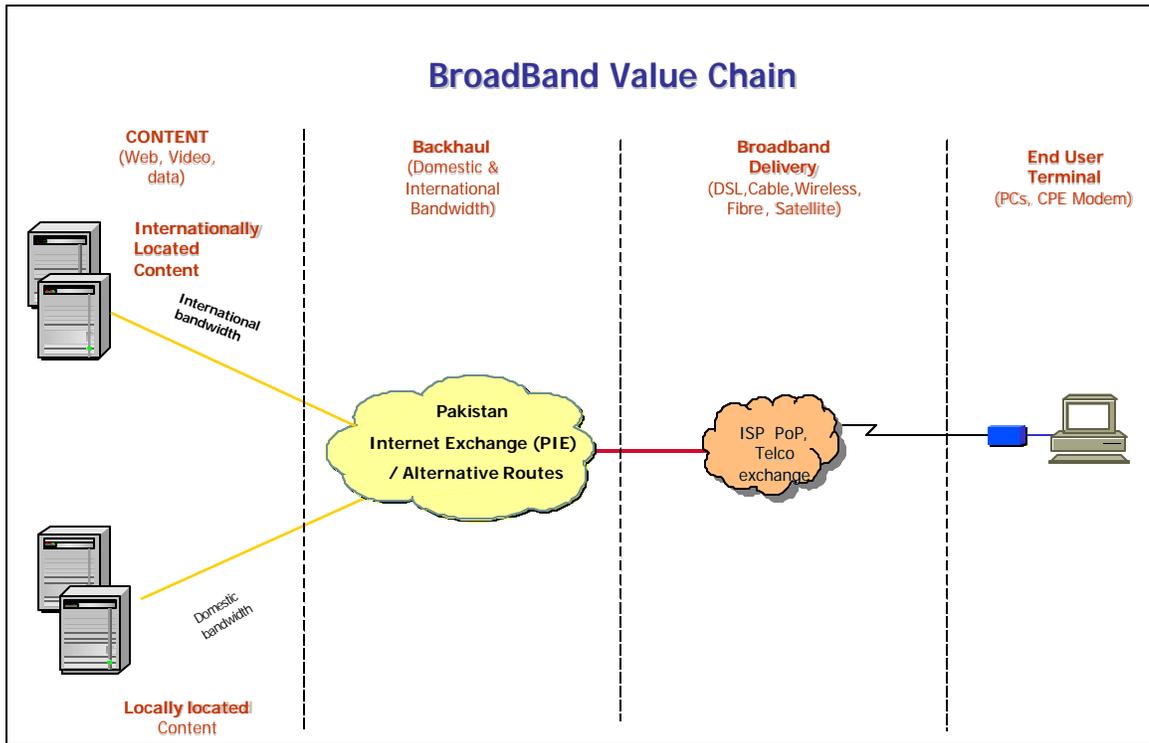


Fig 4- Broadband Value Chain

- 1) Content Facilitation
- 2) Backhaul Facilitation
- 3) Broadband Delivery facilitation
- 4) User Terminal equipment facilitation

### **3.0 CONTENT FACILITATION**

#### **3.1 Locally Located Content:**

Hosting of websites within a country is one of the main drivers for the promotion of broadband growth. It is therefore important to encourage both domestic and foreign operators to host their websites within Pakistan. This will address one of the key dimensions of accelerating broadband penetration, i.e., local content availability. By providing locally located content, this facility will reduce the reliance on the International IP bandwidth as a high proportion of the internet traffic would remain in Pakistan. To achieve this objective, the following steps will be implemented:

**3.1.1 The telecom operators, both fixed and mobile, will be encouraged to provide easy access (such as short access codes) to their networks for third party content providers.**

Third party content represents a significant chunk of revenues from the non-voice services of mobile and fixed line telecom operators. Since this industry directly impacts both content and broadband areas, the above step will help generate content providers in Pakistan.

New generations of communication CPEs in general, and mobile phones in particular, are supporting increasingly rich and advanced content types. The combination of 'quality' and 'ease of downloading' content are leading to rapid growth in the development of the content market. The recent past has seen a plethora of non-voice data services in the mobile area (Some VAS are available on Fixed Lines also) such as SMS, MMS and others delivered over different wireless service protocols. Given the popularity of content on mobile phones, encouragement of content providers to hook up to the cellular operators will help to bring in content providers much needed to facilitate broadband in Pakistan. The end user connectivity if provided in the form of short access codes will encourage the entry and growth of content providers in Pakistan, which in-turn will reduce the reliance on the international bandwidth.

**3.1.2 An e-commerce wing will be set up in the Ministry of IT to encourage the growth of broadband services in the country. This wing will propose and implement strategies for e-fraud prevention, verification of company**

**authentication certificates and reliable services such as money back guarantees.**

A 'National e-government council' has already been set up under the chairmanship of the Prime Minister of Pakistan. This council will oversee the e-government initiatives aiming at automation and e-communication within all federal ministries and assist all the local governments in automating their records and tax and revenue collection functions to improve decision making, besides ensuring electronic bill payment facility for all major utilities.

**3.1.3 In addition to the traditional credit card payment method over the net, all e-commerce content providers could encourage a payment model where their services are charged from the consumers through the broadband service provider monthly bills.**

**3.1.4 Facilitation on co-location of space and bandwidth will be given to companies which will set-up hosting facilities of 1 Tera Byte or more in Pakistan. The total storage to be setup at one time and can be in more than one location.**

This incentive will help bring in the web content located outside Pakistan thereby reducing the reliance on international bandwidth. This could also include the creation of a local mail service with 100MB storage per user. As of today, hosting websites is an expensive proposition due to the bandwidth and space charges that will be required for large hosting platforms. This financial barrier is one of the main reasons responsible for the low level of websites developed in Pakistan, whether in English or in Urdu.

Hosting web sites locally will have the following advantages:

- Access to these sites will be faster
- International IP bandwidth dependency will not be required for these sites
- Foreign exchange will be saved

### **3.2 Local Language Content:**

Even if the broadband policy is successful in reducing the international IP bandwidth barrier (reduced prices, peering networks etc), till such time that there is a demand from the consumers for utilization of this bandwidth, the objectives of the policy will not have been achieved. Whilst no doubt there is enough material available on the world wide web that can be accessed, given the fact that literacy in English is extremely limited amongst the general population, the vast majority of users will not be able to benefit from the increased bandwidth speeds and cheaper access.

Foundation for Advancement of Science and Technology (FAST) Lahore, under a PSDP funded project of technical assistance of the Ministry of Information Technology has developed an Urdu language Unicode based standard for website development. Standardization of the Unicode for Urdu has already happened. This will lead to large software operating system companies to produce standardized software for the language, allowing websites in Urdu to be developed as per normal practice, which allows indexing, searching, sorting and other similar functions to be carried out. For this to gain widespread acceptance, the policy envisages:

**3.2.1 Holding of a series of training workshops to teach the mechanics of developing Urdu language websites using the Unicode based standard.**

Developing the skills required to be able to develop websites in Urdu is not a complex task, and a short training course will equip the participants with the required skill level. Government will conduct a series of "Train the trainers" workshops. These trainers will then replicate these trainings at selected colleges and institutes throughout the country. This will result in a large pool of individuals who are able and willing to develop websites in Urdu.

It is anticipated that there will be a snowballing effect to this activity, since the more websites that are developed in Urdu, the more will be the usage of the internet within the country, which in turn will fuel the demand for more interesting and varied Urdu and other regional languages websites. This is a trend that has been observed in other countries, when a language has been introduced on the web, and there is no reason to believe that developments in Pakistan will not go down this route.

**3.2.2 To promote this concept, the policy envisages a sustained and targeted media campaign run in conjunction with both the state as well as the private electronic media channels.**

A nation wide competition consisting of different categories of websites and web developers will be organized and attractive prizes will be awarded to the winners. This will stimulate the interest of the target audience and result in high quality websites being developed.

**3.2.3 To spur growth in local content, the government will encourage hosting services for any website developed using the Urdu Unicode standard.**

Availability of Urdu language websites hosted locally would combine to raise usage as well as reduce the cost of connectivity, thus driving the usage upwards in

turn. This “virtuous” cycle will result in the objectives of the policy being achieved without any major financial burden on the stakeholders.

## **4.0 BACKHAUL FACILITATION**

Most of the content (international and domestic websites, .pk domain etc) is located on Internet servers outside Pakistan (Largely in the US and to a smaller extent in Europe). This obligates ISPs and the consumers to pay for the expensive International IP bandwidth to access that content. However the ISPs also need the domestic bandwidth to access and connect their individual PoPs located in various cities in Pakistan. The Content, International bandwidth and the Domestic bandwidth make up three of the most important elements of the back end or 'Backhaul' of the Internet and broadband supply chain. (See figure 4). Facilitation of these three elements will therefore have a major bearing on the ability of the service providers to offer cheap and affordable broadband services.

With lowering of the barriers for the broadband users in Pakistan and the expected switch of Internet users from dial up to broadband, the charges incurred in the PRI equipment specific to dial up users will be reduced so that the ISP can re-deploy his PRI equipment in less lucrative areas. See section 4.2.2.

Accordingly, the policy envisages:

### **4.1 Lowering the International IP bandwidth prices**

**4.1.1 The existing IP bandwidth prices will be lowered to a level where the annual broadband user targets stated in this policy would be completely achieved by the service providers.**

International IP bandwidth price is the biggest factor in an ISP cost. At present prices, it can become a major component (up to 60%) of the operational expense of an ISP. Reducing the International IP bandwidth price will therefore enable ISPs to offer better dial up and broadband services at affordable prices. Bandwidth service provider's price reduction can be achieved by various methods including reduction of costs of international capacities via long-term leasing of high bandwidth capacities and applying volume discounts on higher capacities (STM4). With the increased number of LDI service providers and increased competition in the infrastructure available in Pakistan, it is expected that natural price reductions will follow after the first 'artificial' price reduction offered specially for broadband promotion.

### **4.2 Lowering the domestic connectivity prices**

**4.2.1 The existing domestic bandwidth prices will be lowered to a level where the service providers will be encouraged to use local and national peering services and generate local and nationally hosted content.**

A reduction of domestic bandwidth prices by the domestic bandwidth service provider should encourage ISPs to have their own country-wide network and carry their internal traffic on their own network instead of Internet. This will open up cheap new services such as VPNs that ISPs can offer using their national network. ISPs will be able to attract corporate customers and banks for their remote branch connectivity using their national network. It will also encourage companies to develop attractive and e-commerce oriented content that resides in Pakistan, again reducing reliance on the expensive international bandwidth.

**4.2.2 The PRI charges will be lowered to a level where the gap created in the dial up infrastructure usage by the dial up users switching over to broadband services will not make the operational and capital expenditure in the PRI service a liability for the internet service providers.**

PRI (Primary Rate Interface) defines the equipment that is exclusively used to connect the dial up users from their PCs to the ISPs PoP through the telephone exchange. The reduction in charges will ensure that drop in the PRI usage due to users switching to broadband will not hamper the ISPs profitability.

### **4.3 National and Local Peering**

**4.3.1 Establishment of National and Local peering points that connect and switch the domestic traffic between all the ISPs and promote the creation of a national Intranet that provides domestic IP network services, would be encouraged.**

This facility will reduce the dependency of ISPs on the costly backhaul IP bandwidth. By exchanging traffic local to ISPs at peering points, their backhaul IP bandwidth will not be used and the customer will experience smaller delays because of shorter span the traffic needs to travel. It will also free up the backhaul IP bandwidth to be used by traffic that needs to go out of Pakistan hence increasing the overall response time.

This facility would again encourage the development of locally located content, such as domestic email and e-commerce services. Once the Peering service is established, the creation and growth of local content and local e-business will become inevitable. This national intranet will be interconnected with the other intranets in Pakistan such as all the major Universities and Libraries intranet (PERN) and the intranet linking all the government organizations.

The cost of traffic internal within a closed Intranet is significantly lower than traffic on the Public Internet. Development of local intranets such as the already existing PERN network and connectivity between them will again lower the costs

of providing broadband services to the residential and corporate users across Pakistan. This facility will also reduce the reliance on the international IP bandwidth.

## 5.0 BROADBAND DELIVERY FACILITATION

### 5.1 Broadband Delivery Technologies:

Today there are four primary mechanisms for broadband delivery:

<u>Common Terminology</u>	<u>Technical Terminology</u>
1) Copper Telephone lines	- Digital Subscriber Line (DSL)
2) Hybrid of Coaxial and Fibre cable	- HFC Network
3) Wireless	- Broadband Wireless Access
4) Satellite	- VSAT and DTH

### 5.2 Digital Subscriber Line (DSL) delivery

In DSL, voice and data get transferred simultaneously over the existing copper telephone lines by using different frequency ranges on the same line. Voice is transferred on lower frequency bands and data on higher ones.

The technology to do this resides in the DSL transceiver or modem that's installed both at the subscriber end and at the end of the service provider. A DSL modem on the subscriber end sends data over the telephone line to the telephone exchange or Central Office (CO). At the telephone exchange, a DSL Access Multiplexer (DSLAM) terminates and aggregates incoming DSL lines. It redirects the voice traffic to the public switched telephone network (PSTN) and the data to a high-speed digital line that connects to the Internet as illustrated in Annex B. This results in the simultaneous availability of the telephone and Internet on the same line.

#### 5.2.1 Incumbent's facilitation for broadband growth:

International experience shows that DSL succeeds when the local loop service provider follows the policy of providing the service in an aggressive manner, because the LL service provider typically has ownership of upwards of 90% of the copper local loop.

Since virtually all the local loop telephone lines are owned by the incumbent, giving nondiscriminatory access to this facility for use and investment by other operators also becomes crucial. Thus, the incumbents' role and effort is also key to creating overall growth in the market.

All the DSL services will fall in one or more of the following categories:

- 1) Local Loop Service provider's retail DSL service.

- 2) Local loop service provider's wholesale DSL service for ISPs and content providers, where the investment in the entire infrastructure is the wholesaler's responsibility. The retailer will be responsible for marketing, customer acquisition and customer services only.
- 3) ISPs and other operators retail DSL service where the DSLAM investment is the ISPs responsibility.
- 4) Bandwidth provision from LDI operator to other service providers for onward delivery of DSL services.

### **5.2.2 Broadband Business model and SMEs growth in Pakistan:**

Besides the fast 'time to market' advantage, DSL wholesale will provide the cheapest way for a service provider to offer broadband services. The copper loop owner will be able to offer a wholesale service to any broadband service provider without the service provider having to invest in the infrastructure. This low cost and 'fast time to market' service provision is envisaged to present the SMEs (companies with low capital), with a very lucrative business model, thereby creating new companies and increasing the volume and turnovers of private sector service providers in Pakistan.

The following policy enablers for the above categories of DSL services will promote quick growth and competition in the DSL broadband services:

**5.2.3 There will be no restriction on the number of broadband service providers in the market. Any company or entity shall be able to provide broadband services provided that it has met the terms and conditions given under the section 'regulatory framework':**

One of the major reasons for the lack of growth in the broadband users in Pakistan is the restriction in the number of operators allowed to offer broadband DSL services. Unrestricted competition will escalate the growth of Broadband users, similar to the growth seen in the dial up Internet sector.

**5.2.4 PTCL will offer the content service provider (ISPs, Multimedia content providers) data stream access to the customer. Rather than a potential content provider having to obtain leased lines from PTCL, pay collocation charges and invest in DSLAMS, the PTCL manages the transmission link from the customer to the services providers POP for a flat rate service charge. In order to ensure efficient and fair use of PTCL's resources and space for all service providers, the incumbent will offer wholesale services to retailers in exchanges for which the retail service providers have provided a viable business plan.**

This service obligates PTCL to install DSLAMS in its exchanges through which it will provide the ports to its wholesale customers and may also use those DSLAMS to provide retail service to customers. The wholesale service will simplify the broadband service offering by all ISPs and content providers and escalate the spread of the service. Effectively the service providers will be interconnecting at the data stream level rather than the physical copper level.

**5.2.5 PTCL will offer non-discriminatory shared access to its last mile copper, i.e. the service providers can install DSLAMS in PTCL's exchanges. The line will be available to other operators for data services only (as the policy's aim is to promote broadband). PTA will monitor the shared access for fair competition.**

This will distribute the investment load between the operator and incumbent. And the service provider will be able to deploy its DSLAMS where it makes business sense.

**5.2.6 PTCL will have sufficient dedicated staff for the facilitation of the access to its exchanges in order to ensure speedy provisioning of the service to the broadband service providers. The PTCL will be required to provide the service within a predetermined time frame.**

**5.2.7 Service level agreements will be signed between the ISP, the local loop operator and the broadband service provider in case they are all separate entities. Service level agreements will also need to be signed between the wholesale service provider and the retail service provider.**

**5.2.8 PTCL will reduce the monthly rental charge for the copper loop in order to make it viable for the service provider to offer broadband services at an affordable level and contribute to achieving the policy subscriber targets for broadband growth.**

**5.2.9 Service level agreements stating benchmarks for QoS will have to be signed between customers and broadband service provider.**

### **5.2.10 Regulatory Framework for DSL:**

The regulatory approaches on broadband vary from country to country depending on the level of market maturity. Local loop unbundling has occurred in countries such as the UK<sup>i</sup> and the US where teledensity has matured to a saturation level and there is little need to encourage the investor to lay new telephone lines, whereas in growing teledensity countries such as Egypt and India, the local loop owner has to be paid a rent for using its loop for delivering broadband services. While full local loop unbundling will not occur in Pakistan until such time that teledensity has reached some level of maturity, the steps proposed in this policy aim to ensure that high growth areas such as the DSL have minimum level of barriers in Pakistan. However the reduction of the barriers have to be accompanied by the assurance of quality of service for the broadband users in Pakistan and the protection of stake holders investments as well. Any entity will be able to offer broadband services in Pakistan provided that they have met the following terms and conditions:

**5.2.10.1 Service level agreements need to be signed with the licensed local loop and LDI operators in case the broadband service provider wants to offer value added services such as VPNs, video conferencing and call center connectivity.**

The SLAs will ensure that international and domestic voice and other services are only carried out by / under the license holders agreements.

**5.2.10.2 PTA will be authorized to impose penalties on PTCL in case it does not deliver the co-location and copper pair services to the broadband service provider in the pre determined time frame as per clause 5.3.6.**

**5.2.10.3 The broadband service provider in all of the above cases will require separate registration with the PTA prior to commencing its services. In case the broadband service provider is proved to be involved in running illegal operations through its service, PTA will have the right to cancel the registration and the right to direct its licensed service operator to terminate its business contract with the broadband service provider. Copies of all the above agreements must be submitted to PTA as well.**

**5.2.10.4 To ensure fair promotion of Broadband PTA will on bi-annual basis shall review wholesale and retail facilitation provided by PTCL and intervene to correct if any need arises**

### **5.3 Fibre / Coaxial access network**

Broadband services on coaxial networks holds less than 40% of the world broadband market (See Annex B). Its largest location is the US, where cable was deployed as the prime technology for broadband and multimedia services as far back as the 1980's. Before the xDSL and wireless technologies became advanced enough to offer broadband, cable was the medium that offered high bandwidth characteristics. Fibre Optic technology allows for transmission of 10 Gbps which is much higher than DSL technologies. Unlike the DSL service, cost and time constraints would still not allow the fibre to be taken to the customer's premises. However Fibre Optic cables are now being used from the exchange to the more remote feeder points to shorten the length of the copper wire. This may enable high bandwidth services such as broadcast TV and video on demand to be delivered on the DSL. The need for establishing many two way bi directional amplifiers in the network and the need to dig the roads for the laying of fibre and coaxial cable characterizes this technology. Right of Way is the most critical element in the deployment of this technology as far as the broadband policy enablers are concerned.

With the influx of new LL and LDI operators entering the Pakistan market, this might prove to be a major hurdle in rolling out new infrastructure and providing advanced broadband services in a timely manner.

The following policy features will facilitate ROW availability:

**5.3.1 The government has put time limits for replies on ROW applications with detailed explanation in case of rejection for ROW, as per the Telecom Deregulation policy.**

**5.3.2 The government would encourage commercial complexes, local area authorities and operators not to enter into exclusive agreements, which would prevent others from serving potential customers in those areas.**

**5.3.3 Service level agreements stating benchmarks for QoS will have to be signed between customers and broadband service provider.**

### **5.3.4 Regulatory Frame work for HFC network**

The fixed nature of the HFC networks means that the regulatory policies for fibre and coaxial broadband networks will be similar to the policies defined for the fixed line copper networks. Regulatory framework clauses 5.3.10.1 and 5.3.10.3 would also be applicable to the HFC broadband service providers.

## 5.4 Broadband Wireless Access

The ITU has allocated multiple frequency bands for fixed wireless deployment. These are

1) IEEE 802 based bands for Short distance broadband	2.4-2.5,5	GHz
2) Fixed Wireless Access bands	3.4-3.7, 10	GHz
2) Multipoint Microwave Distribution System (MMDS)	2.5-2.7	GHz
3) Local Multipoint Distribution System (LMDS)	24-32	GHz

Due to the convergence of broadband, TV and voice, many of the above listed bands are used for offering all services together. Except for the IEEE 802, multimedia convergence equipment is available in all of the above listed bands. Due to the equipment standardization and economies of scale, these band will offer a potential broadband service provider a very attractive and fast to deploy mechanism to deliver broadband services in Pakistan. However the recent auction of 3.4-3.7 GHz in Pakistan will give the service provider a fast route to delivering the broadband to potential users where fixed lines have either not been installed or their quality is below the standard required for carrying high speed information.

To facilitate the above convergence and international standardization of wireless broadband equipment, the following policy enablers are proposed:

**5.4.1 In order to streamline frequency management and allocation plan for Pakistan in accordance with the international standards, a high level committee with representations from MoIT, PTA, PEMRA and FAB will be formed. The committee will consider measures with the objectives of making appropriate frequency spectrum available to the broadband service providers in Pakistan. All the licensed and unlicensed frequency bands internationally recommended by ITU for broadband wireless access would be analysed and offered to promote the service.**

**5.4.2 Service level agreements stating benchmarks for QoS will have to be signed between customers and wireless broadband service provider.**

5.4.3 *Regulatory Framework for Wireless Broadband Access:*

Regulatory policies vary across the world for wireless access broadband. For instance in some countries import duties and licensing exists on WiFi equipment that uses the unlicensed bands, whereas in mature markets like as the US, Korea and Singapore the regulation has allowed unlicensed usage of these bands resulting in the spread of broadband services in the corporates and confined public places. The bands in the IEEE 802 series need to be unlicensed and free for broadband usage in Pakistan in a non-exclusive manner.

**5.4.3.1 PTA to provide a regulatory framework for the unlicensed bands users that includes concerns such as setting of the maximum permissible power levels and protection of users against the violators.**

Because of the low cost of IEEE 802.11 (WiFi) equipment (off the shelf) and deployment, these technologies are very useful in many situations and make a viable business case for operators to distribute broadband connections to multiple users within a limited distance such as corporate offices (WLAN), airports and shopping malls. Operators using this band within close proximity will need to restrict the power output to levels that does not interfere with the adjacent operators service if they are using the same unlicensed band.

**5.4.3.2 PEMRA will be required to consult FAB before publicising and committing any frequency resource bands for broadcast, VoD (Video on Demand) and other Multimedia / TV service.**

This would be done in the interest of optimal utilization of valuable frequency resource, which in certain areas falls in shared (broadcast, broadband and converged) services. This will eventually lead towards convergence as per the emerging international practices.

**5.4.3.3 PTA and FAB will explore alternative spectrum bands, which are not in the high demand, that could be used for deploying broadband services and develop pricing incentives for their usage.**

Because of the international standardization of frequency bands for a particular service, the infrastructure in those bands is manufactured in large volumes and hence sold at low prices. A similar allocation and standardization of frequency bands in Pakistan will give the broadband service provider in Pakistan a low capital expenditure and fast to deploy route to offering the service, thereby contributing to the spread of broadband in the country.

## **5.5 Satellite Broadband Access**

Satellite technology can provide a very 'fast to deliver' last mile alternative to DSL, HFC and wireless. It can make financial sense to deploy Satellite for delivery of services in remote areas where the other technologies become financially unfeasible due to the physical laying of the infrastructure.

**5.5.1 Satellite broadband services can be provided by ISPs and service providers using VSAT technology, provided they have signed a service level agreement with the licensed 'Non-Voice Data Communication Network' service provider or with a local loop and LDI licensed operator in case of offering voice oriented services such as video conferencing.**

**5.5.2 Satellite broadband services can also be provided by the DTH operators provided they sign service level agreements with the ISPs, local loop and LDI licensed operators, in case they are all separate entities.**

**5.5.3 The Government will encourage the use of PAKSAT for the delivery of broadband services via VSAT and DTH technology.**

**5.5.4 Service level agreements stating benchmarks for QoS will have to be signed between customers and broadband service provider.**

### **5.5.5 Regulatory Framework:**

**5.5.5.1 Copies of the above agreements must be submitted to PTA. The broadband service provider in all of the above cases will require separate registration with the PTA prior to commencing its services. In case the broadband service provider is proved to be involved in running illegal operations through its service, PTA will have the right to cancel the registration and the right to direct its or PEMRA's licensed service operator to terminate its business contract with the broadband service provider**

## **5.6 Government initiatives for broadband rollout in Pakistan:**

The following policy initiatives by the Government would help stimulate the roll out of all the broadband technologies in Pakistan:

**5.6.1 The government would require installation of facilities that enable broadband communications in new buildings built by the state, municipalities and government enterprises.**

**5.6.2 The government will play a proactive role in development of ICT and broadband services in the underserved areas of Pakistan. The road map for the USF also includes plans for ICT in the underserved areas. This will pave way for information and dissemination of broadband services in the rural areas of Pakistan.**

**5.6.3 The Government will encourage the co-existence of all the Broadband delivery technologies in the most efficient manner possible such that no artificial hurdles suppress one technology and maximum competition in the sector is allowed to grow.**

For growth in broadband in Pakistan to be accelerated, competition needs to be fostered and made viable in all of the services. The regulatory environment will ensure that each of these access paths co-exist in the most efficient manner possible such that no artificial hurdles suppress one technology. However almost 60% of the world broadband subscribers access the service along the copper telephone lines via the DSL technology. In line with the world trends and despite the need for the availability of all the possible technologies for broadband, the existence of over 5 million fixed telephone lines in Pakistan makes DSL the fastest possible technology to spread the broadband user base in Pakistan. While it is envisaged that the number of Cable Modem broadband users and, in time to come, the wireless broadband users, will grow at a steady pace, due to the existing availability and spread of the copper line infrastructure, majority of the broadband users expected in Pakistan over then next five years will be through the copper line DSL technology.

The Government will however play a proactive part in encouraging the entry and growth of any new and alternative broadband delivery technologies as well. For example, delivery technologies that might become an alternative to the cable and phone companies for delivering Broadband service such as 'Broadband over Power lines' or BPL could also fuel the spread of broadband households. Such technologies could offer enormous promise because the power grid is ubiquitous and the costs to the industry to offer the new service would be comparatively small. A technology like BPL would not only offer greater competition in the broadband market, but would also allow consumers to easily create networks in their home through special modems that plug into their electrical outlets.

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## 6.0 *END USER TERMINALS FACILITATION*

The availability of low cost access devices is a catalyst for broadband penetration. The policy proposes the following initiatives that will stimulate the sale and penetration of end user devices in Pakistan:

**6.1 Annual depreciation on PCs and broadband terminal equipment will be brought in line with best international practices.**

The advancement of technology often makes such equipment obsolete much faster than that. This increased depreciation will help stimulate investment in the equipment sector. This will encourage the large corporation to update their PCs and make cheap second hand PCs to the lower end of the market, stimulating the use and spread of PCs across Pakistan. This could particularly benefit the schools and colleges in smaller towns and villages across the country.

**6.2 Incentives for organizations and individuals who donate their PC's and other broadband related equipments to designated institutions like schools run by government and other charitable organizations will be devised.**

**6.3 Pakistan Government will introduce low interest rate loan facilitation through 'own a computer initiative', for the purchase of PCs and broadband customer premises equipment.**

Other countries, like Korea, Malaysia and Thailand have taken significant steps with government funding this area for providing low cost and free PC's to low income families and for all schools. The Korean and Malaysian government provided heavy subsidization and low interest rate loans to help families with children obtain PC and further their ICT education.

**6.4 Import duties levied on inputs (parts, components and spares) and finished products used in providing broadband services will be treated same as IT networking equipment .**

This initiative will reduce the prices of customer end broadband devices such as the modem (CPE) and stimulate the increase of broadband penetration in Pakistan. The list of equipment would include the subscriber end equipment (CPEs, Cable and broadband wireless Modems etc) as well as the operator end equipment (DSLAMS, CMTS, BWA Equipment etc) that is used for broadband only. See Annex 3 for the list of equipment.

## **7.0 GENERAL POINTS FOR REGULATORY FRAMEWORK**

These regulatory obligations would encompass all the broadband service providers irrespective of their delivery mechanism.

### **7.1 Code of Conduct**

**7.1.1 Code of Conduct, covering relevant aspects of policy and after reviewing best international practices in the context of narrow and broadband services would be published. PTA will specify this code for the registered service providers.**

**7.1.2 The Code would also specify the grounds for violation resulting in potential termination of registration. The record of violation/breach of conduct would be maintained by the authority. It will be reviewed from time to time and would be applicable after serving of show cause notice.**

### **7.2. Registration**

**7.2.1 The terms and conditions of registration (as per the criteria set by PTA) would be made public within three months of issuance of the policy.**

**7.2.2 Registration fee would be kept to a minimum level and would cover the cost of documentation and relevant administrative costs. Exact amount of this fee would be determined by PTA. Royalty charges and annual fee would also be reviewed by PTA and would be determined while protecting licensees' interests and consumer rights.**

### **7.3. Quality of Service (QoS)**

**7.3.1 PTA, after studying various options/solutions, will specify parameters to ensure quality of service. QoS would cover entire range of services and would aim at protecting consumers' interests. The QoS standards would be reviewed periodically and these would be available on the website after a process of consultation and keeping in view the technological changes, international standards and best practices.**

#### **7.4. Rights of Existing Licensees**

**7.4.1 Rights of existing licensees e.g Electronic information service, ISP, Data network operators etc would be protected and these operators will be allowed to operate under the original terms and conditions of their licenses till the expiry of the same. In the meantime, these operators will also have the option of adopting the new regulatory regime, while adoption would become mandatory after the expiry of their existing licenses.**

## **8.0 BROADBAND PROMOTION AND AWARENESS:**

More than 40% of the internet users in Pakistan do not know what broadband DSL technology is and only 0.4% users have knowledge about the number of DSL service providers in Pakistan. Lack of marketing and awareness of broadband benefits also contribute to the slow growth of broadband users in the country. Broadband services and its benefits need to be aggressively marketed to both the corporate and residential users. The stakeholders need to inform the public of the benefits of broadband, its impact on the quality of life and on the society's social and economic standings. This would help raise the level of understanding of the benefits of broadband and promote its usage. The policy envisages the following measure towards broadband awareness:

- |   |
|---|
| <p><b>8.1 The MoIT in collaboration with the industry will carry out countrywide broadband awareness campaigns through series of seminars, workshops, media advertisements and live demos, spreading the importance of high speed internet in critical and attractive applications such as Tele medicine, Stock Trading and e-learning.</b></p> |
|---|

## **9.0 PAKISTAN BROADBAND ROADMAP:**

This section defines a broadband road map for Pakistan with specific milestones to assess and measure the enablers defined in this policy.

### **9.1 Increasing the DSL user base**

Due to the removal of restriction on the number of Broadband DSL service providers, the reduction in the local loop and bandwidth charges and the availability of low cost wholesale broadband service for SMEs, the first target for this policy is the growth in the DSL users in Pakistan. The target for the end of the first year after the issuing of the policy is to increase the DSL users to 100,000.

### **9.2 Spread of low cost unlicensed wireless technologies such as WiFi.**

Ensuring the availability of all the ITU classified 'unlicensed' frequency bands for the use of the broadband user in Pakistan by the end of the first policy year. Using unlicensed technologies such as WiFi, the Government will have deployed broadband access in hot spots such as Airports, and Universities to set a precedence and encourage the deployment and use of low cost unlicensed hot spot technologies such as WiFi technologies.

### **9.3 Enabling of new technologies**

Broadband technologies such as WiMax and FTTH are still developing and are expected to fully mature by 2006. What is regarded as broadband today will become narrowband in a couple of years. Keeping the objectives of the broadband policy of Pakistan in view, the government will continue to encourage the deployment and spread of new broadband technologies and standards as they develop and mature.

## **Annex A**

# **Glossary**

**APC:** (Access Promotion Charge)- A fund that is given to the 'local loop' operator to help increase its telephone lines in the area.

**Backhaul:** Transmission of content from the content source to the 'local loop' aggregation point such as the exchange, PoP etc.

**BB:** Broadband

**Broadband:** Electronic information access at high speed (> 128kbps)

**BWA:** (Broadband Wireless Access)- Broadband delivery to the customer via wireless.

**BW:** Bandwidth

**Content:** Information in an electronic format eg Websites, TV channels, data, voice etc.

**CPE:** (Customer Premises Equipment)- A piece of equipment that allows the user to convert the sent electronic information into a format that is acceptable by his display unit such as a PC, TV.

**CPP:** (Calling Party Pays)- A pricing regime that charges the person that has initiated a communication link such as making a phone call.

**'Dial up':** A method of connecting to the internet where the user has to dial a telephone number over an analogue or ISDN line and wait for the system to give him a communication link.

**DTH:** (Direct To Home)- A link that allows the receiving of broadcast TV channels over Satellite.

**DSLAM:** (Digital Subscriber Loop Access Multiplexer)- Piece of equipment that is located in the telephone exchange and connects, combines and digitizes multiple analogue telephone lines into one digital data link that terminates into the internet service provider's PoP (point of presence) .

**DSL:** (Digital Subscriber Loop)- A technology that is capable of transforming ordinary phone lines into high speed digital lines capable of supporting applications such as high speed internet and video on demand.

**Exchange:** Point of Presence of the telephone operator company that allows connectivity and switching between telephone users locally and internationally.

**FAB:** (Frequency Allocation Board)- A Pakistan Government organization that manages and allocates the Radio frequency spectrum in Pakistan.

**FAST:** (Foundation for Advancement of Science and Technology, Pakistan).

**FTTx:** (Fiber To The Home/Curb/)- A fibre optic based communication network where 'x' is the physical point where the fibre is terminated.

**GDP:** (Gross Domestic Product)- A measure of the economic standing of a country.

**HFC:** (Hybrid of Fibre and Coaxial cable)- A communication network that comprises of primary fibre cable with an extension of a coaxial cable that terminates at the users premises.

**ICT:** (Information and Communication Technologies)- An international term to represent services and technologies that are driven by computer and Telecommunication networks.

**IEEE:** (Institution of Electronic and Electrical Engineers)- A US based international body that approves / accredits technologies and standards for ICT across the world.

**Intranet:** A closed loop and secure communications network as opposed to the public internet that can be accessed by anyone.

**Incumbent:** The telephone company that owns majority of the telecommunications network in a country.

**IP:** (Internet Protocol)- Procedures that allow transmission of communication packets between various internet PoPs.

**ISDN:** (Integrated Services Digital Network)- A technology that converts the normal analogue telephone lines into higher speed (less than 128kbps) digital lines.

**ISP:** (Internet Service Provider)- Company that owns internet based infrastructure (Routers, Servers) and provides internet access to users.

**ITU:** (International Telecommunication Union)- A UN based world body for setting and approving technologies and standards for Telecommunications.

**Kbps:** (Kilo Bits Per Second)- A measuring unit for electronic data speed in thousands.

**LDI:** (Long Distance International)- Term that defines communication between domestic cities and international countries.

**LL:** (Local Loop)- Term that defines communication between the users within a city/town/village.

**‘Local Loop’:** The physical communication link between the telephone user and the telephone exchange.

**Mbps:** (Mega Bits Per Second)- A measuring unit for electronic data speed in millions.

**Modem:** A device that converts analogue signals to digital and vice versa.

**MoIT:** Ministry of Information Technology, Pakistan

**Narrowband:** a service or connection that only allows a limited amount of information (< 64kbps) to be conveyed such as basic telephony.

**OECD:** Organization for Economic Cooperation and Development.

**Peering:** An interconnected communication network that allows two or more operators to be connected in such an efficient way so as to achieve economies of scale and minimize their intercommunication routes and costs.

**PEMRA:** (Pakistan Electronic Media Regulatory Authority)- Regulator for electronic media services in Pakistan.

**PERN:** (Pakistan Education and Research Network)- An intranet that links all the Universities and higher education institutions in Pakistan.

**PIE:** (Pakistan Internet Exchange)- PTCL’s owned IP based data network that allows the Internet and data traffic to route to locations in and out of Pakistan.

**PoP:** (Point of Presence)- A physical traffic aggregation/ distribution hub for a telecommunications service provider.

**PRI:** (Primary Rate Interface)- An ISDN service that specifies a digital pipe with 23 traffic channels and 1 control channel. It can provide full duplex transmission between 23 source and receiving nodes multiplexed into a single path.

**PSTN:** (Public Switched Telephone Network)- The conventional fixed line telephone network.

**PTA:** (Pakistan Telecommunications Authority)- The telecommunications regulator in Pakistan.

**PTCL:** (Pakistan Telecommunications Company Ltd)- The largest telecommunications infrastructure and service provider in Pakistan.

**QoS:** Quality of Service.

**RoW:** Right of Way.

**SME:** Small and Medium Enterprise

**SW:** Soft Ware

**Unicode:** A 16-bit character set that assigns unique character codes to characters in a wide range of languages.

**USO:** (Universal Service Obligation)- A financial obligation on the service providers for contribution to the development of infrastructure in under served areas.

**VPN:** (Virtual Private Network)- A secure communication network that links various locations of an organization.

**VSAT:** (Very Small Aperture Antenna) – An earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television.

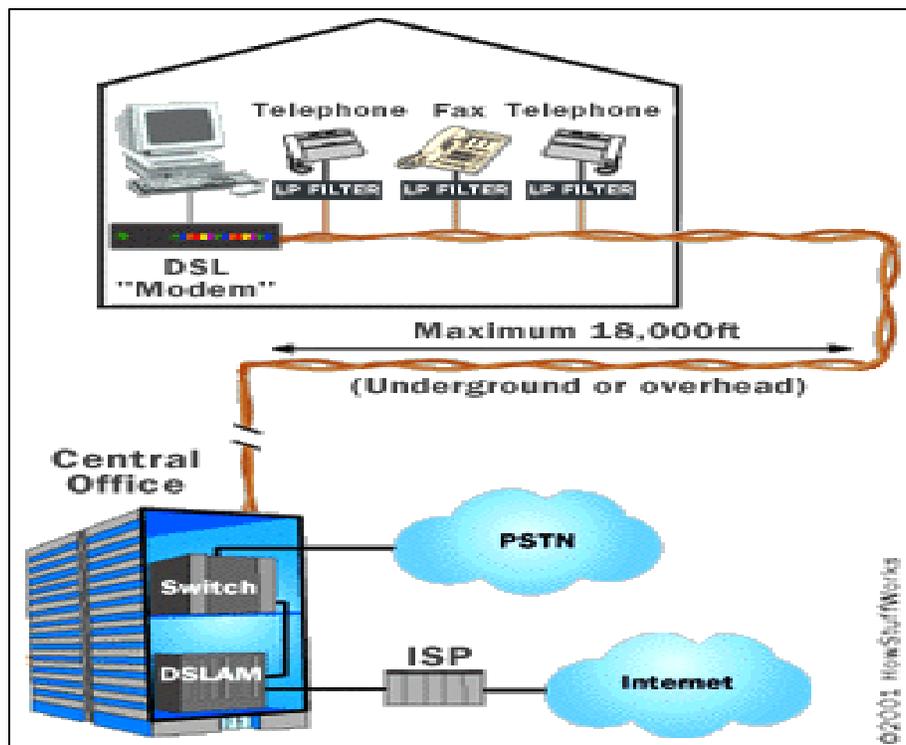
**WiFi:** (Wireless Fidelity) – Technology for low power, indoor wireless data communication.

**WiMax:** (Worldwide Interoperability of Microwave Access) - a standards-based technology enabling the delivery of last mile wireless broadband access over long distances.

# Annex B

## Illustrations

### 1) Copper telephone lines based Digital Subscriber Loop Technology



**Figure 6 - DSL Architecture**

Source – Presentation paper on ADSL by Animation Factory, April 2003.

2) Hybrid Fibre and Coaxial network Architecture

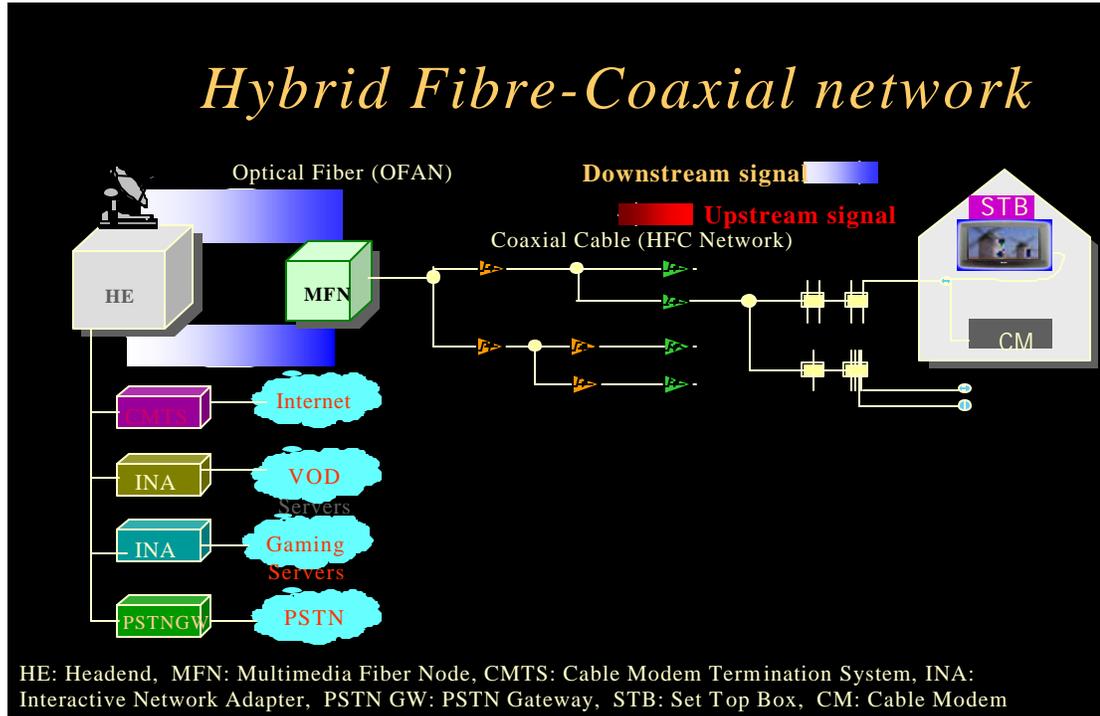


Figure 7 – HFC Architecture

### Wireless Broadband Access Architecture

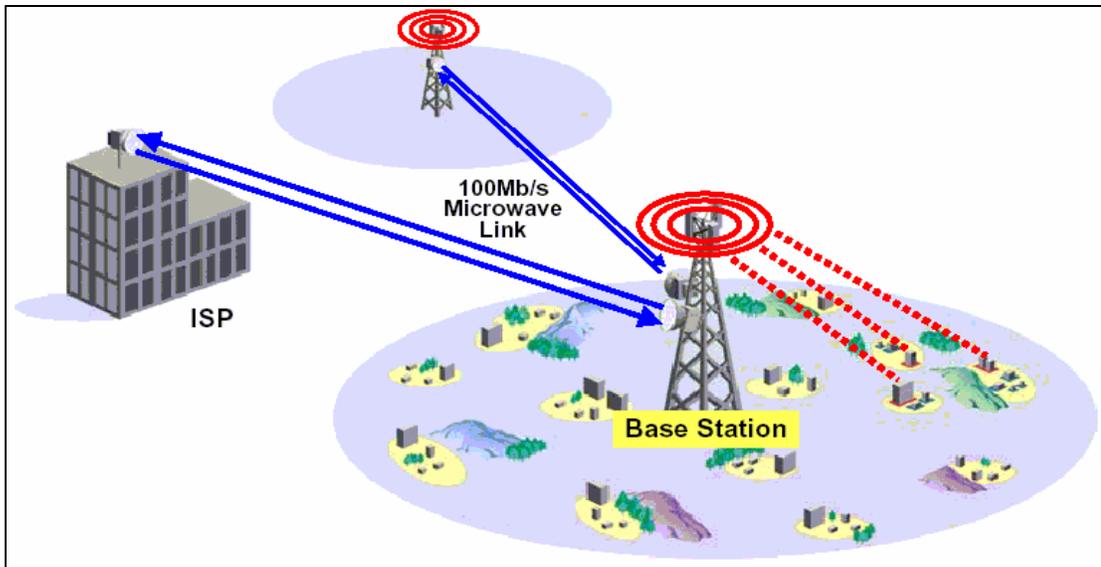


Figure 8 – Broadband Wireless Access Architecture

### Global Distribution of Broadband Technologies

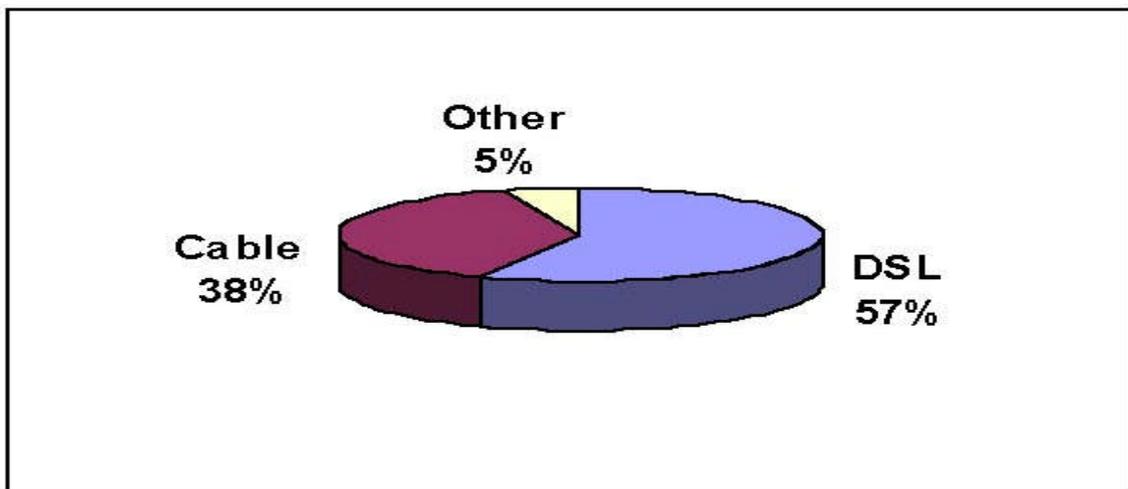


Figure 9 - World market share of broadband technologies

(Source – See Reference i)

**Table –1: Comparative Internet and Broadband Indicators (Mid-2003)**

	<b>Parameters</b>	<b>Korea</b>	<b>Malaysia</b>	<b>China</b>	<b>India</b>	<b>Pakistan</b>
<b>Access &amp;Infrastructure</b>	No. of PCs per 100	78.6	15	2.8	0.8	1.85
	No. of cable TVs per 100 persons	43	0	9	6	4.28
	No. of fixed telephone lines per 100 persons	49	18.5	16.7	4.5	2.8
	No. of mobile phones per 100 persons	68	39.6	16.1	2.4	1.43
	Cost of PC (USD)	[500]	1,100		600	347
	Cost of cable/DSL modem (USD)	60			100	90
<b>Internet Usage</b>	GDP (USD Per capita)	10,000	4,000	965	465	480
	No. of internet connections per 100 persons	58	11	2	0.4	0.2
	No. of users per 100 Persons	59.4	33	5	1	1.4
	Average revenue per user from an Internet customer per month (20 hrs, USD)	N/A	10		9	4.5
<b>Broadband</b>	No. of broadband connections per 100 persons	57.5	0.21	1	0.02	0.01
	Charges for broadband per month (USD)	30	29	16	20	-
	Charges per 100 Kbps per month (USD)	0.25	7.61	3.07	15.63	-

**Figure 10- World Internet and Broadband comparisons**

(Source – See reference ii)

**Table 2 – List of Broadband Equipment to be bracketed with the IT equipment for import duties purpose**

<b><u>Broadband Equipment Items with zero import duties</u></b>
1 DSLAM
2 DSL CPE
3 BWA Modulators
4 BWA Transcievers
5 BWA RF Amplifiers
6 BWA CPE
7 BWA equipment for unlicensed bands
8 CMIS
9 Cable Modem
10 HFC Bi directional RF Amplifiers
11 Ethernet Adaptors

**Figure 11- Proposed list of duties exempted broadband equipment**

## **Annex C**

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