S A T E L L I T E C O M M U N I C A T I O N S

INTRODUCTION TO TELECOMMUNICATION

Telecommunication is the extension of communication over a distance. In practice it also recognizes that something may be lost in the process; hence the term 'telecommunication' covers all forms of distance and/or conversion of the original communications, including radio, telegraphy, television, telephony, data communication and computer networking.

The elements of telecommunication system are a transmitter, a medium (line) and possibly a channel imposed upon the medium and a receiver. The transmitter is a device that transforms or encodes the *message* into a physical phenomenon; the *signal.* The transmission medium, by its physical nature, is likely to modify or degrade the signal on its path from the transmitter area to the receiver. The receiver has a decoding mechanism capable of recovering the message within certain limits of signal degradation. In some cases, the final "receiver" is the human eye and/or ear and the recovery of the message is done by the brain.

Telecommunication can be point-point, point-to-multipoint or broadcasting, which is a particular form of point-to-multipoint that goes only from the transmitter to the receivers. On of the roles of the telecommunications engineer is to analyze the physical properties of the line or transmission medium, and the statistical properties of the message in order to design the most effective encoding and decoding mechanisms.

When systems are designed to communicate through human sense organs (mainly vision and hearing), physiological and psychological characteristics of human perception will be taken into account. This has important economic implications and engineers will research what defects may be tolerated in the signal yet not affect the viewing or hearing experience too badly.

BRIEF HISTORY OF SATELLITE COMMUNICATION

The concept of satellite communications was first proposed by Arthur C. Clarke, based on Herman Potočnik's pseudonymous work from 1929. In 1945 Clarke published an article titled "Extra-terrestrial Relays" in the magazine Wireless World. The article described the fundamentals behind the deployment artificial satellites in geostationary orbits for the purpose of relaying radio signal. Thus Arthur C. Clarke is often quoted as the inventor of the communications satellite.

INTRODUCTION TO SATELLITE TELECOMMUNICATION

A satellite communications (sometimes abbreviated to Comsat) is an artificial satellite stationed in space for the purposes of telecommunications using radio at microwave frequencies. Most communications satellites use geosynchronous orbits or near geostationary orbits, although some recent systems use low Earth-orbiting satellites.

Communications satellites provide a technology that is complementary to that of fiber optic submarine communication cables. Unlike fiber optic communication, satellite communication has a propagation delay (also called a path delay) of at least 270 milliseconds, which is the time it takes the radio signal to travel 35,800 km from earth to a satellite and then back to earth. Satellite Internet connections average a 600-800 millisecond delay, about ten times than that of a terrestrial Internet link. This delay is a challenge to deployment of Virtual private networks over satellite internet connections.

MAIN COMPONENTS:

Satellite communications are comprised of two basic elements:

1. THE SATELLITE

The satellite is also known as the space segment. It is composed of the following separate units; i.e.

a) The satellite and telemetry controls
b) The transponder

The transponder comprised of the receiving antenna to catch-up signals from the ground station, a broad band receiver, an input multiplexer and a frequency converter that is used to reroute the received signals through a high powered amplifier for downlink.

The main function of satellite is to reflect signals. In case of a telecom satellite, the primary role is to pick up signals from a ground station, which is located, a considerable away from the first. This relay action can be two way, as in the case of a long distance phone call. Another use of satellite is the television broadcasts. Number of programs are first up-linked and then down-linked over wide region. The customer having appropriate devices can receive and watch the programs. One of the modern uses of satellite is getting information along with image (commonly known as space/satellite image) of any desired location on earth.

2. THE GROUND STATION

This is called the earth segment. A base band processor, an up-converter, high
Powered amplifier and a parabolic dish antenna is involved to transmit the terrestrial data to an orbiting satellite.

In the case of downlink, the ultimate reverse operation is being down and up-linked signals are recaptured through parabolic antenna.

DIFFERENT UTILITIES OF SATELLITE COMMUNICATION

1. TRADITIONAL TELECOMMUNICATIONS

People have been facing problems in case of long distance telephone network; there has been a need to connect the telecommunications network of one country to another. Submarine cables played a major role to achieve the goal.

Still some crucial and critical factors remained unachieved to connect transoceanic points, geographically remote areas or poor countries that have little communications infrastructure.

2. CELLULAR

Various schemes are invented to make the satellites feasible to increase the bandwidth available to ground based cellular networks. Every cell in a cellular network consists of fixed range of channels which consist of either frequencies, as in the case of FDMA systems, or time slots, as in the case of TDMA. A particular cell that can only operate within those channels allocated to it, overloading can occur. With the help of satellite which operate at frequency outside those of the cell, extra channel can be provided on demand to an overloaded cell. Any of the overloaded cells can easily use these newly satellite-transmitted signals. In this case the cell is not bound by the bandwidth

restrictions as compare to the previous scenario. In other words the satellite provides its own bandwidth for a network of cells that can be used by any cell (that need it) without being bound by terrestrial bandwidth and location restrictions.

3. TELEVISION SIGNALS

Satellites have been used since 1960 to transmit broadcast television signals between the network hubs of television companies and their network members. Sometime, a whole set of programs is transmitted at once and recorded at the affiliate, and then broadcast to the local populace according to the appropriate time. In the 1970's it became possible for private individuals to download the same signals that the network and cable companies were transmitting, using C-band reception dishes. This free viewing of the corporate contents by individuals let to scrambling and subsequent resale of the descrambling codes to individual customers, which started the direct-to-home industry. The direct-to-home industry has gathered even greater response since the introduction of digital direct broadcast service.

4. MARINE COMMUNICATIONS

In the marine community, satellite communication systems such as Immarsat provide good communication links to ships at sea. These links use a VSAT type device to connect to geosynchronous satellites, which in turn links the ship to a land based point having respective telecommunications system.

5. SPACE BOURNE LAND MOBILE

Along the same lines as the marine based service, there are VSAT devices which can be used to establish communication links even from the world's most remote regions. Theses devices can be hand-held or fit into a briefcase or might be bigger. Digital data at 64K ISDN is available with some (Immarsat).

6. SATELLITE MESSAGING FOR COMMERCIAL JETS

Another service provided by geosynchronous satellite is the ability for passenger on an airborne aircraft to connect directly to a land based telecom network.

7. GLOBAL POSITIONING SERVICES

Another VSAT oriented service, in which a small apparatus containing the ability to determine navigational coordinates by calculating a triangulating or the signals from multiple geosynchronous satellites.

TECHNOLOGICAL PERSPECTIVES OF SATELLITE TELECOMMUNICATION SYSTEM

SATELLITES FOR DATA

CHARACTERISTICS

Incorporating satellites into terrestrial networks is often holdback by three characteristics possessed by satellite communication.

- **LATENCY (PROPAGATION DELAY)**

Due to the high altitudes of satellite orbits, the time required for a transmission to navigate a satellite link (2/10^{ths} of a second from earth station to earth station) could cause a variety of problems on a high speed terrestrial network that is waiting for the packets.

- **POOR BANDWIDTH**

Due to radio spectrum limitations, there is a fixed amount of bandwidth allocable to satellite transmission.

- **NOISE**

The strength of a radio signal's strength is in proportion to the square of the distance traveled. Due to the distance between ground station and satellite, the signal ultimately gets very weak. This problem can be solved by using appropriate error correction techniques, however.

» ERROR CORRECTION

Number of Error correction techniques has been approved to deal with the high noise presence on satellite link. These techniques are divided into the two categories; FEC (Forward-error-correction) and ARQ (Automatic-repeat- request).

- **FORWARD-ERROR-CORRECTION (FEC)**

A certain number of information symbols are transformed to new information symbols, but in such a way as to get more symbols than were original had. When these new symbols are checked on the receiving end, the redundant symbols are used to decipher the original symbols, as well as to check for data integrity. The more redundant symbols that are included in the mapping, the better the reliability of the error correction. However it should be noted that the more redundant symbols that is used to achieve better integrity, the more bandwidth that is wasted. Since this method uses relatively a large amount redundant data, it may not be the most efficient choice on a clear channel. However when noise levels are high, FEC can more reliably ensure the integrity of the data.

- **AUTOMATIC-REPEAT-REQUEST (ARR)**

In this method, data is broken into packets. Within each packet is included an error checking key. This key is often of the cyclic redundancy check (CRC) sort. If the error code reflects a loss of integrity in a packet, the receiver can request the sender to resend that packet. ARR is not very good in a channel with high noise, since many retransmissions will be required, and the noise levels that corrupted the initial packet cause corruption in subsequent packets. ARR is more suitable to relatively noise free channels.

- **STOP AND WAIT (SW)**

This form of ARR, the sender must wait for an acknowledgement of each packet before it can send a new one. As it takes 2/10^{ths} seconds for the receiver to get the packet another 2/10^{ths} seconds for the sender to receive the acknowledgement. This can take upwards of 4/10^{ths} of a second per packet.

- **GO-BACK-N (GBN)**

This method of ARR is developed form of stop and wait. It allows the sender to keep sending packets until it gets a request for a resend. When the sender gets such a request, it

sends packets starting at the requested packet over again. It can again send packets until it receives another retransmit request, and so on.

- **SELECTIVE-REPEAT (SR)**

This ARR protocol is an improved form of GBN. It allows the receiver to request a retransmit of only that packet that it needs, instead of that packet and all that follows it. The receiver, after receiving a bad packet and requesting a retransmit, can continue to accept any good packets that are coming. This method is the most efficient method for satellite transmissions of three ARR methods discussed.

ARR methods can be presented to provide a usable error correction scheme, but it is also the most expensive, in terms of hardware. This is in part due to the buffering memory that is required, but more importantly to the cost of the receiver, which needs to be able to transmit re-requests. Systems such as the Digital Broadcast Satellites used for television signal Distribution would become inordinately expensive if they had to make use of ARR, since the home based receiver would now need to be transmitter, and the 18 inch dish would be inadequate for the requirements of transmitting back to a satellite.

» HYBRID NETWORKS

In today's global networking landscape, there are many ways to transmit data from one place to another. It is desirable to be able to incorporate any type of data transmission media into a network, especially in networks that encompass large areas. A hybrid network is one that allows data to flow across a network, using many types of media, either satellite, wireless or terrestrial, transparently. Since each type of media will have different characteristics, it is necessary to implement standard transmission protocol. One that is normally used in hybrid network is TCP/IP. In addition, much work is being done to use TCP/IP over ATM for the satellite segments of hybrid networks.

One way to get around the need in ARR for the receiver to have to request retransmit via an expensive and slow satellite link is to use a form of hybrid network. In one form of hybrid network, the receiver transmits its requests back to the sender via a terrestrial link. Terrestrial link allows for quicker, more economical and less error prone transmission from the receiver, and the costs associated with the receivers hardware are greatly reduced when compared to the costs involved if it had to transmit back over the satellite link. There are products on the market today that allow a home user to get internet access at around 400MB via digital satellite, while its retransmit signals are sent via an inexpensive modem or ISDN line.

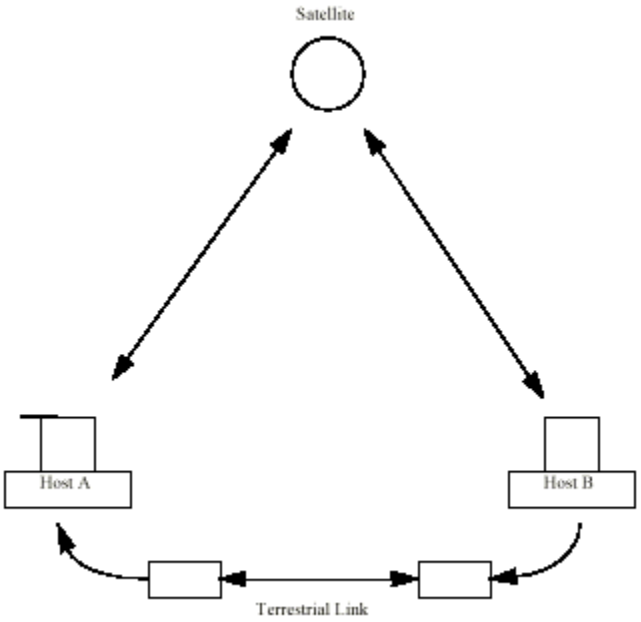


Figure: 4.2-a

In fact, a product currently being marketed by Direct PC called Turbo Internet uses a form of hybrid network. The system uses two network interfaces; one connects via a special ISA bus PC adapter to a receive-only Very Small Aperture Terminal (VSAT), while the other is a modem attached to a serial port. Inbound traffic comes down to the VSAT, while outbound traffic goes through the modem link. The two interfaces are combined to appear as a single virtual interface to upper layer TCP/IP protocol stacks by a special NDIS compliant driver. The Serial Line Internet Protocol (SLIP) is used to connect the modem-based link with an internet service provider. Packets, which are encapsulated by the terminal such that the desired IP address of the destination host is embedded underneath the IP address of the Direct PC Gateway, to which all packets leaving the terminal must go. Once at the gateway, the outer packet is stripped, and the gateway contacts the destination address within. Upon the gateway's receiving the request from the host, it then prepares the packet for satellite transmission, which is then used to send the packet back to the terminal.

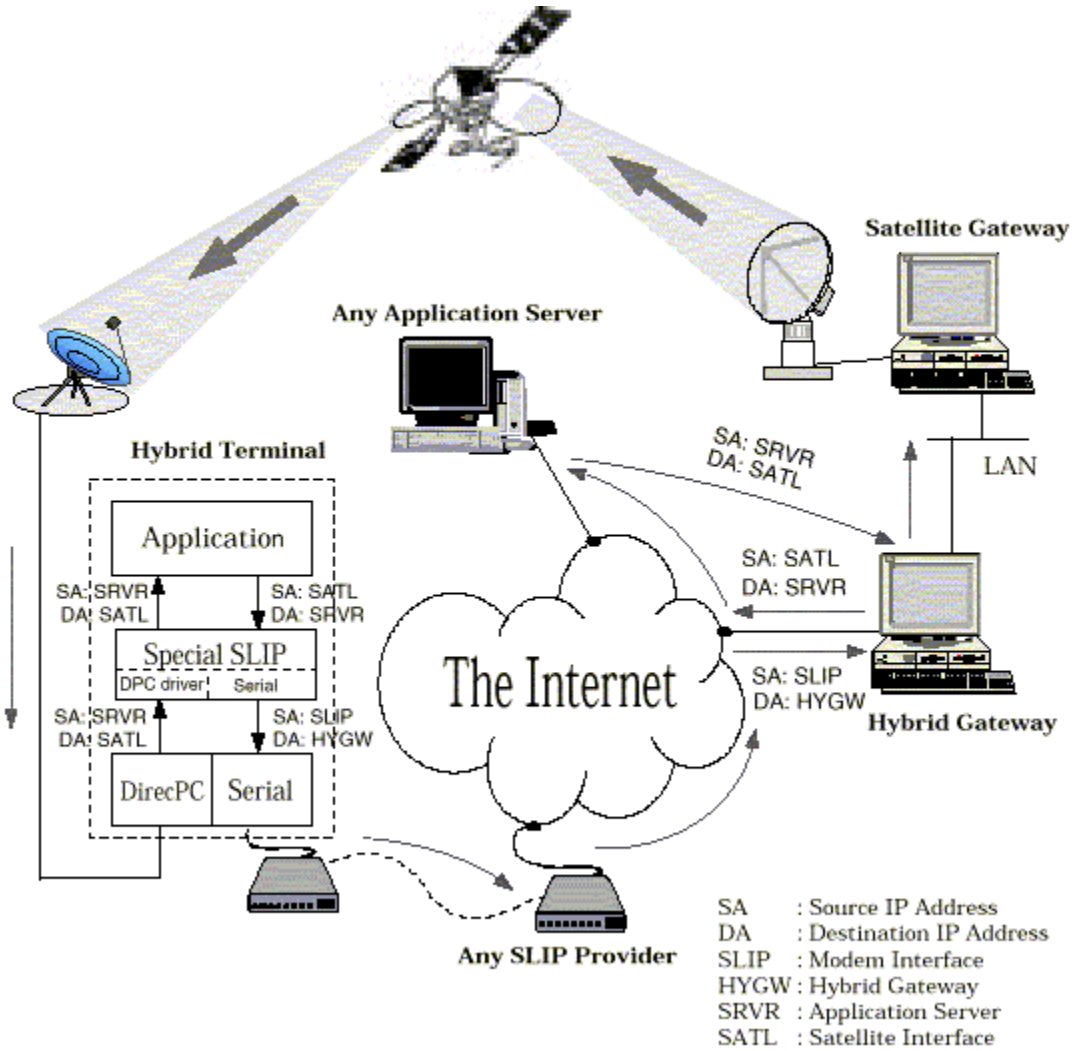


Figure: 4.2-b

» ATM OVER SATELLITE

Two qualities of Asynchronous Transfer Mode (ATM) made it highly desirable for the implementation of satellite links within hybrid networks. The first is the ATM's asynchrony and the second is its ability to use variable transfer rates. In addition, ATM fits well into existing networks with its wide range of upper-layer services and its ability to operate in a wide range of environments.

There are problems, however. ATM's relatively large propagation delays can significantly increase the latency of feedback mechanisms essential for congestion control, acquisition time, cell in-synch time and cell discard probability.

» SATIN - SATELLITE INTEGRATED TERRESTRIAL NETWORK

The goal of SATIN is to create a fully integrated hybrid network in which the method of communication, which can incorporate networks of local, metropolitan and wide are scope, Broadband ISDN, Integrated Network Management, AIN (Advanced Intelligent Networks) and PCS (Personal Communications Services), in addition to ATM (Asynchronous Transfer Mode) over satellite, is totally transparent to the user. The difficulties inherent in this are obvious. Differences in latency, noise, bandwidth and reliability must be equalized in all the media that will encompass the network.

» VSAT NETWORKS

VSAT stands for Very Small Aperture Terminal. Although this acronym has been used amongst telecom groups for some time now to describe small earth stations, the concepts of VSAT are being applied to modern hand held satellite communications units, such as GPS (Global Positioning System), portable Inmarsat phones and other types of portable satellite communication devices.

» ORBITS

— GEO

GEO stands for Geostationary Earth Orbit. This refers to satellites that are placed in orbit such that they remain stationary relative to a fixed spot on earth. If a satellite is placed at 35,900 km above the earth, its angular velocity is equal to that of the earth, thereby causing it to appear to be over the same point on earth. This allows for them to provide constant coverage of the area and eliminate blackout periods of ordinary orbiting satellites, which is good for providing television broadcasting. However their high altitude causes a long delay, so two way communications, which would need to be uploaded and then downloaded over a distance of 72,000 km, are not often used with this type of orbit.

— LEO

LEO stands for Low Earth Orbit, and it refers to satellites in orbit at less than 22300 miles above the earth. This type of an orbit reduces transmission times as compared to GEO. A LEO orbit can also be used to cover a polar region, which the GEO cannot accomplish. Since it does not appear stationary to earth stations, however, earth stations need an antenna assembly that will track the motion of the satellite.

» CONSTELLATIONS

The idea behind a constellation is to use to achieve global simultaneous satellite coverage by placing enough satellites into orbit so that (nearly) every point on earth is covered. There are currently two main types of service being planned at the moment, global voice and global data.

— GLOBAL VOICE COMMUNICATIONS

There are currently several consortiums that are working on global voice via satellite. One of the most prominent is the IRIDIUM constellation, which will consist of 66 interconnected satellites orbiting 420 nautical miles above the earth. The satellites will use a LEO orbit so that very small handheld terminals can be used by ground-based customers. The system will use inter-satellite crosslink transmissions that will take place in the Ka frequency band between 23.18 and 23.38 GHz. The IRIDIUM system will use a combination of Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA) signal multiplexing to make the most efficient. The L-Band (1616-1626.5 MHz) is used to link the satellite and IRIDIUM the subscriber's equipment. The Ka-Band (19.4-19.6 GHz for downlinks and 29.1-29.3 GHz for uplinks) links the satellite and the gateways and earth terminals.

— GLOBAL BROADBAND NETWORKS

There are basically two types of networks being proposed here, namely LEO based and GEO based ones.

▲ LEO

LEO networks use low orbits, which allows for much less latency that do GEO based networks. One problem that these satellites have is that since they are not geostationary (they are constantly orbiting around the earth) they cannot talk continuously to that same ground station. The way this is overcome is by using inter-satellite communications, so that the satellites function together as a blanket of coverage.

▲ GEO

GEO's high points are that its satellites are geostationary, which means that the difficulties of inter-satellite communications are avoided. The problem arises due to the latency delays caused by the high orbit. Applications which rely on steady bandwidth, like multimedia, will definitely be affected.

V S A T

INTRODUCTION

VSAT stands for "Very Small Aperture Terminal;" it refers to receive/transmit terminals, installed at dispersed sites and connecting to a central hub via satellite using small diameter antenna dishes (0.6 to 3.8 meter).

VSAT technology has emerged as a very useful, everyday application of modern telecommunications. VSAT systems can provide a variety of services including broadband communication systems, satellite-based video, audio, Internet and data distribution networks as well as worldwide customer service and support.

VSAT technology represents a cost effective solution for users seeking an independent communications network connecting a large number of geographically dispersed sites. VSAT networks offer value-added satellite-based services capable of supporting the Internet, data, LAN, and voice/fax communications, and can provide powerful, dependable private and public network communications solutions.

TECHNOLOGICAL PERSPECTIVE

It is an earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television. A VSAT consists of two parts, a transceiver that is placed outdoors in direct line of sight to the satellite and a device that is placed indoors to interface the transceiver with the end user's communications device, such as a PC. The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from a ground station computer that acts as a hub for the system. Each end user is interconnected with the hub station via the satellite, forming a star topology. The hub controls the entire operation of the network. For one end user to communicate with another, each transmission has to first go to the hub station that then retransmits it via the satellite to the other end user's VSAT. VSAT can handle up to 56 Kbps.

VSAT Users and Uses

Aral	Germany	Gas/Convenience	2,500	1997	Hughes	DeTeSat
Banco do Brasil	Brazil	Banking	1,580	1993	Hughes	Dedicated
Best Western	USA	Hospitality	2,383	1995	Hughes	HNS
BP/Amoco	USA	Gas/Convenience	8,312	1994	Hughes	HNS
Bridgestone Tires	Japan	Manufacturer	500	1991	NEC	S-Net
Central Bank of Iran	Iran	Banking	1,450	1993	Hughes	ISC
Deere & Co	USA	Manufacturer	1,200	1998	Gilat	Spacenet
Enterprise Rent-a-car	USA	Car Rental	4,648	1998	Hughes	Dedicated
Ford	Australia	Dealerships	295	1997	Hughes	Optus
Ford	USA	Dealerships	6,643	1994	Hughes	HNS
Ford	Mexico	Dealerships	120	1996	Hughes	Telmex
Ford	New Zealand	Dealerships	29	1999	Hughes	Optus
Hungarian State Lottery (SRT)	Hungary	Gaming	1,400	1993	Tridom	GTS
Independent Electoral Commission	South Africa	Government	523	1997	Hughes	Telkom SA
JD Group	South Africa	Retail	706	1995	Hughes	Telkom SA
National Stock Exchange	India	Financial	3,500	1994	Gilat	Dedicated
NICNet	India	Information	500	1985	Equatorial	NICNet
Rite Aid	USA	Retail	4,030	1992	Gilat	Dedicated
Safeway/Argyll	UK	Retail	670	1994	ViaSat	BT
Shenzhen Stock Exchange (SSSCC)	China	Financial	2,400	1993	NEC	Dedicated
Shoppers Drug Mart	Canada	Retail	745	1995	ViaSat	Dedicated
Spanish Post Office (OACT)	Spain	Post Office	785	1994	NEC	Telefónica
TransNet	South Africa	Railway	227	1995	ViaSat	TransTel
US Postal Service	USA	Post Office	10,400	1998	Gilat	Spacenet
Volkswagen Brazil	Brazil	Dealerships	868	1997	NEC	Dedicated
Wal-Mart Stores	USA	Retail	1,523	1985	Hughes	Dedicated

Table: 5.3 (a)

However, VSAT networks do not have to be huge; here is an alternative list of tiny networks deployed in all parts of the world. It is also interesting to see that these tiny networks include some huge names - Coca-Cola and Halliburton for example:

Allied Domenq Spirits & Wine	India	Retail	2	1998	ViaSat	Bharti/BT
Amway India Enterprises	India	Retail	10	1998	Hughes	Hughes Escorts
Banco del Sur	Venezuela	Banking	10	1996	Hughes	Bantel
Canadian National Railway	Canada	Railway	4	1991	Hughes	Telesat
Central Electricity Authority	India	Utility	2	1997	Gilat	HCL Comnet
Coca-Cola	Pakistan	Manufacturer	1	1997	ParaGea	Comstar
Coca-Cola Beverages	Hungary	Manufacturer	6	1994	NEC	SatNet Hungary
Consolidated Natural Gas Transmission	USA	Pipeline	4	1997	Gilat	Nova-Net
Copersuca	Brazil	Manufacturer	3	1999	Tridom	Comsat Brazil
Grain Marketing Board	Zimbabwe	Government	8	1999	Hughes	P&T Zimbabwe
Halliburton	Egypt	Oil/Gas	3	1999	NEC	ESC
India Cements	India	Manufacturer	2	1995	NEC	RPG
NTL	UK	Telecoms	1	1998	Teamcom	Dedicated
TVS Group	India	Manufacturer	10	1996	STM	HCL Comnet

Table: 5.3 (b)

Global Mobile Personal Communication by Satellite (GMPCS)

INTRODUCTION

GMPCS is a personal communication system providing transnational, regional or global coverage from a constellation of satellites accessible with small and easily transportable terminals. Whether the GMPCS satellite systems are geostationary or non-geostationary, fixed or mobile, broadband or narrowband, global or regional, they are capable of providing telecommunication services directly to end users. GMPCS services include two-way voice, fax, messaging, data and even broadband multimedia. According to some estimates, GMPCS services could be expected to constitute approximately 2-3% of the cellular market.

GMPCS networks varied in the make-up of their components, and in the type of service provided, but generally shared a number of characteristics, with satellite constellations providing direct links to users, and interconnecting with existing terrestrial networks. The underlined fact remains that GMPCS complement rather than compete with existing networks.

NEED FOR GMPCS REGULATIONS

While GMPCS is universally recognized as a basic system for development of telecom infrastructure, it is upto the policy makers to make sure that GMPCS services be available on a non-discriminatory basis, co-exist with PSTN services, be cost-effective and preserves the sovereignty of the country. Setting of common standards and uniform GMPCS regulations result in benefits of economy of scales and help addressing other issues such as security, tariffing, licensing, royalties, etc. While the various GMPCS networks each have specific characteristics, they generally share the following features: space segment (satellite constellation), ground segment (earth stations) and the user segment (terminals).

Manifold changes have happened in global and national areas. The sheer volume of change makes it impracticable to have an antagonistic or non co-coordinated method of approaching regulation of GMPCS Services. The underlying issues are rapid technological change, simultaneous global and regional service availability, transcending of national boundaries, less infrastructure on the ground, policy and regulatory bottlenecks, a focus on consumers and markets rather than products and networks, and the resultant need for collaboration between regulators and industry.

GMPCS MoU

In order to facilitate the introduction and development of Global mobile personal communication by Satellite (GMPCS), ITU carved out a Memorandum of Understanding, which was signed by member states in July 1997 at Geneva. In the MoU it was agreed that the issuance of a license or other authorization by an Administration and/or Competent Authority in conformity with the national laws and regulations of that country and the ITU Radio Regulations. GMPCS System Operators and GMPCS Service Providers are subject to the national laws and regulations in each country in which GMPCS Services are being provided. Each GMPCS System Operator shall take steps to inhibit the use of its system in any country that has not authorized its GMPCS service. It was further agreed that consistent with applicable national legislation in the country, GMPCS system operators or service providers will assist with measures intended to identify unauthorized traffic flows and will

provide GMPCS traffic data originating in or routed to that country. MoU is a cooperative framework signed by different participants to set out the non-contractual and non binding terms of their cooperation.

GMPCS LICENSING IN REGIONAL COUNTRIES

A number of models are adopted for GMPCS licensing in the region. Some administrations, such as Sri Lanka and Singapore, have opted for a regulatory framework which does not require service licensing, unless a particular GMPCS system includes the installation of an earth station in the country, in which case a facilities license would be required. Other administrations were licensing systems on first-come, first served basis, with no limit on the number of operators. In both of these categories, service providers offering GMPCS Service from a GMPCS operator had already been licensed to provide telecom services.

In yet some other administrations like Pakistan, GMPCS services remained the domain of a monopoly operator, which was either required to apply for a license from the relevant regulatory authority, or currently authorized to provide GMPCS Service as part of its general operating license. In these latter cases, provision of GMPCS Services from an operator was dependent on conclusion of a commercial arrangement with the incumbent operator. However all administrations required some form of licensing with respect to access to frequencies, following on frequency co-ordination.

GMPCS GUIDELINES FOR PAKISTAN

The framework for GMPCS covers variety of aspects such as service licensing, frequency coordination, adherence to the ITU GMPCS-MoU and its Arrangements, type approval, and several other topics such as tariffs and quality of service.

The framework for GMPCS is being made liberal and open in line with recently approved Telecom De-Regulation policy. Telecom Policy allows two types of licenses i.e. Local Loop (LL) and Long Distance International (LDI). There shall not be any stringent regulatory framework GMPCS service shall not require any license. It will be a solution as part of LDI license (award process). Interconnection and numbering will be as applicable to LDIs but not chargeable to individual GMPCS consortia. The GMPCS service will have the same nondiscriminatory access to networks as PTCL or new LDI operators. Keeping the above facts in view GMPCS Guidelines proposes:

a) An open, technology neutral and non-exclusive regime be followed for the service.

b) Service is encouraged to enhance coverage for **rural and underserved areas.**

c) There will be market based tariffs within ITU GMPCS-MoU for this service to have a meaningful GMPCS presence in the country to improve rural coverage.

d) This service can only be launched under the Long Distance International (LDI) license allowing GMPCS service providers to work under the newly proposed Telecom policy and regulatory framework under commercial arrangement with LDIs on non-exclusive basis.

e) Space segment (i.e. satellite constellations duly coordinated as per ITU regulations) shall be licensed by the operator's home administration, and no further regulation is necessary.

f) The Commercial Agreements be signed between parties on non-exclusive basis. Both GMPCS Consortia and LDI operators would be free to sign-up (under liberal/open) on mutually agreed commercial terms and conditions facilitating enhanced coverage.

g) PTCL is also encouraged to make its existing GMPCS arrangements, on non-exclusive basis as far as possible.

h) LDI licensee will inform PTA before offering GMPCS services including information on coverage and quality of service. Coordination with FAB will be required and shall be done by GMPCS Consortia prior to Agreement and service will only commence, following the successful frequency co-ordination of the satellite system.

i) International benchmarks are adopted for type approval of GMPCS terminals instead of developing any local facility for type approval of terminals.

j) PTA will publish guidelines on its web-sites and publicize same through public process for information of interested parties and stakeholders. Similarly FAB will come out with its own guidelines within spirit of market deregulation in Pakistan.

Broadband Definition

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, most applications can be adequately supported if the minimum user speed is around 128kbps, accordingly broadband in Pakistan will be defined as "Always on Internet connection with a download speed of at least 128kbps connectivity". This download speed target 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.

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

Figure 7.1 (a) – Broadband Applications & download speeds
A = Acceptable, P = Poor Quality, N = Not Acceptable

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 has 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.

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 ecommerce 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. Realizing 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.

BROADBAND IN PAKISTAN

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.

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 29000 (89% cable, 10% DSL and less than 1 % satellite and wireless) broadband subscribers in Pakistan, i.e. a penetration of 1.16 %. 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[1] 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.

BARRIERS TO BROADBAND GROWTH IN PAKISTAN:

PRICE:

The subscription prices for broadband in Pakistan are 60 times higher than in Korea.

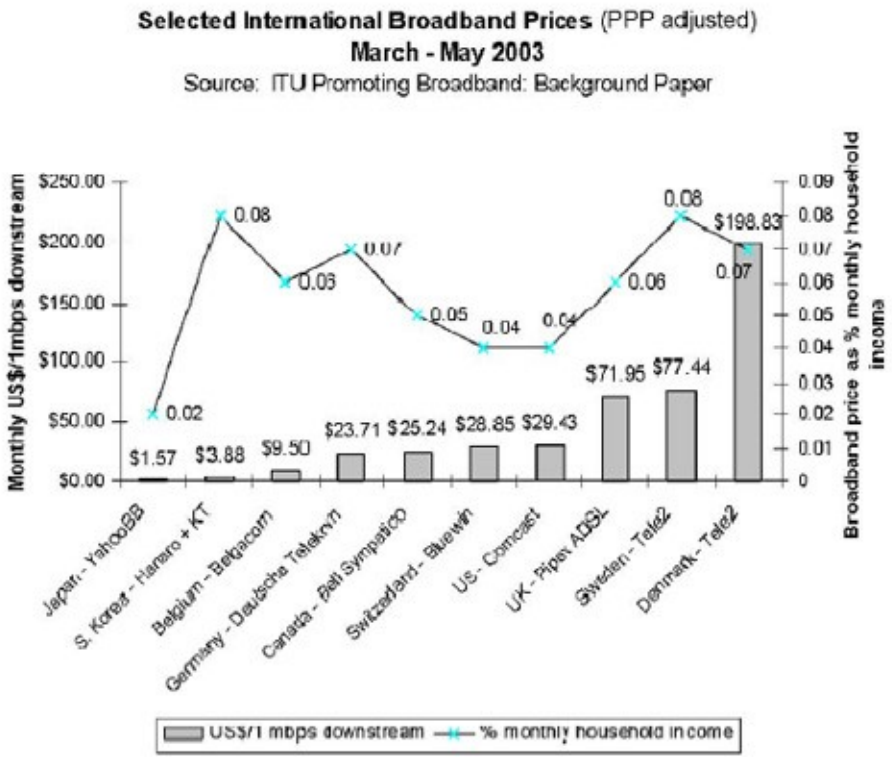


Figure: 7.4 INTERNATIONAL BROADBAND PRICES

However considering the respective purchasing powers of the two economies, this translates to 1600 times' higher prices in Pakistan.

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, online games etc.

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[4], 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 80 Local loop service providers[5]. 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.

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.

BROADBAND 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/commercial 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.

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, and 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.

BROADBAND TARGETS:

> **Broadband in Pakistan will be defined as "Always on Internet connection with a download speed of at least 128kbps connectivity". This download speed target 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.**

The independent study of the consumer patterns in the Pakistani internet market has shown that a major percentage of internet users will switch to broadband if the average cost of internet usage falls reasonably keeping in mind the improvement in speed and broader choice of applications. However keeping in view the fact that a majority of the internet 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 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 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. Although these figures have been estimated the main goal of the policy is to create an environment where

broadband proliferates. With the availability of broadband enabling content and applications as well as systematic well spread out and maintained infrastructure the market will take its own path and determine specific growth rates and targets. 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.

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

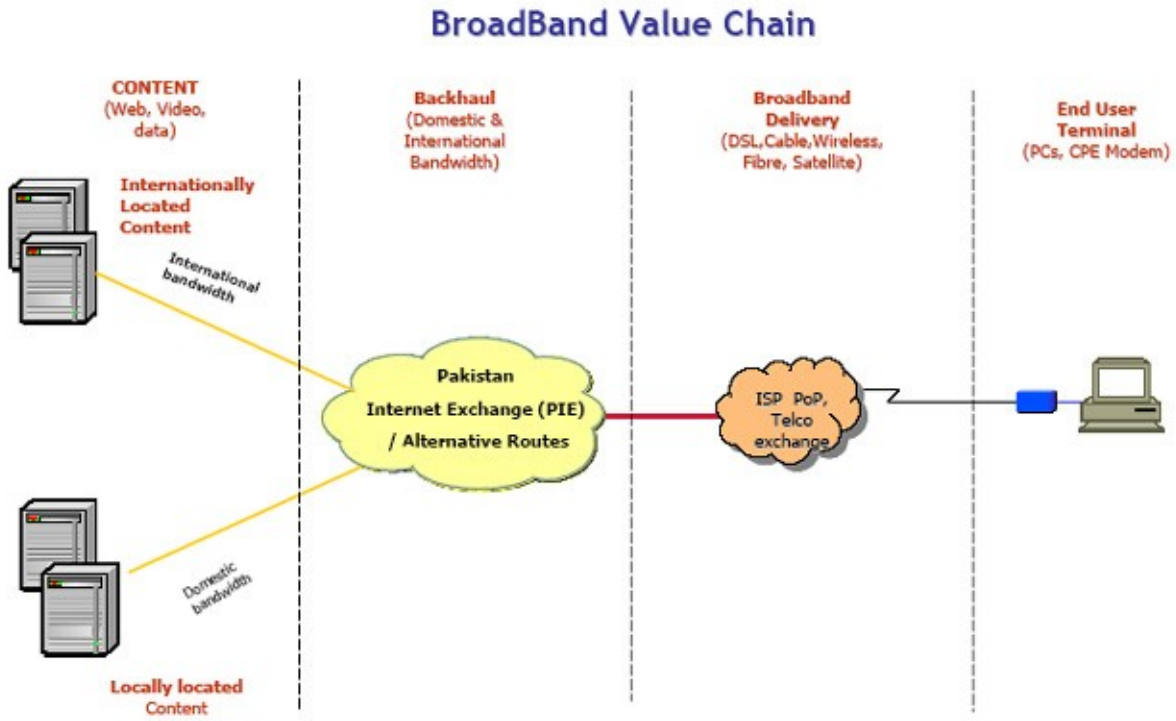


Figure: 8 Broadband Value Chain

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

CONTENT FACILITATION

The content available for use over the internet has very important role in enhancing the utility of internet for local population both in the way of local availability and availability in local language(s). The policy aims to enhance both the areas in tandem by ensuring that the content industry will flourish based on the incentives provided on all the platforms where data related services are delivered to the public including data over cellular and over fixed line CPEs apart from the availability on the internet. Policy aims at promoting new breed of Application Service Providers (APSs) like Malaysia and other countries where content industry has developed.

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:

> **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" on which PTA will issue guidelines.**

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. Several standards for provision of high-speed data services over cellular platforms are emerging. The telecom sector de-regulation policies do not bar the cellular providers from offering these new services under their existing licenses. The issue of convergent/unified services on these platforms will however be the subject of a future study.

> **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. The proposals will be based on the collaborative efforts with all**

the relevant ministries/departments and relevant stake holders e.g. law, commerce etc. for a cohesive view on all these matters.

Availability of useful applications like e-government, electronic tax filing, online stock trading, online gaming etc. have a huge impact on the demand for high speed internet and act as market drivers. The government is proactively working on the introduction of e-government applications. 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, tax and revenue collection functions to improve decision making, besides ensuring electronic bill payment facility for all major utilities. Availability of these services in conjunction with the local language computing platform as envisaged in the policy will have a major impact on driving up the demand for broadband internet.

In addition to the traditional credit card payment method over the net, all ecommerce content providers would be encouraged to offer payment model where their services are charged from the consumers through the broadband service provider monthly bills.

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 website development 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

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 be achievable. 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.

Different government agencies and private sector academic organizations have contributed significantly, with government funding, to the development of an Urdu language Unicode based standard for into website development.

Standardization of the Unicode for Urdu has already materialized. 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. The Unicode development will also pave the way for integration of the Urdu language into most popular computing platforms like Microsoft Windows and also prompt the growth of related industry like keyboard manufacturing and Urdu speech-to-text conversion and translation services for the widespread acceptance of the new Unicode for Urdu, the policy envisages:

> **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.

> **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.

> **To promote above concepts on content industry, 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**.**

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. LDI Licensees will have the option to develop their own backbone networks including National Internet Exchanges (NIEs) to provide competitive connectivity to all existing and new data communication and Broadband service providers.

Accordingly, the policy envisages:

REDUCTION IN INTERNATIONAL IP BANDWIDTH PRICES

> **The existing International IP and associated 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.

REDUCTION IN DOMESTIC BANDWIDTH PRICES

> **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 countrywide 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.

> **To promote IT industry, 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. Provision of alternative methods to the current distance based dedicated resource tariffs can be one of the steps that could lead to reduction in broadband prices for the end-user. Facilitation of such steps will introduce options for the broadband service providers and help in lowering the costs for the end-user.

> **Incumbent will be encouraged to work out alternative products and pricing plans (e.g. Ethernet/ IP ports etc.) complementing the current distance based dedicated resource tariffs, hence increasing the options for the service providers to lower the end-user prices.**

NATIONAL AND REGIONAL PEERING

> **Establishment of National and Regional 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.

BROADBAND DELIVERY FACILITATION

BROADBAND DELIVERY TECHNOLOGIES:

Today there are four primary mechanisms for broadband delivery:

Common Terminology	Technical Terminology
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

DIGITAL SUBSCRIBER LINE (DSL) TECHNOLOGY

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.

INCUMBENT'S FACILITATION FOR BROADBAND GROWTH:

International experience shows that DSL succeeds when the local loop service providers follow 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 the key to spur 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.

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:

> **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. Since the incumbent's initiatives are of key importance in the recently deregulated telecom sector, this policy just like the de-regulation policies of the fixed and mobile sector puts some obligations on PTCL to act as stimulus for the smooth entry of new providers into the market.

> **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 exchange side broadband related equipment, 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.

> **PTCL will offer non-discriminatory shared access to its last mile copper, i.e. the service providers can install their own exchange side broadband equipment 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.

> **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. PTCL will be required to provide the service within a predetermined time frame.**

Service level agreements will be signed between the ISP, the LL/LDI operators 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. In the case of non-availability of desired network infrastructure from any existing LDI/LL licensee, the broadband service provider (either retail or wholesale), can lay down their own purpose specific transport/local loop infrastructure just for providing broadband services, after three months of failure to obtain the network transport desired.

To contribute to the policy subscriber targets, 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 price level.

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

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[i] 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 has to be accompanied by the assurance of quality of service for the broadband users in Pakistan and the protection of stake holder's investments as well. Any entity will be able to offer broadband services in Pakistan provided that they have met the specified terms and conditions:

Service level agreements need to be signed with the licensed local loop and LDI operators by the broadband service provider who may also offer value added services such as VPNs, video conferencing and call center connectivity remaining within the scope of class license template as explained in Section 7.

FIBER / 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. Fiber 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 fiber to be taken to the customer's premises.

However Fiber 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 the dig the roads for the laying of fiber 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:

> **The government will encourage local governments and utility companies etc. to offer non-exclusive, non discriminatory and uniform ROWs and space contracts thereof for the concerned market segment, as per the Telecom Deregulation policy section 4.1.**
>
> **The government would encourage owners/builders of multi-storied buildings and commercial complexes, including local area authorities and operators not to enter into exclusive agreements, which would prevent others from serving potential customers in those areas.**

Although local governments, authorities and utility providers do not fall under the jurisdiction of the MoIT, facilitative steps taken for appropriate resolution of these crucial issues at the government level will be helpful for the new market entrants.

REGULATORY FRAME WORK FOR HFC NETWORK

The fixed nature of the HFC networks means that the regulatory policies for fiber and coaxial broadband networks will be similar to the policies defined for the fixed line copper networks. Regulatory framework clause 5.2.10.1 would also be applicable to the HFC broadband service providers. The broadband service providers desirous of deploying HFC network will have to meet the regulatory requirement of PRMRA if any.

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
3) Multipoint Microwave Distribution System (MMDS) 2.5-2.7 GHz
4) 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 bands will offer a potential broadband service provider a very attractive and fast method 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 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:

> **In order to streamline frequency management and allocation plan for Pakistan in accordance with the international standards; a high level technical 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 analyzed and offered to promote the service. An inter-ministerial committee will take appropriate decisions based on the recommendations of the technical committee.**

The proceedings of the committee meetings will lead to the development of a road map leading to the gradual availability of the unlicensed ITU standardized frequency bands for the broadband deployment. The committee will also examine the scenario of overlap of regulatory authorities of different regulatory bodies like PEMRA, PTA, and FAB etc. and will suggest a framework for the smooth co functioning of the regulators while ensuring the facilitation of the new broadband service providers for the purpose of increase of investment in the sector. The recommendations of this committee would be placed before an inter ministerial body or cabinet committee for final decision.

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

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 corporate 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.

> **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.

PEMRA will be required to consult FAB before publicizing 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.

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.

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.

Satellite broadband services can be provided by Broadband service providers using VSAT technology provided they meet the class license requirements.

Satellite broadband services can also be provided by the DTH operators provided they have local loop and LDI licenses, keeping in mind the existing limitations of the DTH license issued to them from PEMRA.
The broadband service providers will operate under the class license (including registration with PTA). In case the broadband service provider is proved to be involved in running illegal operations through its service, PTA will take action according to license template and shall also have the right to cancel the registration. In case of violation by PEMRA's licensed service providers, PTA will refer the matter to PEMRA.

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:

> **The government would require installation of facilities that enable broadband communications in new buildings built by the state, municipalities and government enterprises.**
>
> **The government will play a proactive role in development of ICT and broadband services in unnerved/underserved areas of Pakistan. The roadmap for the USF also includes plans for ICT including broadband in both the areas. This will pave way for proliferation of broadband services in the rural areas of Pakistan.**
>
> **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.

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:

> **Provisions relating to equipment depreciation and other fiscal incentives provided for in the IT policy will be maintained in the context of this policy.**

The advancement of technology often makes IT equipment obsolete in a short span of time. This increased depreciation will help stimulate investment in the equipment sector. This will encourage the large corporations to update their PCs and make cheap second hand PCs available 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.

> **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.

REGULATORY FRAMEWORK AND ROLE OF PTA

The aim of the broadband policy is to simplify the licensing mechanism for the promotion of broadband services in particular and all types of data communication services in general. In pursuance of the already approved deregulation policies (section 13) existing licenses for the Data, ISPs, and EIS are proposed to be phased out after the expiry of their current license tenure or converted into class license. Those who opt to adopt the new class regime will be eligible to the incentives being provided in the Broadband policy. As part of class license the existing Data, ISPs, and EIS and new broadband operators will be free to sign bandwidth and local loop agreements with operators of their choice within policy framework for LDI/LL licensees. The existing data/Internet licensees can opt to continue under their existing license till its expiry within terms and conditions of their license, thereafter they will be governed under class license template. This action will result in simplification of regime with the incentive of lower c lass license upfront registration charges and elimination of recurring charges etc. The template for class license (registration) of Data, ISPs, and EIS and broadband Service Providers will be made by PTA taking into account conditions specifying requirements of security, violations, voice and illegal termination and penalties thereto. The template will also take care of substantive conditions of contractual obligations to be included in operator and customer agreements. PTA would also specify the necessary requirements for the SLAs and QOS to be incorporated in LL/LDI agreements and in broadband service providers' performance obligations. The idea of registration with PTA is to make sure that all the clauses of the policy are adhered to by the new service providers and for the purpose of national security. While formulating the class license templates, PTA, by incorporating suitable clauses regarding matters pertaining to the use of VSAT by Broadband service providers and VPN and related services, will ensure the

protection of the interests of all stake-holders. The overall role of the regulator (PTA) is encompassed in the following text. These regulatory obligations would encompass all the broadband service providers irrespective of their delivery mechanism.

CLASS LICENSING

Pursuant to section 13 of the Telecom Sector Deregulation Policy existing licenses for the Data, ISPs, and EIS will be phased out after the expiry of their current period of validity and will be converted into class license and they will be eligible to the incentives being provided in the Broadband policy. The broad band service will also fall under the class license regime to ensure uniformity. The existing Data, ISPs, and EIS licensees can opt to continue under their existing license till its expiry within terms and conditions of their license or to be governed under class license template regime.

The existing Data, ISPs, and EIS licensees, who want to provide broadband services, will have to comply with the class license templates for the broadband operators including QoS provisions and service level agreements (SLAs).

PTA will prepare the class license templates and registration terms of Broadband, Data, ISPs, and EIS under the class licensing scheme taking into account conditions specifying requirements of security, violations (including illegal voice origination/termination) and penalties thereto.

The templates will incorporate substantive conditions of obligations to be included in the network transport contracts between broadband operator and the LL/LDI as well as the customer agreements of the broadband operators. The templates will also set time lines for the LDI/LL operators for the availability of their infrastructure for the Broadband operators and the mechanism of the monitoring for the designed SLAs.

PTA will also lay down a comprehensive framework for the required QoS and other performance obligations for the broadband operators. The resulting inter-operator and customer-operator SLAs will reflect these obligations. Detailed SLA and QoS parameters will be published regularly and updated periodically keeping pace with technological developments, by PTA.

CLASS LICENSE REGISTRATION

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.

Class license 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, while protecting licensees'

interests and consumer rights. Royalty charges and annual fee would be kept to a minimum level and incorporated in the class license template.

CODE OF CONDUCT

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.

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.

QUALITY OF SERVICE (QOS)

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.

RIGHTS OF EXISTING LICENSEES

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.

POLICY IMPLEMENTATION PLAN

Implementation plan and roadmap for the Ministry (MoIT) and its related entities like Pakistan Software Export Board (PSEB) etc., the regulator (PTA), the incumbent (PTCL) have been laid out and appended as Annex D.

All these entities will work together for the smooth implementation of the road map and hence ensuring the ultimate success of this policy.

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:

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.

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.

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.

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 precedence and encourage the deployment and use of low cost unlicensed hot spot technologies such as WiFi technologies.

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.

POLICY REVIEW

Keeping in view the fast pace of technology change the GoP may issue addendums and enhancements to the broadband policy if such necessity is warranted.

Annex A

G L O S S A R Y

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

ASP: Application Service Providers

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.

EIS: Electronic Information Services

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.

FTTx: (Fiber To The Home/Curb/) - A fiber optic based communication network where 'x' is the physical point where the fiber 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 (PTCL in context of Pakistan).

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.

USF: (Universal Service Fund) A fund in lieu of USO to be administered by the GoP.

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

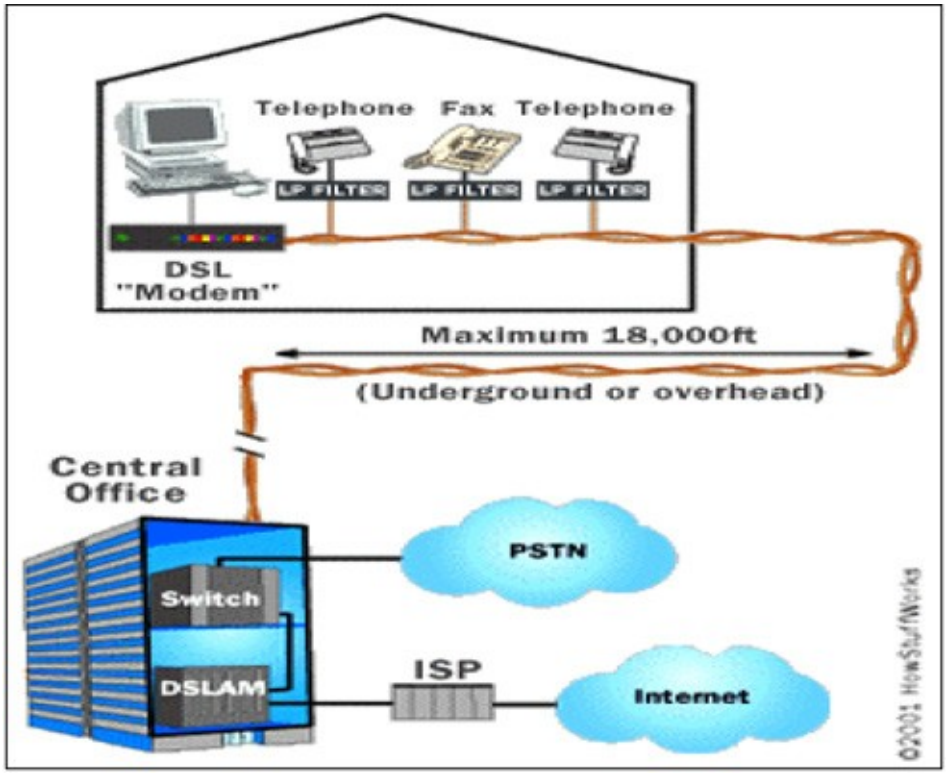
VSAT: (Very Small Aperture Antenna) – An earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television.

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.

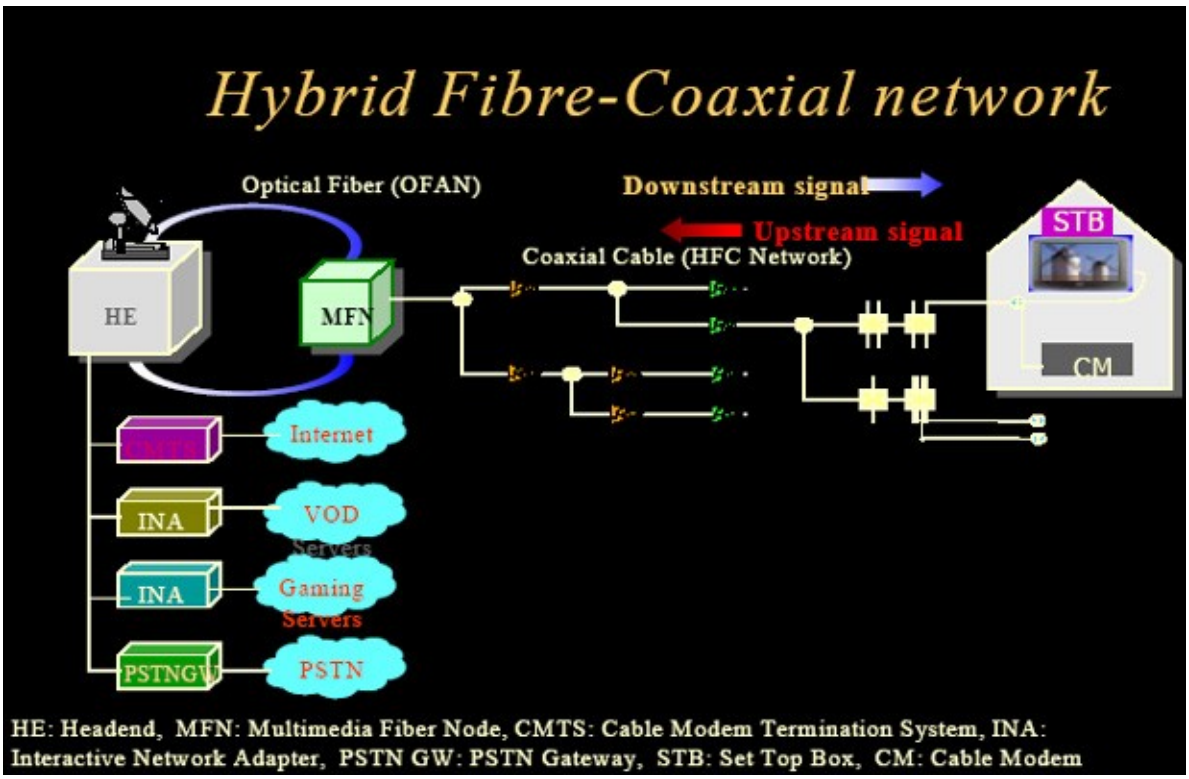
Annex B
I L L U S T R A T I O N S

1) Copper telephone lines based Digital Subscriber Loop Technology



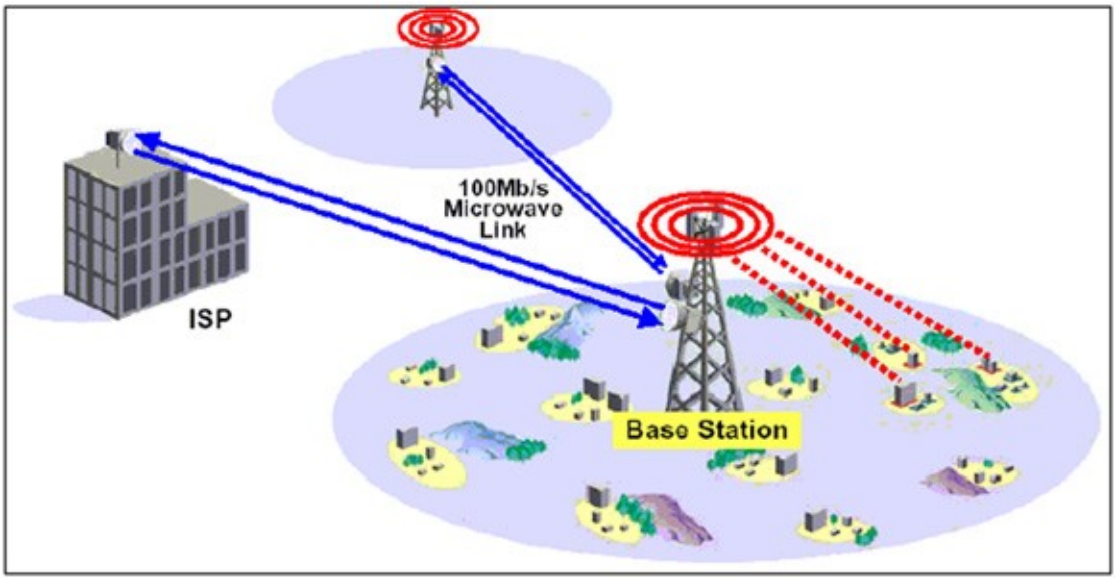
DSL Architecture

2) Hybrid Fiber and Coaxial network Architecture



HFC Architecture

Wireless Broadband Access Architecture



Broadband Wireless Access Architecture

Global Distribution of Broadband Technologies

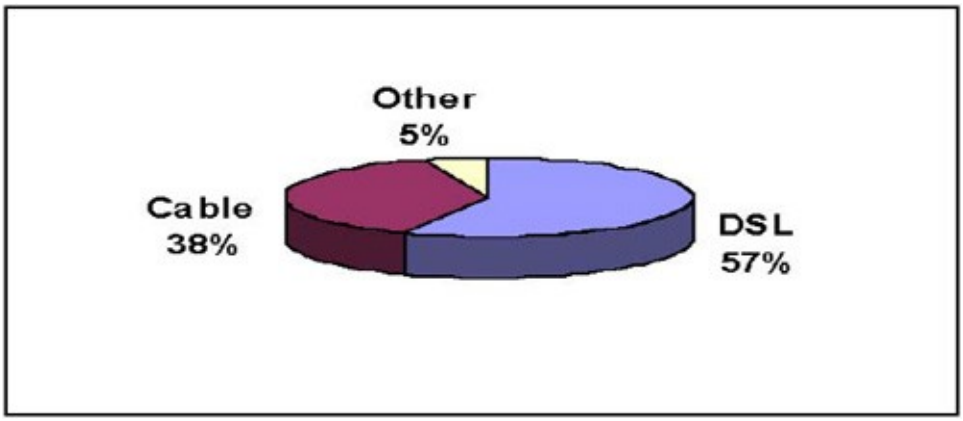


Figure: GD-1 World market share of broadband technologies

Table: A-B (1): Comparative Internet and Broadband Indicators (Mid-2003)

	Parameters	Korea	Malaysia	China	India	Pakistan
Access & Infrastructure	No. of PCs/100	78.6	15	2.8	0.8	1.85
	No. of Cable TVs/100 Persons	43	0	9	6	4.28
	No. of Fixed Telephone Lines/100 Persons	49	18.5	16.7	4.5	2.8
	No. of Mobile Phones/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
Internet Usage	GDP (USD/Capita)	10,000	4,000	965	465	480
	No. of Internet Connections/100 Persons	58	11	2	0.4	0.2
	No. of Users/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
Broadband	No. of broadband connections/100 Persons	57.5	0.21	1	0.02	0.01
	Charges for Broadband/Month(USD)	30	29	16	20	-
	Charges per 100 Kbps per month (USD)	0.25	7.61	3.07	15.63	-

World Internet and Broadband comparisons

TELECOMMUNICATIONS REFERENCE

- DEFINITIONS
- ABBREVIATIONS
- ORGANIZATIONS

DEFINITIONS

ADVANCED INTELLIGENT NETWORKS

Systems that allow a wireless user to make and receive phone calls while roaming in areas outside the user's "home" network. These networks, which rely on computers and sophisticated switching techniques, also provide many Personal Communications Services features such as "one person/one phone."

AIR TIME

Actual time spent talking on the cellular telephone. Most carriers bill customers based on how many minutes of air time they use each month.

ALPHANUMERIC

A message or other type of readout containing both letters ("alphas") and numbers ("numerics"). In cellular, "alphanumeric memory dial" is a special type of dial-from-memory option that displays both the name of the individual and that individual's phone number on the cellular phone handset. The name also can be recalled by using the letters on the phone keypad. By contrast, standard memory dial recalls numbers from number-only locations.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

A private organization that develops widely accepted standards for many pieces of modern day equipment.

ANALOG TECHNOLOGY

The traditional method of modulating radio signals so that they can carry information. AM (amplitude modulation) and FM (frequency modulation) are the two most common methods of analog modulation. Voice messages are electronically replicated and amplified as they are carried from the transmitting antenna to the receiving antenna. A problem with this technology, however, is that the amplification procedure tends to pick up "noise," sometimes making the message difficult to hear. Traditionally, cellular phones have utilized analog transmission signals.(See "Digital Technology")

ANTENNA

Any system of wires, poles, rods, reflecting discs, or similar devices used for the transmission or reception of electromagnetic waves.

ANTENNA ARRAY

A group of antenna elements on the same geometric plane.

ANTENNA, COMMERCIAL

An antenna in any zoning district used in conjunction with a business, commercial enterprise, trade, calling, vocation, profession, occupation or means of livelihood, whether or not carried on for gain or profit, including, but not limited to public utilities, wireless telephone communications or privately owned or publicly supported AM or FM radio stations not otherwise exempt from the provisions of the Zoning Ordinance, cable television operations or television broadcast stations, but excluding FCC licensed amateur radio stations and standard television receive only (TVRO) non-parabolic antennas.

ANTENNA, CONCEALED

Also called disguised, camouflaged, "stealth" antennas, etc. These antennas are blended into the environment so as not to be seen or recognized. They include architecturally screened roof-mounted antenna, façade-mounted antenna as design features, "tree" poles which may appear to be palms or pines, clock towers, entry statement signage, and other types of concealment.

ANTENNA, DIRECTIONAL

Flat rectangular panels that typically don't exceed six square feet (6sf) [.5m^2] with a maximum six feet (6') [2m] in length and two feet (2') [.5m] in width, and are typically, but not always, mounted to a triangular support structure atop a wood pole or steel monopole. Typically fifteen (15) panel antennas are required for each cellular facility. They can be exposed or concealed behind a radome cover.

ANTENNA, DISH (See Antenna, Parabolic)

ANTENNA ELEMENT

Individual components of an individual antenna.

ANTENNA, GROUND-MOUNTED PARABOLIC

A parabolic antenna, the weight of which is fully or partially supported by an approved platform, framework, pole, or other structural system, which system is affixed or placed directly on or in the ground.

ANTENNA HEIGHT

The distance from the grade of the property at the base of the antenna or, in the case of a roof-mounted antenna, from the grade at the exterior base of the building, to the highest point of the antenna and its associated support structure when fully extended. The vertical distance between the highest point of a parabolic antenna when actuated to its most vertical position and the grade below, for a ground-mounted parabolic antenna, and to the roof below for a rooftop parabolic antenna.

Antenna, Microwave Relay Parabolic

A transmitting and receiving antenna, typically parabolic, disc or double convex shaped with an active element external to the disc. That communicates by line of sight with another similar antenna or a geosynchronous orbiting satellite.

ANTENNA, NONCOMMERCIAL

A television receive only (TVRO) parabolic or non-parabolic antenna in any district.

ANTENNA, NON-ROOF-MOUNTED (NRMA) (See Antenna Structure, Free-standing)

ANTENNA, NON-PARABOLIC

An individual array or group of arrays used to transmit and/or receive electromagnetic signals, including, but not limited to radio waves related to amateur radio stations licensed by the Federal Communications Commission (FCC) and microwaves related to wireless telephone communications.

ANTENNA, OMNI DIRECTIONAL

Cylindrical shaped antenna which transmits and receives in 360 degrees. This antenna typically does not exceed three and one-half inches (31/2") [9cm] in diameter and ranges from two feet (2') [.5m] to fifteen feet (15') [4.5m] in height. Also called "stick antenna" and "whip antenna."

ANTENNA PARABOLIC

A parabolic, semi-parabolic, disc, convex or double-convex shaped accessory structure, including, but not limited to, a main dish and covering, feed horn, receiving element, structural supports and all other components thereof, which transmits and/or receives television signals or electromagnetic waves by line of sight with another similar antenna or a geosynchronous or orbiting satellite. Because of their shape and function, they are often also called "dish" antennas, microwave dishes, and satellite dishes.

ANTENNA, ROOF-MOUNTED (RMA) (See Co-location)

ANTENNA, SATELLITE

Any antenna used to receive and/or transmit radio or television signals from orbiting communications satellites.

ANTENNA, SATELLITE EARTH STATION

A parabolic or dish-shaped antenna or any other apparatus or device that is designed for the purpose of receiving radio waves.

Comment: Many local ordinances have attempted to control the location and size of satellite antennas for aesthetic reasons. Recent court cases have ruled that Federal Communications Commission (FCC) regulations have preempted local control over these devices or at least require them to be treated as any other antenna (Alsan Technology v. Zoning Board of Adjustment, 235 N.J. Super. 471; Nationwide v. Zoning Board of Adjustment, 243 N.J. Super. 18). Local control of satellite antennas may be upheld if the local ordinance is crafted to meet the following three-point test:

1. The ordinance should not differentiate between satellite dish antennas and other types of antennas;
2. There should be a reasonable, clearly defined health, safety, and/or aesthetic objective as the basis for the ordinance; and
3. The ordinance should not impose unreasonable limitations on reception or impose costs on the user disproportionate to total investment in antenna equipment and installation.

ANTENNA SATELLITE UPLINK

A commercial parabolic antenna which receives and transmits electromagnetic waves by line of sight with geosynchronous orbiting satellites.

ANTENNA STRUCTURE

An antenna array and its associated support structure, such as a mast or tower, but not to include a suspended simple wire antenna, that is used for the purpose of transmitting and/or receiving electromagnetic signals, including but not limited to radio waves and microwaves.

ANTENNA STRUCTURE, FREESTANDING

An antenna structure or mast that is not attached to a building, fence or other such structure. Freestanding antenna structures include communications towers, wooden utility poles, standard or decorative concrete and steel monopoles.

ANTENNA STRUCTURE, LATTICE

Free-standing or guyed (wire ground connections) steel structure frame.

ANTENNA STRUCTURE, MONOPOLE

A tubular antenna structure made of metal, reinforced concrete, or wood.

ANTENNA, TVRO

A television receive only (TVRO) parabolic or non-parabolic antenna. A standard roof-mounted antenna array and its associated support structure that is used solely to receive broadcast television signals.

ANTENNA, VERTICAL WHIP

Pole or single element vertical antennas no more than three inches (3”) [7.5cm] in diameter, and its associated support structure.

AUTOMATIC VEHICLE MONITORING (AVM)

The use of non-voice signaling methods from and to vehicles to make known at fixed points the location of the vehicles. AVM systems may also transmit status and instructional messages related to the vehicles involved.

BAND

A clearly defined range of radio frequencies dedicated to a particular purpose.

BANDWIDTH

A relative range of frequencies that can carry a signal without distortion on a transmission medium.

BASE STATION (BASE TRANSCEIVER STATION, BTS)

A fixed station at a specified site authorized to communicate with mobile stations. Base stations are usually housed in metal cabinets or small structures within close proximity to the antenna structure.

BASIC TRADING AREA (BTA)

A service area designed by Rand McNally and adopted by the FCC to promote the rapid deployment and ubiquitous coverage of Personal Communications Services (PCS) and a variety of services and providers. There are 493 BTAs in the United States.

CALIFORNIA STATE PUBLIC UTILITIES COMMISSION (CPUC)

The CPUC regulates those telecommunications which are also considered public utilities. Where the telecommunications service being provided is a public utility, such as telephone service, including local, long distance or cellular telephone service, then those services fall under CPUC jurisdiction.

CALIFORNIA TELECOMMUNICATIONS INDUSTRY ASSOCIATION (CTIA)

An organization for private sector telecommunications service providers.

CELL

The basic geographic unit of a cellular system. Also, the basis for the generic industry term "cellular." A city or county is divided into smaller "cells," each of which is equipped with a low-powered radio transmitter/receiver. The cells can vary in size depending upon terrain, capacity demands, etc. By controlling the transmission power, the radio frequencies assigned to one cell can be limited to the boundaries of that cell. When a cellular phone moves from one cell toward another, a computer at the Mobile Telephone Switching Office (MTSO) monitors the movement and at the proper time, transfers or hands off the phone call to the new cell and another radio frequency. The handoff is performed so quickly that it's not noticeable to the callers.

CELL SITES

1. Capacity Site

   Shorter telecommunications structures that cover smaller areas with a more concentrated demand. Capacity sites serve to increase the capacity when surrounding sites have reached their practical channel limits.

2. Coverage Site

   Higher telecommunications structures covering a larger geographic area, but with a lower service demand. Coverage sites serve to expand coverage in large areas or in areas with difficult terrains and to enhance coverage for portable systems. Coverage sites allow users to make and maintain calls as they travel.

3. Transition Site

   Transition sites are needed for frequency re-use. Tall monopoles create a problem in frequency re-use because they "see" everything. In order to control frequency re-use problems, these tall sites must be removed and replaced temporarily by transition sites. Transition sites allow the cellular company to increase capacity and maintain coverage simultaneously.

CELLULAR

Common carrier mobile telephones operating in the 850 MHz region.

CELLULAR CARRIERS ASSOCIATION OF CALIFORNIA (CCAC)

Organization devoted to cellular issues in California.

CELLULAR DIGIT PACKET DATA (CDPD)

Technology that allows data files to be broken into a number of "packets" and sent along idle channels of existing cellular voice networks.

CELLULAR GEOGRAPHICAL SERVICE AREA (CGSR)

The actual area in which a cellular company provides cellular service. This area may be somewhat smaller than the MSA surrounding it.

CELLULAR SERVICE

Two-way voice and data communications through hand-held, portable, and car mounted phones. Geographic coverage areas for cellular service are very large, and can cover cities, counties, and entire states.

CHANNEL

A path along which a communications signal is transmitted.

CODE DIVISION MULTIPLE ACCESS (CDMA)

A spread-spectrum approach to digital transmission. With CDMA, each conversation is digitized and then tagged with a code. The mobile phone is then instructed to decipher only a particular code to pluck the right conversation off the air. The process can be compared in some ways to an English-speaking person

picking out in a crowded room of French speakers the only other person who is speaking English.

CO-LOCATION

1. Siting multiple antenna structures within the same local area. Also called "antenna farms."
2. Multiple antennas attached to an existing or proposed freestanding antenna structure. Also called donor sites and "piggy-backing."
3. Roof-mount antenna (RMA) attached to the top of a building or other structure.
4. Façade-mount in which the antenna is attached to (an) exterior wall(s) of a building or other structure.
5. Enclosed in which the antenna facility is entirely contained within a building primarily occupied by another permitted use. Types 3, 4, & 5 are tenant improvements (TI).

CO-LOCATION ISSUES

Co-location may be problematic to accommodate the following technical, service and aesthetic concerns.

1. Co-location may create signal interference both horizontally and vertically requiring additional area or height. Twenty feet (20') [6m] is the ideal platform separation, and the cumulative effect of adding multiple platforms (beanstalk effect) may have a more significant aesthetic impact than individual sites.
2. Antenna structural design may not allow additional weight or wind loads from future antennas without significant modification and potential visual impacts.
3. The more aesthetically treated monopoles do not have external handholds and attachments for servicing. To service these antennas, the entire structure must be lowered. Maintenance and repairs to one antenna would also disrupt service to the other telecommunications system(s).
4. In the permitting of the original site, it may not be infeasible to plan for future co-location. How many sites per location? How many antennas per structure? How high a structure to accommodate multiple antennas? This is further complicated by terms of the master lease.
5. Liability concerning personnel injury or antenna damage becomes an issue with shared sites.
6. Whereas single antenna structures may be visually attenuated, an antenna "farm" or "forest" could have a more significant visual impact.
7. Multiple users will have compounded problems in adapting to new technologies.

COMMERCIAL MOBILE RADIO SERVICE (CMRS)

The regulatory classification that the FCC uses to govern all commercial wireless service providers including Personal Communications Services, cellular and Enhanced Specialized Mobile Radio.

DATA SERVICE

The electronic transfer of data or digital information.

DIGITAL TECHNOLOGY (See Analog Technology)

Data (including voice messages) are converted into digits that represent sound intensities at specific points in time. Because natural pauses in the conversation are eliminated, (1) the background noise that is generally heard in the analog system becomes inaudible, and (2) more capacity becomes available from the same amount of spectrum, thus reducing the need for new sites. There are two forms of digital technology: 1) Code Division Multiple Access (CDMA) and 2) Time Division Multiple Access (TDMA). Both of these forms of digital technology render multiple access over one frequency, or channel.

DONOR SITE (See Co-location)

E-MAIL (ELECTRONIC MAIL)

The electronic transfer and storage of written messages.

EARTH STATION

A telecommunication facility that transmits to and/or receives signals from an orbiting satellite.

ELECTROMAGNETIC COMPATIBILITY (EMC)

The ability of equipment or systems to be used in their intended environment within designed efficiency levels without causing or receiving degradation due to unintentional electromagnetic interference. Proper shielding of devices reduces interference.

ELECTROMAGNETIC FIELDS (EMFS)

Though often referred to as radiation, EMFs do not actually radiate out from a source. Rather, they are best described as local electric and magnetic fields that envelop the surrounding space. The most ubiquitous source of EMFs is from the movement and consumption of electric power-transmission lines, household appliances, electronic devices, and lighting. (See Non-ionizing Electromagnetic Radiation)

ELECTRONIC SERIAL NUMBER (ESN)

Each cellular phone is assigned an ESN, which is automatically transmitted to the base station every time a cellular call is placed. The Mobile Telephone Switching Office (MTSO) checks the ESN to make sure it is valid, that the phone has not been reported stolen, that the user's monthly bill has been paid, etc., before permitting the call to go through.

ENHANCED SPECIALIZED MOBILE RADIO (ESMR)

A PCS that offers two-way voice and data communications through hand-held and car mounted phones and through wireless modems incorporated into devices such as portable computers and electronic notebooks. ESMR is expected to offer many enhanced features such as voice mail and call waiting. Geographic service coverage areas are anticipated to be very large, and may cover cities, counties, and entire states.

EXTREMELY LOW FREQUENCY (ELF) RADIATION

Energy transmitted from electric power such as overhead power lines, electrical wiring, and electrical appliances. ELF is a component of Electromagnetic Fields (EMFs). (See Electromagnetic Fields)

FEDERAL AVIATION ADMINISTRATION (FAA)

The FAA also has a limited role in the regulation of telecommunications tower sites. Their review focuses on the height and location of towers to prevent interference with aircraft operations.

FEDERAL COMMUNICATIONS COMMISSION (FCC)

The federal government agency that licenses most radio services. FCC regulations supersede some of the authority of local jurisdictions to regulate telecommunications facilities. The FCC has primary regulatory control over telecommunications facilities through its powers to control interstate commerce and specifically through the Federal Communications Act which established the FCC to provide a comprehensive national system to regulate radio frequency transmissions and related facilities. [FCC Rules and Regulations: Part 90 (Abridged) Private Land Mobile Radio Services.]

FLOWER TOWER

A monopole design with arching panels resembling a flower. (See "antenna structure, monopole")

FREQUENCY DIVISION MULTIPLE ACCESS (FDMA)

Method of radio transmission that allows multiple users to access a group of radio frequency bands without interference.

GENERAL ORDER 159 (A) (G.O. 159)

"Rules Relating to the Construction of Cellular Radiotelephone Facilities in California" from the Public Utilities Commission of the State of California.

GIGAHERTZ (GHZ)

Billions of Hertz.

GROUPE SPECIALE MOBILE (GSM) (NOW TRANSLATED IN ENGLISH AS GLOBAL STANDARD FOR MOBILE)

The Pan-European digital cellular system standard.

HERTZ

A measurement of electromagnetic energy, equivalent to one "wave" or cycle per second.

INTEGRATED DIGITAL ENHANCED NETWORK (IDEN)

Previously called Enhanced Specialized Mobile Radio (ESMR).

IMAGING

The transmission of still images such as faxes, pictures, or slides.

INFORMATION SKYWAY

The informal name for wireless telecommunications including PCS, cellular, and others. The origin of this name is *Information Highway* which refers to the flow of electronic information.

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

Professional organization which, among other activities, provides recommendations regarding EMF and RFR safety.

INTERFERENCE, HARMFUL

Any emission, radiation, or induction which specifically degrades, obstructs, or interrupts the service provided by such stations.

KILOHERTZ (KHZ)

Thousands of Hertz.

LAND MOBILE RADIO SERVICE

A regularly interacting group of base, mobile and associated control and fixed relay stations intended to provide land mobile radio communications service over a single area of operation.

MAST (SEE ANTENNA STRUCTURE)

MEGAHERTZ (MHZ)

Millions of Hertz.

MAJOR TRADING AREA (MTA)

A Personal Communications Services area designed by Rand McNally and adopted by the FCC. There are 51 MTA's in the United States.

METROPOLITAN STATISTICAL AREA (MSA)

An MSA denotes one of the 306 largest urban population markets as designated by the U.S. government. Two cellular operators are licensed in each MSA.

MOBILE DATA

A PCS that is expected to provide two-way wireless communication of text, voice messages, and potentially video messages among computers, personal digital assistants, and databases. Mobile data services can be provided by a number of technologies such as cellular, PTS, mobile satellite, and ESMR, as well as networks built exclusively for data PCS applications.

MOBILE SATELLITE

A PCS that is anticipated to provide two-way voice and data communications using satellites, hand-held phones, and wireless modems incorporated into devices such as notebook computers. It is expected that Mobile Satellite services will offer enhanced features such as call waiting and voice mail. Geographic service coverage is anticipated to be larger than most PCS and may even be world-wide. A single satellite can provide coverage to the whole United States.

MOBILE TELEPHONE SWITCHING OFFICE (MTSO) (ALSO CALLED MAIN SWITCHING OFFICE MSO)

The central computer that connects a cellular phone call to the public telephone network. The MTSO controls the entire system's operations, including monitoring calls, billing and handoffs.

MONOPALM

A simulated palm tree monopole.

(See Antenna Structure, Monopole)

MONOPOLE

(See Antenna Structure, Monopole)

NARROWBAND PCS

Services that are expected to include advanced voice paging, two-way acknowledgement paging, data messaging, and both one-way and two-way messaging and facsimile.

NON-IONIZING ELECTROMAGNETIC RADIATION (NIER)

Non-ionizing radiation is a form of electromagnetic radiation. It includes ordinary light which we can see, and infrared radiation, which we sense as heat. Another type of non-ionizing radiation which our bodies ordinarily cannot detect is Radio-

frequency (RF) radiation, including radio and TV signals and microwaves. (See Electromagnetic Fields)

PAGING

A one-way communications service from a base station to mobile or fixed receivers that provide signaling or information transfer by such means as tone, tone-voice, tactile, optical readout, etc. A PCS that provides primarily one way voice and data communications such as a voice or electronic message, or a data transfer, to a pager or a device such as a laptop computer with a built in pager. Geographic service coverage areas for paging are very large with some paging providers offering nation-wide coverage.

PERSONAL COMMUNICATIONS SERVICES (PCS)

FCC terminology describing intelligent, digital wireless, personal two-way communications systems. A broad range of telecommunications services that enable people and devices to communicate independent of location. PCS networks and devices operate over a wide range of frequencies assigned and authorized by the Federal Communications Commission (FCC).

PERSONAL DIGITAL ASSISTANT OR PERSONAL COMMUNICATOR

Portable computing devices capable of transmitting data. These devices make possible services such as paging, data messaging, electronic mail, stock quotations, handwriting recognition, personal computing, facsimile, date book and other information handling capabilities.

PERSONAL MOBILITY

A feature that may be offered by some PCS which tracks and routes calls and information to specific people rather than specific locations.

PERSONAL NUMBER OR UNIVERSAL NUMBER

A telephone number that is assigned to a person and not a geographic location such as a residence or a business.

POP

Short for population. One "POP" equals one person. In the wireless industry, systems are valued financially based on the population of the market served.

PRIVATE CARRIER

An entity licensed in the private services and authorized to provide communications service to other private services on a commercial basis.

RADIODETERMINATION

The determination of position, or the obtaining of information relating to position, by means of the propagation of radio waves.

RADIOFACSIMILE

A system of radio communication for the transmission of fixed images, with or without half-tones, with a view to their reproduction in a permanent form.

RADIOFREQUENCY RADIATION (RFR)

Radiofrequency Radiation is one of several types of electromagnetic radiation consisting of waves of electric and magnetic energy moving together through space. These waves are generated by the movement of electrical charges. For example, the movement of a charge in a transmitting radio antenna, i.e., the alternating current, creates electromagnetic waves that radiate away from the antenna and can be picked up by a receiving antenna.

RECEPTION WINDOW

The area within the direct line between a satellite antenna and those orbiting communications satellites carrying available programming.

RURAL SERVICE AREA

One of the 428 FCC-designated rural markets across the United States. An area with low capacity requirements and large coverage requirements.

SHADOWING EFFECT (SHADOW)

Area in which a radio signal transmitted from a particular location is received poorly or not at all due to natural or manmade obstructions.

SMART CARD

A credit card-like device capable of storing and transferring information regarding the card's user to communications devices such as hand-held and car phones, notebook computers, and personal digital assistants. This information could include how the user would like their phone calls handled, method of payment, and the user's personal number.

SPECIALIZED MOBILE RADIO (SMR)

Private business service using mobile radiotelephone and base stations communicating via the public phone network.

STEALTH SITES

Stealth sites are architecturally blended into the existing environment. They may be hidden in a church bell tower. They may be surrounded by a water tower. They may be able to be covered by a silo. Wherever these antennas are, nobody can see that they are antennas. (See "antenna, concealed" and "co-location")

STICK ANTENNA

(See "antenna, omni-directional")

TELECOMMAND

The transmission of non-voice signals for the purpose of remotely controlling a device.

TELECOMMUNICATIONS FACILITIES

Communications towers, antennas and the necessary appurtenances. A land use that sends and/or receives radio frequency signals, including antennas, microwave dishes or horns, structures or towers to support receiving and/or transmitting devices, accessory development and structures, and the land on which they all are situated.

TELECOMMUNICATIONS SITE

The defined area subject to review, under any land use permit application request for communication facilities.

TELECOMMUNICATIONS TOWER

Any structure which is used to transmit or receive electromagnetic communications signals or which supports such a device. Private radio and TV receiving antennas for residential use are specifically excluded.

TELEPOINT

A PCS that can provide either one or two way voice and data communications through hand-held phones and electronic devices such as electronic notebooks. It is anticipated that telephonic services will cover smaller geographic areas and offer fewer features than other PCS such as cellular and PTS, at a lower price.

TENANT IMPROVEMENT (TI) (SEE CO-LOCATION)

Tenant improvements include roof-mounted antennas, façade-mounted antennas, and other types of antennas integrated into existing structures.

TIME DIVISION MULTIPLE ACCESS (TDMA) (SEE DIGITAL TECHNOLOGY)

A method of digital wireless communications transmission allowing a large number of users to access (in sequence) a single radio frequency channel without interference by allocating unique time slots to each user within each channel.

VIDEO MAIL

The electronic storage and transfer of voice and motion video messages.

VOICE-ACTIVATED DIALING

A feature that permits you to dial a phone number by speaking it to your wireless phone instead of punching it in yourself. The feature contributes to convenience as well as driving safety.

VOICE MAIL (ALSO CALLED VOICE MESSAGING)

The electronic storage or transfer of audible messages.

WHIP ANTENNA

(See "antenna, omni-directional")

WIRELESS LANS

Wireless Local Area Networks (LANs) provide wireless connections for devices such as portable computers and personal digital assistants to other devices and to databases. Wire LANs are expected to be built for private user groups such as a business within a small coverage area such as a business campus or downtown area.

WIRELESS PBX (PRIVATE BRANCH EXCHANGE)

Wireless PBX is a PCS which is essentially a wireless business telephone. It is expected that Wireless PBX service will provide the same features that desktop business telephones currently provide such as voice mail and three-way teleconferencing. The phone handset will be cordless, with the user able to both make and receive calls wherever he or she may be within a service coverage area. Coverage areas for Wireless PBX are anticipated to be primarily within buildings and in defined outdoor areas such as a business campus or a neighborhood.

◙ ABBREVIATIONS

A/E architect/engineer

AGL	above ground level	
AIN	Advanced Intelligent Network	
AM	amplitude modulation	
AMPS	Advanced Mobile Phone	Service
ANI	automatic number identification	
ANSI	American national standards institute	
AUC	authentication center	
AVM	automatic vehicle monitoring	
BSC	base station controller	
BSS	base station system	
BTA	basic trading area	
BTS	base transceiver station	
C/N	carriers to noise ratio	
CAI	common air interference	
CAP	competitive access provider	
CCAC	Cellular Carriers Association of California	
CCIR	International Radio Consultative Committee	
CCITT	Consultative Committee International Telephony & Telegraphy (Comité Consultatif International Télégraphique & Téléphonique)	
CCS	custon calling services	
CDMA	code division multiple access	
CDPD	cellular digital packet data	
CEQA	California Environmental Quality Act	
CFR	Code of Federal Regulations	
CGSA	cellular geographical service area	
CMC	cellular mobile carrier	
CMRS	commercial mobile radio	service
CO	central office	
CODEC	coding/decoding device	
COW	cell on wheels	
CPU	central processing unit	
CT-2,3	digital cordless telephony (2nd, 3rd generation)	
CTIA	Cellular Telecommunications Industry Association	
CUP	conditional use permit	
dB	decibel	
DBS	direct broadcast satellites	
DCT	digital cordless telephone	
DECT	Digital European Cordless Telephony	
DSDIR	Development Services Department	
EIR	environmental impact report	
EIS	environmental impact study	
ELF	extremely low frequency radiation	
E&M	ear and mouth	

E-mail	electronic mail
EMC	electromagnetic compatibility
EMF	electromagnetic field
EMR	electromagnetic radiation
EPA	Environmental Protection Agency
ERP	effective radiated power
ESMR	enhanced specialized mobile radio
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FLMPTS	future land mobile personal telephone service
FM	Frequency Modulation
FSN	full service network
GB	ground built
GEO	geostationary earth orbit
GO 159	General Order 159
GSM	Global System for Mobile communication (Groupe Special Mobile)
HAAT	height above average terrain
ICNIRP	International Commission on Non-Ionizing Radiation Protection
iDEN	integrated digital enhanced network
IEEE	Institute of Electrical and Electronics Engineers
IN	intelligent network
IP	intelligent peripheral
ISDN	integrated services digital network
ISN	information systems network
ITS	improved mobile telephone service
ITU	International Telecommunication Union
LAN	local area network
LEC	local exchange carrier
LEO	low earth orbit
MOU	minutes of use
MSO	main switching office
MSA	metropolitan serving area
MTA	major trading area
MTS	message telecommunications service; mobile telephone service
MTSO	mobile telephone switching office
MW	microwave
NCRP	National Council on Radiation Protection and Measurement
NIER	non-ionizing electromagnetic radiation
NRMA	non-roof-mounted antenna
NWN	national wireless network
O&M	operation and maintenance
OCC	other common carrier
PBX	Private branch exchange

PC	planning commission, personal computer
PCIA	Personal Communications Industry Association
PCN	Personal communications network
PCS	Personal communications Service
PDA	personal digital assistant
PIN	personal identification number
POP	total population coverage
POTS	plain old telephone service
PT	pocket telephone
PTN	personal telephone number
PUC	Public Utilities Commission
RASP	remote antenna signal Processor
RF	radio frequency
RFI	radio frequency interference
RFR	radio frequency radiation
RMA	roof-mounted antenna
RSA	rural serving area
R/W	right-of-way (row)
SAR	specific absorption rate
SMR	specialized mobile radio
SMSA	standard metropolitan statistical area
TDMA	time division multiple access
Telco	telephone communications
TI	tenant improvement
TIA	Telecommunications Industry Association
TVRO	television receive only
UHF	ultra high frequency
UP	urban planner
VHF	very high frequency
VLAN	vehicle local area network
VMS	voice messaging service
WATS	Wide area telecommunications service
WTB	Wireless Telecommunications Bureau
WTS	wireless telephone systems

◙ ORGANIZATIONS

AMERICAN MOBILE TELECOMMUNICATIONS ASSOCIATION (AMTA)
1150 18th NW, Suite 250
Tel 202/331-7773
Fax 202/331-9062

CALIFORNIA PUBLIC UTILITIES COMMISSION (CPUC)
505 Van Ness Avenue
San Francisco CA 94102
Tel 415/703-2782
Fax 415/703-1758

CELLULAR CARRIERS ASSOCIATION OF CALIFORNIA (CCAC)
1225 Eight Street, Suite 550
Sacramento California 95814

Tel 916/553-5810
Fax 916/553-5811

CELLULAR TELECOMMUNICATIONS INDUSTRY ASSOCIATION (CTIA)
1250 Connecticut Avenue, N.W.,
Suite 200
Washington, D.C. 20036
Tel 202/785-0081
Fax 202/785-0721
WWW http://www.wireless-apps.com/ctia/index.html
Cellular Industry Report
Cellular Technology Report

FEDERAL COMMUNICATIONS COMMISSION (FCC)
Los Angeles Office
Cerritos Corp. Tower
18000 Studebaker Road Rm 660
Cerritos CA 90701-3684
Tel 310/809-2096
Fax 310/865-0736
WWW http://www.fcc.gov/wtb/wirehome.html
Sheryl Wilkerson
Tel (202) 418-1902
E-mail swilkers@fcc.gov

INTERNATIONAL TELECOMMUNICATION UNION (ITU) (UNION INTERNATIONALE DES TELECOMMUNICATIONS UIT)
Palais des Nations
CH-1211 Geneva 20, Switzerland
Tel 22 7305111
Fax 22 7305785
Telecommunication

NATIONAL ASSOCIATION OF CELLULAR AGENTS (NACA)
6128 Snowden
Mesa AZ 85215
Tel (713) 522-0528 & (800) 820-2284
Fax (800) 820-2284
Cellular Agent

PERSONAL COMMUNICATIONS INDUSTRY ASSOCIATION (PCIA)
1501 Duke Street
Alexandria VA 22314-3450
Tel 703/739-0300
Fax 703/836-1608
WWW http://www.pcia.com

PCIA Bulletin
PCIA Journal

PAKISTAN TELECOMMUNICATION LTD (PTCL)
Sector G-8
Islamabad.

Tele-Communications Association (TCA)
701 N. Haven Avenue, Suite 200
Ontario CA 91764-4925
Tel (909) 945-1122
Fax (909) 483-3888
New Connections

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2001 Pennsylvania Ave NW, Suite 800
Washington DC 20006-1813
Tel (202) 457-4912
Fax (202) 457-4939
TX 595236 USTSACGO
Industry Pulse

WIRELESS TELECOMMUNICATIONS BUREAU
Karen Brinkman, Associate Chief
Tel (202) 418-0783
E-mail kbrinkma@fcc.gov
Steve Markendorff, Chief of the Broadband Branch
Tel (202) 418-0620
E-mail smarkend@fcc.gov
