Consultation Paper

on

IP Telephony

Pakistan Telecommunication Authority

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Table of Content

Executive Summary

Objective:

Circuit Switching is giving way to packet switching, slowly but surely. The objective of this paper is to examine the relevance of migration to packet switching in achieving the national policy objectives for the telecommunication sector in the country. Establish the role and responsibilities of various service providers in the context of public IP Telephony Offerings and probable impact thereof on penetration and cost of telecommunication for the end user.

Another objective of this document is to examine the role of IP Telephony in driving (or impeding) deployment of Next Generation Networks.

IP Telephony-Introduction

Voice over Internet Protocol, also called VOIP, IP Telephony, Internet telephony, Broadband telephony, Broadband Phone and Voice over Broadband, is the routing of voice conversations over the Internet or through any other IP-based network.

There are quite a few implmentation challenges for IP Telephony i.e. user terminal is fed from domestic power which is prone to frequent interruptions, quality of service cannot be assured all the time, emergency calls from customers need special arrangement for propoer termination at appropriate emergency centres.

With managed internet and deploymant of PSTN/IP Gateways, IP Telephony can substitute PSTN in its refined form where above problems can be addressed adequately. It can also be deployed as a cheap best effort telephony service with nomadic use. Consumer benefits stem from much lower cost of communication over IP telephony as compared to conventional telephone calls especially for international communication.

IP Telephony has several characteristics and capabilities which are quite different from conventional circuit switching in many ways. Implementation of voice services over IP platform means transforming whole economic and competitive dynamics of telecommunications market.

VOIP rides over the Internet. The Internet itself may be characterized as a logical architecture that is independent of any particular network, but which permits multiple different networks to be interconnected in such a way that computers and people can communicate without the need to know which network they are using or how to route information to them.

The single most important thing to absorb about broadband technologies is that they drive intelligence and ingenuity to the edge of networks. More than ever before in the history of telecommunications, it will be not so much the network but rather the people connected to

it that count. The power of computing to generate and organize knowledge – or to germinate and nurture art – will suffocate without the media to convey it from one person to another. Broadband networks empower individuals and groups to create and collate, innovate and inspire, without restrictions of time and distance.

In many countries, broadband is now available in several different user niches on either cable TV and/or DSL networks: at home on a desktop PC or with a Wi-Fi equipped laptop in the airport.

One of the most explosive new areas is Voice over IP. This technology is exciting in so many ways, because for the first time in history, customers really do have a choice in the service provider they use for their local and long-distant phone calls.

Many of the world's carriers have begun deploying IP-based networks that can carry both voice and data. In this way, operators are able to invest in a single network that can be used more efficiently for many different forms of traffic. Many of these operators have started to offer VOIP to their customers.

Recognition of this shift in practice and service is widespread and international. In fact, international VOIP increased by 35 per cent from 2003 to 2004 (See Figure below). Many historic operators around the globe were using VOIP to carry part of their international traffic in 2004. In fact total number of fixed-line VOIP subscribers (broadband) had reached nearly 160 million at the end of the 2004. Broadband internet subscribers represented approximately 2.5 percent of the world's population, and 38 per cent of all internet subscribers worldwide in 2004.

IP Telephony Regulation

Principle of technology neutrality has been adopted to encourage competition. The policy has generally yielded positive results for similar services. The emerging challenge is how to interpret technology neutrality between services based on technologies with very different attributes.

There are quite a few dimensions to the issues related to regulation of IP Telephony. There are legal issues, policy issues then there are issues related to licensing and regulation of the service. Following table traces short term to long term issues related to the evolution of IP Technology, the transition of telecom market and the regulatory model which will need to follow the migration from circuit switching to packet switching bracing for the radically different communication model as opposed to the conventional model.

IP Transition	Short and Medium Term Evolution	Long Term Evolution

Technical Concepts	1) PSTN phone services and VOIP services exist in parallel. 2) PSTN/IP network gateways are needed in most cases. 3) E.164 numbers are mainly used; in addition ENUM use of E.164 numbers is increasing. 4) IP-phones and soft phones are used while regular phones with terminal adopter are also used.	1) IP/NGN networks and VOIP services are potentially predominant. 2) Subscribers and services are addressed mainly by different types of Internet addresses. 3) E.164 numbers, however, are likely to prevail at least in the global context. 4) New terminals supporting converged services over IP are used which are able to use other WLAN coverage areas. 5) VOIP is one service within a broad set of services.
Market Transition	**Market in Transition Period** 1) Voice traffic is shifting to IP based traffic and revenues from traditional phone services are decreasing 2) New type of competition based on advantages in cost structures. 3) Innovative services based on nomadic use of IP/Internet telephony 4) Low level pricing models are common	**Competition & Market Structure Transformed** 1) Integrated, innovative and personalized or customized services are common. 2) Cost and revenue models of service providers have changed radically. 3) Nomadic use is important, increasing the amount of cross-border services. 4) The transport network and the services delivered over it are clearly separate.
Regulatory Model	1) Changes are required to the current regulatory regime including the need to take into account long term influences as laid out in opposite column. 2 Changes should strike a balance between two basic objectives: a) Stimulate development of new innovative services and investment	1) A new regulatory model is needed to deal with increasing problems and inconsistencies inherent in current approaches 2) Arbitrary nature of allocations of shared costs to individual services to determine "fair" prices in a converged network a) Growing market and competitive distortions from supply side subsidies

	in new broadband networks b) Ensure acceptable social and consumer protection	b) Increasing overlap of separately regulated networks for broadcasting and telecommunications c) Higher revenues from lightly regulated mobile services than from heavily regulated fixed ones d) Very different governance of Internet from traditional telecommunications

IP Telephony offerings can roughly be divided into three categories: a) Voice communication between computers without access to POTS. b) Communications within companies or used within a public operator's core network. c) Publicly available services provided to the end-user using VOIP technology.

PTA is mandated to protect the interest of the end user while promoting availability of wide range of efficient, high quality, cost effective competitive telecommunication services throughout Pakistan. Further PTA is mandated to promote rapid modernization of telecommunication systems and services.

PTA is committed, through its vision statement, to creating a fair regulatory regime to promote investment, encourage competition, protect consumer interest and ensure high quality Information and Communication Technology Services.

Telecommunication sector in Pakistan is presently highly competitive. The sector is rapidly migrating from circuit switching to packet switching. Almost all the long distance and international service providers have deployed Next Generation Network and operating in IP environment in the core network.

Licensing regime for fixed line services is technology neutral and permits deployment of IP/VOIP within the flexibility of the license. The licenses issued for the provision of Internet and Data services specifically prohibit carriage of voice over data circuit as also over the internet.

Operators licensed in fixed line sector are not sure as to what exactly are their rights and obligations in terms of IP Telephony. The rights granted under the license permit them to deploy any technology, IP/VOIP, to suit their business plan however they are not sure where the boundary of legal IP telephony ends and grey traffic over IP starts. Spelling out clear boundaries will provide certainty to the operators to market their services and plan further investment for growth of fixed line sector.

There are roughly four options the way IP Telephony offerings can be regulated:

1. All forms of IP Telephony service are legal with minimal regulation.

2. **S**ome forms of IP Telephony service are legal with significant conditions placed upon IP Telephony entrants.

3. Public consultation is underway to seek opinions before definitive rules on IP Telephony are issued;

4. IP Telephony is illegal except for use in the core by the telcos

It is recommended that IP Telephony offerings are distinguished into three categories for regulation purposes: i). IP Telephony offerings that are not any-to-any communication enabled and do not touch PSTN. ii). Offerings that are partly any-to-any communication enabled and operate through gateways for connection to fixed line and mobile customers. ii). IP Telephony offerings that are any-to-any communication enabled and calls can be originated as well as terminated to/from fixed line and mobile customers.

Following framework is recommended for the regulation of the above categories of IP offerings.

No regulation, authorization or licensing should be imposed on communication between computers which is not POTS enabled. (Category 1)

POTS enabled IP Telephony offerings should distinguish between outbound only and inbound only calling. (Category 2)

In accordance with the principle of technology neutrality, fixed line facilities-based voice operators (composite license-LL & LDI) are allowed to offer IP Telephony services (Category 3) with connections to and from the circuit-switched PSTN and public mobile networks.

The entire set of obligations relating to existing (PSTN) voice services will apply to IP Telephony services (Category-3). However, over an interim period the PTA may grant temporary exemptions from some of the obligations to category-2 service providers on a specific basis and with the condition that consumers' interests are adequately protected through marketing information which informs customers about potential risks or absent features such as caller location in access to emergency services

Geographic numbers will be provided for use by IP Telephony (Category-3) providers. Number portability between incumbent operator POTS and IP Telephony services will be allowed. Use of geographic numbers will be contingent upon the IP Telephony service being marketed and appearing as a fixed line telephony substitute, used from the consumer's permanent address

Non-geographic numbers (for Category-2 service providers) from a series to be established (07x) will be made available for nomadic use, with the condition that the risks connected with nomadic use will be adequately described through marketing information to protect consumers' interests

Interconnection between IP-based networks must be arranged by the service providers

Interconnection between IP network services and the PSTN and public mobile networks shall be arranged on the same principles and with the same obligations on operators, both with and without dominant or significant market power, as have already been established for operator interconnections, where however it will be the responsibility of the IP network operator to implement the transformation of its packet voice signals into and from the formats used in the PSTN and public cellular networks.

1. INTRODUCTION

A. IP Telephony-Technology/Service

VOIP is an application that uses IP infrastructures, including the Internet to transmit voice telephony from point A to point B.

Voice over Internet Protocol, also called VOIP, IP Telephony, Internet telephony, Broadband telephony, Broadband Phone and Voice over Broadband, is the routing of voice conversations over the Internet or through any other IP-based network.

Companies providing VOIP service are commonly referred to as providers, and protocols which are used to carry voice signals over the IP network are commonly referred to as Voice over IP or VOIP protocols. They may be viewed as commercial realizations of the experimental Network Voice Protocol (1973) invented for the ARPANET providers.

IP Telephony is a manifestation of the growth of the Internet (both public and private versions) whose origins, principles, and to a large extent equipment suppliers are very distinct from those of the traditional telecommunications industry (although traditional telecommunications suppliers have been striving to capture as much of the Internet-related equipment markets as possible).

For a long time, POTS (Plain Old Telephony Services) was seen as a natural monopoly. In the new regulatory paradigm, it is generally accepted that the networks must be opened up for competition through unbundling and interconnection regulation. However, within the traditional telecom paradigm, competition will at best exist between a few actors in an oligopolistic market. The central reason for this has its roots in the technological architecture of infrastructure and service development platforms.

The POTS network is a dedicated network, which is optimized for voice communication. Because of the deployed technology and the way POTS services have historically been organized, a centralized structure has been implemented to offer POTS. Two network layers are deployed in parallel in order to establish a network connection and to transmit services between point A and B, the so called transport and signaling/control layers. Consequently, service creation and provision require access to both the control/signaling layer and the transport layer of the network, which in turn requires access to the whole telecom infrastructure. Even though interconnection to the POTS networks is possible, there are still large entry barriers for newcomers to offer services in the POTS networks. The precondition for service provision in POTS is access to all infrastructure and services development platforms, which requires huge investments.

Using VOIP has gradually changed this situation and through the convergence process has opened up new conditions for service development. Using VOIP technology and the general Internet as backbone, new providers can offer competitive prices, particularly for long distance and for international calls. The transmission of the service over long distances within the Internet is much cheaper than keeping the service within POTS

with its distance-related cost structure and interconnection pricing schemes. The entry barriers for these service providers are lower and the number of them is increasing, contributing to the overall competition in the public voice market.

B. Advantages

The advantages of IP Telephony over traditional fixed-line telephony stem from its more efficient use of bandwidth, well-established and less expensive IP infrastructure compared to the costs of a circuit-switched telephone network.

IP Telephony makes it possible for a service provider to compete in offering services to customers from a base outside the geographic region of responsibility of a regulator within which these customers reside;

IP Telephony enables competition to established network operators from service providers operating with fundamentally different business models, cost structures and cultures, e.g. Skype, Google, Vonage etc;

Advanced features such as 'mobility' and 'presence' are supported.

'**Mobility'** refers to the ability of a customer to use the same "telephone number" in nomadic mode. Different IP phones at different locations can be contacted at the same telephone number.

'Presence' refers to the ability to indicate whether the customer is available to receive Internet telephone calls, so that the party who wishes to call is aware of the customer's availability. This is similar to the case of Instant Messaging, where the customer can indicate a presence such as "available", "away", or "out-for-lunch".

IP Telephony eliminates the traditional intimate links between a telecommunication service and the network or transport facility it uses;

1. Cost

Consumer benefits stem from much lower cost of communication over IP telephony as compared to conventional telephone calls especially for international communication. The discrepancies are enhanced in countries which still have very unbalanced tariff structures where high prices for long distance calls subsidize local telephony, in contrast to the largely distance independent costs and pricing of communications over the Internet.

Service provider benefits from the fact that little additional telephony infrastructure is needed on top of the current IP infrastructure for the provision of IP telephony, reducing the overall infrastructure cost radically.

Service provider further benefits from the cost savings through utilization of a single network to carry voice and data, especially where users have existing underutilized network capacity that can carry VOIP at no additional cost. VOIP to VOIP phone calls are sometimes free, while VOIP to PSTN may have a cost that's borne by the VOIP user.

IP based networks use transmission media much more efficiently as compared to conventional network where speech channels are not shared by the simultaneous users

neither by destinations. Efficient use of transmission media further reduces the cost of infrastructure.

2. Types

There are two types of PSTN to VOIP services: DID (Direct Inward Dialing) and access numbers, DID will connect the caller directly to the VOIP user while access numbers require the caller to input the extension number of the VOIP user. Access numbers are usually charged as a local call to the caller and free to the VOIP user while DID usually has a monthly fee.

C. Functionality

VOIP can facilitate tasks that may be more difficult to achieve using traditional networks. Incoming phone calls can be automatically routed to VOIP phone, regardless of where the phone is connected to the network. VOIP phone can be taken on a trip, and wherever it is connected to the Internet, it can receive incoming calls.

Call center agents using VOIP phones can work from anywhere with a sufficiently fast and stable Internet connection.

Many VOIP packages include PSTN features that are normally charged by most telecom companies, such as 3-way calling, call forwarding, automatic redial, and caller line identification.

1. Mobility

VOIP allows users to travel anywhere in the world and still make and receive phone calls. Users of Instant Messenger based VOIP services can also travel anywhere in the world and make and receive phone calls. Subscribers of phone-line replacement services can make and receive local phone calls regardless of their location.

VOIP phones can integrate with other services available over the Internet, including video conversation, message or data file exchange in parallel with the conversation, audio conferencing, managing address books and passing information about whether others (e.g. friends or colleagues) are available online to interested parties.

2. Number Portability

Number portability is essential for new market entrants, as subscribers are much more reluctant to change operator if they are unable to keep their number. Number portability is important for both new market entrants offering their services by use of existing technologies, and for operators building their service provision on new alternative infrastructures.

Number portability between fixed and mobile services (Cross Portability) could potentially lead to increased competition between fixed and mobile services. However, cross portability will lead to less transparency in tariffs, as it will become impossible for a consumer to distinguish between calls to fixed and mobile phones.

Furthermore it is doubtful if cross portability is necessary to facilitate competition between fixed and mobile services. Mobile customers have exceeded fixed subscribers

in almost all countries in the world. This indicates that mobile phone services have been able to compete without offering cross portability.

The situation may be different with regard to VOIP. The penetration of VOIP subscribers is still much lower than that of mobile subscribers, and the service offered by VOIP is more similar to fixed telephony. In this case lower prices are the main advantage. Therefore cross portability between POTS and VOIP will be an important measure in order to facilitate development of VOIP.

D. Drawbacks

1. Difficulty with sending faxes

One drawback is the difficulty in sending faxes due to software and networking restraints in most home systems. An effort is underway to remedy this by defining an alternate IP-based solution for delivering Fax-over-IP.

Another possible solution to overcome the drawback is to treat the fax system as a message switching system which does not need real time data transmission - such as sending a fax as an email attachment or remote printout. The end system can completely buffer the incoming fax data before displaying or printing the fax image.

2. Internet connection requirement

Another drawback of VOIP service is its reliance upon another separate service - an Internet connection. The quality and overall reliability of the phone connection is entirely reliant upon the quality, reliability, and speed of the Internet connection which it is using. Shortcomings with Internet connections and Internet Service Providers (ISPs) can affect VOIP calls. Higher overall network latencies can lead to significantly reduced call quality and cause certain problems such as echoing.

VOIP is not entirely reliant upon internet connections, however. VOIP systems can also utilize regular telephone lines and business-grade connections like E1 for voice service. A few business VOIP providers offer dedicated point-to-point E1 connections, not relying on an Internet connection for service. Although residential VOIP service typically uses only an Internet connection, business-grade VOIP service can use a variety of connection methods to provide ongoing phone service.

Many VOIP users still maintain a traditional analog voice line (business line) which allows them to dial emergency numbers and utilize a traditional fax machine.

3. Power outages

Another drawback of VOIP is the inability to make phone calls during a power outage, but this problem also exists with many phones used with conventional land lines. Cordless phone units in particular are more affected by power outages as many do not have a battery backup option for the base transmitter half. This can be remedied with a battery backup like a UPS. During a power outage one also has the choice to forward calls to a cell phone or alternate number.

If VOIP is used in solitary LAN (with no Internet connection), it would consume more resources compared to a PABX.

2. IMPLEMENTATION CHALLENGES

The challenge is routing VOIP traffic through firewalls and address translators, Private Session Border Controllers are used along with firewalls to enable VOIP calls to and from a protected enterprise network. Skype uses a proprietary protocol to route calls through other Skype peers on the network, allowing it to traverse symmetric Network Address Translations (NAT) and firewalls. Other methods to traverse firewalls involve using protocols such as STUN1 or ICE2.

Delay/Network Latency

Latency is a time delay between the moment something is initiated, and the moment one of its effects begins. The word derives from the fact that during the period of latency the effects of an action are latent, meaning "potential" or "not yet observed". Even within an engineering context, latency has several meanings depending on problem domain (i.e. communication, operational, or mechanical latencies).

Latency in a packet-switched network is measured either one-way (the time from the source sending a packet to the destination receiving it), or round-trip (the one-way latency from source to destination plus the one-way latency from the destination back to the source). Round-trip latency is more often quoted, because it can be measured from a single point. Note that round trip latency excludes the amount of time that a destination system spends processing the packet. Many software platforms provide a service called ping that can be used to measure round-trip latency. Ping performs no packet processing; it merely sends a response back when it receives a packet, thus it is a relatively accurate way of measuring latency.

Because User Datagram Protocol (UDP) does not provide a mechanism to ensure that data packets are delivered in sequential order, or provide Quality of Service guarantees, VOIP implementations face problems dealing with latency and jitter. This is especially true when satellite circuits are involved, due to long round trip propagation delay (400 milliseconds to 600 milliseconds for geostationary satellite). The receiving node must restructure IP packets that may be out of order, delayed or missing, while ensuring that the audio stream maintains a proper time consistency. This functionality is usually accomplished by means of a jitter buffer.

Packet loss

Fixed delays cannot be controlled but some delays can be minimized by marking voice packets as being delay-sensitive. The principal cause of packet loss is congestion, which

[1] **STUN** (**Simple Traversal of UDP (User Datagram Protocol) through NATs (Network Address Translators)**) is a network protocol allowing a client behind a NAT (or multiple NATs) to find out its public address, the type of NAT it is behind and the internet side port associated by the NAT with a particular local port. This information is used to set up UDP communication between two hosts that are both behind NAT routers. The protocol is defined in RFC 3489.

[2] The **Interactive Connectivity Establishment** (ICE) draft, developed by the IETF's MMUSIC working group, provides a mechanism for NAT traversal, using various techniques. In particular, it is used to allow SIP-based VOIP clients to successfully traverse the variety of firewalls that may exist between a remote user and a network.

can be controlled by congestion management and avoidance. Carrier VOIP networks avoid congestion by means of traffic engineering.

Jitter

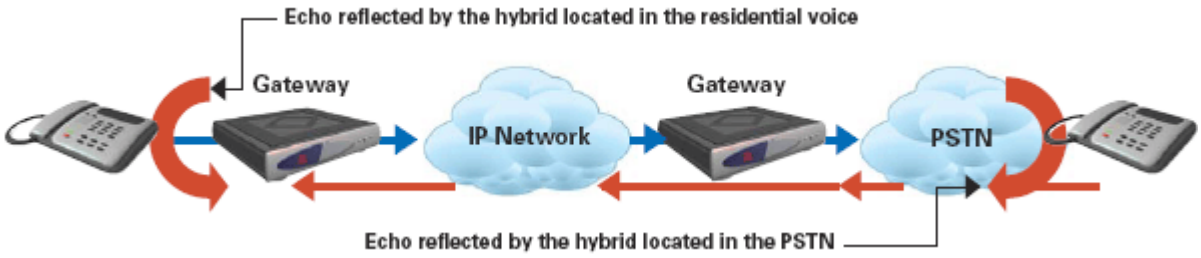
Variation in delay is called jitter. The effects of jitter can be mitigated by storing voice packets in a buffer (called a play-out buffer) upon arrival, before playing them out. This avoids a condition known as buffer underrun, in which the playout process runs out of voice data to play because the next voice packet has not yet arrived, but increases delay by the length of the buffer.

Echo

Reflection of audio signal on a transmission line, a natural acoustic phenomenon named after the nymph, is canceled through Echo Cancellation Techniques for reductions in the perception of electrical and acoustic echo. Common causes of echo include impedance mismatches in analog circuitry, and acoustic coupling of transmit and receive signal at the receiving end.

In legacy time division multiplex (TDM) networks, the reflections typically occur quickly. PSTN-based echo cancellation equipment is calibrated for these quick echoes. Packet networks, with longer delays, produce reflections beyond the time threshold in which existing echo canceller work today. Therefore, VOIP end equipment has to be equipped with embedded echo cancellers capable of handling long echo tails in order to eradicate echo caused by packet-based traffic flows.

The process of locating echo in speech is called convergence. Poor echo canceller designs can take a long time to converge. When an echo is heard early in a VOIP call, it is because the echo cancellers have a hard time pinpointing the echo and nullifying it. This is because they have not converged on the echo. In normal circumstances, once the echo canceller converges on the echo, it performs adequately for the duration of the call. There are situations where convergence is lost during a call and the echo canceller must restart.



It is important to test VOIP equipment's echo cancellation ability in challenging conditions to determine if its designers have made the right decisions regarding cost versus quality. With the ubiquity of mobile phones, it is even more likely that one party on a call will be in a noisy environment such as a car or airport. A high level of background noise, particularly when the background noise changes suddenly, is especially challenging to echo cancellation.

Video IP phones will likely feature speakerphone functionality, so acoustic echo cancellation will be a critical element influencing end users' experiences with them. Consumers are likely to pay a premium for video phones, and they are also likely to be the provider's premier customers. Poor VOIP implementation in a video phone, especially in the tricky area of acoustic echo cancellation, could result in consumers blaming the service provider for quality issues caused by poor acoustic echo cancellation on their video IP phone.

1. Reliability

Conventional phones are connected directly to telephone company phone lines, which in the event of a power failure are kept functioning by back-up generators or batteries located at the telephone exchange. However, household VOIP hardware uses broadband modems and other equipment powered by household electricity, which may be subject to outages dictating the use of an uninterruptible power supply or generator to ensure availability during power outages.

Early adopters of VOIP may also be users of other phone equipment, such as PBX and cordless phone bases that rely on power not provided by the telephone company. Even with local power still available, the broadband carrier itself may experience outages as well.

While the PSTN has matured over decades and is typically extremely reliable, most broadband networks are less than 10 years old, and even the best are still subject to intermittent outages. Furthermore, consumer network technologies such as cable and DSL often are not subject to the same restoration service levels as the PSTN or business technologies such as E-1 connection.

2. Quality of Service

As communications providers migrate from legacy circuit-switched networks to IP-based networks, consumers will expect their VOIP phones and "phone lines" to at least enable them to do the same things they do today with their telephony lines and devices. End users quite justifiably will expect a VOIP voice service to be a full-featured telecommunications service capable of handling any service and any device they had plugged in to an RJ-11 jack in the past. Equipment manufacturers and service providers alike need to anticipate these requirements when creating their products.

With POTS, there are detailed recommendations on QOS from the ITU. In managed VOIP services it is possible to provide measurable QOS. But this is more difficult in best effort services; however, in both cases regulatory measures may be necessary. Another important issue is the facility based operators willingness to offer access to QoS provision to non-facility based operators. For example, a major debate in Europe and other regions is the lack of QoS provision in the wholesale Bit stream access products offered by the PSTN incumbents.

Voice is not the only application for which telephony lines are used. Modem-based devices are still quite common, with fax being the most common of these. There are numerous issues to contend with when sending a fax, but the first is simply detecting that the call is a fax call and not a voice call or some other kind of modem call. False detection of fax tones can result in frustrating failure of the call. Once detected, fax tones can be transmitted using G711 encoding, but the scheme is not as robust as the

T.38 fax relay, which breaks a fax call down and sends the fax data across in a packet format. The result is greatly improved reliability and call completion rates.

Fax technology is designed to operate between two machines directly connected via the PSTN. This is a nearly optimal connection from the perspective of delay, and therefore fax machines are very intolerant of "unusual" delays. Connecting fax machines via a packet network virtually assures that the delays will be outside the fax machines' operating parameters. Fax transmissions implement a fax protocol between two machines involved in the transmission of a fax. This protocol can be "spoofed" to compensate for the delays. If packets are lost during negotiation between the machines, or even in the middle of the fax call, problems will occur.

Consumers have become accustomed to communicating with automated attendants and voice-mail interfaces using touch tones. Legacy telephones and cellular phones generate standard tones that are transmitted across the network and are received by a wide variety of tone-driven interfaces.

DTMF tones must be accurately detected and reproduced during calls

VOIP phones mimic legacy phones by sending IP-based "tones" to the media gateway. At the media gateway, the tones are detected and repackaged in real time and then transmitted to their destination. Many things can go astray in this process.

Working together, the VOIP CPE device and the media gateway must detect and re-create tones, including dialed digits, fax detection, modem detection and call progress tones that have the same amplitude, frequency, and timing as those generated by the legacy telephony equipment to which they are connecting. For example, if tones sent by an IP phone to access voice mail are not accurately detected, translated, transmitted, or received, access will be denied and the end user will not gain voice-mail access. A good VOIP implementation will exceed ITU-T Recommendation Q.24 tone detection standards.

Some broadband connections may have less than desirable quality. Where IP packets are lost or delayed at any point in the network between VOIP users, there will be a momentary drop-out of voice. This is more noticeable in highly congested networks and/or where there is long distances and/or interworking between end points. Technology has improved the reliability and voice quality over time and will continue to improve VOIP performance as time goes on.

3. Emergency calls

A particular problem related to VOIP is tracing of emergency calls. At present, it is not possible to trace an emergency call from a VOIP phone. The nature of IP makes it difficult to geographically locate network users. Emergency calls, therefore, cannot easily be routed to a nearby call center, and are impossible on some VOIP systems. The call may therefore be routed to a wrong location (even in a wrong country). It is possible to assign a physical address to a VOIP number, but the same VOIP number

may be used from many different locations just as mobile phones are (nomadic use). In the US, at least one major police department has strongly objected to this practice as potentially endangering the public.

Moreover, in the event that the caller is unable to give an address, emergency services may be unable to locate them in any other way. Following the lead of mobile phone operators, several VOIP carriers are already implementing a technical work-around. For instance, one large VOIP carrier requires the registration of the physical address where the VOIP line will be used. When user dials the emergency number for his country, they will route it to the appropriate local system. They also maintain their own emergency call center that will take non-routable emergency calls (made, for example, from a software based service that is not tied to any particular physical location) and then will manually route your call once learning your physical location.

The United States government had set a deadline, requiring VOIP carriers to implement E911; however, the deadline is being appealed by several of the leading VOIP companies.

Situation with IPBX systems is different where these corporate systems often have full E911 capabilities built into the system.

4. Security

The majority of consumer VOIP solutions do not support encryption yet. As a result, it is relatively easy to eavesdrop on VOIP calls and even change their content. There are several open source solutions like VOIPong or Vomit that facilitate sniffing of VOIP conversations. A modicum of security is afforded due to patented audio codecs that are not easily available for open source applications, however such security through obscurity has not proven effective in the long run in other fields. Some vendors also use compression to make eavesdropping more difficult. However, real security requires encryption and cryptographic authentication which are not widely available at a consumer level.

5. VOIP Numbering Schemes

For a long time to come the VOIP services will co-exist with the POTS. The success of VOIP will depend on its access to the national E.164 number plans. Any regulatory obstacles in accessing numbers can impede or slow down VOIP development. One model is to assign a new number series for VOIP services.

Such a model differentiates between normal PSTN service and IP based telephony service providing tariff information to the caller from the very number assigned to IP Telephony subscriber however such a user will have to change his number without a recourse to cross portability (PSTN to IP Telephony).

The ideal model would be to assign numbers similar to the current PSTN numbers and to require number portability, so people are not forced to change their phone numbers when they want to change to a competitive offering VOIP services.

The most common addressing systems are:

- E.164: The ITU-T recommendation used in PSTN
- URI: Universal resource identifier, used in internet

- ENUM: E.164 addressing plan based NUMber
- GDS: Global Dialing Scheme
- DUNDi: Distributed Universal Number Discovery

ENUM

ENUM is a protocol defined by IETF those facilitates resolving of E.164 telephone numbers into other resources or services on the Internet.
e.g. PSTN number *+204689761234* into 4.3.2.1.6.7.9.8.6.4.0.2.e164.arpa

GDS

GDS, Global Dialing Scheme, is a dialing scheme for enabling global number recognition for H323. GDS is structure:

- The International Access Code (IAC)
- Country Code (CC)
- Organizational Prefix (OP)
- Endpoint Number (EN)
- e.g.: 00(IAC) 1(CC) 189(OP) 7201234(EN): 0011897201234

DUNDi

Opposed to ENUM and GDS which are based on servers for resolving addresses the DUNDi is a p2p standard (one can say p2p version of ENUM). DUNDi is not a numbering standard but an implementation standard. Instead of DNS server registration a client has a record of all nodes connected to it. When a client needs to look up for a number it will contact all connected nodes to find the address, they in turn ask the nodes they are connected to for finally to find the destination.

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3. IP TELEPHONY ADOPTION

1. Mass-market telephony

A major development starting in 2004 has been the introduction of mass-market VOIP services over **broadband Internet access** services, in which subscribers make and receive calls as they would over the PSTN. Full phone service VOIP phone companies provide inbound and outbound calling with Direct Inbound Dialing. Many offer unlimited calling to the U.S. and some to Canada or selected countries in Europe or Asia as well, for a flat monthly fee.

These services take a wide variety of forms which can be more or less similar to traditional POTS. At one extreme, an analog telephone adapter (ATA) may be connected to the broadband Internet connection and an existing telephone jack in order to provide service nearly indistinguishable from POTS on all the other jacks in the residence.

This type of service, which is fixed to one location, is generally offered by broadband Internet providers such as cable companies and telephone companies as a cheaper flat-rate traditional phone service. Often the phrase "VOIP" is not used in selling these services, but instead the industry has marketed the phrase "Internet Phone" or "Digital Phone" which is aimed at typical phone users who are not necessarily tech-savvy.

Typically, the provider touts the advantage of being able to keep one's existing phone number. According to a study by Telephia, the top ten providers in the United States include Vonage, Verizon VoiceWing, AT&T CallVantage, SunRocket, Lingo, NetZero, BroadVoice, America Online, Packet8, and Earthlink. Verizon VoiceWing and AT&T CallVantage are both listed in second place with 5.5% market share.

At the other extreme are services like Gizmo Project and Skype**(136 M users worldwide)** which rely on a software client on the computer in order to place a call over the network, where one user ID can be used on many different computers or in different locations on a laptop.

In the middle lie services which also provide a telephone adapter for connecting to the broadband connection similar to the services offered by broadband providers (and in some cases also allow direct connections of SIP phones) but which are aimed at a more tech-savvy user and allow portability from location to location.

One advantage of these two types of services is the ability to make and receive calls as one would at home, anywhere in the world, at no extra cost. No additional charges are incurred, as call diversion via the PSTN would, and the called party does not have to pay for the call. For example, if a subscriber with a home phone number in a U.S. area code calls someone else in his home area code, it will be treated as a local call regardless of where that person is in the world. Often the user may elect to use someone else's area code as his own to minimize phone costs to a frequently called long-distance number.

For some users, the broadband phone complements, rather than replaces, a PSTN line, due to a number of inconveniences compared to traditional services. VOIP requires a

broadband Internet connection and, if a telephone adapter is used, a power adapter is usually needed.

2. Corporate and telco use

VOIP is widely employed by carriers, especially for international telephone calls. It is commonly used to route traffic starting and ending at conventional PSTN telephones.

Many telecommunications companies are looking at the IP Multimedia Subsystem (IMS) which will merge Internet technologies with the mobile world, using a pure VOIP infrastructure. It will enable them to upgrade their existing systems while embracing Internet technologies such as the Web, email, instant messaging, presence, and video conferencing. It will also allow existing VOIP systems to interface with the conventional PSTN and mobile phones.

Electronic Numbering (ENUM) uses standard phone numbers (E.164), but allows connections entirely over the Internet. If the other party uses ENUM, the only expense is the Internet connection.

Although few office environments and even fewer homes use a pure VOIP infrastructure, telecommunications providers routinely use IP telephony, often over a dedicated IP network, to connect switching stations, converting voice signals to IP packets and back. The result is a data-abstracted digital network which the provider can easily upgrade and use for multiple purposes.

Corporate customer telephone support often use IP telephony exclusively to take advantage of the data abstraction. The benefit of using this technology is the need for only one class of circuit connection and better bandwidth use. Companies can acquire their own gateways to eliminate third-party costs, which is worthwhile in some situations.

3. Click to call

Click-to-call is a service which lets users click a button and immediately speak with a customer service representative. The call can either be carried over VOIP, or the customer may request an immediate call back by entering his phone number. One significant benefit to click-to-call provider is that it allows companies to monitor when online visitors change from the website to a phone sales channel.

4. VOIP IN NGN VALUE CHAIN

It is widely believed that telecommunication infrastructure and networks have constituted an engine of economic growth and social development for many decades and will continue to do so. The telecommunications environment, however, is currently, and has been for the past 20 years, in a state of change induced by technology advances, deregulation, privatization and increasing global competition.

Changes have occurred and continue to occur from both the policy and technological points of view. From the policy point of view, we have moved from a system based mainly on State-controlled monopolies to a system based mainly on competitive, privately-owned companies supervised for some of their activities by national regulators. From the technological point of view, we have moved from a system in which most revenues were derived from long-term investments in slowly-evolving voice services based on fixed lines, to a system in which future revenues will be derived mostly from fast-changing telecommunication services and applications using mobile and IP-based technologies.

1. Internet

The Internet may be characterized as a logical architecture that is independent of any particular network, but which permits multiple different networks to be interconnected in such a way that computers and people can communicate without the need to know which network they are using or how to route information to them. In other words, the Internet is a conceptual creation consisting of protocols and procedures, which are then used by the constituent networks to interconnect. IP-based networks were described in the past as "dumb networks", in which innovation can take place "at the edges" without any need to modify the central network.

Historically, this approach made sense, since it would have been difficult to implement the Internet architecture if many different networks had to be modified to support the concept of Internetworking. The notion of layering was introduced to describe the introduction of added services over and above the actual communications capabilities. Indeed, the use of routers between individual networks was another example of this approach, since no changes to any given network were required to participate (via a router) in the nascent Internet.

More recently, the possibility was raised that applications could be developed in a more integrated fashion within one or more of the underlying networks. These integrated applications may still be considered part of the Internet, if not embedded in NGN, provided that the applications could interoperate with other networks that support the end application.

2. Broad-band

What may be more important in broadband network than its capacity is what one can *do* with broadband networks. Instead of the old, single-purpose networks, broadband networks can carry any combination of voice, data and multimedia (graphics, video and audio), in any format.

Indeed, broadband networks are already generating new permutations on old media: audio "podcasts" downloaded to portable players from websites, chat functions incorporated into online video games. The list goes on. The evolution of new applications is suddenly without boundaries, and human ingenuity is now free to pursue services and applications that will improve lives and bolster economies.

The term "broadband" does not just mean an interesting set of network technologies. It is an entirely new paradigm, potentially as different from standard voice telephony as telephony is from the telegraph services of 150 years ago. Never before has there been such power to combine images and information in ways that can actually augment the user's experience into something more enriched than actually being there.

The single most important thing to absorb about broadband technologies is that they drive intelligence and ingenuity to the edge of networks. More than ever before in the history of telecommunications, it will be not so much the network but rather the people connected to it that count. ICT technology may never catch up to human creativity and diversity, but broadband networks will allow it to remain closely linked. The power of computing to generate and organize knowledge – or to germinate and nurture art – will suffocate without the media to convey it from one person to another. Broadband networks empower individuals and groups to create and collate, innovate and inspire, without restrictions of time and distance.

As they empower individuals, broadband capabilities will increase the potential for generating content that will be relevant, meaningful and understandable to communities. The key to sustainable network services is demand. And the key to demand is providing useful, culturally sustaining content, in local languages, about local circumstances as well as global realities. Although it certainly will not happen overnight, there is no reason why individuals in the remotest areas cannot eventually become broadcasters in their own communities, educators in their own homes, and performing artists for worldwide audiences.

For increasing numbers of consumers, especially in developed countries, the answer is that they already have it – and are likely to get more of it. In many countries, broadband is now available in several different user niches on either cable TV and/or DSL networks: at home on a desktop PC or with a Wi-Fi equipped laptop in the airport. For these lucky users, the future will be about convergence onto multiple platforms – interactive digital televisions, broadband mobile phones and streaming video on computers, just to name a few – and inter-modal competition.

3. Voice Over Internet Protocol

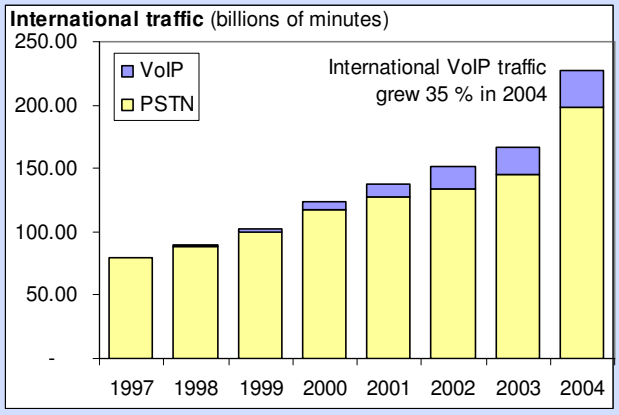
One of the most explosive new areas is Voice over IP. This technology is exciting in so many ways, because for the first time in history, customers really do have a choice in the service provider they use for their local and long-distant phone calls. In addition, VOIP does not simply mean "voice". While the marketing term has become well-entrenched, VOIP technology also enables video telephony and data collaboration: services that were either non-existent or expensive to use with older access technologies.

Many of the world's carriers have begun deploying IP-based networks that can carry both voice and data. In this way, operators are able to invest in a single network that

can be used more efficiently for many different forms of traffic. Many of these operators have started to offer VOIP to their customers.

Recognition of this shift in practice and service is widespread and international. In fact, international VOIP increased by 35 per cent from 2003 to 2004 (See Figure 1.8 below). Many historic operators around the globe were using VOIP to carry part of their international traffic in 2004.

Growth of International Traffic



Source: ITU World Telecommunication Indicators Database and TeleGeography *Global Traffic Statistics 2006 report*.

4. Triple Play

The provision of triple play services – TV, broadband and phone - is set to become a major growth area as demand for converged services intensifies. So say the researchers at technology consulting firm Booz Allen Hamilton.

According to the report The Future Role of Cable in Shaping the Digital Home in Europe, the market for digital home services will take off in Europe over the next 12 months, and the long-term winners will be those players able to offer "triple play" on a single bill at a decent price.

While many cable companies have pushed ahead with their triple play offerings, the research points out that an increasing number of telecoms providers are now forcing their way into the TV market. "With that, the competition is set to steeply increase, although the balance of power remains uneven," the report says.

In the UK, the major players are already lining up to take a shot at securing their place in the digital home. NTL has bought fellow cable company Telewest to increase its clout, and now wants to nail down the acquisition of Virgin Mobile.

BSkyB, which has 9 million pay-TV subscribers, recently, bought the ISP Easynet to add broadband and phone services to its existing TV offering

5. Next Generation Network

The Next Generation Network (NGN) changes the face of consumer communications and network computing. As data and voice networks converge in a single network with the potential of streaming rich media as well, the NGN will become the standard infrastructure for the next ten to 20 years. For businesses and service providers hoping to compete in delivering Internet, video, and telephone services in an NGN world, quality of service will be the most important competitive differentiator, and timing and synchronization will play a huge role in delivering high performance. Highly accurate timing and sync will be essential for the uninterrupted flow of data, voice, video and other new forms of communication and entertainment. With a proven track record of reliability and innovation

The most important advantage is quality of service, which will allow businesses to keep and attract more customers. Quality will be the primary differentiator in NGN technology – customers will not tolerate shaky VOIP connections or dropped frames during their favorite TV shows. NGN will allow all network components to work efficiently toward the smooth transmission of data, voice and video.

In recent years, the telecommunication market has undergone significant change in terms of technology and business climate. We have entered an age where broadband access comes in so many different flavors, including cable, DSL, Wi Fi, WiMAX, fiber and customer access to various services available over the Internet are unparalleled.

Voice over internet holds the center stage in NGN scheme of things. Most of the above services cannot be offered if voice over internet (broadband) is not allowed.

Comments are invited on the

Conclusion that VOIP holds the center stage in Next generation Networks.

5. IP TELEPHONY ISSUES

An overview of the short term and long term IP Telephony is presented. It should be noted that different countries find themselves at different stages and are moving at widely varying speeds towards the long-term revolution as a consequence of their diversity in aspects such as:

a) Overall economic development, wealth, and sophistication of customer demands and expectations;

b) Past investments and decisions of current competitors in the provision of network facilities and services;

c) Past and ongoing regulatory and public policy decisions which influence the competitive environment in the telecommunications market and the costs and prices of alternative network technologies and services.

1. Legal issues

As the popularity of VOIP grows, and PSTN users switch to VOIP in increasing numbers, governments are becoming more interested in regulating VOIP in a manner similar to legacy PSTN services.

In the U.S., the Federal Communications Commission now requires all VOIP operators who do not support Enhanced 911 to attach a sticker warning that traditional 911 services aren't available. The FCC recently required VOIP operators to support CALEA[3] wiretap functionality. US Telecommunications Act of 2005 proposes adding more traditional PSTN regulations, such as local number portability and universal service fees. Other future legal issues are likely to include laws against wiretapping and network neutrality.

Some Latin American and Caribbean countries, fearful for their state owned telephone services, have imposed restrictions on the use of VOIP, including Panama where VOIP is taxed. In Ethiopia, where the government is monopolizing telecommunication service, it is a criminal offence to offer services using VOIP. The country has installed firewalls to prevent international calls being made using VOIP. These measures were taken after a popularity in VOIP reduced the income generated by the state owned telecommunication company.

In the European Union, the treatment of VOIP service providers is a decision for each Member State's national telecoms regulator, which must use competition law to define relevant national markets and then determine whether any service provider on those national markets has "significant market power" and thus should be subject to certain

[3] The **Commission on Accreditation for Law Enforcement Agencies** (CALEA) was created in 1979 as an independent accrediting authority by the four major law enforcement membership associations:

International Association of Chiefs of Police (IACP), National Organization of Black Law Enforcement Executives (NOBLE)

National Sheriffs' Association (NSA) & Police Executive Research Forum (PERF)

obligations. A general distinction is usually made between VOIP services that function over managed networks (via broadband connections) and VOIP services that function over unmanaged networks, the public Internet.

VOIP services that function over managed networks are often considered to be a viable substitute for PSTN telephone services, despite the problems of power outages and lack of geographical information; as a result, major operators that provide these services, in practice, incumbent operators most of the times, may find themselves bound by obligations of price control or accounting separation.

VOIP services that function over unmanaged networks are often considered to be too poor in quality to be a viable substitute for PSTN services; as a result, they may be provided without any specific obligations, even if a service provider has "significant market power".

The relevant EU Directive is not clearly drafted concerning obligations which can exist independently of market power e.g., the obligation to offer access to emergency calls, and it is impossible to say definitively whether VOIP service providers of either type are bound by them. A review of the EU Directive is under way and expected to be completed within this year.

In India, it is legal to use VOIP, but it is illegal to have VOIP gateways inside India. This effectively means that people who have PCs can use them to make a VOIP call to any number, but if the remote side is a normal phone, the gateway that converts the VOIP call to a POTS call should not be inside India.

In the UAE, it is illegal to use any form of VOIP, to the extent that websites of Skype and Gizmo Project don't work. However, the irony lies in the fact that the telecom provider, Etisalat, earns a significant amount of its revenues by routing calls by VOIP.

2. Policy Issues

A host of factors need to be considered before a policy on IP Telephony is firmed up. Following are a few of them.

1) IP Telephony has several characteristics and capabilities which are quite different from conventional circuit switching in many ways. IP Telephony is widely labeled as disruptive technology. Implementation of voice services over IP platform means transforming whole economic and competitive dynamics of telecommunications, in fact, entire electronic communications sector.

2) IP Telephony Policy cannot be considered separately from the most basic issues associated with overall policy on telecommunications licensing and the fundamental objectives of national telecommunications policy and planning.

3) In some countries IP Telephony is seen as a major threat to established operators because it undercuts their domestic and international long distance rates and radically reduces their revenues. Strict regulation to protect the revenues of established operators through prohibition of IP Telephony may harm the development of the sector in the longer term.

5) The impact of lower prices and innovative features enabled by IP Telephony may benefit users directly and help increase the number of users and their volume and types of usage. Policy decisions, under the circumstances should be based on trend data and analyses of different future market scenarios and the effect of alternative regulation, positive or adverse, on the overall market structure.

6) Enhanced competition may lead to availability of innovative, less expensive services in the interest of users, however, regulation also needs to ensure consumer protection and take social concerns into account, including how to achieve objectives such as universal service access and quality-of-service.

7) Principle of technology neutrality has been widely adopted to encourage competition. The policy has generally yielded positive results for similar services. The emerging challenge is how to interpret technology neutrality between services based on technologies with very different attributes.

8) Measures to protect the national incumbent operator may be based on specific social policies, such as extending universal service.

3. Regulatory Issues

IP Telephony brings in a number of regulatory issues being grappled by the regulators the world over. A few of them are laid out here.

1) Regulation should guarantee reasonable regulatory certainty for investors to recover their investment. The period to realize the investment is getting increasingly shorter in the face of technological development whereas incumbent with historic heavy investments, spread over a period of time, needs to be protected.

2) The opposing objectives make the regulator walk a tight rope where a balance needs to be struck between protecting the incumbent and encouraging new investment in less expensive and more powerful technologies that benefit users.

3) However more and more regulators around the world are moving towards minimum regulation to encourage market entry or the creation of innovative new services. Thus regulators have adopted “light-touch” regulation particularly for newer technologies, so that suppliers are encouraged to develop creative technical solutions.

4) Measures to protect the national incumbent operator may be based on specific social policies, such as extending universal service. Regulatory approach needs to weigh the impact of short and long-term policy and regulatory approaches from the end user perspective and potential market entrants as also from the view point of the incumbent operator.

6) The main challenge in the regulation of IP Telephony services is to balance short and long-term policy and regulatory approaches while adhering to public security considerations and other such issues.

Another underlying concern of regulators and policy makers the world over, today, is how to manage seamless transition to the new world of IP networks. Following issues need careful consideration and vision.

a) For how long the PSTN network should be maintained and when further investment on PSTN should be stopped;

b) Assess the time needed to make changes to existing legislation or rulings to provide legal stability in a time of flux

c) Deciding how, and how rapidly, competition policy should change to reflect an IP based network rather than a PSTN era.

However the pace at which these issues are decided does not necessarily lie entirely within the hands of government or the regulator. Markets are subject to several other influences including the actions of legal operators and illegal or grey market service providers, as well as demands from users.

If the incentives for providing IP Telephony are significant no regulator can possibly control the behavior of service providers despite regulatory obstacles or penalties more so when the service can be provided from across the border.

4. Licensing Issues

Most of the issues confronting regulators in IP Telephony context are similar to circuit switched network, they have been grappling with for a long time. However the characteristics and capabilities of IP Telephony create a very different context for their resolution. Some of the issues different from conventional switching are reproduced here

1) What are the rights and obligations of IP Telephony Licensee?

2) Should the IP Telephony provider be obligated to provide access to emergency services to its users and contributes towards universal service obligation or not.

3) Is the IP Telephony provider required to enter into interconnect agreement or not and models thereof, facility based or otherwise

2) Numbering of IP Telephony services i.e. availability, capabilities, QoS, nomadicity, assignment, costs, number portability, call routing etc.

6) Application of Competition Law to IP Telephony, e.g. regarding the right (or not) of existing network operators (fixed and mobile) to block IP Telephony calls over their facilities

7) Spam over IP Telephony (junk mail in voice form), Communication Security i.e. user authentication, confidentiality, access control, data integrity, privacy, national security etc.

Summary of IP Telephony Issues

IP Transition	Short and Medium Term Evolution	Long Term Revolution

Technical Concepts	1) PSTN phone services and VOIP services exist in parallel. 2) PSTN/IP network gateways are needed in most cases. 3) E.164 numbers are mainly used; in addition ENUM use of E.164 numbers is increasing. 4) IP-phones and soft phones are used while regular phones with terminal adopter are also used.	1) IP/NGN networks and VOIP services are potentially predominant. 2) Subscribers and services are addressed mainly by different types of Internet addresses. 3) E.164 numbers, however, are likely to prevail at least in the global context. 4) New terminals supporting converged services over IP are used which are able to use other WLAN coverage areas. 5) VOIP is one service within a broad set of services.
Market Transition	**Market in Transition Period** 5) Voice traffic is shifting to IP based traffic and revenues from traditional phone services are decreasing 6) New type of competition based on advantages in cost structures. 7) Innovative services based on nomadic use of IP/Internet telephony 8) Low level pricing models are common	**Competition & Market Structure Transformed** 4) Integrated, innovative and personalized or customized services are common. 5) Cost and revenue models of service providers have changed radically. 6) Nomadic use is important, increasing the amount of cross-border services. 4) The transport network and the services delivered over it are clearly separate.
Regulatory Model	1) Changes are required to the current regulatory regime including the need to take into account long term influences as laid out in opposite column. 2 Changes should strike a balance between two basic objectives: a) Stimulate development of new innovative services and investment in new broadband networks	3) A new regulatory model is needed to deal with increasing problems and inconsistencies inherent in current approaches 4) Arbitrary nature of allocations of shared costs to individual services to determine "fair" prices in a converged network a) Growing market and competitive distortions from supply side subsidies b) Increasing overlap of separately regulated

	b) Ensure acceptable social and consumer protection	networks for broadcasting and telecommunications c) Higher revenues from lightly regulated mobile services than from heavily regulated fixed ones d) Very different governance of Internet from traditional telecommunications

From the preceding discussions, it is evident that the question of whether, and if so how and with what rights and obligations, IP Telephony service providers should be required to obtain licenses or some other form of formal authorization, is central to the shape and scope of future regulation of IP Telephony, and the competitive dynamics of IP Telephony-based voice services against traditional circuit-switched or PSTN-based voice.

6. IP POLICY-GLOBAL VIEW

A. Trends in VOIP Regulation

In many countries Internet telephony qualifies for streamlined regulation on grounds that it is an "enhanced", "value added", or information service (consistent with regulatory treatment of the Internet generally).

As VOIP becomes a closer substitute for conventional voice telephony, regulators may be less inclined to eliminate regulatory requirements. This is particularly the case where VOIP services are close substitutes for traditional telephony, for example where VOIP operators seek telephone number assignments and number portability.

Most of those countries that have developed a VOIP regulatory policy have adopted a "light touch" approach in general, and have targeted regulatory interventions to specific matters, such as access to telephone numbers, number portability, and access to emergency services; universal service, and national security.

In the European Union, VOIP can be classified as either an Electronic Communication Service, or a Publicly Available Telephone Service, and is regulated accordingly. Which classification applies depends on variables such as:

1. Availability of the service to the public,

2. Use of telephone numbers, and

3. Access to emergency services.

Increasing VOIP traffic will undermine the profitability of incumbent operators, and sources of revenue such as international accounting rate settlements and access charge payments for terminating voice telephony traffic. As a result many governments prohibit or try to limit VOIP services.

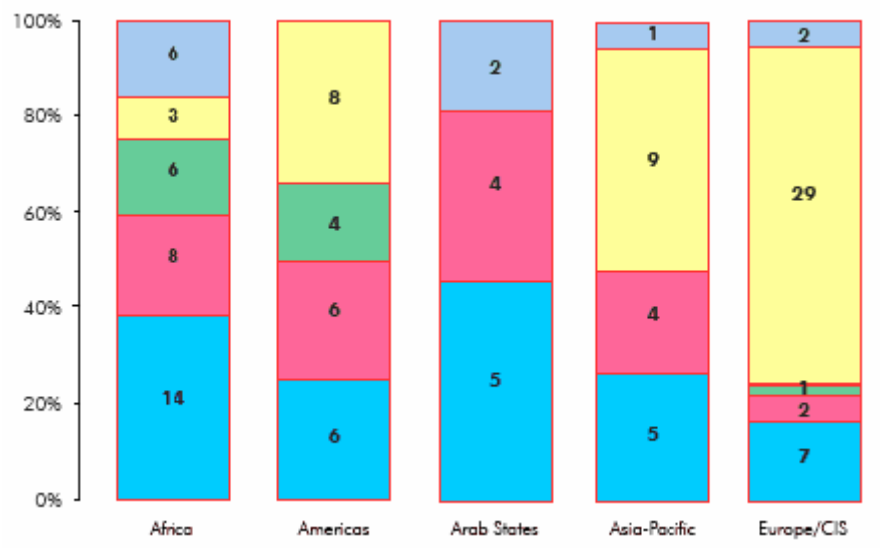
In its 2004 Regulatory Survey the ITU reported that 37 nations restrict VOIP to licensed Public Telecommunications Operators, while 49 nations allow full competition (see Figure 1). Countries that attempt to limit VOIP to incumbent operators include Azerbaijan, Jordan, Costa Rica, Cote D'Ivoire, Egypt, Ethiopia, and Ghana.

Countries that do permit VOIP (possibly subject to limited regulation) include Australia, Canada, Columbia, the European Union, Hong Kong, Indonesia, Japan, South Korea, and the United States.

China initially banned Internet telephony, however despite the ban VOIP services have flourished. The Chinese government is reviewing the situation. Still other countries, such as Kenya, allow independent VOIP offerings, but subject the service providers to licensing as well as certain operating requirements.

In practice, a ban on VOIP services is not readily enforceable, because outbound traffic can originate via most broadband connections to the Internet and inbound traffic can merge with permissible voice telephony. Some commentators estimate the volume of "gray market" VOIP services at 30 to 50 percent of international voice traffic.

To date, few countries have specifically addressed VOIP interconnection and pricing. VOIP operators have managed to secure satisfactory arrangements on arm's length commercial terms. The relatively low volume of VOIP traffic has not yet triggered demands for compensation from most network operators. However, as VOIP traffic increases, the potential for disputes and outright refusals to interconnect will rise and regulators will have to turn their minds to VOIP interconnection.



Key

No policy	The respondent did not answer this specific question, or indicated that there was no current policy, or that a new policy is currently being formulated.
Full competition	All public telecommunication operators (PTOs), whether licensed or not, may use both IP-based networks and the public Internet for the conveyance of voice calls.
Partial competition	Non-licensed PTOs may use either IP-based networks or the public Internet for the conveyance of voice calls.
Prohibited	All PTOs (even licensed ones) are prohibited from using IP-based networks or the public Internet for the conveyance of voice calls.
Restricted	Only licensed PTOs are able to use IP-based networks or the public Internet for the conveyance of voice calls.

B. Categories of IP Telephony Regulation

1. Liberalized Approach

Various countries have legalized IP Telephony services at different levels. For example, all forms of IP Telephony service are legal in Canada, the European Union, Japan and Korea. Following table lays down specific examples.

Liberalized Approach
European Union ■ The European Regulators Group (representing regulators from 27 European countries) has produced a common agreed statement that IP Telephony should be used to enable the greatest possible level of innovation and competitive entry in the market, whilst ensuring that consumers are adequately protected. ■ Application and interpretation of rights and obligations in relation to IP Telephony should be in accordance with the European regulatory framework including the policy goals and regulatory principles existing today. Consumers and service providers should be provided with adequate information to make informed choices about services and service provision. **United States of America:** ■ The 1996 Telecommunication Act separates telecommunication services and information services. The FCC has formalized the policy of not imposing traditional telecommunications rules on new Internet applications (information services). ■ FCC has ruled that both DSL and cable modem services – broadband access facilities are information and not telecommunications services, Fiber loops (whether FTTH or FTTC) are also exempt from sharing obligations. **Canada** ■ CRTC published a decision in May 2005 that it would only regulate IP Telephony service when it is provided and used as a local telephone service and will be subject to same regulation as applicable to ■ The CRTC's decision provides for the registration of IP Telephony resellers; access to numbers and local number portability; directory listings; equal access to interexchange carriers; winback rules etc. ■ In line with its approach to retail Internet services, the CRTC will not regulate computer to computer (peer to peer) IP Telephony services which reside solely on the Internet. **Japan** ■ IP Telephony in Japan is permitted and is subject to minimal regulation. The legal framework distinguishes between three types of IP Telephony services; based QoS. ■ With guaranteed PSTN QoS, IP Service provider qualifies for normal PSTN numbering ranges. If the service provider guarantees a defined minimum end

Liberalized Approach

to end QoS, it qualifies for assignment of 050-prefix numbers. Japan had some 10 million IP Telephony over broadband subscribers as of Q3, 2005, a growth rate of 39% over the preceding 12 months.

South Korea

- South Korea adopted a broadly similar approach to IP Telephony in September 2004.

Singapore

- In June 2005, Singapore announced policy framework for Internet Protocol (IP) Telephony. With IP Telephony, a user can potentially use any broadband Internet access connection to make and receive local or international voice, data and video calls with a phone number.
- IP Telephony Service substituting PSTN is assigned according number ranges i.e. 8-digit level "6" numbers, whereas IP Telephony service providers using level '3' numbers, are not required to provide number portability, emergency service connection, directory enquiry and printed directory services, or conform to QoS levels set by IDA.

Philippines

- In August 2005, the National Telecommunications Commission issued new regulations, treating IP Telephony as a value-added service, for which only registration, not authorization, is required.
- Local exchange and inter-exchange operators and overseas carriers who have previously received authorization are not required to register with the NTC when providing IP Telephony services.
- Non facilities based IP Telephony providers are required to enter into negotiated interconnection agreements with network operators while the Regulator will ensure interconnection is provided under fair terms.

South Africa

- As of 1 February 2005, any holder of a value-added network service, or enhanced service license is allowed to carry voice on their networks. Until this date, all VANS providers were prohibited by legislation from allowing their networks to carry voice.
- This restriction formed the basis of various regulatory complaints by Telkom, the incumbent operator, during its period of exclusivity. In recognition of the removal of the restriction on voice, the terms and conditions for VANS licensees were revised and now include the right of a VANS provider to apply for numbering resources, spectrum and interconnection with any operator.
- Other restrictions lifted on 1 February 2005, suggest that VANS may also self-provide telecommunications facilities and no longer have to obtain them solely from Telkom and/or the Second Network Operator, when it begins operation.
- However, the Minister of Communications stated for the media in late January 2005 that VANS are still required to obtain facilities from any licensed telecoms operator, including mobile operators, but cannot self-provide such facilities. While some VANS providers and market analysts

Liberalized Approach

disagree, to date this statement in the media has not been challenged.

- Various Internet Service Providers and VANS operators have begun to offer and advertise aggressively IP Telephony services on a retail basis. Internet Solutions, a subsidiary of Dimension Data is offering a "Voice over Internet Solutions" (VoIS) over their MPLS network billed as a full portfolio of converged voice and data services, including calling between branches of the same company; calls to customers of other ISPs; national long distance calls; calls to cellular phones; and international calls.
- There is no direct regulation of rates and tariffs for IP Telephony services, but the regulator is considering quality of service issues and access to emergency services on IP Telephony networks. It is worth noting that all the Second Network Operator's traffic will be IP based by virtue of its deployment of a Next Generation Network.

2. Incremental Approach

Following table depicts some of the countries where incremental approach has been adopted to regulate IP Telephony where some form of IP Telephony is allowed at the same time other forms of IP Telephony are under close watch to devise appropriate regulatory framework.

Incremental Approach

India

- India has offered Internet telephony legally since April 2002. Internet telephony covers the "following types of connections using the public Internet: (i) PC to PC (both within the country as well as abroad), (ii) PC to Phone (PC in India, Phone abroad), and (iii) IP based H.323/SIP Terminals in India to similar Terminals both in India and abroad, employing IP addressing scheme of the Internet Assigned Numbers Authority (IANA)."
- Internet Telephony through PCs or IP based terminals should also be available through India's Public Tele-Info Centers & Internet Kiosks. Facility based operators can provide Internet telephony.
- TRAI has issued regulations on quality for IP Telephony international long distance calls, differentiating between two quality levels: toll quality and below toll quality. Tariffs of IP Telephony services offered by ISPs are not regulated.

Bolevia

- IP Telephony is considered to be a telephony service as the telecommunications Regulations define a telephony service as every real-time voice communication, irrespective of how it is transmitted. In January 2005, a Bolivian ISP (Unete) announced that it was investing US$5 million to launch a national and international long distance voice service.

Incremental Approach

Ecuador

- In Ecuador telephony providers are either required to have a license for local and long-distance public telephony or to establish resale agreements with licensed operators. In February 2005, the regulator CONATEL published regulations covering cyber-cafes and telecenters. The regulations limit the number of terminals assigned for IP Telephony services to up to 25 per cent of the total, or one if the cyber-café accommodates only two or three terminals.

Honduras

- In Honduras the regulator has allowed IP Telephony services, provided operators contract with the monopoly incumbent operator Hondutel. The organizations doing this are described as "sub-operators" and can have their own networks and use them to sell other licensed services. However, the international traffic must be conveyed through Hondutel, the incumbent operator (however, this requirement lapsed at the end of 2005).

3. Consultative Approach

In some countries IP Telephony is undergoing public consultation process. Following table depicts the status of consultation in these countries.

Consultation on IP Telephony

Chile

- In July 2004 the Chilean regulator SUBTEL launched a public consultation on IP Telephony According to the consultation document, if voice services are offered through the existing PSTN network, the operator is required to comply with the regulations that apply to PSTN services.
- Within the framework of technological neutrality and non-discrimination, service providers offering IP Telephony calling through direct access are subject to the same conditions as for PSTN services.
- But if services are provided over the Internet, they are not subject to the same conditions. The regulator is suggesting a broadband voice license that allows the provision of voice using the IP protocol.
- Some operators responding to the consultation document have indicated that the classification is too rigid and potentially problematic in an increasingly converged environment.
- The Chilean incumbent operator argues that the introduction of IP telephony will only benefit a small group of the population but will reduce its income thereby decreasing the financing of current networks, discouraging investment and harming the access to services for poorer members of society.

Colombia

Consultation on IP Telephony

- In June 2004, the Ministry of Communications issued a consultation document on IP Telephony services. The consultation has been completed but no action had been taken by August 2005.
- IP Telephony is considered to be a telephony service as the telecommunications Regulations define a telephony service as every real-time voice communication, irrespective of how it is transmitted. In January 2005, a Bolivian ISP (Unete) announced that it was investing US$5 million to launch a national and international long distance voice service.
- The use of a PC to make calls over the Internet is not restricted. The Ministry of Communications is seeking to classify IP Telephony in the existing telecommunications service categories of public telephony, but a number of respondents have suggested that IP Telephony needs a new service category because it will not fit the old ones.
- The consultation addressed the following issues: emergency calling; numbering; network availability in event of disaster; services provided from other countries; market definition; the treatment of access to free services and lawful interception.

Jordan

- In May 2005, the Jordanian regulator issued a consultation document on the delivery of voice services using Internet protocol. This document sought comments on a number of issues including: distinctions between different types of voice services and the role of network and service providers in relation to network integrity.
- Comments were also invited on interconnection, requirement for a class license for IP Telephony service providers, even if the operator is off-shore, and quality of service issues.
- The Ministry of Communications is seeking to classify IP Telephony in the existing telecommunications service categories of public telephony, but a number of respondents have suggested that IP Telephony needs a new service category because it will not fit the old ones.
- The consultation addressed the following issues: emergency calling; numbering; network availability in event of disaster; services provided from other countries; market definition; the treatment of access to free services and lawful interception.

Hong Kong, China

- In June 2005, Hong Kong's regulator (OFTA) published its statement on Regulation of Internet Protocol (IP) Telephony. This statement outlines the position of OFTA after having evaluated the comments on a consultation document released in October 2004.
- According to the statement, OFTA decided to introduce two different licenses for IP Telephony providers. a) IP telephony with service attributes similar to PSTN and b) IP Telephony service that do not have the same attributes. Type "b" is subject to minimum regulation, although service providers are required to inform customers about the limitations of their services.
- In recognizing the multiple modes of IP service provision in the scope of Hong Kong's regulations, OFTA states that "the provision of IP Telephone

Consultation on IP Telephony

service by overseas websites will be outside the jurisdiction of the OFTA unless the provision involving the establishment or maintenance of means of telecommunications, or offering of telecommunications services, takes place within the territory of Hong Kong."

4. Prohibition of IP Telephony

There are a considerable number of countries where IP Telephony remains illegal. Governments and regulators in these countries adopt a number of different strategies to try and eliminate grey market operators. Some countries seek to ban websites that allow users to make international calls. Others periodically confiscate or seize the equipment of grey market operators. Some jurisdictions back up these sanctions with severe jail sentences and in one instance, the owners of several ISPs were jailed for a short period.

Prohibition of IP Telephony

Panama

- Before the ending of the monopoly in Panama in 2003, the Public Services Regulator mandated all ISPs to block IP ports identified with IP Telephony services. In addition, sometimes telephone companies filter (stop) IP Telephony service providers on their own.

Mexico

- An ISP in Mexico filters IP Telephony service providers including Skype

Kenya

- Incumbent operator in Kenya have also filtered IP Telephony traffic

Saudi Arabia

- ISP are monitored against porno sites as also for monitoring/blocking of IP Telephony.

In almost all those countries where estimates of the grey market are given by the incumbent operator operator, the amount of "lost" traffic" is on a scale that would indicate that few of these strategies are successful at completely closing down grey market operators and preventing access by users to some form of IP Telephony service. Estimates of the "grey market" proportion of international calling revenues range from 20-50% in countries in Latin America, Asia, and Africa.

C. Current Global State of VOIP Regulation

This section examines the way IP Telephony is currently regulated in various countries around the world.

1. Thai Regulator NTC has very recently allowed Phone to phone IP Telephony for all ISPs.

2. Chile's Free Competition Defence Court (TDLC) has fined Telefonica CTC CLP581 million (USD1 million) for blocking access to third party voice over Internet protocol (VOIP) telephony providers. The court ruled that CTC's policies hindered fair competition and that it must eliminate contract clauses that ban VOIP.

3. The Filipino telecoms regulator the National Telecommunications Commission (NTC) granted voice-over-internet protocol (VOIP) licenses to local firms BC Net and Broadband2Go Communications in October 2006, enabling them to begin offering internet call services. The awards bring the total number of VOIP licensees and resellers in Philippines to 14.

4. Centennial Communications has recently announced the launch of its integrated broadband telephony service suite Aptus in **Puerto Rico**, designed for enterprise and commercial customers. The telco is introducing a mobile PBX telephony. It is a converged service that enables businesses to have control over all voice communications via a single, integrated VOIP platform.

5. Singapore Telecom (SingTel) has announced the launch of a new integrated super highway communications service for residential users, dubbed Generation MIO (more-in-one). The new offering, which is provided over the operator's IP backbone via a standard fixed line is claimed to be capable of delivering mobile, Wi-Fi and broadband access on a single platform. MIO will enable it to roll out other services such as Pay-TV, home security and other remote monitoring services in the future.

6. The Czech Republic's second largest cable TV and broadband services provider, Liberty Global-backed Karneval Media launched VOIP telephony in September 2006.

7. Hungarian alternative operator GTS Datanet will launch double-play and IP Centrex services over VOIP platform. With broadband subscriptions rising rapidly in Hungary GTS Datanet sees a good opportunity to exploit the potential of VOIP.

8. Singaporean ISP Pacific Internet has announced the launch of voice over internet protocol (VOIP) services for enterprise users based in India. Named PacNet Vocal, the enterprise grade IP-based service comes with a suite of value added services. The company hopes to roll out the new service through direct marketing channels and distribution partners in major cities across the country. A similar service is planned for Singapore next month and the Philippines and Thailand in March this year.

9. Brazilian wireless broadband provider Neovia plans to expand its São Paulo state network by increasing its number of base stations from 5,000 to 8,000, with an investment of USD15 million in 3.5GHz WiMAX The operator is offering wireless internet access since 2002. Pay-TV operator TVA is also preparing to launch a WiMAX

certified service in the southern city of Curitiba by the middle of this year, using the WiBro system developed by Samsung.

10. According to reports in the UK newspaper the Observer (December 2006), Google is in talks with French mobile giant Orange about a multi-billion-dollar strategic alliance to develop a Google mobile phone capable of doing web tasks efficiently by way of Google software inside the terminal. The new handsets, the paper speculates, could hit the market as soon as 2008 with Taiwanese manufacturer HTC being linked to the plans. HTC specialises in developing smart phones and PDAs, and could be involved in developing the new unit which would house a screen similar to a video iPod, but with built-in Google software that would dramatically improve on the slow and cumbersome experience of surfing the web from a mobile handset.

11. Skype has been signing up almost 100,000 new users a day in China over the past three months, according to the VOIP firm's local partner, Tom Online. According to Australian online news site CRN, Tom Online now has at least 23.5 million registered users in the People's Republic, suggesting that almost one in five Skype users is Chinese; Skype claims 136 million registered users.

12. IP services in France are provided on a competitive basis. The regulatory description disregards whether the technology used to provide these service is IP or non-IP. The provision of public telephone services is subject to prior declaration (it was subject to individual licensing before 25 July 2003). The other kinds of service are freely provided.

13. The Federal Communications Commission (FCC) has historically classified Internet services as "enhanced services," which are not subject to traditional access charges. Still, it has reserved a decisive definition when it comes to telecommunications services over the Internet. In late 1996, the FCC ruled that telephony services provided by enhanced service providers are not subject to access charges. On the basis of these rulings, VOIP service providers are paying a lower reciprocal compensation rate than they would for long distance and wireless providers. Concerns about the increased burden of social responsibility of the Universal Service Fund (USF) and the discriminatory access charge and inter-carrier compensation for similar services prompted various organizations to file petitions challenging this definition. Although the FCC has made a few rulings on VOIP regulation, it has usually reserved the right to adopt different approaches based on the findings of its Internet Policy Working Group.

A few states have tried to pre-empt FCC rulings by subjecting VOIP service providers to local regulations similar to those imposed on local-exchange carriers (LECs). The FCC recently made a clear and decisive ruling that IP-enabled services such as VOIP fall under the interstate domain and therefore the states and Public Utilities Commission (PUC) do not have jurisdiction over these services.

14. In the recent Brand X decision, the U.S. Supreme Court ruled that cable companies do not have to share their infrastructure with competing Internet service providers. The FCC has defined cable broadband as an "information service"—a definition that, under agency guidelines, frees cable companies from regulations that would require operators to share their networks with competitors, including Internet service providers (ISPs) such as Brand X. Following that ruling, the FCC redefined its

classification of digital subscriber line (DSL) services. DSL is now considered an information service rather than a telecommunication service. This puts DSL in line with the classification of cable modem services—and exempts the telcos from opening up their infrastructure to competing ISPs and VOIP service providers such as Vonage.

15. In the meantime, Congress is debating a bill that proposes rules for three types of broadband services: VOIP, broadband video and broadband Internet transmission services (BITS). The industry is now voicing its opposition to the draft's failure to impose "net neutrality" requirements equally on all three categories of services.

7. CURRENT VOIP STATUS IN PAKISTAN

1. Background

Policy with regard to VOIP cannot be considered separately from the most basic issues associated with overall policy on telecommunications licensing and the fundamental objectives of national telecommunications policy and planning. The basis of this observation is the recognition that as a result of several of its characteristics and capabilities VOIP, or more accurately the internet platform on which it is one application, is a broadly disruptive technology or means of implementation of voice service which is transforming the economic and competitive dynamics of the entire telecommunications, or more broadly electronic communications sector:

1. VOIP eliminates the traditional intimate links between a telecommunications service and the network or transport facility it uses;

2. VOIP makes it possible for a service provider to compete in offering services to customers from a base outside the geographic region of responsibility of a regulator within which these customers reside;

3. VOIP enables competition to established network operators from service providers operating with fundamentally different business models, cost structures and cultures, e.g. Skype, Google, Vonage etc;

4. VOIP is a manifestation of the growth of the Internet, both public and private versions, whose origins, principles, and to large extent equipment suppliers are very distinct from those of the traditional telecommunications industry although traditional telecommunications suppliers have been striving to capture as much of the Internet-related equipment markets as possible.

2. Telecommunication Law

Following statues currently govern the regulation of fixed line (LL/LDI), internet and broadband in Pakistan

1) Pakistan Telecommunication (Re-organization)(Amendment), (xxx) Act 2006

> **4. Functions of the Authority.—**(1) The Authority shall—
>
> (c) promote and protect the interests of users of telecommunication services in Pakistan;
>
> (d) promote the availability of a wide range of high quality, efficient, cost effective and competitive telecommunication services throughout Pakistan;
>
> (e) promote rapid modernization of telecommunication systems and telecommunication services;

2) De regulation Policy for the Telecommunication Sector July 2003

12. Technology Neutral Licensing

12.1 The policy and licensing regime are proposed to be technology neutral.

12.2 LL / LDI licensees may employ any technology such as IP, VOIP, DWDM, CDMA and so forth within flexibility of license.

13. Miscellaneous

13.1 Class licensing regime is proposed to be enforced based on templates to be approved as part of policy process.

13.2 Corporations that wish to establish intra-corporate networks will be facilitated. New operators and PTCL will be obliged to provide infrastructure and services for corporate networks at cost oriented prices.

13.3 Open regime will be enforced for companies desirous of providing value added services such as Broadband, pre-paid calling cards, premium rate services and the new value added services that become available.

3) Broadband Policy Objectives

Following is an extract from broadband policy
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.

4) Licensing Regime

Class Value Added Licensed Service (CVALS) regime consists of only two types of licenses i.e. A Data type and a Voice type.

a. A 'Data' CVALS provider may provide any one or more service types allowed to its customers e.g. Multimedia, Burglar Alarm, Vehicle Tracking, Video Conferencing, Data Service, Internet Service, Internet Cards (for data only) and Virtual Private Network services or as added by the Authority from time to time.

b. A 'Voice' CVALS provider may provide any one or more service types allowed e.g. Payphone, Trunk Radio and Premium Rate Services or as added by the Authority from time to time.

3. Regulatory Framework

1) Licensing is technology neutral – Deregulation Policy

2) LL/LDI may employ any technology i.e. IP, VOIP within the flexibility of the license—Deregulation Policy

3) CVALS (Data) providers are authorized to provide data services only. It follows from the nomenclature given to the license data/internet operators are not allowed to carry voice.

4) Broadband policy defines broadband as follows:

"Always on Internet connection with a download speed of at least 128kbps connectivity"

Being internet connection albeit with higher download connectivity and "always on" **Broadband** is internet all the same, as such, does not allow transport of voice.

4. PTA Mandate

Telecommunication Act 1996 (as amended) mandates PTA to:

1) Promote and protect the interests of users of telecommunication services in Pakistan.

2) Promote the availability of a wide range of high quality, efficient, cost effective and competitive telecommunication services throughout Pakistan.

3) Promote rapid modernization of telecommunication systems and telecommunication services.

5. PTA Vision

"Create a fair regulatory regime to promote investment, encourage competition, protect consumer interest and ensure high quality Information and Communication Technology Services."

6. Telecom Market

Telecommunication sector in Pakistan is presently highly competitive. The sector is rapidly migrating from circuit switching to packet switching. Almost all the long distance and international service providers have deployed Next Generation Network and operating in IP environment in the core network.

Cut throat competition in long distance and international communication has taken all the profits out of the sector and more and more operators are finding it hard to compete under the present tariff level where the operators has to pay Access Promotion Charge to the local loop operator where he terminates the traffic.

Operators with no customer base of their own are finding it hard to survive on calling card business alone. IP in the core has aggravated their problems where the traffic is handled dynamically and partner operator aggregating traffic abroad can switch the traffic termination immediately to a competing service provider in Pakistan on

encountering any problem i.e. congestion, low ASR or more attractive termination charge.

Market has entered in consolidation phase where some of the operators are trying to sell out their business to cut the losses. The danger of rapid fall in prices through regulation of IP Telephony is hardly there. In fact it has already started happening.

Telecommunication market in Pakistan is preparing to enter the second phase of packet switching i.e. End to end IP for the customer through deployment of "Class five" NGN equipment and the WiMAX where IP based telecommunications systems have already started replacing PSTN.

Licensed operators are not sure where the boundary of legal IP telephony ends and grey traffic over IP starts. What exactly are the rights and obligations of the operators granted rights to deploy any technology including IP/VOIP. Spelling out clear boundaries will provide certainty to the operators to market their services aggressively and plan further investment for growth of fixed line sector.

Comments are invited on

i) Conclusion that telecom sector in Pakistan has already started migration from circuit switching to packet switching

ii) Conclusion that the boundary between VOIP and gray traffic is not clearly defined

iii) Conclusion that regulation of IP Telephony will not push the prices further down

8. IP Telephony Offerings

For the purposes of the licensing, VOIP service includes:

- Peer-to-peer calls (that is, calls made between two computers, that do not connect to the PSTN,
- PC-to-phone services, and
- Phone-to-phone services.

Category 1*:* IP Telephony offerings that are not any-to-any communication enabled.

Within this category, no gateway to the PSTN/ISDN or mobile networks exists, and hence there is no capability of initiating or receiving calls to/from traditional telephone services (POTS). Examples of category 1 IP Telephony offerings are the plain or classic version of Skype, and purely internal or intra-corporate communications.

Category 2*:* IP Telephony offerings that are partly any-to-any communication enabled.

Within this category, a gateway to the PSTN or mobile networks exists, giving the capability *either* to initiate or receive calls to/from POTS, but not *both* to initiate and receive calls to/from such services. Examples of category 2 IP Telephony offerings are Skype Out and Skype In. Category 2A refers to outbound calling only (e.g. Skype Out) and Category 2B to inbound only (e.g. Skype In).

Category 3*:* IP Telephony offerings that are any-to-any communication enabled.

Within this category, a gateway to the PSTN or mobile networks exists, giving the capability of both initiating and receiving calls to/from POTS.

Comments are invited on

Placing IP Offerings in three categories

9. OPTION EVALUATION CRITERIA

IP Telephony option selection criteria is based on the present regulatory framework and the overall policy objectives set out in mobile, fixed line and broadband policies.

1. Policy Objectives and Principles

The twin goals of regulation are to ensure effective competition, as a means to the end of delivering long term demand-side benefits, and to sustain innovation which is inherently uncertain and hence risky in terms of outcome and investment in a very capital-intensive industry.

Sustaining innovation and investment requires that investors see a reasonable risk/reward opportunity to achieve attractive returns on their investments before the value of these investments are rendered obsolete or uncompetitive by technological progress and/or unforeseen changes in regulations that alter the investors' legitimate expectations or even agreements at the time the investments were made.

Yet ensuring effective competition implies allowing entrants with new ideas and new technologies to enter the market without placing unreasonable obstacles in their way, so as to make the benefits of these new ideas and technologies available to customers as soon as possible.

A pattern of frequent major changes in regulation that make it unreasonably difficult for any investor, established or successive entrants, to achieve attractive "Return on Investment" would eventually have the effect of discouraging all investors and innovators, while failure to change regulations over too long a period would have the effect of discouraging entrants as well as innovations by existing competitors, which would ultimately lead to the same undesirable outcome.

So each policy option should be evaluated together with recommendations for the optimal timing and stages of its implementation, taking account of its current status, as well as its long term coherence with the vision of the sector.

A principal regulatory objective of PTA is to further the interest of citizens of Pakistan in relation to communication services, which is where IP Telephony has a significant potential role to play.

2. Evaluation Criteria

To best achieve PTA's regulatory objectives, given the existing restrictions and demands of the market, the following set of evaluation criteria can be applied to the IP Telephony options:

Promote and protect the interests of users of telecommunication services in Pakistan.

Promote the availability of a wide range of high quality, efficient, cost effective and competitive telecommunication services throughout Pakistan.

Promote rapid modernization of telecommunication systems and telecommunication services.

The impetus to allow and even to encourage the availability of IP Telephony services in Pakistan is particularly linked to all of the criteria or goals just listed (affordability; availability; and efficiency and innovativeness of communication services).

The options identified will be evaluated against their likely contributions over time to achieving these goals, tempered by their potentially adverse impact upon the financial capabilities of incumbent. In evaluating the latter however, the reasonable capability of incumbent to adjust its strategies and tactics to respond competitively to the challenges posed by the advent of IP Telephony services, which is a highly desirable consequence, will be taken into account.

Comments are invited on

i) Proposed IP licensing option evaluation criteria

10. OPTION SELECTION

1. Policy Options

The policy options for IP Telephony at this time fall into several broad categories. They are not mutually exclusive in the sense that it is conceivable to transition from one policy category to another over time, most commonly towards the goal of ultimate full liberalization as the all-IP/NGN environment becomes prevalent, which has already started to happen.

Almost all the LDI operators, including the incumbent, have deployed packet switching in the core network for national and international networks. The cost of communication has plummeted in the face of cheaper cost of doing business.

Transition from circuit switching to next generation network has already invaded the market and it is a matter of time when end to end IP deployment hits the market. Incumbent has already started exploring deployment of Class 5 switches while installation of WiMAX is already under way by other operators.

Pakistan market has reached a stage where regulatory approach needs immediate adjustment to take care of the emerging telecom scenario for the growth of the market before events overtake the actions and regulatory adjustments are made to follow the market instead of guiding them where customers opt for the services without having legal protections which can only be guaranteed through a proper and effective regulatory arrangement taking into consideration market forces and customer rights and balancing the two in an equitable and fair manner.

There are four options to deal with the situation.

1. **Liberalized option** – all forms of IP Telephony service are legal with minimal regulation.

2. **Incremental option** – some forms of IP Telephony service are legal with significant conditions placed upon IP Telephony entrants.

3. **Consultation (largely "wait and see")** – a public consultation is underway to seek opinions before definitive rules on IP Telephony are issued;

4. **Prohibition** – IP Telephony is illegal except for use in the core network i.e. long distance and international networks which almost all LDI operators have deployed but it does not touch the customer.

The first two policy options cover a continuum of approaches in terms of what is deemed to be legal and the scope of the conditions which IP Telephony service providers have to meet. Option 3 represents either a worthy attempt to gather as much expert opinion and judgment as possible before deciding what to do, and/or a delaying tactic to avoid having to make hard choices.

The danger of Option 3 is that the process may take so long that the impact of fast moving competitive and technological developments will create "facts on the ground" that in practice preempt the ability of regulators to influence the direction of IP Telephony to achieve their desired goals.

In practice some of the facts have already been created where IP in the core has extensively been deployed by various operators including the incumbent. International inbound and outbound traffic is being carried over the IP by almost all the LDIs, LL operators are providing international services over internet protocol against E.164 numbers allocated to them for the provision of local loop service in Pakistan. There is no credible way to stop broadband operators from providing full blown fixed line service over broadband internet except for the inconvenience of accessing the called partner over the internet address.

Option 4 is often impractical or extremely difficult to enforce as evidenced by the presence of the "grey market" and confirmed by unearthing of illegal gateways on regular intervals despite the fact that the cost of international calls have come down drastically. This last option can at best be short lived, given the underlying forces of technology and economics.

2. PTA Objectives

PTA Vision

"Create a fair regulatory regime to promote investment, encourage competition, protect consumer interest and ensure high quality Information and Communication Technology Services"

PTA Mandated Objectives

1) Promote and protect the interests of users of telecommunication services in Pakistan.

2) Promote the availability of a wide range of high quality, efficient, cost effective and competitive telecommunication services throughout Pakistan.

3) Promote rapid modernization of telecommunication systems and telecommunication services.

3. Impact of the Options on the Objectives of PTA

The IP Telephony options are evaluated against agreed objectives to assess which option is best for PTA. The objectives that are most relevant in the context of IP Telephony are:

1. Increase teledensity (particularly broadband) as committed
2. Make available affordable high quality, innovative communications and information services to all segments of the population
3. Bridge the digital divide

4. Promote a viable and dynamic domestic industry characterized by a significant number of competitive players.

The fundamental economics and capabilities of IP Telephony services, fueled by progress in Internet-related and voice processing technologies, have now improved to the point where they should lead to reduced costs and prices and enhance capabilities for the voice telecommunications services available to customers in the Pakistan including residential and business users.

Attractiveness and value of broadband access to customers is enhanced when voice services become another application or service that is made available over them at no incremental costs, through IP Telephony. Hence the PTA's mission statement and objectives would favor allowing the introduction of IP Telephony as broadly and rapidly as possible to bridge the digital divide.

However from the above discussion it is abundantly clear that now is the time to allow IP Telephony for the development of telecommunication as also to meet the mandated objectives of PTA

Comments are invited on

i) Conclusion that option3 and option 4 are not viable anymore

ii) Conclusion that VoB will catalyze the growth of Broadband.

11. RECOMMENDED FRAMEWORK

In view of the discussions in previous chapters, PTA prefers to promote a policy and an approach towards IP Telephony ("Incremental Option") which is initially differentiated with respect to distinct categories of IP Telephony service and to allow evolution over time. Steps in this evolution will be determined on the basis of regular assessments of evidence and IP Telephony experience in the country itself and abroad, keeping in mind the vision that IP Telephony will eventually become the predominant platform for voice traffic, over mobile as well as fixed access networks.

PTA distinguishes between three categories of IP Telephony offerings:

Category 1*:* IP Telephony offerings that are not any-to-any communication enabled.

Within this category, no gateway to the PSTN/ISDN or mobile networks exists, and hence there is no capability of initiating or receiving calls to/from traditional telephone services (POTS). Examples of category 1 IP Telephony offerings are the plain or classic version of Skype, and purely internal or intra-corporate communications.

Category 2*:* IP Telephony offerings that are partly any-to-any communication enabled.

Within this category, a gateway to the PSTN or mobile networks exists, giving the capability ***either*** to initiate ***or*** receive calls to/from POTS, but ***not both*** to initiate and receive calls to/from such services. Examples of category 2 IP Telephony offerings are Skype Out and Skype In. Category 2A refers to outbound calling only (e.g. Skype Out) and Category 2B to inbound only (e.g. Skype In).

Category 3*:* IP Telephony offerings that are any-to-any communication enabled.

Within this category, a gateway to the PSTN or mobile networks exists, giving the capability of both initiating and receiving calls to/from POTS.

Initial Steps

1. No regulation or authorization or licensing is imposed on Category 1 IP Telephony offerings, which will be freely allowed. The use of IP Telephony as a pure transmission technology within a network which does not constitute a service offered to the consumer but is an activity internal to an operator is also excluded from regulation.

2. Category 2 IP Telephony offerings are treated as follows, distinguishing between outbound only and inbound only calling:

   a. 2A (inbound): Only fixed line facilities-based voice operators licensed in the Long Distance & International are allowed to offer such a service, in which customers may use either geographic or non-geographic numbers from a numbering range to be established (07x).

   (All LDIs are currently terminating international incoming traffic through IP core over PSTN and mobile networks. With new authorization LDIs will be

entitled to number ranges from a new range to be established (07) for subsequent assignment to their customers for termination of call over IP).

b. 2B (outbound): Only Local Loop operators are allowed to offer this service, which does not require customers to be allocated a separate telephone number. Consumers' interests are adequately protected through marketing information which informs customers about the limitations of these services with respect to, for example, lack of access to emergency services. Further LDI operators are allowed to offer the service through calling cards. Currently some LL operators are already operating such a service.

3. In accordance with the principle of technology neutrality, fixed line facilities-based voice operators (composite license-LL & LDI) are allowed to offer IP Telephony services (Category 3) with connections to and from the circuit-switched PSTN and public mobile networks.

4. The entire set of obligations relating to existing (PSTN) voice services will apply to these IP Telephony (Category-3) services. However, over an interim period PTA may grant temporary exemptions (to Category-2 service providers) from some of the obligations on a specific basis and with the condition that consumers' interests are adequately protected through marketing information which informs customers about potential risks or absent features such as caller location in access to emergency services

5. Geographic numbers will be provided for use by IP Telephony providers (Category-3). Number portability between incumbent operator POTS and IP Telephony services will be allowed. Use of geographic numbers will be contingent upon the IP Telephony service being marketed and appearing as a fixed line telephony substitute, used from the consumer's permanent address

6. Non-geographic numbers from a series to be established (07x) will be made available (to Category-2 service providers) for nomadic use, with the condition that the risks connected with nomadic use will be adequately described through marketing information to protect consumers' interests

7. Interconnection between IP-based networks must be arranged by the service providers

8. Interconnection between IP network services and the PSTN and public mobile networks shall be arranged on the same principles and with the same obligations on operators, both with and without dominant or significant market power, as have already been established for operator interconnections, where however it will be the responsibility of the IP network operator to implement the transformation of its packet voice signals into and from the formats used in the PSTN and public cellular networks.

9. Incumbent operator will be enjoined from attempting to block IP Telephony-originated calls from transmission over its network facilities when these calls are presented in accordance with agreed interconnection and termination arrangements between licensed operators. To summarize following are the obligations of three categories of VOIP Services.

Obligations of VOIP Service Providers (Category 1)

PTA proposes to impose no obligations on VOIP services in this category.

- No gateway to the PSTN/ISDN or mobile networks exists, and hence there is no capability of initiating or receiving calls to/from traditional telephone services (POTS).

- The activity is purely individual or within the organization itself and there are no publicly available offerings.

Obligations of VOIP Service Providers (Category 2) to the Public

- To interconnect with Public Switched Telephone Network (PSTN) and the Mobile Networks so that customers will be able to send OR receive calls (**NOT the Both**) from competing fixed line, WLL operators and public mobile networks,

- Give a clear description of the service on offer to customers highlighting the absence of access to emergency services.

- Highlighting availability of **best effort** quality of service.

- Access to special number ranges (07X) for subsequent allocation to its customers.

Obligations of VOIP Service Providers (Category 3) to the Public

PTA proposes to impose the following obligations on organizations providing VOIP services to the public:

- To interconnect with Public Switched Telephone Network (PSTN) and the Mobile Networks so that customers will be able to send and receive calls from other VOIP operators, competing fixed and fixed-wireless operators and public mobile networks,

- Provide access to emergency services free of cost to customers,

- Give a clear description of the service on offer to customers,

- Contribute to Universal Service Fund and Access Promotion Contribution.

- Make adequate provisions for disabled users, and

- Comply with quality of service parameters laid out in the relevant license conditions for LL and LDI and provide directory enquiry services as per fixed line license and comply with directives issued by PTA from time to time.

- Access to normal PSTN number ranges is allowed as provided in the relevant license for fixed line segment.

VOIP and Bypass

The termination of international voice services over the domestic switched telecommunication network or mobile network, by a person who does not originate the

call or possess a valid interconnection agreement with that domestic or mobile network operator with respect to international voice service.

PTA proposes exempting the three categories of VOIP services from the Bypass

PTA has identified VOIP as a key enabler of bypass. For this reason, it proposes that:

- The use of Net2phone, Vonage, Voice Sticks and any other such VOIP devices will be allowed, provided these VOIP providers enter into a partnership with a holder of an LDI License and such services are provided under the name of the PTA Licensee.
- Importers of VOIP adapters (IP to telephone line) or IP phones must produce a valid PTA license and appropriate Type Approval from PTA.

Subsequent Steps

1. The PTA actively monitors and assesses IP Telephony regulatory developments and experiences worldwide, with special attention to benchmarking countries, on an ongoing basis.

2. Examples of IP Telephony-related issues that are likely to arise include: (i) whether to authorize non-facilities-based IP Telephony service providers following the models of independent ISPs whose customers access the Internet over broadband; and (ii) the introduction of IP Telephony services over mobile channels as and when higher speed (3G and beyond) wireless channels become available

3.. PTA develops a long term vision for IP Telephony regulation – or regulation in general – in anticipation of the time when IP networks and IP Telephony services are predominant, and maps out a transition path with further steps to be taken towards this vision taking account of findings from 1 and 2.

In light of the rapidity of developments in IP Telephony markets and services worldwide, these aspects of PTA's activities will be updated regularly, at least on an annual basis.

Comments are invited on

i) Conclusion that Incremental Approach is the right way to go.

ii) Proposal that IP Telephony offerings are placed under three categories

iii) Proposal that category 2 offerings are split into two types i.e. "IP IN" and "IP OUT".

iv) Proposed recommendations for IP Telephony authorization.