Telecom Regulatory Authority of India

(TRAI)

Recommendations

on

Issues related to Internet Telephony

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Preface

The fast technological developments are facilitating higher processing power of end devices, miniaturization, reducing memory storage cost and capability to perform various applications on common platform. This trend is driving convergence of devices and services. As a result telecommunication requirements are fast changing with increasing demand of new value added services and applications. Internet sector is witnessing the popularity of various IP based services such as Internet Telephony, IP TV, Video streaming, and Video on demand etc. Internet Protocol is emerging as widely acceptable protocol in backbone due to its robust and resilient characteristics, which is able to support Quality of service (QoS), effective bandwidth management, better resource utilization and overall ease of use by subscribers.

The present licensing framework has envisaged different type of access service providers (Unified Access Service Licensee (UASL), Basic Service Operators (BSOs), Cellular Mobile Service Providers (CMSPs)), National Long Distance service providers (NLDs) International Long Distance service providers (ILDs) and Internet service providers (ISPs). While access service providers are permitted to provide various services and applications to their subscribers under Universal Access Services License (UASL), the role of other licensees like NLD and ILD is limited to provide long distance services and Internet service providers are permitted to provide access to Internet. It was expected that access service providers will provide highly popular services like Internet Telephony and boost broadband penetration but it has not happened on the ground. There seems to be complete market failure as our subscribers are denied advanced value added services in contrast to world scenario where such Internet based services are very popular. ISPs are not permitted to provide unrestricted Internet Telephony though they have Internet protocol (IP) based Infrastructure. Such regulatory restrictions discourage technological

advancements and result is grey market activities to provide these services to common masses.

The Authority noted that while there is an urgent need to extend benefit of technology advancements to common masses and removal of all roadblocks, it is also concerned with the issue of level playing field if present restrictions are removed. In order to examine various related issues, the Authority suo-motu under section 11(1)(a) of TRAI Act initiated consultation process on various issues related to Internet Telephony on 12th May 2008.

Based on the comments of the stakeholders, internal in-depth studies and International experience, the Authority has framed these recommendations. Due importance have been given to level playing field among various service providers, including Interconnection mechanism, Interconnect Usage Charges (IUC), Numbering, Lawful Interception (LI), Emergency number Dialing, Interoperability and Quality of Service etc.

These recommendations are a step forward to develop supportive regulatory environment enabling convergence, availability of unrestricted Internet Telephony and boosting broadband penetration. It will also help to extend cost effective and innovative service to end-users. It is hoped that these forward looking recommendations will also help achieve much required Broadband growth while providing new business opportunities to various telecom service providers.

(Nripendra Misra)
Chairman, TRAI

Chapter 1

Introduction

1.1 The Indian telecom sector was opened to private participation in 1994. The prevailing licensing framework has envisaged access providers, National Long Distance service providers (NLDs), International Long Distance service providers (ILDs) and Internet service providers (ISPs). While access service providers are permitted to provide various services and applications under Universal Access Services License (UASL), the role of other licensees like NLD and ILD is limited to provide long distance services and Internet service providers are permitted to provide access to Internet.

1.2 The existing licensing provisions have been effective and have contributed to growth of telecom sector. However fast technological development, Convergence of networks, services and end-devices is blurring the boundaries of scope of services among different licenses. Rapid changes are taking place worldwide with respect to business models, service delivery platforms and regulatory frameworks to meet the challenges posed by the convergence.

1.3 Convergence is primarily driven by increasing processing power, high capacity memory storage devices, reduced price, lesser power requirement and miniaturization of the devices. High-speed data transfer is now possible which is necessary for delivering innovative and advanced multimedia application. Recent trends indicate that Telecom operators are adopting converged platforms to deliver multimedia rich applications containing voice, video and data.

1.4 Emergence of IP based Network is another trend driving the change. The economical solutions provided over IP networks have shown highly efficient bandwidth utilization over the period of time. This marked improvement has made IP networks a mature technology.

Recent reports estimate that Service providers around the world are expected to invest US$300 billions in all-IP networks by 2015.

1.5 Presence of unified IP based backbone and the benefits associated with the converged telecom access scenario has enabled the service providers world over to launch more and more converged services such as Internet Telephony, IPTV, Mobile TV etc. The separation of service provisioning and its management from the underlying network infrastructure in packet based networks is further increasing the acceptability of IP based Networks. It is now possible to separate provision of service contents, configuration and modification of service attributes regardless of the network catering such service. There has been enough evidence to suggest that in future IP networks will play much important role and may ultimately encourage migration of conventional networks towards Next Generation Networks or an All IP Network.

1.6 The acceptability of IP based networks globally has facilitated growth of Broadband. However, this growth is highly dependent on availability of innovative IP based services and their affordability. Telecom service providers across the world are realizing profits by carrying the TDM traffic over IP based Network in their backbone and access networks. Internet Telephony is considered to be the one of the front-runner IP based converged service which is transmission of voice over IP based Network.

1.7 **Definition of Internet Telephony**

1.7.1 International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) Study Group 2 (SG2) has given explanation of the term "IP Telephony" as given below:

"IP is an abbreviation for Internet Protocol. It is a communications protocol developed to support a packet-switched network. The protocol has been developed by the Internet Engineering Task Force (IETF). IP

telephony is the exchange of information primarily in the form of speech that utilizes a mechanism known as Internet Protocol."

1.7.2 There are two major categories for voice transmission over IP networks based on type of IP network used. When voice is transmitted over public Internet, it is termed as Internet Telephony. Similarly when voice is transmitted over managed IP networks, it is termed as Voice over IP (VoIP). The primary difference between voice services on managed and unmanaged IP Networks is quality of speech. However this difference is getting diminished with technological advancement, new coding techniques and availability of higher bandwidth as provided by broadband connections.

1.8 Growth of Internet in India

1.8.1 India is a country of one billion people. Huge broadband growth has been projected for the country. This becomes evident if we see growth of wireless and wireline connection in country. The total wireless subscribers (GSM, CDMA & WLL (F)) base stood at 286.86 million at the end of June 2008, which shows a growth of more than 25 Million over the last quarter. (refer Fig. 1.1). Monthly growth of wireless subscribers has been consistent at approx. 8 million per month over a period of time. Among these wireless subscribers there are more than 70 million subscribers who can have access to data services including Internet access. With the introduction of 3G & BWA and 70 million potential wireless broadband subscribers, the IP based services over wireless are bound to increase broadband growth multi-fold.

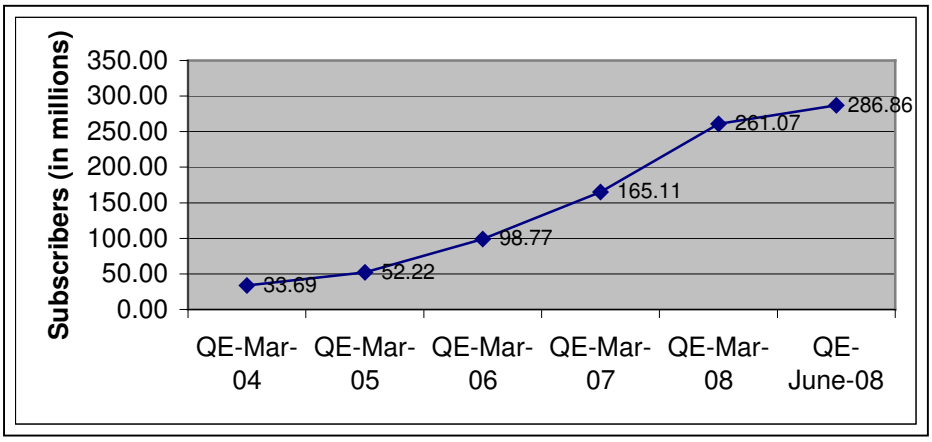


Figure 1.1- Growth of Wireless subscribers

1.8.2 The wireline subscribers in the country are stagnating at 39.42 million at the end of March 2008 (refer Fig. 1.2). Most of the broadband connections are on DSL at present. Broadband subscriber base is 4.38 million at the end of June 2008. If we consider moderate possibility to convert at least 1/3rd of total wireline connection as broadband enabled (i.e. nearly 10 Million), then there exist enormous opportunity for DSL broadband growth in the country.

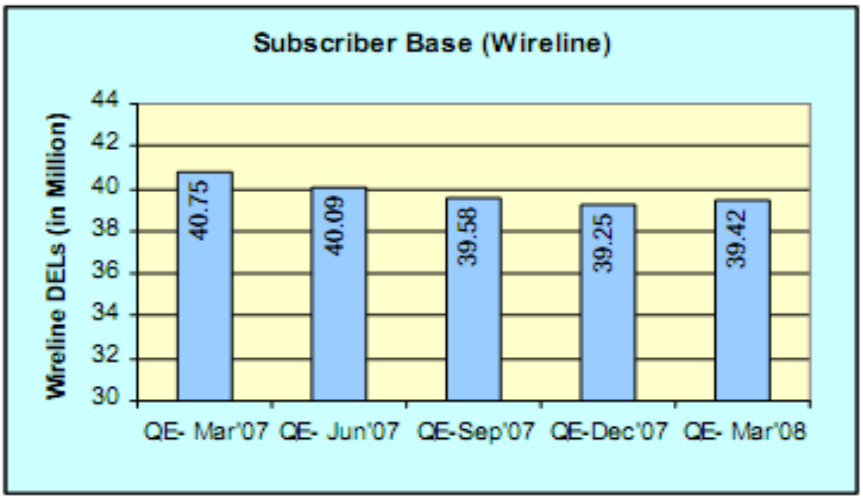


Figure 1.2- Growth of wireline subscribers

1.8.3 In rural areas there are nearly 20000 exchanges, which are connected through reliable media. These exchanges can help broadband penetration in rural areas. In fact according to reports, installed exchange capacity in such areas is underutilized to provide wire line subscribers. Presently there are 11.64 million rural wireline subscribers at end of March 2008, which is declining (refer Fig. 1.3). Provisions of broadband connections will not only provide value added services and applications to our rural subscribers, but will also arrest declining trend of wire line subscribers and improve business model of telecom operator serving in rural area.

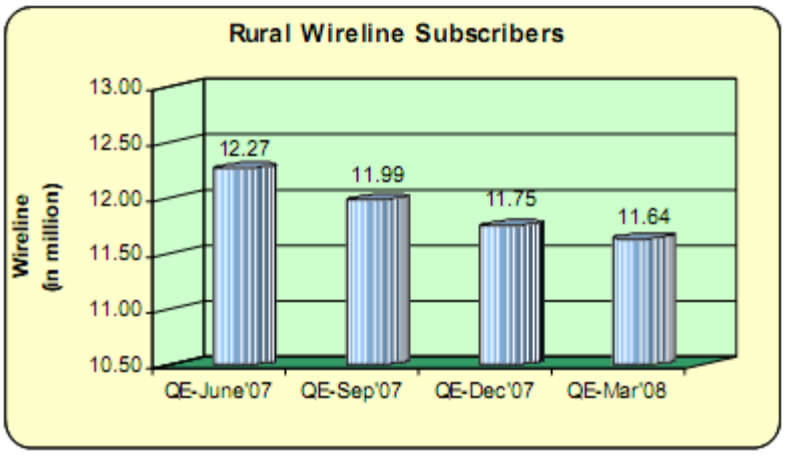
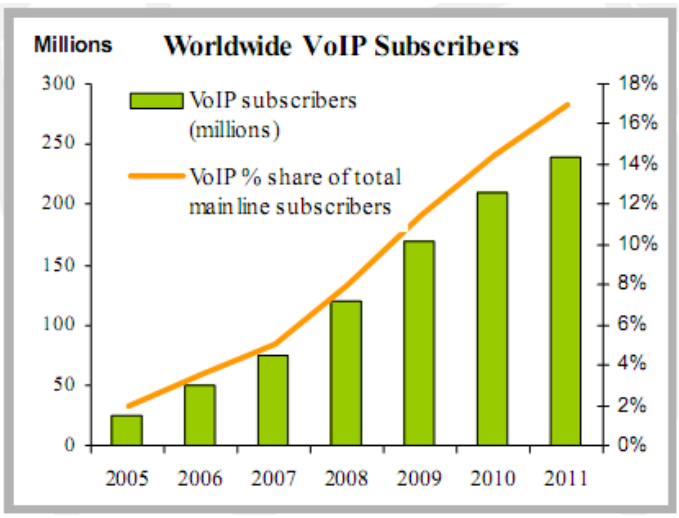


Figure 1.3- Growth of rural wireline subscribers

1.8.4 Universal Services Obligation Fund (USO fund) of Government of India is also taking several initiatives to spread the broadband penetration in rural areas of country. Inspite of fast development of infrastructure in rural and remote areas, the penetration of telecom services in rural and far-flung areas is just around 8% indicating low competition levels. There is a need to introduce much cheaper voice services, which can heighten the level of competition in such areas. IP Based services such as Internet Telephony can play a major role.

1.9 Global Scenario of Internet Telephony

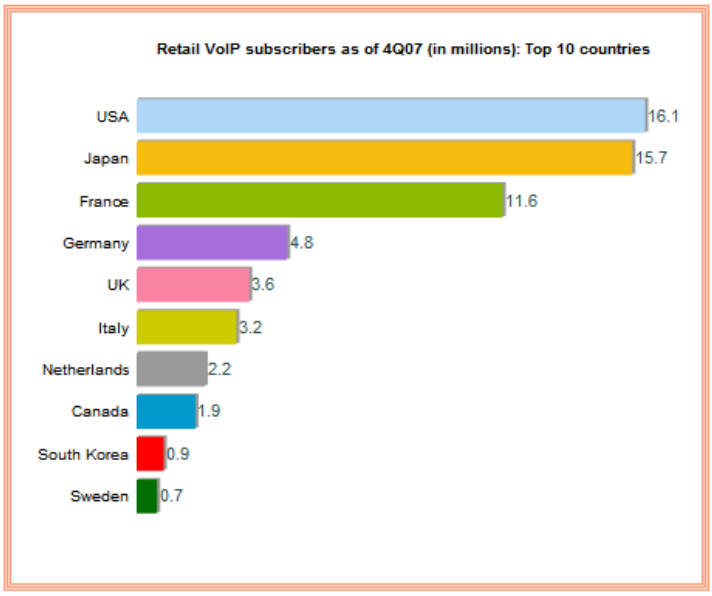
1.9.1 US analysts Telegeography predict that revenues from Internet Telephony (termed as VoIP) will reach USD 5 billion having 16% of total telephony subscribers by 2010. (refer Fig. 1.4) Other estimates are much higher. According to Juniper Research, revenues from VoIP services in the business sector alone will reach USD 18 billion by 2010, with hosted VoIP business revenues reaching USD 7.6 billion.



Source: iDate

Figure 1.4- Worldwide VoIP subscribers and revenue projection

1.9.2 As per recent reports US has stood first among the top 10 countries providing retail VoIP services followed by Japan & France (refer Fig. 1.5).



Source: iLocus

Figure 1.5- Retail VoIP subscribers as of Q4 2007

1.9.3 A recent survey of MVNOs carried out by iLocus has revealed the number of mobile VoIP subscribers served by MVNOs to reach around 1.6 million by the end of 2008. At present there are estimated 450,000 mobile VoIP subscribers served by MVNOs worldwide as of April 2008. The market in terms of these subscriber numbers is led by Truphone followed by H3G. There is a forecast that 450,000 mobile VoIP subscribers worldwide will grow to 2.4 million by the end of 2008 and will be 26.6 million by 2012 according to the report.

1.9.4 A recent report by In-Stat found:

- 73% of total VoIP subscribers worldwide do not want to understand technicalities while adopting new technology. They are more concerned with type, quality and cost of service rather than the platform providing the same.
- In North America and Canada, cable operators are aggressively expanding their VoIP footprint, but are marketing VoIP as plain old telephone service.
- In Asia, South Korea will have the highest VoIP growth rate, followed by Hong Kong and Singapore.

1.9.5 In Europe, broadband ISPs, such as Free Telecom (France) and FastWeb (Italy) are leading the way with innovative consumer triple-play service bundles.

1.10 **Evolution of regulatory framework for Internet Telephony:**

1.10.1 Internet services in India were first launched in 1995 by erstwhile VSNL then a government owned PSU. However at that time Internet telephony in any form was not permitted. Later in November 1998, the Government issued new guidelines for Internet services and ISP licenses were issued to private operators. Even at this stage Internet telephony was not envisaged as a service.

1.10.2 In the New Telecom Policy 1999 (NTP 1999) announced by the government in March 1999 various steps were taken to support the Internet services however still Internet telephony was not allowed.

1.10.3 Later, Department of Telecom announced the guidelines for opening of Internet telephony w.e.f. 1st April 2002 with restricted use of Internet Telephony. Existing ISPs were permitted to offer Internet telephony services only after signing the amended ISP license called Internet Telephony Service Provider (ITSP) license. Internet telephony was permitted only in limited way, as there were restrictions on the type of the technology and devices, which could be used. ITSPs were not permitted to have connectivity with PSTN/PLMN. Initially provisioning of Internet telephony service did not envisage any financial implications (no additional entry fee or license fee).

1.10.4 In April 2004, TRAI made recommendations on "Accelerating growth of Internet & Broadband penetration". Subsequently, based on this recommendation, Government declared the Broadband Policy in Oct. 2004. Broadband subscriber targets were stipulated by government (refer table 1.1) to enable the time bound broadband growth in country.

Year Ending	Internet Subscribers	Broadband Subscribers
2005	6 million	3 million
2007	18 million	9 million
2010	40 million	20 million

Table 1.1- Broadband Targets under Broadband Policy 2004

1.10.5 NLD & ILD sectors were liberalized in Nov. 2005. Government reduced entry fee for NLD /ILD license to Rs. 2.5 Crores each from 100 crores. License fee was also reduced to 6% of AGR. The rollout obligations were reduced.

1.10.6 DoT imposed a license fee of 6% of AGR earned from Internet telephony by ITSPs with effect from 1st Jan. 2006.

1.10.7 In March 2006, Unified Access Service Providers (UASPs) and Cellular Mobile Service Providers (CMSPs) were permitted to provide Internet telephony and broadband services. However these services are still not started at large levels.

1.10.8 In May 2006, based on TRAI recommendations, Government permitted use of special characters such as *, #, $, from mobile subscriber terminal for provisioning of intra-network value added services or accessing/provisioning of high-speed data services.

1.10.9 On 10th May 2007, TRAI sent recommendations on "Review of Internet Services". The restrictions imposed on use of different devices/ATA/Adapters to provide Internet telephony were removed as per subsequent guideline issued by DoT. Now any device or adapter conforming to the Standards of International Agencies can be used to make Internet telephony calls to PSTN/PLMN abroad. However, ISPs are still not permitted to have connectivity with PSTN/PLMN within the country.

1.10.10 As per the new guidelines for grant of license for operating Internet Services issued by DOT in August 2007, all ISPs were permitted to provide Internet telephony and separate category of Internet

Telephony Service Providers (ITSPs) has been done away with. Lecense fee of 6% of AGR was imposed on all ISPs except on the revenue earned from provisioning of pure Internet access services.

1.10.11 The very fact that majority of International long distance telephone calls are being carried over IP networks is the biggest proof of success of VoIP in India. With just 11 million Internet subscribers, including the 4.38 million broadband subscribers, the Internet telephony is quite popular. Its offerings can further expand with light regulatory provisions.

1.10.12 The regulatory restrictions on ISPs to provide unrestricted Internet telephony, and lack of interest of access providers to offer similar services are encouraging development of grey markets to provide Internet telephony. Some press reports and other information indicate extension of other countries numbers in Indian Territory to provide Internet telephony, using broadband connection. Many users perceive Internet telephony as value application to take broadband connection.

1.11 In view of above, the Authority had suo-motu initiated consultation process with Stakeholders on 12th May 2008 by floating a detailed consultation paper to deliberate the "Issues related to Internet Telephony". An Open House Discussion was held at Kolkata (West Bengal) with stakeholders to get their views.

1.12 The Authority has considered written submissions of the stakeholders (Annexure-II), comments during Open House Discussions (OHD), International practices (Annexure-I) and internal analysis while finalizing its recommendations. Emphasis has been given to organized and steady growth of telecom sector while extending technological innovations and ensuring availability of value added services and applications to esteemed subscribers.

1.13 The recommendations have been structured in four chapters. Chapter 2 deals with Technical Aspects of Internet Telephony. Chapter 3 deals

with regulatory issues related to Internet Telephony. Chapter 4 summarizes all the recommendations.

Chapter 2

Technical Aspects of Internet Telephony

2.1 IP Converged Network

2.1.1 The conventional Telecom Networks (TDM networks) owned by large facility based access service providers are undergoing rapid changes. Recent trends indicate that operators are largely in favor of replacing vertically separated networks by an all IP converged Network. This may also be considered as a natural path for migrating to Next Generation Network.

2.1.2 In circuit-switched networks, circuit is dedicated during the entire conversation, and the entire information follows the same dedicated path. In packet switched networks, the message (voice data) is broken into packets, each of which can take a different route to the destination, where the packets are recompiled into the original message. In packet switching environment a single circuit can be shared by number of simultaneous calls, increasing bandwidth utilization efficiency. As such, packet switching is supposed to be a much more efficient and cost effective way of sending messages (data) including voice.

2.1.3 Fig 2.1 shows a basic PSTN network comprising of different type of switches in access and core telecom network. A Class-5 switch is an access switch, which is normally located near to the end-user providing first interface point to the subscriber. This Class-5 switch is further connected to Class-4 Switch placed at the end point of core network. The signalling system (SS7) handles the signalling requirement of various interconnected switches.

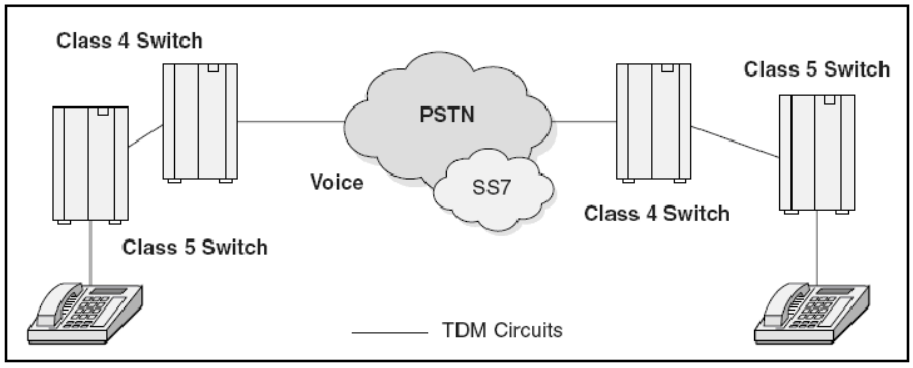


Fig. 2.1 Basic PSTN Network

2.1.4 Convergence of networks, services and devices across the globe is fast changing the network architecture in the telecommunication landscape. As defined by ITU, Convergence is *"Coordinated evolution of formerly discrete networks towards uniformity in support of services and application".* This coordinated evolution has subsequently paved way for emergence of converged networks which in essence is "IP-*based networks that generally make use of various telecommunications technologies to support a range of multimedia services such as voice, data, still image and video".* (Source: ITU E.417 (05), 3.5)

2.1.5 Operators worldwide are exploiting the data handling capabilities of the Converged IP Core in order to meet the increasing traffic growth. Use of Media Gateways (MGW), Signaling Gateways (SGW) in converged scenario is on the rise to convert the TDM to IP packets and handle signaling requirement for both PSTN & PLMN. (Refer Fig 2.2)

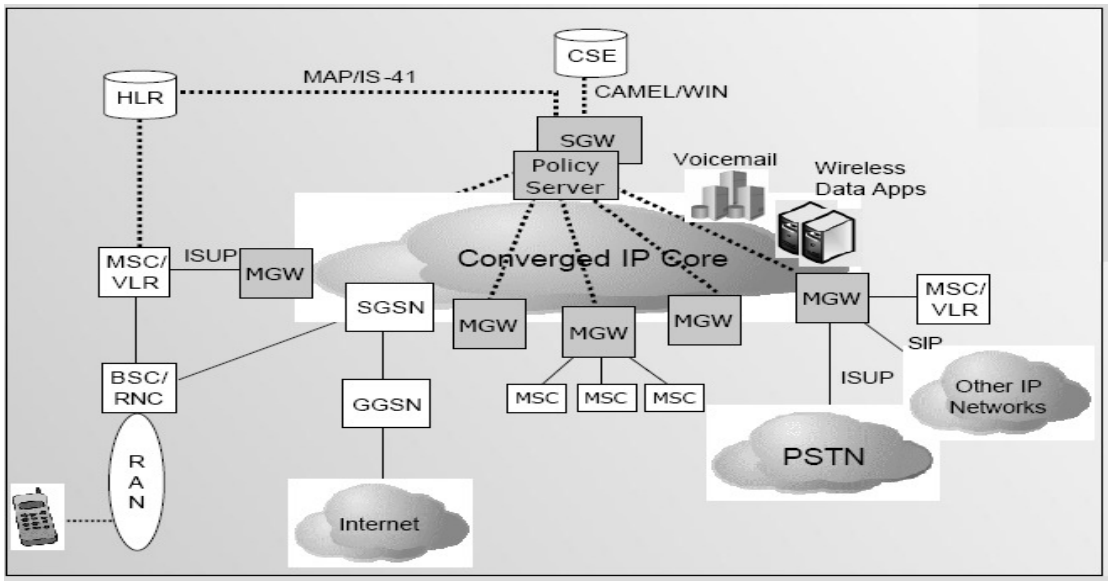


Fig. 2.2 Mobile carrier use of converged core

2.2 Evolution of Internet telephony

2.2.1 As early as November' 77, the Internet Engineering Task Force (IETF) published the "Specifications for the Network Voice Protocol (NVP)". This was primarily aimed for supporting Advanced Research Projects Agency (ARPA's) Network's Secure Communications project to demonstrate the feasibility of secure, high-quality, low-bandwidth, real-time, full-duplex (two-way) digital voice communication over packet-switched computer communication networks. However, actual growth of Internet telephony started in mid-90's. This was aptly supported by rise in deployment of IP Networks. IP Telephony is used as a generic term for many different ways of transmitting voice, fax and related services over packet-switched IP-based networks. Internet Telephony is a form of telephony, which uses Internet Protocol (IP) for transmitting IP packets over Internet cloud. The basic steps involved in originating an Internet telephone call are conversion of the analog voice signal to digital format (binary data) at subscriber premise itself and compression/translation of the data into IP packets for transmission over the Internet. The process is reversed at the

receiving end. This process is called modulation-demodulation. The communication usually takes place in real time. Thus, the main difference between Internet Telephony and normal telephony is that whereas in normal telephony, circuit-switching technology is used, whereas Internet Telephony is based on packet switching technology. As per present service models following main deployment scenarios for Internet telephony are possible:

- PC-to-PC Internet telephony
- PC-to-Phone Internet telephony
- Internet telephony using adapter boxes
- Unrestricted Internet telephony having interconnection with PSTN/PLMN
- Phone-to-Phone Internet telephony

The details have been discussed below.

2.2.2 **PC-to-PC Internet telephony:** In this scenario, the calling and called parties both have computers or similar devices that enable them to connect to the Public Internet (refer Fig. 2.3). Both end-users are able to establish communication (Data or voice communication) only by prior fixation, as they have to be connected to the Internet at the same time and use compatible software. Presently, large numbers of Instant Messaging applications are available on Internet to make PC-to-PC Internet telephony possible. The ISP's role in such scenario is limited to provide access to the Internet. The ISP network is transparent to such application used by the subscribers. Today PC equivalent devices like personal digital assistants (PDA) or advanced mobile handsets are available, which can also run such software supporting Internet telephony. This type of Internet Telephony is permitted under existing ISP license.

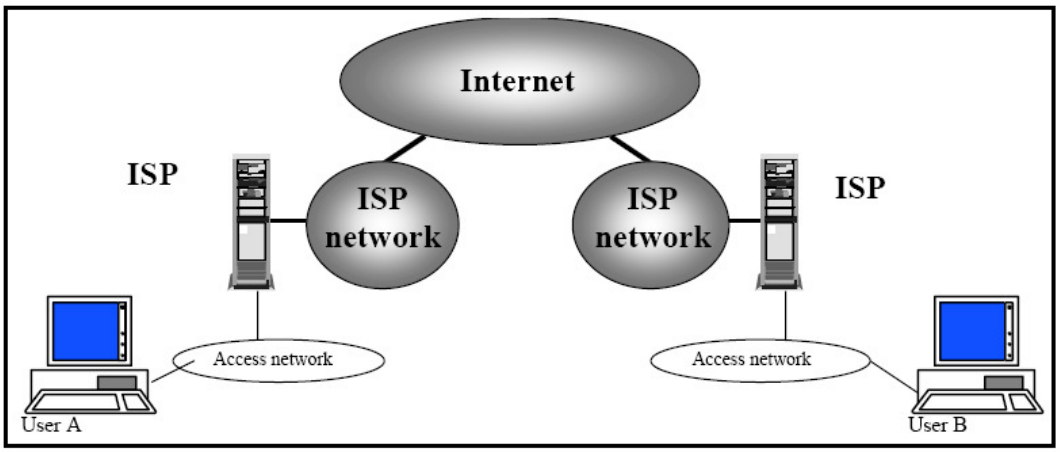


Fig. 2.3 PC-to-PC Internet telephony

2.2.3 **PC-to-Phone Internet telephony:** In this type of Internet telephony, user at one end connects his PC or equivalent device to Internet connection provided by an ISP while user at other end is a PSTN/PLMN subscriber (refer Fig. 2.4). User A, when connected to Internet has to use the services of some Internet Telephony Service Provider (ITSP) operating Internet telephony gateway to connect to called PSTN/PLMN subscriber (User B). This gateway will handle all signaling relating to the telephone call at the called party end. User A runs software (Dialer) installed at his PC (Equivalent device) to dial the number of the user B. Hence user of this type of Internet telephony must have knowledge to operate computer for making such Internet telephony calls. ITSP are presently permitted to provide one-way PC-to-Phone service for International long distance outgoing calls only on PSTN/PLMN abroad to such countries where termination of Internet telephony calls are permitted.

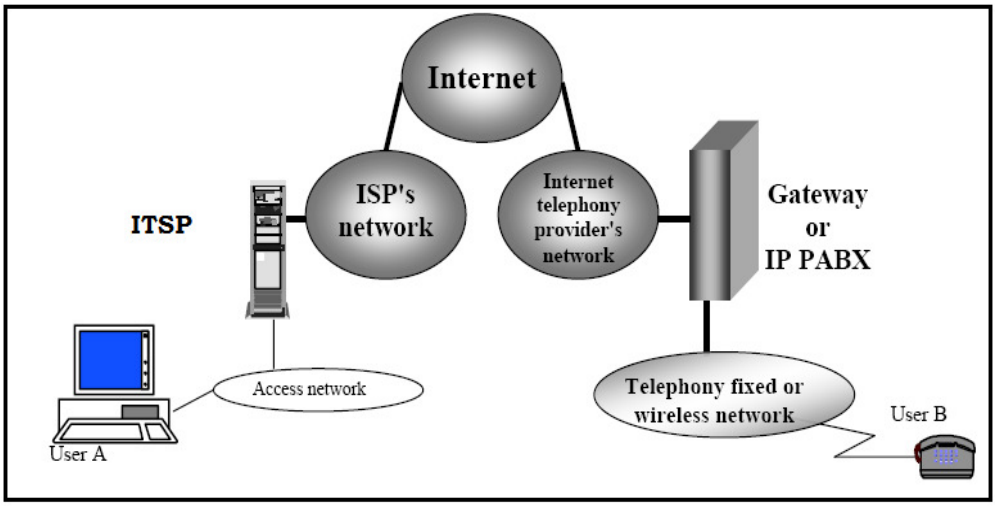


Fig. 2.4 PC-to-Phone Internet telephony

2.2.4 **Internet telephony using adapter boxes:** This is an advanced version of PC to Phone communication where functionalities of the PC are performed by a device called adapter. Internet telephony subscriber uses an adapter (similar to modem box), which is installed between the user's conventional telephone set and Broadband Customer premise equipment (CPE) (refer Fig.2.5). In this mode of Internet telephony subscriber need not have any knowledge of computer and can use conventional telephone instrument to dial user B number as in any normal TDM telephone. Such user-friendly and cheaper IP access devices (like Analog Telephone Adaptors (ATA)) usually provided by ITSPs to make Internet telephony call is making this form of Internet telephony popular. The adapter converts voice into IP packets and sends it through Internet to VoIP gateway of ITSP for further routing of the call. Recently government has permitted ISPs to provide Internet telephony services using standardized ATAs to call PSTN/PLMN numbers abroad. Under present ISP licensing conditions any device / Adapter conforming to prescribed standards is permitted to make Internet Telephony calls to similar device / Adapter within or outside India. However such adapters can only be used to make Internet Telephony calls to PSTN/PLMN numbers abroad.

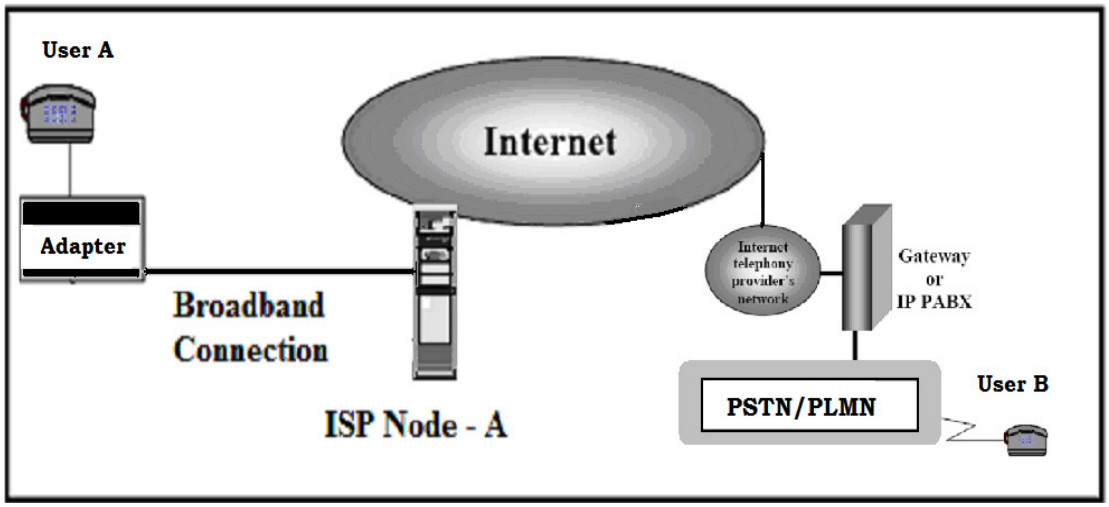


Fig. 2.5 Internet telephony – Use of Adapter

2.2.5 **Unrestricted Internet telephony having interconnection with PSTN/ PLMN:** This type of Internet telephony is similar to type using adapters. In para 2.2.4 we have used the functionalities of VoIP gateway for termination of calls on PSTN/PLMN abroad. Since these recommendations especially concentrate on processing of call for termination on PSTN/PLMN within the country, the detailed functionality of such Internet telephony is important.

2.2.5.1 The SIP based Internet telephony using Public Internet cloud and ENUM database is one of the most popularly used technique to process Internet telephony calls. In this method, the Internet telephony provider (ISP) allocates one E. 164 number to its subscriber. He also provides a Session Initiated protocol device (SIP Device) properly configured and pointing to Internet telephony service provider with which this ISP has agreement to provide Internet telephony service.

2.2.5.2 An Internet Telephony call from a particular service provider to a destination telephone number served by another service provider comprises of sending a Session Initiated Protocol (SIP) INVITE message from an originating device to SIP server of its provider. The SIP server queries a T**e**lephone **Nu**mber **M**apping (ENUM) server of

service provider(s) (first, second or a third provider). ENUM server maintains Uniform Resource Identifier (URI) details of subscribers. The ENUM server may be internal or external to the service provider. The query of ENUM server gives detail of Uniform Resource Identifier (URI) associated with the destination E. 164 telephone number. The service provider query a Domain Name Server (DNS) based on the URI information received from ENUM server and receives Internet Protocol (IP) address of SIP server of the called party service provider. The originating service providers SIP server and called party SIP server are used to set up a bearer path for the Internet Telephony call between the originating and destination switch. Details of routing of an Internet based SIP calls in ENUM environment is discussed in Annexure-III. Fig. 2.6 & 2.7 explains details of IP-to-IP calls and IP-to-PSTN/PLMN calls respectively.

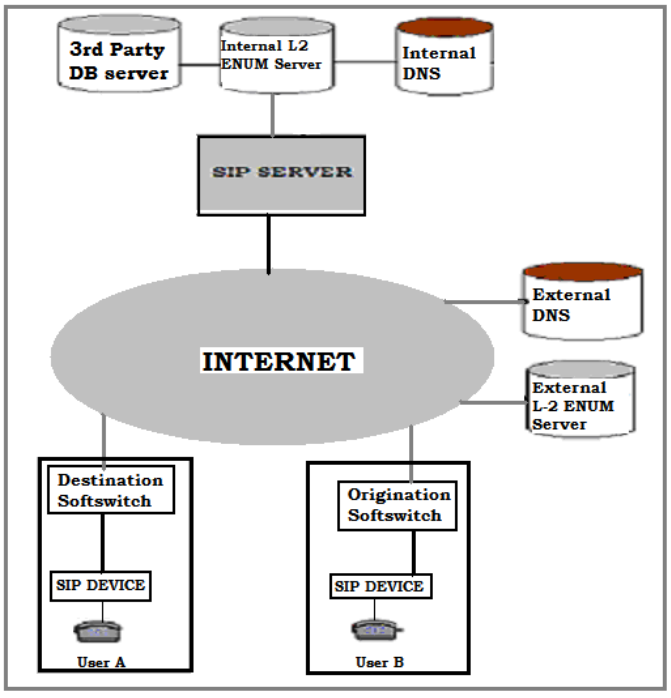


Fig. 2.6 ENUM based call routing

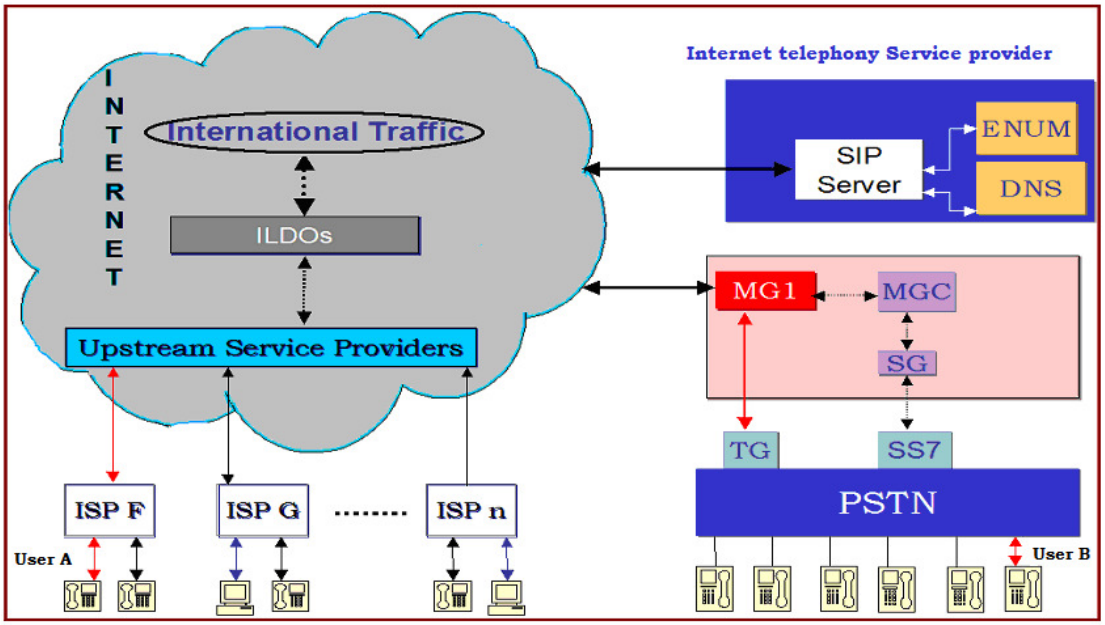


Fig 2.7: Termination of Internet telephony call at the nearest soft switch gateway

2.2.6 **Phone to Phone Internet telephony:** In this mode of Internet Telephony subscribers at origination and destination use normal telephone. The call in this method is made through IP Based managed/ unmanaged network according to various options available. The cost saving by transmitting the call over IP based network may be passed on to the user in the form of lower tariff as compared to that of normal end-to-end TDM calls. Various mode of Phone to Phone Internet Telephony is possible depending on the method used by the carrier and tariff plans offered to the subscribers:

a) **Phone-to-Phone telephony using IP Network of same service provider:** In this mode of phone-to-phone telephony both calling (User A) and called (User B) parties are normal PSTN/ PLMN users. Both users use their telephone sets for having normal voice communication. This means that one or more telecommunication operators have established gateways that enable the transmission of voice over dedicated IP network in a way that is transparent to

telephone users. This mode of Internet Telephony uses "managed" IP network environment, i.e. a network using IP protocol has been dimensioned in such a way as to guarantee carrier class voice quality to end subscribers. This is part of normal telephone service and subscriber is not aware of the technology being employed by the access service provider for putting through his call. Figure 2.8 illustrates such a scenario. In this scenario, the gateways and managed IP network could belong to either an integrated service provider or to different service providers. The service providers can use IP technology in their long distance network reducing cost of carriage and enhancing network efficiency. Such configurations for providing Internet Telephony are normally termed as VoIP. This type of network is becoming very popular especially on International long distance networks.

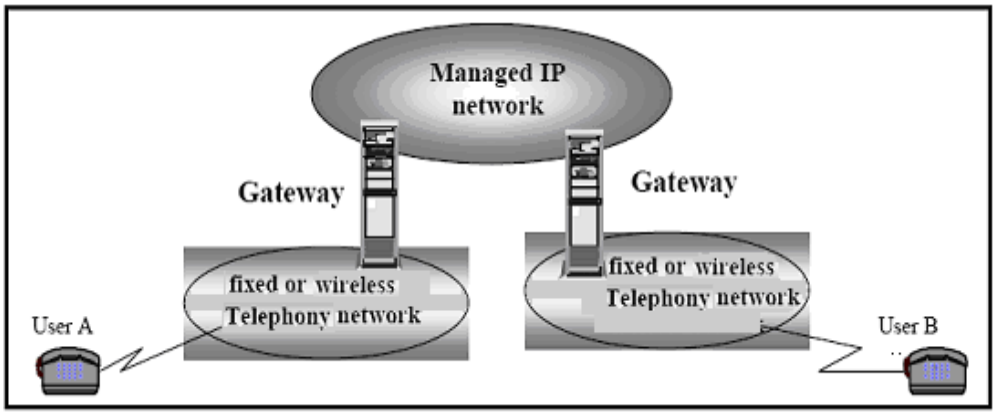


Fig. 2.8 Phone-to-Phone telephony using IP Network

b) **Phone-to-Phone telephony using Carrier Selection:** In this mode of phone-to-phone telephony also both calling (User A) and called (User B) parties are normal PSTN/ PLMN users. The only difference in this mode is that long distance IP based network as described in para 2.2.6 (a) belongs to a different service provider. The caller has the option to choose long distance network to carry his call by dialing certain prefix digit(s) before dialing destination numbers.

Such selected Long distance network may be using IP Protocol either managed or unmanaged (i.e. through internet cloud) which routes subscriber's call towards destination on its network. Carrier selection introduces the competition in long distance network including use of IP based network for carriage of voice call. This method of Internet Telephony is prevalent in some countries where carrier selection is permitted for making long distance calls.

c) **Phone-to-Phone telephony using Toll free Number Dialing:** In this mode of phone-to-phone telephony also both calling (User A) and called (User B) parties are normal PSTN/ PLMN users. The caller dials a toll-free number over the PSTN/PLMN connection, which can belong to any ISP/Internet Telephony Service provider providing the Internet Telephony service. The service provider in this case sells the Internet Telephony minutes through pre-paid card. Once connected Internet Telephony Service provider authenticates the subscriber, prompts him to dial the desired subscriber number, carries the Internet Telephony call over its managed/unmanaged IP based Network and finally terminate it in the desired telecom network. The originating subscriber's access network gets access charges either directly by subscriber or through the Internet telephony service provider depending on the commercial agreements. The call in this case is end-to-end IP based within Internet telephony provider's network. This is very user-friendly method of providing Internet telephony and therefore very popular across the globe.

2.3 **Quality of Service:**

2.3.1 Quality of Service of an IP network used for telephony is also an important issue. The packet mode of data transmission used by IP networks may introduce degradation in speech quality due to following factors:

- Packet Loss: Possible disappearance of packets during the communication. Highly stable media like optical fiber reduces packet loss to virtually zero.
- Delay: This refers to transit time, including the time taken to reassemble the packets upon arrival and compensate for fluctuations in transit times (this overall transit time must be lower than 400 ms.). Such delays are network dependent and are taken care in network designing.
- Jitter: Variation in the packet arrival delay. Synchronization of network is very important to reduce such jitter.
- Echo: This refers to the delay between the transmission of a signal and receipt of the same signal as an echo. Effective echo cancellation can be used in well-planned networks.

2.3.2 The planning of the IP networks have to take into consideration these issues to ensure good quality of Internet services to the subscribers.

Chapter 3

Regulatory Issues

3.1 The telecom licensing framework of India segregates the service providers according to scope of the license for providing various kinds of services to subscribers. The present licensing framework provides following licenses:

Name of License	**Telecom Service provided**
Basic Service Operator	Wireline Telephony
Unified Access Service License	Access service including Wire line, Wireless Telephony and Internet access services
Cellular Mobile Telecom Service	Wire less Telephony
Internet Service Provider	Internet Access Service, Restricted Internet telephony
National Long Distance	Domestic Long Distance service
International Long Distance	International Long Distance service

Table 3.1- Type of licenses

3.2 The present regulatory framework permits Basic Service Operators (BSO), Unified Access Service Licensee (UASL) and Cellular Mobile Telecom Service (CMTS) licensees to provide traditional voice services within country. They have been permitted to provide unrestricted Internet Telephony also i.e. Internet Telephony service within and outside country. The relevant clauses of UASL and CMTS licensees are reproduced below:

Clause 2.2 (a)(i) of UASL

"*… Access Service Provider can also provide Internet Telephony. Internet Services and Broadband Services. If required, access service provider can use the network of NLD/ILD service licensee."*

Clause 2.1 (a) of CMTS License

"*… The Licensee can also provide Internet Telephony, Internet Services and Broadband Services. If required, the Licensee can use the network of NLD/ILD service licensee …".*

3.3 Although UASL & CMTS license permits the licensee to provide Internet Telephony since 14.12.2005 & 06.02.2006 respectively, so far this service has not been started by these service providers. Internet telephony has been clearly defined for UASL, CMTS and BSO as *""Internet Telephony" Means "Transfer of message(S) including voice signal(S)* ***through public Network".***

3.4 Internet Telephony is also permitted to Internet Service Providers (ISPs) in restricted manner under new ISP licensing conditions issued by government in October 2007. As per ISPs licensing provisions, there is no restriction on PC-to-PC Internet Telephony calls. PC or adapter can be used to call PSTN/PLMN abroad, however Internet Telephony calls from such devices to PSTN/PLMN in India are not permitted under ISP license. ISPs are also not allowed to have interconnection with PSTN/PLMN networks.

3.5 The scope of services as stated under Clause 2.2(ii) of Part II in ISP License for provision of Internet Services is reproduced below:

"Internet telephony mean a service to process and carry voice signals ***offered through Public Internet*** *by the use of Personal Computers*

(PC) or IP based Customer Premises Equipment (CPE) connecting the following:

a) *PC to PC; within or outside India*
b) *PC / a device / Adapter conforming to standard of any international agencies like- ITU or IETF etc. in India to PSTN/PLMN abroad.*
c) *Any device / Adapter conforming to standards of International agencies like ITU, IETF etc. connected to ISP node with static IP address to similar device / Adapter; within or outside India.*

Explanation: Internet Telephony is a different service in its scope, nature and kind from real time voice service as offered by other licensed operators like Basic Service Operators (BSO), Cellular Mobile Service Operators (CMSO), Unified Access Service Operators (UASO)."

Addressing under Clause 2.2 (iv):

"Addressing scheme for Internet Telephony shall only conform to IP addressing Scheme of Internet Assigned Numbers Authority (IANA) exclusive of National Numbering Scheme / plan applicable to subscribers of Basic / Cellular Telephone service. Translation of E.164 number / private number to IP address allotted to any device and vice versa, by the licensee to show compliance with IANA numbering scheme is not permitted.

Interconnection under Clause2.2 (v):

"The Licensee is not permitted to have PSTN/PLMN connectivity. Voice communication to and from a telephone connected to PSTN/PLMN and following E.164 numbering is prohibited in India".

3.6 From the discussions in para 3.3 and 3.5, it is clear that Internet telephony means carrying of voice signals through Internet cloud. The

deliberations in this chapter will focus on transmission of voice signals through Internet cloud (Un-managed public networks).

3.7 The rapid technological developments and better quality of voice communications are shaping the future of telecom. The enormous increase in data traffic in international scenario, increasing acceptability of IP networks, adoptability of NGN by many countries, and very liberal regulatory regime for Internet telephony require a fresh review of existing licensing conditions in India. It presents a dilemma. While the present regulatory framework denies fruits of technological advancements to reach to common masses, on the other hand permitting these services under various licenses may raise the issue of the level playing field. Globally telecommunications are being shaped by steep growth of broadband and wireless subscribers. The regulatory environment should be dynamic, enabling, efficient and encourage competition. Hence regulatory framework for Internet telephony has to be considered in view of convergence and other similar developments taking place across the globe.

3.8 Several countries have opened up their markets further for new and cost effective services such as Internet telephony by creating conducive conditions. Worldwide, the regulatory trends and practices are supporting technological neutrality, competition and introduction of technological advancements in telecom sector. Importantly, organizations such as World Bank, International Telecommunication Union etc have actively favored deployment of IP based networks and services for achieving optimum telecom growth and cost effective telecom services to subscribers.

3.9 In view of the above discussions, the Authority has considered regulatory framework, which enables technological developments, innovations and growth of the telecom sector for benefit of common masses while ensuring that business models of telecom service providers are not adversely impacted. Minimum necessary

amendments to existing licensing framework have been recommended protecting overall licensing framework**.**

3.10 **Level Playing Field**

3.10.1 Having discussed the existing regulatory framework and need to permit ISPs to provide Internet telephony with a facility to terminate Internet telephony calls on PSTN/PLMN within India (henceforth called unrestricted Internet telephony), the moot issue for deliberation is whether such permission will impact level playing field among various type of telecom service providers.

3.10.2 The issue was flagged for comments of the stakeholders during consultation process on "Issues related to Internet telephony".

3.10.3 Stakeholders are clearly divided on level playing field issue. The Access providers vehemently opposed opening of unrestricted Internet Telephony to Internet Telephony Service providers but ISPs, ILDOs, NLDOs and application service providers wanted that Internet telephony with facility to terminate Internet telephony calls on PSTN/PLMN should be opened immediately.

3.10.4 The main argument by access service providers' is that they have paid huge entry fee and have made heavy investments to create infrastructure. The opening up of unrestricted Internet telephony to ISPs will impact their business model to a great extent as they apprehend reduction of voice traffic on their network, which will affect their business prospects adversely. They feel that access providers are subjected to higher regulatory levies, already paid huge upfront entry fee and have huge sunk-in investments on infrastructure developments, hence their overheads will be higher as compared to ISPs if ISPs are permitted to provide unrestricted Internet telephony. As per them it will disturb level playing field among different licensees. They also submitted that infrastructural developments can be impacted due to reduced margins if ISPs start unrestricted Internet

telephony. Access providers are of strong opinion that in case ISPs want to offer unrestricted Internet telephony then ISPs should also pay the same entry fees and levies as paid by access service providers.

3.10.5 On the other hand ISPs, NLDOs, ILDOs, and application service providers argued in favor of opening of unrestricted Internet telephony immediately. They pointed out that there is absence of major IP Based services like Internet Telephony though the Access Service Providers have been permitted for providing such services since 2006. They claimed that fruits of technological advancements are restricted by regulatory framework and common masses are deprived of popular innovative services like Internet telephony. It was strongly argued that the fruits of convergence and technological developments should not be denied to common masses any further. They also pointed out that all the major resources employed by the Internet Service Providers today are taken from access Service providers and NLDOs. They pay huge charges for such resources to access providers. They demanded that ISPs (Generally non –facility based operators) should not be compared with access service providers and they should be subjected to lighter regulatory framework as done in various other countries.

3.10.6 As discussed earlier present regulatory framework in our country provides for different licenses. The entry fee, regulatory levies are different on different licensees. The details of entry fee, license fee etc has been compiled in table 3.2:

License	**Entry Fee**	**License fee (% of AGR)** *USO: 5% of license fee** *Administrative fee 1% of license fee**
Unified Access Service	It is licensed service area wise. The total entry fee to obtain license for all circle comes to Rs. 1651 Crores	Metro & Category A Service Area: 10% Category B Service Area: 08% Category C Service Area: 06% Spectrum charges levied separately
Cellular Mobile Telecom Service	No new license proposed to be issued but existing licensees have paid entry fee	Metro & Category A Service Area: 10% Category B Service Area: 08% Category C Service Area: 06%
Basic Service Operator	No new license proposed to be issued but existing licensees have paid entry fee	Metro & Category A Service Area: 10% Category B Service Area: 08% Category C Service Area: 06%
Internet Service Provider	Category A Service Area: Rs. 20 Lakhs Category B Service Area: Rs. 10 Lakhs	6 % (Only for revenue from Internet Telephony Services) Minimum amount to be paid: Category A Service Area: Rs. 50,000/- per annum Category B Service Area: Rs 10000/- per annum
National Long Distance	Rs. 2.5 Crore	6%
International Long Distance	Rs. 2.5 Crore	6%

** Applicable only to UASL, CMTS and BSO*

Table 3.2: Details of entry fee, License fee etc for different licensees.

3.10.7 From the table 3.2, It is clear that entry fee of ISPs is comparatively very low and they are subjected to lower license fee. The important issues of concern is to analyze the impact of permitting unrestricted Internet telephony to ISPs on access service providers and to suggest measures to ensure availability of Internet telephony to common masses.

3.10.8 The ISPs at present are heavily dependent on the resources of access service providers for provisioning of Internet Services to end-users.

According to an industry estimates as high as 85% of revenue presently being earned by an ISP is used to hire resources. These resources are taken from access providers (UASL, BSO), NLDs and ILDs. This situation warrant a consideration as to whether the ISPs, mostly being non-facility based operators, by merely providing unrestricted Internet Telephony will acquire equal footing to access service provider and will be capable of rocking the business model of access providers who will remain the major providers for all resources.

3.10.9 In case the ISPs are permitted unrestricted Internet telephony, the identification of potential subscribers is critical. The good quality voice through Internet telephony will require high speed Internet access through which such services are permitted. That is, such Internet telephony subscribers must have access to minimum 256 Kbps Internet commonly known as broadband. The number of broadband (BB) subscribers at end of June 2008 is 4.38 Million as per the information available with TRAI. Inspite of initiatives by Government to enhance the present broadband penetration, including allocation of spectrum for BWA & 3G services the target of 20 Million broadband subscribers by 2010 is a distant dream. Even if achieved the broadband subscribers remain a very insignificant percentage compared to total telephone users, which is 325.78 Million at the end of June 2008, and increasing at an average rate of 8 Million per month. Therefore unrestricted Internet Telephony by ISP does not appear to be capable to impact access providers' business model significantly.

3.10.10 If the Internet Telephony is allowed to ISPs with facility to terminate Internet telephony calls on PSTN/PLMN, then initially most of the calls origination from ISPs Internet telephony subscribers will be destined for PSTN/PLMN networks. This is likely to bring additional revenue to PSTN/PLMN access providers in the form of termination

charges based on the applicable termination charges per minute from time to time.

3.10.11 The increase in ISPs traffic will require additional resources to process the Internet telephony traffic and provide the service. Since most of the ISPs are non-facility based, they have to acquire additional resources from access providers, NLDs and ILDs. This will again increase the resource utilization of the access providers, NLDs and ILDs and support access providers' business model.

3.10.12 Internet telephony has been permitted to ISPs in almost all the countries. There are no reports of serious impact on business interests of access providers. In fact many countries are coming up with different regulatory framework defining facility-based operators and non-facility based operators. Liberal permissions are given to non-facility based operators to start different services. This is increasing competition and giving better options to the subscribers.

3.10.13 It may not be out of place to mention that International regulatory practices generally treat ISPs with light touch regulations. The time has come to review regulatory restriction imposed on ISPs in reference to Internet Telephony in Indian context. The Internet telephony is a powerful application and capable to drive broadband growth. Such initiative to improve broadband penetration is urgently desirable as higher broadband growth will have very positive impact on the economy of the country.

3.10.14 The Authority is of view that regulatory provisions shall be technology neutral and should not act as a barrier to extend the fruits of technological innovations to the end users. The end-users in country must be delivered the innovative and cost effective services, which is the main aim to innovate any new technological platform.

3.10.15 In view of above, the Authority recommends that Internet telephony with permission to terminate Internet telephony calls on PSTN/PLMN within country may also be permitted to ISPs.

3.10.16 **The Authority recommends**

- **Internet telephony may be permitted to ISPs with permission to provide Internet telephony calls to PSTN/PLMN and vice-versa within country. Necessary amendments may be made in the license provisions.**

3.11 **Interconnection:**

3.11.1 As discussed in preceding paras, ISPs are being permitted to provide Internet telephony with facility to terminate Internet telephony calls on PSTN/PLMN and vice-versa within country. This will require some form of interconnection between ISPs and access providers.

3.11.2 There may be different options available to facilitate termination of Internet telephony calls on PSTN/PLMN; however such methodology have to be selected keeping in view various aspects such as least modifications in existing interconnection model, ease of facilitation, technological feasibility, reduction in long distance call charges and fast roll out of Internet telephony services. Regulatory restriction should not preclude introduction of the technology. Financial burden on existing access service providers have to be minimized to boost Internet telephony services. Any mandate as far as possible must be avoided.

3.11.3 Various technical possibilities and their regulatory implication have been analyzed in details in paras to follow with emphasis on suitable model facilitating termination of unrestricted Internet Telephony calls from ISPs to PSTN/PLMN within the country.

3.11.4 One of the easiest options is to permit direct interconnection between ISPs and access service providers. Direct interconnection of Access providers and ISPs is not permitted at present. Apart from regulatory restrictions on interconnections, this methodology seems unviable/impractical for reasons discussed below:

- As per the latest information 78 Category “A”, 115 Category “B” and 145 Category “C” ISPs are licensed in the country. Even if we restrict the provision of direct interconnection with PSTN/PLMN to category “A” ISPs only, still it will require large number of ports for interconnection. This will become tedious task and may require additional equipment by access providers to make available such large number of ports for Point of Interconnection (POI). The possibility of increase in number of category “A” ISPs subsequently resulting in further demand of POIs cannot be ruled out. This may open up a Pandora’s box as such ISPs will require Interconnections at several places with PSTN within the access providers’ network in order to abide by the present Interconnection regime. An ISP will have to connect with PLMN network of different mobile operators at the GMSC levels and with the PSTN network at various SDCAs level in order to successfully terminate its Internet telephony traffic on PSTN/PLMN across the license area.
- The huge demand of point of Interconnection will create very complex network and will require huge access network resources unnecessarily affecting their network planning in long run. The South Korea experience during initial phase of provisioning of unrestricted Internet Telephony with above method of interconnection clearly brings out pitfalls in this methodology.
- The rollout of Internet Telephony by the willing ISPs using this method of interconnection is likely to be delayed.
- ISPs will have to incur heavily to arrange resources for such interconnections at multiple POIs with various access service providers. This will be a wasteful expenditure. Internet Telephony will loose cost advantage by using this methodology, which is the main driver for Internet telephony.

- Present regulatory provision in ISP license does not permit direct interconnection of access service providers with ISPs. Major changes in access providers' licenses shall be required to permit such interconnections.
- ISPs will be required to execute large number of Interconnection agreements with access providers, which may create complications apart from financial burdens, delaying the process and may run in legal disputes.
- In case of direct connectivity between ISPs with access service providers, Category "A" ISPs may like to carry inter-circle Internet Telephony calls on their networks impacting NLDs business model. This may also raise complications.

3.11.5 Other method may be to connect ISPs to access providers through an intermediate entity. In this method, the intermediate entity may setup interconnection with access service providers' networks at one end and with Internet cloud on the other hand. The biggest advantage of this methodology is simplicity of interconnection with access service providers and no additional resource requirement at ISPs side as this entity takes IP packets from ISPs through Internet cloud.

3.11.6 Some of the advantages of this type of interconnection are:

- Since this entity is having interconnection arrangement with access service providers, ISPs will not require any direct commercial interconnection with access service providers.
- ISPs will not require any additional resources to handover Internet telephony traffic as such traffic can be picked up through Internet cloud. ISPs will simply handover their Internet traffic using their upstream provider.

- ISPs will require commercial agreement with only one such intermediate entity simplifying the total business model. This will drastically reduce the roll out time for Internet telephony.
- ISPs may not require any direct settlement with access service provider for termination charges to PSTN/PLMN. Instead such intermediate entity will do the call termination charge settlement on behalf of ISPs.
- The intermediate entity may also handle Internet telephony call routing and call flow control if mutually agreed, facilitating start of unrestricted Internet telephony services within the country.

3.11.7 The analysis of present licensing framework indicates that National long distance (NLD) operators are permitted to have POI with access service providers and also have their national network. NLD operators seem to be in best position to serve as intermediate entity for ISPs for terminating Internet Telephony calls on PSTN/PLMN. Most of the NLD operators already have interconnection agreement with PSTN/PLMN for termination of voice calls. Presently there are 23 National long Distance Operators with all major NLDOs having networks presence across the country. Therefore the NLDO can act as intermediate entity for carrying unrestricted Internet telephony calls originated from ISPs network for termination on PSTN/PLMN and vice versa. Such NLDs may require suitable modification in Interconnection agreements if they decide to carry Internet telephony calls and facilitate termination of such calls on PSTN/PLMN.

3.11.8 According to the clause 17.1 of NLD license access service providers are mandated to provide network interconnection to NLDO:

It shall be mandatory for Basic Service Providers, Cellular Mobile Service Providers, Unified Access Service Providers, Cable Service Providers, to provide interconnection to NLD service providers whereby

the subscribers could have a free choice to make inter-circle/international long distance calls through NLD service provider."

3.11.9 Scope of work of National Long Distance operators defined in clause 2.2 (a) of NLD license emphasizes carriage of inter-circle calls of access service providers:

"The NLD Service refers to the carriage of switched bearer telecommunications service over a long distance and NLD Service Licensee will have a right to carry inter circle traffic excluding intra - circle traffic except where such carriage is with mutual agreement with originating service provider".

3.11.10 It is therefore clear that NLDO are presently doing similar nature of work as discussed for intermediate entity in para 3.11.5. NLD therefore can have an agreement with ISPs to carry their inter-circle as well as Intra-circle calls to PSTN/PLMN and facilitate termination. The call charges reconciliation may also be facilitated by NLDOs.

3.11.11 As regard handover and carriage by a NLD operators, clause 2.2 (b) and 2.2 (c) of license states:

Clause 2.2 (b)

"The LICENCEE can also make mutually agreed arrangements with Basic Service Providers for picking up, carriage and delivery of the traffic from different legs between Long Distance Charging Center (LDCC) and Short Distance Charging Centers (SDCCs)."

Clause 2.2 (c)

"In the case of Cellular Mobile Telephone Service traffic, the inter-circle traffic shall be handed/taken over at the Point of Presence (POP) situated in LDCA at the location of Level I TAX in originating/terminating service area…."

3.11.12 From the above discussion, it is clear that NLD can carry and handover intra-circle calls with mutual consent of originating service providers. Since Internet telephony calls will not have any other

channel for handling Intra-circle calls, it shall be desirable to make explicit provision so that NLDs can facilitate termination of Internet telephony calls on PSTN/PLMN originated from ISPs within the telecom circle also.

3.11.13 DoT issued clarification to Clause no. 2.2(a) of NLD license. As per clarification handover, takeover, termination etc of the intra-circle traffic shall continue to be governed by the terms and conditions of license agreement of the originating service provider, irrespective of whether the traffic is carried by the originating service provider itself or through NLDO. Since ISPs have no direct connectivity with PSTN/PLMN, the point of interconnection for Intra-circle calls from ISPs for termination on PSTN/PLMN shall have to be decided. The Interconnection aspect falls within jurisdiction of TRAI and shall be governed by regulations, directions, and determination issued by the Authority under TRAI Act 1997. Suitable provisions in this regard need to be included in the NLD licensing conditions.

3.11.14 As per clause 16.3 and 16.5 of NLD license terms and conditions, NLDs are entitled to setup media gateway switch for inter-networking between circuit switched and VoIP based networks. The extracts of the clauses are reproduced below:

Clause 16.3

"Interconnection with the switched networks of different service providers within India shall be as per national standards of CCS No.7 issued from time to time by Telecom Engineering Center (TEC). For interconnection with Packet Switched network of different service providers within India relevant national standards are to be followed. For inter-networking between circuit switched and VoIP based network of NLD Service Licensee & Access Service Licensee, the NLD service licensee shall install media Gateway Switch. There shall be no bar installation of Media Gateway switch by Access Service Licensee"

Clause 16.5

"The licensees (who are International Long Distance, National Long Distance, Basic or Cellular Mobile Telephone service operators) can have only one Switch to perform the functions of ILD/ NLD/Cellular/ Basic services provided that the switch is located at the same station and separate accounts of all the operations are maintained by duly apportioning the costs between various service. Separate TAX and Gateway switch is not mandatory. NLD service providers are permitted to deploy circuit switched or managed Packet Switched network to engineer their NLD networks"

3.11.15 It may be noted that NLD at present are permitted to route NLD traffic only through managed packet networks. Since we are envisaging facility of routing Internet telephony traffic through NLD network to terminate PSTN/PLMN calls. NLD must be permitted to route such Internet telephony calls through unmanaged network (Internet cloud) also.

3.11.16 NLD licensee as per clause number 17.8 is also allowed to negotiate interconnection charges with other networks subject to IUC regulations and instructions issued by TRAI from time to time under TRAI Act, 1997. Therefore an ISP willing to route its Internet Telephony calls can make mutual agreement with such NLD who want to act as intermediate entity.

Clause 17.8

"The charges for access or interconnection with other networks for origination, termination and carriage of calls shall be based on mutual agreements between the service providers subject to the restrictions issued from time to time by TRAI under TRAI Act, 1997."

3.11.17 The carriage charges to facilitate termination of Internet telephony calls on PSTN/PLMN shall be guided by IUC regime and in no case will be more than the upper ceiling limit prescribed by TRAI. This will facilitate mutually agreed carriage charges in competitive market environment.

3.11.18 From above discussions it is clear that NLD operators can facilitate termination of Internet telephony calls on PSTN/PLMN; however it will require suitable amendments in existing NLD license(Refer Annexure V & VI). These modifications will enable NLD to carry Internet telephony calls for termination on PSTN/PLMN. As no mandatory provisions are being prescribed, it will not impact those NLD operators who do not wish to provide services related to Internet telephony. The AGR of NLD will also include revenues earned from facilitating termination of Internet telephony calls on PSTN/PLMN.

3.11.19 NLD operators willing to facilitate termination of Internet telephony shall make all technical arrangement necessary to facilitate termination of Internet telephony calls from ISPs to PSTN/PLMN and vice-versa. This may include:

- Creation of ENUM database containing URI entries related to Internet telephony subscribers connected to ISPs and served by NLD.
- ENUM database may also include URI or carrier code of all the PSTN/PLMN subscribers along with information of nearest IP Gateway.
- Allocation of domain name to ENUM gateway server.
- DNS to resolve domain name to IP address.
- Creation of Internet telephony subscriber database (Served by other NLDs (IT)) along with their master domain name.

3.11.20 Department of Telecom while allocating the numbering resources to ISPs for Internet Telephony calls will also indicate the ENUM gateway

domain name proposed to be used by the ISPs. This will help NLD to maintain its own local database for Internet telephony subscribers served by other ISPs and map it with ENUM gateway domains for processing of call.

3.11.21 The ISPs willing to offer unrestricted Internet Telephony may have to perform very limited functions such as allocating E.164 number to subscribers, pre-configuring SIP devices etc. Additional function can also be performed by ISPs except taking Interconnection with PSTN/PLMN. Call termination at PSTN/PLMN shall be facilitated through NLD only. ISPs while providing Internet telephony calls to PSTN/PLMN shall ensure that such calls are successfully routed to terminating service providers. This will facilitate fast roll out of the Internet telephony service.

3.11.22 The NLDs may be in better position to maintain CDR of the calls being processed through it on behalf of the ISPs, which in turn can help reconciliation of termination charges with PSTN/PLMN. ISPs offering Internet Telephony can also maintain CDRs of their calls deploying dedicated equipment. Maintenance of CDRs of Internet telephony calls shall be prime responsibility of ISPs as per present licensing provisions.

3.11.23 It may be noted here that Internet telephony calls from ISPs to NLD shall be routed through Internet cloud. Therefore NLD operators shall have to arrange sufficient bandwidth to facilitate routing of Internet telephony packets from ISPs to NLD gateway. Cost of such bandwidth shall be born by NLD. NLD will charge call carriage charges from ISPs for Internet telephony calls on per minute basis based on mutual negotiations and within prescribed upper limit specified by TRAI from time to time. The exchange of information between ISPs and NLD shall be using IP protocol through Internet cloud. No direct connectivity between NLD operators and ISPs except through public Internet is envisaged at this stage.

3.11.24 Sometimes it is argued that ISP providing the Internet lease line to NLD may ask for higher lease line charges and even demand for per call charges as the link is used to carry Internet telephony calls. This may seriously impact the business model for Internet telephony.

3.11.25 Here it may be noted that Internet lease lines are charged based on the pipe size, QoS supported and service level agreements. The type of applications and services supported on the Internet lease line are not the consideration for Internet lease line charge. The very popularity and success of the Internet is due to Net neutrality, i.e packets of all services and applications shall be processed and delivered without any discrimination by the intermediate service providers.

3.11.26 It can also be argued that the advantage of so-called Internet telephony is due to use of IP packets and its inherent capability to efficiently utilize the bandwidth. Hence, in all probability NLD may use their dedicated packet network for carriage of such Internet telephony calls from ISPs and may follow almost same path as followed for existing access providers. Therefore, such calls will neither be cheaper nor serve any other meaningful purpose.

3.11.27 Though it may be possible for NLD to route Internet telephony calls using its conventional network, we must lay more emphasis on prevailing business models world over. The technological innovations are consolidating separate Internet and dedicated IP networks in one single network with possibility to create tunnels for dedicated point-to-point use. Such networks also support access to Internet. Any network, which is accessible to public and not closed in itself, is termed as Internet cloud as Internet cloud is group of interconnected networks. Effective resource utilization, prioritization of the packets on IP networks, and busty nature of data traffic enables very high bandwidth utilization, which is generally not feasible in case of dedicated point-to-point links. International experiences also indicate great success of Internet telephony using Internet cloud. Hence the

possibility of use of Internet cloud to process Internet telephony calls in our country is also very high.

3.11.28 As far as routing of calls from PSTN/PLMN to ISP's Internet Telephony subscribers are concerned, the access providers based on the called telephone number will route Internet telephony calls to NLD. NLD will analyze the called party number and route the call to concerned ISP through Internet cloud. The access providers shall negotiate such call handling charges with NLD.

3.11.29 The Authority has considered various issues and is of the opinion that termination of Internet telephony calls on PSTN/PLMN from ISPs and vice-versa may be facilitated through NLD.

3.11.30 **In view of above, the Authority recommends**

- **ISPs shall be permitted to have interconnection with NLD operators through public Internet (Internet cloud) only for the purpose of provision of unrestricted Internet telephony within country.**
- **National Long Distance (NLD) Operators shall be permitted to connect to ISPs through public Internet (Internet cloud) to facilitate termination of Internet telephony calls on PSTN/PLMN and vice-versa including among ISPs both within telecom circle as well as across the telecom circles.**
- **The terms and conditions of Interconnection including standard interfaces, point of interconnection and technical aspects shall be governed by guidelines/ orders/ Directions/ Regulations issued from time to time by TRAI under TRAI Act 1997.**
- **The AGR of NLD for the purpose of calculation of license fee shall include revenue from carriage of Internet telephony also apart from their normal revenue.**

- **The agreement between ISPs and NLD to facilitate termination of Internet telephony calls on PSTN/PLMN shall be on mutual agreement basis. TRAI shall monitor the progress and may intervene in case mutual agreements are not effective.**
- **NLD shall negotiate carriage charges with ISPs within the ceiling limit prescribed by TRAI under IUC regulations from time to time. In no case, carriage charges shall be more than upper ceiling limit prescribed by TRAI.**
- **NLD shall make suitable commercial and technical arrangements with access providers (PSTN/PLMN) and ISPs to facilitate Internet telephony call termination on PSTN/PLMN and ISPs.**
- **DoT shall also indicate the ENUM gateway domain name proposed to be used by the ISP while allocating the numbering resources to ISPs for Internet Telephony calls.**

3.12 **Applicability of Interconnect Usage Charge (IUC):**

3.12.1 The present licensing framework clearly defines Interconnect Usage Charges (IUC) among service providers. This facilitates settlement of the interconnection charges smoothly and curbs the possibility of the disputes.

3.12.2 The IUC framework defines Rs 0.65/ - per minute as an upper ceiling for the carriage charges and a fixed Rs 0.30/- per minute for termination of the calls on PSTN/ PLMN irrespective of the technology being used in such networks for termination of calls. This IUC framework have been very effective in the past as it succeeded in overall regulating interconnection charges yet leaving lot of scope to service providers for bringing new tariff packages and effective competition among the service providers. This time tested IUC framework can easily be applied to the Internet telephony being

envisaged to ISPs with facility to terminate on PSTN/PLMN network. No change in existing IUC regime to enable Internet telephony services within India is envisaged at this stage.

3.12.3 The ISPs providing Internet telephony shall not be treated as access service providers. Therefore any change in IUC regulations shall be done by TRAI under relevant provisions of TRAI Act 1997 as amended from time to time.

3.13 **Numbering**

3.13.1 Internet telephony to call PSTN/ PLMN abroad is permitted under ISPs license however use of number resources is not permitted. Clause 2.2 (iv) of ISPs license reads as:

3.13.2 ISPs license Clause 2.2 (iv):

"Addressing scheme for Internet Telephony shall only conform to IP addressing Scheme of Internet Assigned Numbers Authority (IANA) exclusive of National Numbering Scheme / plan applicable to subscribers of Basic / Cellular Telephone service. Translation of E.164 number / private number to IP address allotted to any device and vice versa, by the licensee to show compliance with IANA numbering scheme is not permitted.

3.13.3 Therefore ISPs providing Internet telephony call cannot use number resources either from National E.164 numbering plan or private numbers by converting it to IP addresses subsequently. In case Internet telephony calls from ISPs are permitted to terminate on PSTN/ PLMN within country, the users can dial the E.164 number of the PSTN/PLMN. However such Internet telephony subscribers cannot receive incoming calls from PSTN/ PLMN networks. The only option to establish a call between two Internet telephony subscribers provided by ISPs is to dial an IP address, SIP ID or URL which is not very user friendly as it is difficult to remember such numbers, and require very different procedure for dialing. Moreover instruments, which are

capable of dialing IP addresses, are costly and not so common in use in India.

3.13.4 UASL, CMTS and BSO licensees are also permitted to provide Internet telephony defined as " "Internet Telephony" Means "Transfer of message(s) including voice signal(s) through Public Internet". From the definition, it appears that UASL, CMTS and BSOs are permitted to provide Internet Telephony calls including termination to PSTN/PLMN subscribers within the country. These licensees are also allocated number resources for PSTN / PLMN subscribers. Still, there is ambiguity, if these licensees can use their allocated number resources for their Internet telephony subscribers. Even if we assume for the sake of discussion that they can provide their number resources to Internet telephony subscribers also, the moot question remains whether there should be uniform numbers for Internet Telephony, which is easily identifiable across the service providers irrespective of the category of the license.

3.13.5 The issue was flagged for comments of the stakeholders. While there was complete unanimity that number resources should be provided to Internet telephony subscribers no specific comments were received on whether such numbering resources should be easily identifiable across the operators or otherwise.

3.13.6 It is worth noting that Internet telephony can be offered without allocation of number resources from E.164 numbering plan. However, it is not possible to call an Internet telephony subscriber from an existing PSTN/PLMN network without allocation of a number, which can be recognized, by the traditional fixed and mobile telecom network. This will greatly restrict the scope and popularity of the Internet telephony services.

3.13.7 The fruits of technological innovations will reach to common masses if convergence between Internet and telephony is permitted to flourish in on un-restricted manner. Needless to say that allocation of user-

friendly numbering plans for Internet telephony is desirable. This will not only help the subscribers for originating Internet telephony calls but will also help in identifying a subscriber from the Calling Line identification (CLI) display.

3.13.8 In view of above discussion, it seems necessary to allocate number resources for Internet telephony; however available number resources are limited. The present numbering plan may not be able to cater to the requirement of mobile telephone number requirements till 2010, when total telephone subscribers base (Excluding Internet Telephony) is likely to be 500 Million. Telephone number resources are scare and needs to be used most efficiently and optimally.

3.13.9 DoT has recently constituted a committee to look into the additional telephone number requirements and suggest solutions. It is understood that 11 digit-numbering scheme is being suggested instead of existing 10 digit number allocation especially keeping in view the mobile subscribers growth. The increasing popularity of Internet Telephony and its growth in other countries require detailed study of number resources requirement for Internet telephony subscribers also. Based on the study, appropriate number blocks may be earmarked for Internet telephony in newly recommended 11 digit numbering plan.

3.13.10 The Internet telephony is very different when compared to present PSTN/PLMN. It requires minimum 256 Kbps Internet connections for good speech quality. The incoming calls shall be feasible only when broadband is connected and functioning well. Identification of such Internet telephony numbers from other PSTN/PLMN numbers will be desirable. Considering distinct service features of Internet telephony, a separate series of numbers may be necessary for Internet telephony services irrespective of the license under which such services are being provided. Since Internet telephony supports CLI, it is desirable

that Internet telephony service providers for the benefit of subscribers also provide calling line identification.

3.13.11 As discussed above, efficient use of number resources is necessary and has to be ensured. ISPs desirous to provide Internet Telephony Service may be allocated number resources from the identified Internet telephony service numbers in a block of 1000 numbers or it's multiple. ISPs license does not commit allocation of E.164 numbers. Hence DoT may prescribe charges for E.164 number allocation to ISP's, if any, considering availability of number resources, ISP's business model etc. No fee for allocation of the numbers shall be charged from UASL, BSO & CMTS for allocation of such numbers. Additional numbers to these licensees shall be allocated only after they submit proof of utilization of 60% allocated numbers for Internet telephony.

3.13.12 Once the number resources have been allocated for Internet telephony services, their proper record and mapping with ENUM server domain (IP address) of Internet telephony provider gateway will be desirable for efficient processing of the Internet telephony calls. It is envisaged that NLD shall facilitate Internet telephony call routing and such NLD are likely to be more than one. Hence all such NLD must maintain database mapping all Internet Telephony numbers with their respective ENUM gateway server domain name. This can be facilitated by DOT. DOT while allocating number resources for Internet telephony to ISPs, UASLs, CMTSs and BSOs may also indicate the domain name of the respective ENUM server gateway. Based on this information, all NLD shall update their records within 10 working days.

3.13.13 **In view of above, the Authority recommends**

- **Allocation of E.164 number resources may be permitted to ISPs also for providing Internet telephony.**

- **TEC to conduct the study to assess Internet Telephony number resource requirement. Based on the study, appropriate number blocks may be earmarked for Internet telephony in newly recommended 11 digit numbering plan.**
- **ISPs providing Internet telephony services shall be allocated number resources from the earmarked Internet Telephony number resources in a block of 1000 numbers or it's multiple.**
- **DoT may prescribe charges for E.164 number allocation to ISPs, if any, considering availability of number resources, ISP's business model etc.**
- **UASPs, BSOs & CMSPs shall also be allocated number resources to provide Internet telephony from the identified blocks earmarked for Internet telephony. No fee shall be charged from UASPs, BSOs & CMSPs for allocation of number resources for Internet telephony service. Additional number resources shall be allocated to access service providers, for Internet telephony, only after they submit proof of utilization of 60% allocated numbers.**
- **DOT shall notify the domain name of the respective ENUM domain while allocating number resources for Internet telephony to ISPs, UASLs, CMTS and BSOs. Based on this information, all NLD facilitating Internet telephony shall update their records within 10 working days.**

3.14 **Emergency number Calling**

3.14.1 The facility to call nearest authority like hospital, police, fire station etc has been termed as Emergency Number calling. Accurate identification of geographical location of subscriber is a must for availing emergency services. The concept of emergency number calling has changed with introduction of the mobile services. It is envisaged

that accurate location of the caller will also be available to the authority (Hospital, Police, Fire-station) handling emergency situation along with emergency number calls.

3.14.2 Different telecom networks adopt different technologies to facilitate emergency number calling. In case of usage of Internet telephony services from a fixed location, it is possible to map the position information and route emergency calls to appropriate agency. However, one of the promising features of Internet telephony services is the nomadic use. In the nomadic use it may be difficult to accurately map position information while originating the emergency call. The issue is being debated world over.

3.14.3 There are various technical options available to make emergency number call even using Internet telephony. One of the simplest options is to route emergency services call to appropriate geographically decentralized emergency service centers and provide them with the appropriate location information. A soft switch in such cases can effectively handle emergency number calls and provide sufficient location information, though such information may not very accurately point to subscriber's geographical location.

3.14.4 The prevailing International scenario to facilitate emergency number calling is different in different countries. Some of the countries have gone ahead with Internet telephony services without mandating emergency number calling facility. They have emphasized the issue of transparency and desired that Internet Telephony service provider shall inform their subscribers that Internet telephony service will not support emergency numbers calling. There are other countries, which have mandated emergency numbers calling. Further analysis of introduction of Internet telephony internationally indicates that emergency number calling was not initially mandated and internet telephony initially was subjected to very light regulatory restrictions.

As the services matured, it was subjected to more stringent conditions such as emergency number calling.

3.14.5 Stakeholders also suggested that emergency number calling to Internet telephony service providers should not be mandated. It should be left to the service providers whether to provide emergency number calling or not. Almost all the stakeholders emphasised that status of emergency number calling facility must be informed to the subscribers by Internet Telephony service provider so that subscribers can take informed decision.

3.14.6 Presently there are only 4.38 million broadband subscribers in the country. The good voice quality on Internet telephony call will require minimum 256 Kbps Internet access speed. Therefore the number of Internet telephony users atleast to start with will be limited. It is important that telephone tele-density in urban India is now more than 60. It can be assumed that many subscribers will also be using either fixed or mobile phone in addition to Internet telephony service. Therefore such subscribers can avail emergency number access through such phones.

3.14.7 The Authority is aware of the need and importance to facilitate emergency number calling. Imposition of restrictions and mandatory obligations may kill the initiative to provide unrestricted Internet telephony before a service can commercially pickup. In order to strike a balance, the Authority is of the view that Internet telephony service providers may be encouraged to facilitate access to emergency number calls; however they may not be mandated to provide such services at present. The Authority will review its decision to mandate Emergency Number Calling at appropriate time. Internet telephony service providers must inform their subscribers' availability/ non-availability of emergency number calling facilities in unambiguous terms. The Authority shall consider mandating emergency number calling using Internet telephony services at appropriate time.

3.14.8 **In view of above, the Authority recommends**

- **Internet telephony service providers may be encouraged to facilitate access to emergency number calls; however they may not be mandated to provide such services at present.**
- **The Authority will review its decision to mandate emergency number dialing at appropriate time.**
- **Internet telephony service providers must inform their subscribers' availability/ non-availability of emergency number calling facilities in unambiguous terms.**

3.15 **Lawful Interception and Monitoring**

3.15.1 Lawful Interception and Monitoring of the telecom networks is necessary for security and integrity of the country and to check unlawful activities. Like any other Public Telephony service, an Internet telephony service is also subjected to Lawful Interception by national security agencies.

3.15.2 Internet itself is a vulnerable platform and can employ higher level of encryption then permitted, posing serious threat for decoding of the message. Therefore there is a need to mandate effective lawful interception facility to all ISPs and NLD (IT) providing Internet telephony services.

3.15.3 Many stakeholders have suggested that the service providers offering Internet telephony service should be required to install the appropriate interception equipment to facilitate Lawful Interception and Monitoring keeping in view of Government concern on national security.

3.15.4 The use of the advance encoding and encryption techniques by Internet telephony service providers can pose a challenge to lawful interception and monitoring. Here it is important to recognize vital requirement of lawful enforcement authorities to monitor and

intercept the Internet based voice signal traffic. Hence ISPs providing Internet telephony have to ensure that encryptions if used should confirm to the provisions given in the ISPs license. At present only 40 Bit encryption is permitted. Therefore in no case higher degree of encryption is used. The higher degree of encryption is only permitted if the encryption key is given to enforcement agencies in advance.

3.15.5 Clause 2.2 (vii) 0f ISP license states, "*The Licensee shall ensure that Bulk Encryption is not deployed by ISPs. Further, Individuals/ Groups/ Organizations are permitted to use encryption up to 40 bit key length in the symmetric key algorithms or its equivalent in other algorithms without obtaining permission from the Licensor. However, if encryption equipments higher than this limit are to be deployed, individuals/groups/organizations shall obtain prior written permission of the Licensor and deposit the decryption key, split into two parts, with the Licensor".*

3.15.6 Clause no 34 of ISP license issued by DoT in October 2007 stipulates detailed security guidelines including monitoring facilities. It is expected that all ISPs providing Internet telephony shall abide by all such provision or any additional provision prescribed by licensor or TRAI from time to time.

3.15.7 It is important to note here that effective lawful interception equipments are deployed in different countries and are commercially available. All ISPs willing to provide Internet telephony services must install such equipment prior to start of such services. The effectiveness of such equipments may get certified in advance from the security agencies. DOT may provide numbering resources to ISPs willing to provide Internet telephony only after receiving a copy of the security agencies clearance to LI equipment.

3.15.8 **In view of above, the Authority recommends**

- **Each Service provider intended to provide Internet telephony service within country shall install Lawful Interception (LI) equipment fulfilling all the requirements stipulated by the security agencies.**
- **Each Service provider intended to provide Internet telephony service within country should abide by the provisions related to encryption as prescribed in the respective license. All ISPs providing Internet telephony shall also abide by additional provision prescribed by licensor or TRAI from time to time.**
- **All Service Providers providing Internet telephony within country shall ensure installation of suitable LI equipment in time bound manner as prescribed by DoT.**
- **Pre-clearance of LI equipment by security agencies shall be required prior to starting of Internet telephony services.**
- **DoT may not allocate number resources to ISPs willing to provide Internet telephony services until security clearance for LI equipment from security agencies is obtained.**

3.16 **Interoperability & Standardization**

3.16.1 Different technical standards are used for Internet telephony services. For the benefit of users, it is important to establish interoperability between these standards. The interoperability so implemented can either be technological or commercial in nature. These developments are required to be monitored by regulators, and if the market players do not find adequate solutions for interoperability, regulatory measures may be necessary.

3.16.2 Some stakeholders have suggested that it should be ensured that internationally accepted standards are followed to ensure interoperability between IP networks and traditional TDM networks while permitting Internet telephony. On the contrary some

stakeholders also suggested that standardisation for Internet telephony may not be regulated, as it would unnecessarily increase the cost of service and CPEs. Regulatory intervention for standardization and interoperability may impede growth of budding technologies.

3.16.3 It is important to note that ISPs providing Internet telephony have to make pre-agreement with NLD, configure the device accordingly before supplying the same to subscribers. In majority of cases such devices are likely to be provided by service providers or at least pre configured before activation of services. Once interoperability of such customer end devices and NLD is established, call can flow in the network and will not be impacted by the type of device being used by subscriber being dialed. Moreover cost of customer premises devices have comedown drastically. Any mandate may restrict rollout of service and have added financial burden than the cost of such customer premises devices.

3.16.4 Presently the customer premises devices are being provided by using standard international protocols only. Also very few devices are available in the market for making Internet telephony calls. Therefore the issue of interoperability and standardisation may not be of large significance now. The Authority is of the view that interoperability and standardisation should be left to the market forces at present. However, the Authority will monitor the market developments and if required, will review the same at a later stage.

3.16.5 **In view of above, The Authority recommends**

- **Interoperability and standardization should be left to the market forces at present. The Authority will monitor the market developments and will review the same at a later stage if required at appropriate time.**

3.17 **QoS for Internet telephony services**

3.17.1 A subscriber who is accustomed to carrier-grade voice quality from PSTN /PLMN services will expect similar quality from Internet telephony service providers also irrespective of the technology used to provide such services.

3.17.2 The quality of voice had been a great challenge for Internet telephony in the past, but it has improved to great extent in recent years. In many cases quality of Internet telephony is so good that its discrimination from carrier grade service is not easily possible. The use of advanced coding technologies and other innovative mechanism play important roll in further improving voice quality.

3.17.3 Many operators are now using advanced protocols such as Multi-Protocol Label Switching (MPLS), which runs on an IP network's routers, and gives priority to certain type of IP packets. Some cable operators also have developed technology that will provide good voice quality. For instance, CableLabs has developed PacketCable specifications that are designed to provide quality of service to a variety of IP-enabled services including Internet telephony, interactive gaming and broadband audio-visual services.

3.17.4 TRAI in its "Regulation on Quality of service for VoIP based International long distance service 2004" have defined certain parameters for International long distance segment like End to end delay not exceeding 150 ms, Jitter not exceeding 5 ms, packet loss not exceeding 0.1% and R-value greater than 80. At that point of time Internet telephony within country on PSTN/ PLMN was not considered.

3.17.5 Many stakeholders are of the view that there is no need to mandate QoS for provisioning of Internet Telephony. They also opined that market forces will compel the service providers of Internet Telephony services to compete on quality of service and price, among other

factors, which should ultimately ensure that customers receive the quality of service they demand at best price.

3.17.6 It will be important to mention that Indian telecom is very competitive market with presence of six to eight access providers in each telecom circle. Internet telephony service providers, when entering the market, have to provide comparable voice quality to capture the market. The need for survival of such Internet telephony providers and their commercial models will force them to strive for the better QoS. Artificial regulatory restrictions to impose QoS while permitting unrestricted Internet telephony within country may not be desirable at present.

3.17.7 The Authority is of the view that QoS on Internet telephony may be left to the market forces at present. The service provider must inform this aspect to their subscribers so that they can take informed decision. The Authority shall review the decision regarding mandating QoS to Internet telephony service providers at appropriate time.

3.17.8 **In view of above, The Authority recommends**

- **QoS on Internet telephony may be left to market forces at present.**
- **The service providers must inform QoS parameters supported by them to their subscribers so that they can take informed decision.**
- **The Authority shall review the decision regarding mandating QoS to Internet telephony service providers at appropriate time.**

Chapter 4

Summary of Recommendations

4.1 Level Playing field *(para 3.10.16)*

4.1.1 **Internet telephony may be permitted to ISPs with permission to provide Internet telephony calls to PSTN/PLMN and vice-versa within country and necessary amendments made in the license provisions.**

4.2 Interconnection *(para 3.11.30)*

4.2.1 **ISPs shall be permitted to have interconnection with NLD operators through public Internet (Internet cloud) only for the purpose of provision of unrestricted Internet telephony within country.**

4.2.2 **National Long Distance (NLD) Operators shall be permitted to connect to ISPs through public Internet (Internet cloud) to facilitate termination of Internet telephony calls on PSTN/PLMN and vice-versa including among ISPs both within telecom circle as well as across the telecom circles.**

4.2.3 **The terms and conditions of Interconnection including standard interfaces, point of Interconnection and technical aspects shall be governed by guidelines/ orders/ Directions/ Regulations issued from time to time by TRAI under TRAI Act 1997.**

4.2.4 **The AGR of a NLD for the purpose of calculation of license fee shall include revenue from carriage of Internet telephony also apart from their normal revenue.**

4.2.5 **The agreement between ISPs and NLD to facilitate termination of Internet telephony calls on PSTN/PLMN shall be on mutual agreement basis. TRAI shall monitor the progress and may intervene in case mutual agreements are not effective.**

4.2.6 **NLD shall negotiate carriage charges with ISPs within the ceiling limit prescribed by TRAI under IUC regulations from time to time. In no case, carriage charges shall be more than upper ceiling limit prescribed by TRAI.**

4.2.7 **NLD shall make suitable commercial and technical arrangements with access providers (PSTN/PLMN) and ISPs to facilitate Internet telephony call termination on PSTN/PLMN and ISPs.**

4.2.8 **DoT shall also indicate the ENUM gateway domain name proposed to be used by the ISP while allocating the numbering resources to ISPs for Internet Telephony calls.**

4.3 Numbering *(para 3.13.13)*

4.3.1 **Allocation of E.164 number resources may be permitted to ISPs also for providing Internet telephony.**

4.3.2 **TEC to conduct the study to assess Internet Telephony number resource requirement. Based on the study, appropriate number blocks may be earmarked for Internet telephony in newly recommended 11 digit numbering plan.**

4.3.3 **ISPs providing Internet telephony services shall be allocated number resources from the earmarked Internet Telephony number resources in a block of 1000 numbers or it's multiple.**

4.3.4 **DOT may prescribe charges for E.164 number allocation to ISPs, if any, considering availability of number resources, ISP's business model etc..**

4.3.5 **UASPs, BSOs & CMSPs shall also be allocated number resources to provide Internet telephony from the identified blocks earmarked for Internet telephony. No fee shall be charged from UASPs, BSOs & CMSPs for allocation of number resources for Internet telephony service. Additional number resources shall be**

allocated to access service providers, for Internet telephony, only after they submit proof of utilization of 60% allocated numbers.

4.3.6 **DOT shall notify the domain name of the respective ENUM domain while allocating number resources for Internet telephony to ISPs, UASLs, CMTS and BSOs. Based on this information, all NLD facilitating Internet telephony shall update their records within 10 working days.**

4.4 Emergency number Calling *(para 3.14.8)*

4.4.1 **Internet telephony service providers may be encouraged to facilitate access to emergency number calls; however they may not be mandated to provide such services at present.**

4.4.2 **The Authority will review its decision to mandate emergency number dialing at appropriate time.**

4.4.3 **Internet telephony service providers must inform their subscribers' availability/ non-availability of emergency number calling facilities in unambiguous terms.**

4.5 Lawful Interception and Monitoring *(para 3.15.8)*

4.5.1 **Each Service provider intended to provide Internet telephony service within country shall install Lawful Interception (LI) equipment fulfilling all the requirements stipulated by the security agencies.**

4.5.2 **Each Service provider intended to provide Internet telephony service within country should abide by the provisions related to encryption as prescribed in the respective license. All ISPs providing Internet telephony shall also abide by additional provision prescribed by licensor or TRAI from time to time.**

4.5.3 **All Service Providers providing Internet telephony within country shall ensure installation of suitable LI equipment in time bound manner as prescribed by DoT.**

4.5.4 **Pre-clearance of LI equipment by security agencies shall be required prior to starting of Internet telephony services.**

4.5.5 **DoT may not allocate number resources to ISPs willing to provide Internet telephony services until security clearance for LI equipment from security agencies is obtained.**

4.6 Interoperability & Standardization *(para 3.16.5)*

4.6.1 **Interoperability and standardization should be left to the market forces at present. The Authority will monitor the market developments and will review the same at a later stage if required at appropriate time.**

4.7 QoS for Internet telephony services *(para 3.17.8)*

4.7.1 **QoS on Internet telephony may be left to market forces at present.**

4.7.2 **The service providers must inform QoS parameters supported by them to their subscribers so that they can take informed decision.**

4.7.3 **The Authority shall review the decision regarding mandating QoS to Internet telephony service providers at appropriate time.**

Annexure-I

International Experience

1. United State of America

The FCC Wireline Competition Bureau has granted a petition for a declaratory ruling filed by Time Warner Cable in March 2006, which requested that all wholesale telecommunications carriers be entitled to interconnect and exchange traffic with incumbent local exchange carriers (ILECs), including traffic originating from VoIP service- based providers. The Commission must promote competition in every sector it oversees and create a level playing field among service providers.

The FCC made clear that the obligation to provide local number portability extends to interconnected Voice over Internet Protocol providers and the telecommunications carriers that obtain numbers for them. FCC changed its relatively liberal regulatory environment to one where VoIP services that interconnect with the PSTN must provide access to emergency services, in line with the requirements that apply to incumbents.

In June 2006, the FCC voted unanimously to require taxes on all VoIP services that connect to the PSTN. The tax revenue will be used by the Universal Service Fund, which subsidizes phone service in rural and low-income areas. Wireless, wire line, payphone and DSL providers already contribute to the fund.

In response to requests by the Federal Bureau of Investigation (FBI), the U.S. Congress enacted the Communications Assistance for Law Enforcement Act (CALEA) On 25 October 1994. CALEA defines obligations for telecommunications carriers to cooperate with law enforcement when served with a lawfully authorized surveillance order. The Federal Communications Commission (FCC) ruled that

telecommunications carriers must be CALEA-compliant by 30 June 2002.

As telecommunications technology evolved from analog POTS to VoIP, based on a petition from the FBI, DEA and DoJ, in September 2005 FCC extended lawful intercept obligations to interconnected VoIP and facilities based broadband access providers. Some of the provisions of CALEA are following:

- A telecommunications service provider that does not comply with CALEA requirements is liable to a penalty of $10,000 per day.
- The Attorney General may pay carriers for all reasonable costs incurred by telecommunications service providers in order to comply with the legislation and a special fund has been set up for this purpose.

If a telecommunications service provider uses devices that are in compliance with the standards put forward by the industry or an organization, it is to comply with the requirements on interception capability.

2. Canada

Canadian Radio-television and Telecommunication Commission (CRTC) will regulate the VoIP only for domestic use keeping in view service neutrality. Regulation of VoIP will be at such place where local competition is not permitted. PSTN-interconnected VoIP services have the regulatory status of telecommunication services. VoIP providers are thus classified similar to competitive local carriers with following conditions:

- Access to numbers and local number portability
- Access to directory listing
- Equal access to inter exchange carriers

Canadian Radio-Television and Telecommunications Commission (CRTC) required VoIP providers to offer emergency 911 services. In addition, they were obliged to notify customers about limitations to their services. VoIP operators are required to contribution to national service fund as well.

The lawful interception of communications was provided for in the Criminal Code and the Canadian Security Intelligence Service Act. In order to include new communications technologies like wireless data networks and Voice over Internet Protocol in the ambit of Canada's law enforcement community Modernization of Investigative Techniques Act was introduced in 2005.

3. Singapore

In June 2005, IDA introduced a VoIP regulatory framework that included minimal obligations to encourage the adoption of VoIP services. Two sets of numbering ranges were assigned to VoIP services for this purpose. VoIP operators providing VoIP services using level "3" numbers are not required to meet number portability, directory or emergency services or IDA's QoS levels, but must inform users of service limitations and provide clear information to subscribers about service capabilities (emergency service access and quality). Facilities-based operators use level "6" numbers, the number range currently reserved for fixed-line PSTN voice services, for VoIP services if they can provide number portability, emergency services, directory enquiry and printed directory services, and ensure QoS levels equivalent to local fixed-line services. However, service providers will have to ensure that customers understand limitations.

4. Malaysia

Malaysia has also adopted Light regulation for encouraging to VoIP services. MCMC guidelines on telephony over IP were released in July 2005. VoIP is defined as fixed service under service access prefix 0154, but 'nomadic' services are also allowed. An account holder with a VoIP telephony provider can access services through any IP telephony device, through PSTN dial-up; broadband; or, cellular. There is no regulation for QoS, retail prices and termination / origination prices. However, providers are "encouraged" to provide emergency access.

5. Thailand

As per National Telecommunications Commission (NTC), Internet service-provider licensees could now start offering a Voice over Internet Protocol (VoIP) calling service from phone to phone. The operators of the phone-to-phone VoIP service will also be subject to the NTC interconnection charge regime, which requires all telecom operators to share voice and data revenues between the networks involved in the calls on a fair basis. The NTC has allocated the prefix of 06 mainly for providing the VoIP service from phone to phone, including other new telecom-technology services, under its interim numbering plan. The phone-to-phone VoIP service will use the 06 prefix, followed by an eight-digit number.

6. Indonesia

In Indonesia VoIP license is generally awarded to ISP – Internet Service Provider. These VoIP operators are classified as service-based operators, because they do not have their own customer base, but provide services to the customers of PSTN and Mobile operators. Almost all of VoIP operators are using a two-step dialing scheme using the 170XY access code and dependent of E1 line from PSTN and/or mobile operators. Other than the existing PSTN and cellular operators, other operators may be given single step dialling using 010XY access code,

but they cannot operate this method before they have the agreement of the incumbent PSTN and mobile operators. Given the present network condition in Indonesia, where the majority of the networks are still narrow-band, VoIP PC-to-PC is classified as an ISP service. But in the near future, VoIP operators will probably be able to build their own customer base using the IP networks (e.g WiFi, WIMAX). The Government is now considering the growth of VoIP for network or facility-based operators, instead of as service-based operator as it is now. Therefore, it will be necessary to re-formulate some regulatory issues like numbering, access code, routing, interconnection etc.

7. Hong Kong

In June 2005 OFTA published a statement on "Regulation of IP Telephony" for enabling service-based operators to be allowed to compete with facility-based operators and ensure Technological Neutrality. As regard to Interconnection service are divided into Class-1 Services in which IP telephony offered with services attributes similar to those of conventional telephone services- SPS to fulfil basic telephonic licensing conditions and Class-2 Services that do not have the same attributes as conventional telephony and attracts minimal regulation. Class 1 service is an IP telephony service that has all the attributes of the conventional telephone service. These carry eight-digit numbers and a '2' or '3' as prefix. Class 2 services do not have all the attributes of the conventional telephone service and are distinguished by their '57' or '58' prefix. However, number portability is provided only by Class 1, but not by Class 2 IP telephony service. Both classes of providers are obliged to provide free emergency call services and back-up power supply for 'lifeline' devices.

8. Korea

The first VoIP services began in 1999. Facility Based Operators and their resellers were permitted to provide Internet telephony with a prefix

70. In order to provide internet telephony, Facility-based provider need to have more than 60 PoIs to PSTN and mobile network, whereas resellers need to have minimum 12 PoIs to PSTN and 1 PoI to mobile network. Internet Telephony Service Providers (ITSPs) were allowed to interconnect via Internet. However, this resulted in a too complicated Interconnection and billing system as an ITSP needs multiple cooperations and systems to interconnect to PSTN and mobile network. ITSPs also need to run mobile Number Portability Database (NPDB) and also need to install trunk gateway.

In order to address the above problems, initial trial for implementation of ENUM started in 2003. In the first phase ENUM-based call routing was implemented. In the second Phase ENUM-based VoIP Clearing House for ITSP was setup. Initially all the ITSPs are required to interconnect via VoIP Clearing House, however, they have to maintain separate PoIs with PSTN and mobile networks. In the third and final phase PSTN and mobile operators will also be connected to VoIP Clearing House enabling a single point for exchange of VoIP traffic between ITSPs and PSTN/mobile networks.

9. Japan

VoIP is permitted and is subjected to minimal regulation in Japan. Tariff and access charges not regulated and Interconnection is required only if VoIP SP is facility based. Access charges by VoIP SP to terminate the calls on PSTN are being made. Japan is only country, which has adopted QoS based controls for VoIP services. Three levels of call quality have been defined based on the resultant value of Transmission Rating Factor (R-value).

- No QoS: PC to PC communication, no separate numbering required
- Minimal QoS: In term of end to end QoS and voice delay, “050” – prefix numbers
- Normal QoS: Same numbers a s PSTN

Emergency calls and direct access must be available from VoIP lines, and numbers must observe location correspondence.

10. Europe

Under the EU regulatory framework of July 2003, players (including VoIP providers) are free to enter the market for electronic communications services without prior authorization, provided they abide by the conditions of the general authorization applicable in each Member State. European Commission (EC) strongly promotes Industry self-regulation for VoIP services. However, Individual national regulators under EC are free to follow own set of regulation. EU Regulatory Framework requires Member States to put in place arrangements to ensure that calls to emergency services are adequately answered and handled. The prime concern of EC is that VoIP operators clearly inform customers about the limitations of the services.

In the European Union, the European Council Resolution of 17 January 1995 on the Lawful Interception of Telecommunications stipulates operational needs of Law Enforcement Agencies (LEAs) with respect to interception of public telecommunication networks and services. This applies to all telecommunications services, circuit and packet switched, fixed and mobile networks and services.

11. United Kingdom

VoIP services are subjected to Industry self-regulation. Operators need to make customers aware of VoIP limitations. Emergency access has been mandated by OFCOM recently. Special VoIP numbering scheme with prefix '056'/ '055' is adopted and both Geographical and non-geographical numbers are allocated. However, number portability is not mandated yet. OFCOM also issued guidelines for consumers on buying & using VoIP services.

In July 2000, the United Kingdom enacted the Regulation of Investigatory Powers Act (RIPA) for regulating the powers of public bodies to carry out surveillance, investigation and interception of communications. RIPA allows a Cabinet Minister, in practice the U.K. Home Secretary, to impose obligations upon providers of publicly available communication services to maintain a reasonable intercept capability. It was introduced to take account of technological change such as the growth of the Internet and strong encryption. RIPA is technology neutral in its coverage and also enables the government to demand ISPs to fit equipment to facilitate surveillance.

RIPA has provisions for payment to be made in order to compensate holders of communications data for the costs involved in complying with provisions of RIPA. This may include arrangements for payments to be made out of money provided by Parliament.

12. Czech Rep.

VoIP services including prices remain unregulated as a data service. VoIP providers do not have to be an owner of a telecommunications license for provision of PSTN services. Operators and service providers need to sign interconnection agreements with other operators, with a "model" agreement on interconnection has been developed by the APVTS Economic Committee. A number of operators offer VoIP services and the Czech regulator Česky Telekomunikacní Úrad assigned the service number 910 in the Numbering plan to VoIP services.

13. Italy

The Italian Communications' Regulatory Authority ("ICRA") has issued its decision no. 11/06/CICR, which regulates the provision of Voice over Internet Protocol Services and makes the necessary amendments

to the national telephone numbering plan. (the "VoIP Decision"). As for nomadic services (and number portability towards fixed lines as well) they are introduced and a special numbering ("5") is assigned exclusively to VoIP services. The VoIP Regulation opens VoIP "5" numbering to listing in the national telephone directories

14. **Norway:**

Most of the VoIP providers currently operating in Norway fall within Category-3 VoIP Providers offerings VoIP services with any-to-any communication enabled. Within this category, a gateway to the PSTN/ISDN or mobile networks exists, giving the possibility to both call and receive calls from POTS.

Geographic numbers are opened for use by VoIP providers. Furthermore, porting of such numbers from POTS to VoIP providers shall be allowed. Use of geographic numbers are contingent upon that the service is marketed and appears as a fixed line telephony substitute, and principally is used from the end-user's permanent address. If the VoIP service is marketed for nomadic use, non-geographic numbers from the 85x-series shall be used. The 85x-series has been dedicated to nomadic VoIP use. Numbers from the Norwegian national numbering plan shall be used in Norway. However it will be possible to use Norwegian numbers dedicated to nomadic VoIP use for limited periods abroad, in the same way as Norwegian mobile phone numbers can be used abroad by Norwegian users (roaming).

VoIP services that are used on fixed locations only will not be exempted from the obligation to provide caller location information available to authorities handling emergency calls. VoIP providers that offer services that can be used nomadically, will have an option to be granted temporary exemptions from the emergency calls caller location requirement based on further conditions, inter alia an obligation to inform its customers about potential risks.

Providers of Category 3 VoIP services shall measure and report the quality of their services. Norwegian Post and Telecommunications Authority (NPT) is currently revising the method for reporting quality for Category 3 VoIP services. In this process NPT will assess which parameters the providers of Category 3 VoIP services shall measure and report.

Category 3 VoIP services are included in the relevant retail markets for fixed telephony and the relevant wholesale markets for call origination, call termination and transit services in the fixed public telephone network. Providers of Category 3 VoIP services who can affect their own termination price are designated as providers with significant market power (SMP) in the markets for call termination in their own fixed network. These providers are subject to specific regulation, e.g. the regulation of call termination prices.

15. Portugal

ANACOM has approved the public consultation report on VoIP, which sets out regulatory guidelines for this new service. In the light of the rising consumer demand, it has become necessary to clarify the obligations and rights of VoIP service providers and, most importantly, ensure that consumer interests are protected and that competition is encouraged. ANACOM has also created a new “30" number range in the National Numbering Plan to accommodate nomadic Voice over Internet Protocol (VoIP) numbers.

As regards numbering and portability, the regulator considered that, where VoIP is provided to a fixed location, a geographic number could be attributed, with the service provider being responsible for fulfilling this requirement (Use at a single fixed location). At the same time, however, it was decided to make a new range of non-geographic numbers available that would distinguish nomadic-use VoIP from fixed telephone services

Concerning access to the emergency service, ANACOM considers that all VoIP providers, including nomadic-use VoIP whose services are included in the National Numbering Plan, should ensure the service provides connection to 112, as well as CLI – Calling Line Identification, a function which identifies the caller's number so that the emergency services can call them back.

16. South Africa

Any Value added network services (VANS) or enhanced service licensee can provide voice services on their network. VANS are eligible for numbering, spectrum, and interconnection with any operator. Presently there is no regulation on QoS and access to emergency services.

17. Australia

Most VoIP services connected to the public network are considered a standard telephone service and will attract regulatory obligations. ACMA has introduced (Apr, 07) a new, location-independent service type and number range. Telecommunications Numbering Plan 1997 (the Numbering Plan) has been amended to create the new service type and the 0550 number range. Under the new arrangements, service providers will have a choice of number ranges. If a provider wishes to offer a traditional fixed telephone service or a service that is a close substitute, it will continue to be able to access geographic numbers or if it chooses, it can diversify to the new 0550 number range. Amendments to the Telecommunications (Emergency Call Service) Determination 2002 came into effect in Nov 2007 that confirm the obligation to provide free-of-charge access calls to Triple Zero from voice over internet protocol (VoIP) services with both dial-in and dial-out functionality.

The framework for Australia's system of lawful access is provided by two major laws: the Telecommunications (interception) Act 1979 and the Telecommunications Act 1997. Both acts require that a warrant be

issued before law enforcement agencies may access stored data or intercept private communications in real time. However, the Telecommunications (Interception and Access) Amendment Act 2007 transferred the provisions of the Telecommunications Act that deal with this capability, as well as those dealing with the associated assignment of costs to the Telecommunications (Interception and Access) Act 1979.

Australia's Act is technology neutral and applies to all telecommunications including the Internet. The Telecommunications Act 1997 does not refer specifically to Internet service providers (ISPs) or Internet access providers (IAPs). However, it applies to ISPs and IAPs because they fall into the category of carriage service providers (CSPs). CSPs supply services for carrying communications to the public using a carrier's network. All the obligations that apply to CSPs apply to ISPs.

There is provision for cost sharing between the telecommunications industry and law enforcement agencies. Telecommunications service providers pay most of the capital costs and ongoing costs of developing and maintaining an interception capability, whereas Law enforcement agencies pay costs incurred in the formatting and delivery of information.

The maximum penalty in the event of non-compliance with the requirements of the Act is $50,000 for an individual, and $10 million in the case of a company.

ISPs will only be required to provide plain text versions of encrypted communications where the ISP has itself encrypted the communication. ISPs are not responsible for decrypting communications, which have been encrypted by a user.

18. New Zealand

In November 2004, New Zealand passed the Telecommunications (Interception Capability) Act, which requires network operators to

ensure an interception capability of telecommunications networks and services.

19. **Argentina**

Regulation in Argentina considers IP as a mere way to offer telecommunication services, such as telephony in the form of VoIP, thus there are no legal barriers that impede market access or any plans to regulate different types of the service. Any provider is free to offer telecommunication services with different technologies and network architectures, based on the network neutrality principle. It is also considered inconvenient to limit VoIP services to those who run over the IP network, without connection to the PSTN. A specific resolution states that VoIP services are free to compete in the market, and there are no efforts to regulate or impose restrictions on it.

Any operator who wants to offer VoIP needs a Unique License for Telecommunications Services, which covers all telecommunications services, independently of the technology and network infrastructure used. Unique licenses are granted on demand, without time limit, enabling providers to offer any kind of telecommunication service, whether it is national, international, fixed, mobile, etc. It does not guarantee, however, availability of means necessary to provide each service. Internet Service Providers (ISPs) need a value added service license to operate, and have to pay interconnection rates to local telephone companies. It is specified in regulations that there is freedom between the parties to agree on the interconnection fees. Service providers have to negotiate their interconnection agreements with the incumbent operators. Neither the CNC nor the SECOM get in the way of these discussions. The foreign investment policy is liberal and there are no distinctions between local and foreign companies. According to the network neutrality principle, there are no regulated technological standards or protocols for VoIP.

There is no specific numbering plan for VoIP. Some companies such as DIGIVoice offer the DID (Direct Inward Dialing) service, which is a PSTN number. Every call received in this number will be considered local and redirected to the user, even if the user is in other parts of the world. Since VoIP services may use traditional numbering through DID, they must fulfill the requirements of a communication service, providing emergency service numbers, guides, free customer service number and QoS, among others. In practice, not every provider meets the requirements.

20. Brazil:

Two of the incumbents, BrasilTelecom and Telemar, offer VoIP services. Even though there is no service regulation, the companies have an operating license and meet the requirement of traditional telephony, such as contributing to service universalization. Some incumbents are offering VoIP services at both residential and business levels. In Brazil there is a clear VoIP services definition, distinguishing amongst those between two Computers, those restricted to private networks and those interconnecting with the traditional telephony network, either with a generating or an ending call. A license is needed for any of the last two classes. Even though a few incumbent operators offer VoIP services, they still do not seem too enthusiastic at the moment of deploying this technology.

21. Chile

In Chile, a VoIP regulatory framework will probably be enacted soon. According to the VoIP services classification, it was determined to regulate only those services interconnecting with the PSTN. Interconnection between VoIP and PSTN operators will be mandatory. Several companies disagree with this proposal and with the fact that VoIP is considered a public telecommunication service and needs a license to operate. Numbering will provide users with a single telephone

number and emergency services access will be mandatory. The incumbent does not offer VoIP. The incumbent is not offering VoIP services as it is supposed to be competing against itself. The incumbent operator could probably face a strong competition from VoIP operators.

Annexure-II

Gist of Stakeholders' Comments

1. **Permitting Internet Telephony to PSTN/PLMN within India:**

There are mixed responses from the Stakeholders to the proposal of permitting Internet telephony to PSTN/PLMN within the country. Many stakeholders are against such proposal claiming that the same would raise non-level playing field issues. They are of the view that there should be same entry fee and regulatory norms as for UASL or ISP or any other licensee if they are permitted to provide voice telephony within country. Some stakeholders are of the view that only UASLs/CMSPs are permitted to provide Internet Telephony service to PSTN/PLMN within country as per their respective license, but due to lack of clarity on various ambiguities like Numbering, Routing, Security, Carriage charges etc, the implementation of Internet telephony could not take off. Few stakeholders claim that ISP license do not permit such interconnection and ISPs should acquire UAS license for providing this service within the country. Some expressed that there are certain legal and policy issues involved in allowing ISPs to migrate to/acquire a UAS license.

It has also been said that the proposal will infringe upon the scope of access providers and adversely affect sustainability and viability of their business. NLD operators' business plans will be adversely affected and will thus inhabit creation of long distance infrastructure. Also the entire interconnection regime will be disturbed.

However, some stakeholders have welcomed the proposal as the same would provide wider connectivity and benefit the masses. Few stakeholders are of the opinion that ISPs should be allowed to interconnect with PSTN/PLMN networks in India by amending their licenses. The UASL/CMTS licensees should also be amended

accordingly. Allowing ISPs to offer Internet Telephony Services to (and from) the PSTN/PLMN in parity with UASPs/CMSPs would introduce additional competition that would encourage lowering of prices, expanded access opportunities and also would allow important new services. The converged voice, data and video capabilities for Internet Telephony, when run efficiently over an IP-enabled platform, can create unprecedented efficiencies for call center operations, remote teleworker applications, and video or IP conferencing. This will support the Indian economy by ensuring that it remains a competitive location for telecom-dependent industries to operate, and by promoting the manufacture of and investment in Internet Telephony equipment and software. By contrast, the continuation of existing barriers to Internet Telephony in India will impede both economic growth and consumer benefits.

Some stakeholders say that ISPs should have the first right to be permitted for Internet services to PSTN/PLMN within India. The ISPs having no long distance media of their own, are dependent on the NLD/ILD/UASL operators for resources as such over 85% of the ISP revenue goes back to these service providers. India is short of Broadband penetration especially in small cities/remote and rural areas. Unrestricted Internet Telephony could be one application which can boost the broadband penetration by providing an economical via media for citizens to call within as well as outside India, hence may help in serving the very purpose of Government of India i.e. widespread penetration of Internet in India.

2. **Level Playing Field:**

Some of the stakeholders have expressed that the UASL/CMTS operators have obtained their licenses after paying huge entry fees and have invested thousands of crores of rupees to create a state-of-the-art

nationwide infrastructure. By allowing ISPs to provide Internet Telephony to PSTN/PLMN within country will raise issue of non-level playing field as it brings ISPs on the same footing as UASL licensees specially regarding voice services without paying the required fees, Bank Guarantees, Levies etc. In view of the above, ISP licensees may be only permitted to provide Internet Telephony (restricted/unrestricted) on payment of requisite entry fee matching those paid by the UASLs for different circles and complying with other terms and conditions of UASLs licenses in order to ensure level playing filed among UAS licensees.

Some stakeholders have also expressed that there will not be any level playing field issue as ISPs basically re-sell services provided by UASL/NLD/ILD Operators. They have also expressed that the ISPs are largely depend on the NLD/ILD/UASL for most resources for which they pay for. More than 85% of the ISP revenue goes back to these service providers, primarily the state-owned incumbents. They say that Voice business opportunity throughout the world is more inclined towards mobile technology; hence landline and other dependent voice services like Internet Telephony should not be seen at par with mobile or traditional wire line technology. The business opportunity, because of the technical and functional advantage is not same between mobile/wire line and Internet Telephony services. The issue of level playing field does not arise in this case as well as for the proposed Internet telephony, as each will have it's niche market but together has and will grow with the overall market including increased revenue for the Government.

Few stakeholders are of the view that Level playing field issues, if at all, should be addressed by setting appropriate terms and conditions, including entry fees, license fees, obligations and interconnection regime, for the ISPs that are permitted to offer unrestricted Internet Telephony.

3. **Interconnection Model/Architecture/Point of Interconnection:**

Some stakeholders are of the view that Interconnection should be required at circle level. ISP should be allowed to carry the traffic over Internet or through dedicated links between their POPs and could handover the call to the PSTN/PLMN interconnection partner at a desired location. TRAI should ensure that ISPs should not deny interconnection by UASL/NLD/ILD operators and at reasonable cost.

Some stakeholders who have not favored interconnection with PSTN/PLMN network have mentioned that in case it is decided to permit interconnection, the ISPs must follow similar interconnection model as applicable to other access service providers for the purpose of interconnection with PSTN/PLMN networks for internet telephony calls i.e. they must create an equivalent network architecture to ensure level playing field. They further say that Arrangements will have to be made by the Category "A" ISPs to redefine their networks so that they can be clearly identified with equivalent circle level networks of other access service providers. Once this is achieved, the interconnection with PSTN can be established at the level of Level-II TAXs for terminating intra circle calls and at the level of Level-I TAXs for out going inter-circle calls. Also, their interconnection with the cellular networks should be at the level of Gateway MSCs in the respective circles.

A few stakeholders say that Internet telephony service providers can be allowed to interconnect with PLMNs at GMSCs and PSTNs at SDCA levels. The IP calls would be converted into TDM format before termination on PSTN/PLMN. The IP telephony service provides would be required to pay termination for terminating calls on PSTNs and PLMNs. In case Internet telephony provider interconnects PSTN at a higher Level II TAX or Level I TAX then relevant transit carriage charge should also be payable.

4. **Internet Telephony & IUC Regime:**

In this regard some stakeholders say that ISP who has interconnection should be governed by the prevailing IUC regime and should be required to adhere to all parameters laid down there under, including Point of Interconnection, IUC Charges etc. The Interconnection charges (i.e. Set up cost, Port charges etc.), IUC charges including termination charges etc. should be at par with what is applicable to the BSOs/CMSPs/UASPs and no preferential treatment should be given to ISPs for the purpose of IUC in the disguise of promoting Internet Telephony.

Some stakeholders have contrary view. According to them ISPs could be restricted only to PRI interconnect technically. Hence, the IUC charges could be lower than the other telecom services. Government should ensure that Interconnection should not be more than one location with all the operators. ISPs should be allowed to handover traffic to incumbents at the circle level. Setting up POP at SSA level will put a heavy burden on ISPs and the cost advantage to the customer will be lost. Few stakeholders say the VOIP service providers can be brought under the IUC framework with minor modifications. The usage charges will have to be mainly based on minutes of usage (MOU) and packets transported by the network elements such as routers, gateways etc. The details of interconnection charges can be settled between network operators involved in call carriage by mutual negotiations.

Few stakeholders have also said that there should not be any change in the existing IUC regime.

5. **Numbering:**

Some stakeholders have suggested that the available numbering allocation using E.164 format for wire line connections to be revisited and re-looked afresh as there is already a number crunch. Another option could be adopting Telephone Number Mapping (ENUM) which globally adopted methodology for addressing the end devices in case of

Internet Telephony. ENUM permits additional means for identifying user, enriching the user identification information creating private number plans, introducing special billing arrangements. (for e.g., reverse billing, split billing etc) makes it suitable for Internet Telephony based solutions, but ENUM has its own limitations and need deliberations to resolve these disadvantages. They also say that if Internet Telephony is to be allocated a separate number block if may be carved out within the Levels 5 & 6. At present "5 & 6" are being shared by 3 operators for basic services. Since, the number of subscribers in these two levels is only about 1 million, it is evident that there is ample excess capacity in these levels, which can easily be utilized for Internet telephony service. The best was to utilize these levels efficiently would be to transfer the subscribers of any of the levels (level with fewer subscribers) to the other level and allocate the vacated level for Internet telephony services. This will also make the Internet Telephony service distinctly identifiable.

Some stakeholders have suggested that in order to differentiate the Internet telephony calls from PSTN/PLMN, government may consider 3 digit service providers code and 7 digit numbers to consumers. Internet Telephony numbers should be operators specific, as Internet does not know any boundary. It is also suggested that TEC should consider this aspect while reviewing Numbering plan besides keeping in view of ISP network architecture which will be either circle centric or country centric.

With respect to receiving of Internet telephony calls, some stakeholders have expressed that an E164 number should be allocated per IP device. However, services providers can offer two differentiated services – with incoming facility and without incoming facility.

6. **Emergency Number Dialing:**

Many stakeholders feel that free access to emergency services like Fire, Ambulance, Police, Public Disaster management etc, is essential in consumer interest. Therefore service providers should be mandated to provide free access to emergency numbers on Internet Telephony services. The service provider can have direct connectivity to Emergency services agency or route via existing PSTB operator by paying appropriate IUC charges. Some feel that ISPs shall make available location based Emergency Numbers subject to technical feasibility.

While others feel that there should be no mandatory requirement for Internet Telephony service providers to provide emergency access and it should be left to the discretion of the service provider. The main requirement is that it must be absolutely made clear to customers that access to emergency service may not be available to them while using Internet telephony. Some stakeholders feel that globally access to Emergency numbers through Internet Telephony is not yet a mature function to the same level as possible in the TDM/PSTN system, therefore, this obligation should not be imposed.

7. **Lawful Interception & Monitoring:**

Many of the stakeholders have suggested that the service providers offering Internet telephony service should be required to install the appropriate interception equipment to facilitate lawful interception and monitoring keeping in view of Government concern on national security. Monitoring of calls won't be an issue for all calls that are landing on to a PSTN/PLMN service provider. At the same time lawful interception and monitoring Internet calls should also be done at gateway level/central monitoring. Some stakeholders are of the view that monitoring of IP traffic is definitely a concern keeping in view of its nature of dynamic routing features.

There is also a suggestion regarding the need for adopting an existing, internationally accepted standard such as ETSI (European Telecommunications Standards Instituted) for lawful interception for broadband and IP based network

8. **Interoperability:**

Some stakeholders have suggested that it should be ensured that internationally accepted standards are followed to ensure interoperability between IP networks and traditional TDM networks while permitting Internet telephony. The standardization for IP based services should be in line with ITU-T Recommendation H.323, which offers high degree of inter-operability and protocol standards as stipulated by International standardization agencies like ITU, ETSI, IETF etc.

There are also some contrary views saying Internet telephony may not be regulated and standardized, as it would unnecessarily increase the cost of service and CPEs. Regulatory intervention for standardization and interoperability may impede growth of budding technologies. IP network services can offer many more features to users than TDM networks. Any regulated interoperability requirements should be for the minimum set of parameters needed for basic voice service interconnection.

Another view says that regulation of interoperability should left to be self monitored by ISPs themselves; however, the same can be review by the competent authority at a later stage.

9. **Need to mandate Quality of Service:**

Many stakeholders have stated that it is important to lay down QoS regulation/ standards for Internet Telephony. They say that QoS standards have already been laid down for VOIP based ILD service and QoS parameters have been fixed for assessing real time services like Voice on IP based network. On the same lines, QoS parameters also should be fixed for Internet telephony.

Some stakeholders have contrary view. They say that there is no need to mandate QoS for provisioning of Internet Telephony terminating at PSTN/E-164 within country, as no such QoS has been necessitated for similar termination to PSTN abroad over the past 6 years. They further quote that Internet telephony services are different from traditional PSTN/PLMN voice services using a fundamentally different technology as well as different service attributes, with different capabilities & limitations and also raise different policy considerations. Therefore only light-handed regulation is needed as followed by many regulators in other countries. They have also said that market forces will compel the providers of Internet Telephony services to compete on quality of service and price, among other factors, which should ultimately ensure that customers receive the quality of service they demand.

Annexure-III

Routing of an Internet based SIP calls in ENUM environment

i. The SIP based Internet telephony using Public Internet cloud and ENUM database is one of the most popularly used technique to process Internet telephony calls. In this method, the Internet telephony provider (ISP) allocates one E. 164 number to its subscriber. He also provides a Session Initiated protocol device (SIP Device) properly configured and pointing to Internet telephony service provider with which this ISP has agreement to provide Internet telephony service.

ii. The Internet Telephony service provider maintains ENUM database having Uniform Resource Identifier (URI) for all the numbers to which this service provider is providing Internet telephony service.

iii. URI will have Internet telephony subscriber E.164 number, domain/ IP address of nearest gateway, SIP device ID, IP address allocated to the SIP device (Either static or Dynamic) as mandatory fields and other optional fields such as mobile telephone number, E-mail ID, fax number etc.

iv. Internet telephony service provider also maintains domain name server (DNS) to resolve the domain name to IP address. The internet telephony service provider can also maintains Internet telephony subscribers database (Served by other operators) along with master gateway domain name. This information can also be maintained by a third party depending upon the business model.

v. Internet telephony service provider also makes adequate arrangements for the generation of the CDRs to facilitate reconciliation between ISPs and Internet telephony service providers. The detailed diagram is given below (Refer Fig. (a)):

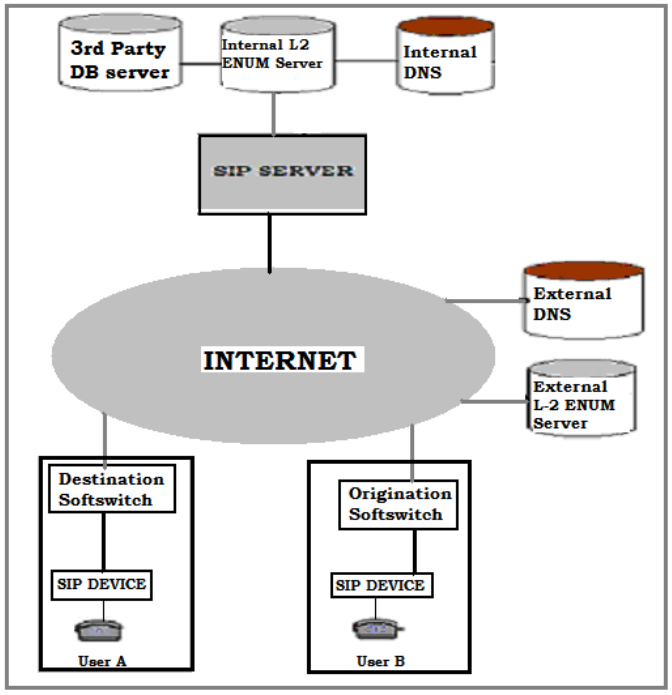


Fig. (a) ENUM based call routing

vi. Let us now take a case where User A connected to broadband initiates Session Initiated Protocol (SIP) based Internet Telephony call. The originating subscriber device sends a SIP INVITE message to service providers SIP server. This SIP server is responsible for finding an IP address of the destination softswitch associated with destination telephone number of User B.

vii. The SIP server of service provider further queries an Internal ENUM server to resolve the destination telephone number. ENUM server of service providers also maintains the URI of all PSTN/PLMN. The URI information of PSTN/PLMN numbers include nearest IP gateway address. If the called number is of the same service provider, it will get URI details of the destination telephone number. In case the called number is not of the same service provider, the originating service providers SIP server queries a third party database server for domain name of the ENUM server having URI details of destination telephone number. The SIP server of Originating service provider then performs an internal DNS lookup to resolve the domain name

of ENUM gateway server of called telephone number. The internal DNS server performs a recursive query to an external DNS server to attempt to resolve the domain name and obtains an IP address of the external ENUM server. IP information is returned back to SIP server for further processing of the call.

viii. The SIP server uses the IP address to query the external ENUM server to attempt to resolve the destination telephone number through a session border control gateway. The External ENUM server returns a URI associated with the destination telephone number to SIP server.

ix. The SIP server finally queries the DNS system to find the IP address of the domain name of softswitch of called number. After getting the IP address of the domain name of the destination telephone number the SIP server attempt to set up a bearer path to a destination softswitch for the Internet Telephony call through Internet cloud. If successful a voice path is established between originating and destination softswitch based on the URI information. Fig. (a) & (b) explains details of IP to IP calls and IP to PSTN/PLMN respectively.

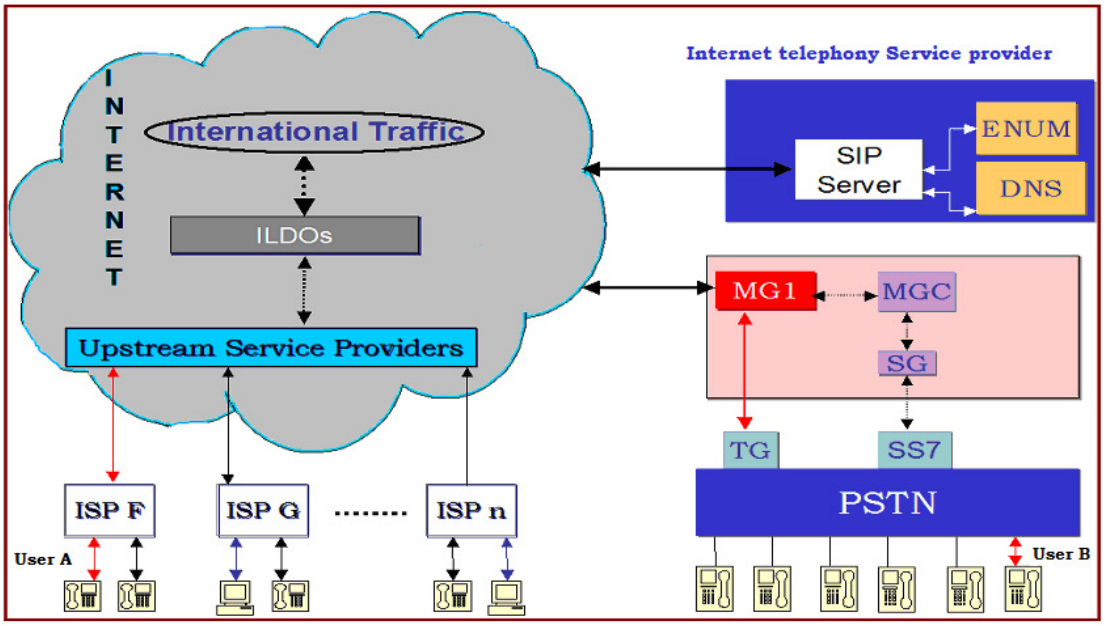


Fig (b): Termination of Internet telephony call at the nearest soft switch gateway

x. If no match is found for domain name of the ENUM server having URI details of destination telephone number, the ENUM server returns a no-record-found message to the SIP server. In this case, the SIP server defaults to a Public Switched Telephone Network (PSTN) / Public Line Mobile Network (PLMN) gateway or another default route to further process the call.

Annexure-IV

Telephone Number Mapping (ENUM)

Global practices adopted by different countries advocate use of Telephone Number Mapping (ENUM) for routing the calls on IP Networks. ENUM has being defined by Internet Engineering Task Force's (IETF's) Telephone Number Mapping Working Group. The charter of this working group was to define a Domain Name System (DNS)-based architecture and protocols for mapping a telephone number to a Uniform Resource Identifier (URI), which can be used to contact a resource associated with that number.

The protocol provides facilities to resolve E.164 telephone numbers into other resources or services on the Internet. The syntax of Uniform Resource Identifiers (URIs) is defined in RFC 2396 (1998). Another important related RFC is RFC 2168: Resolution of Uniform Resource Identifiers using the Domain Name System.

Internet Architecture Board (IAB) in concurrence with ITU has selected e164.arpa domain specifically for this purpose. Under IAB supervision .arpa is considered to be a well-managed, stable and secure operational environment. A Single domain structure under e164.arpa becomes the authoritative “root” for E.164 telephone numbers. ENUM makes extensive use of the Naming Authority Pointer Resource Records (NATPR) as defined in RFC 2915 in order to identify available ways and services for contacting a specific node identified through E.164 number. The Public ENUM infrastructure comprises of Tier-0, Tier-1 and Tier-2 databases. The Tier-0 database is indexed by country codes and points queries to an appropriate Tier-1 database. The Tier-0 database is operated by RIPE (Réseaux IP Européens) in Europe. The Tier-1 databases are to point queries to and appropriate Tier-2 database. The Tier-1 databases are to be operated by individual countries. In Country code 91, the function of Tier-1 is

subdivided into Tier-1a and Tier-b. The Tier-1a, which is indexed by NPA, points queries to and appropriate Tier-1b, which is indexed by full E.164. Each country may operate its own Tier-1b. Tier-1b points queries to the Tier-2 having actual records of services associated with each of a plurality of telephone numbers. ENUM involves the following steps:

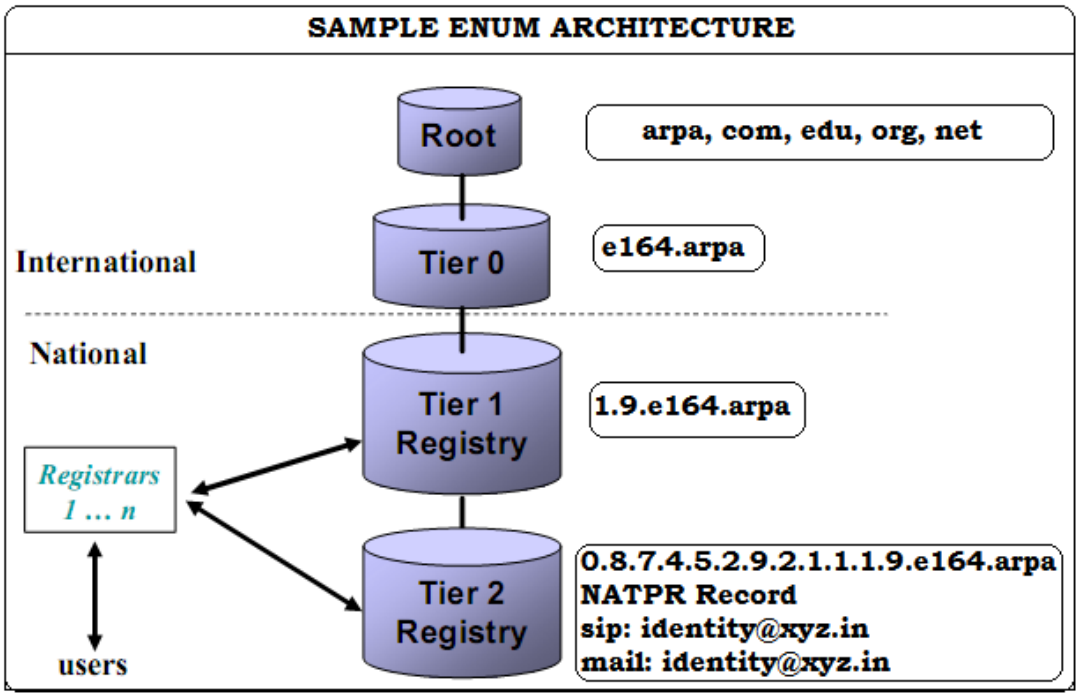


Fig. 2.6 ENUM Architecture

- ENUM turns a phone number into a fully qualified domain name (FQDN). It does this by first adding the city, or area, and country code. For example, 2925-4780 of Delhi, becomes +91-11-2925-4780, where 11 is the area code, the 91 represents the country code for India, and the + indicates that the number is a fully qualified E.164 number.
- ENUM removes all the characters except for the digits and reverses the order (e.g., +91-11-2925-4780 becomes 087452921119). Finally, it places dots between the digits and appends the domain E164.ARPA at the end of the string (e.g., 0.8.7.4.5.2.9.2.1.1.1.9.E164.ARPA).
- Use of ENUM issues a DNS query on the FQDN created in step 1.
- DNS returns a list of URIs that contains information about what resources, services, and applications are associated with that specific phone number.

- ENUM protocol can store more than one type of contact information in the DNS record that belongs to a specific ENUM number. An ENUM record associated with an Organization www.xyz.in might contain instructions for a
    - VoIP call (e.g., h323: identity@server.xyz.in or sip: identity@sip.xyz.in)
    - A FAX call (e.g., fax: identity@fax.xyz.in)
    - E-Mail communications (e.g., mailto:identity@xyz.in).
- Additional services can be developed in future and included in the ENUM name records. A phone number in ENUM can therefore be the single contact number for multiple types of communication to a particular entity irrespective of type of services like voice call, fax, e-mail, mobile, text messaging, location-based services, and Web pages etc.

Annexure V

Proposed Amendments in terms and conditions of NLD License

Sl.	Clause No.	Present Clause	Amended Clause
1	2.2 (a)	"…NLD Service Licensee will have a right to carry inter circle traffic excluding intra -circle traffic except where such carriage is with mutual agreement with originating service provider."	"….NLD Service Licensee will have a right to carry inter circle traffic excluding intra -circle traffic except where such carriage is with mutual agreement with originating service provider." **NLD service licensee shall facilitate termination of inter-circle as well as intra-circle Internet Telephony calls on PSTN/PLMN originated by Internet telephony subscribers and vice versa.**
2	16.3	"..For interconnection with Packet Switched network of different service providers within India relevant national standards are to be followed…"	"..For interconnection with Packet Switched network of different service providers **including that of ISP providing unrestricted Internet Telephony within** India relevant national standards are to be followed…"
3	16.5	"The licensees (who are International Long Distance, National Long Distance, Basic or Cellular Mobile Telephone service operators) can have only one Switch to perform the functions of ILD/ NLD/Cellular/ Basic services provided that the switch is located at the same station and separate accounts of all the operations are maintained by duly apportioning the costs between various	"The licensees (who are International Long Distance, National Long Distance, Basic, Cellular Mobile Telephone service operators **or ISP**) can have only one Switch to perform the functions of ILD/ NLD/Cellular/ Basic services/ **Internet Telephony services** provided that the switch is located at the same station and separate accounts of all the operations are maintained by duly apportioning the costs between various service. Separate TAX and Gateway switch is not mandatory. NLD service providers are permitted to deploy circuit switched or managed Packet Switched network **to engineer their NLD network. NLD is also permitted to build unmanaged**

		service. Separate TAX and Gateway switch is not mandatory. NLD service providers are permitted to deploy circuit switched or managed Packet Switched network to engineer their NLD networks.	**packet switched network to facilitate termination of Internet telephony calls on PSTN/PLMN and vice versa."**
4	17.2	"…Public network is not to be connected with leased circuits/CUGs. It is clarified that NLD service Licensee can provide bandwidth to other telecom service licensee also…"	"…Public network is not to be connected with leased circuits/CUGs. It is clarified that NLD service Licensee can provide bandwidth to other telecom service licensee also. **However, connectivity of NLD with ISP through Internet cloud shall be permitted to facilitate termination of Internet telephony calls on PSTN/PLMN and vice versa."**
5	17.8	The charges for access or interconnection with other networks for origination, termination and carriage of calls shall be based on mutual agreements between the service providers subject to the restrictions issued from time to time by TRAI under TRAI Act, 1997.	The charges for access or interconnection with other networks for origination, termination and carriage of calls shall be based on mutual agreements between the service providers subject to the restrictions issued from time to time by TRAI under TRAI Act, 1997. **ISPs will not be entitled for any termination charges in lieu of calls terminating on their network from PSTN/PLMN through NLD.**
6	22.1	"The LICENSEE shall ensure the Quality …..as required by therein."	"The LICENSEE shall ensure the Quality…….as required by therein. **However this may not be applicable in case of Internet telephony traffic which licensee may carry in order to facilitate termination of Internet telephony calls on PSTN/PLMN and vice versa.**

Note: Amendments as proposed above are indicative and not exhaustive in nature.

Annexure VI

Proposed Amendments in terms and conditions of ISP license

Sl.	Clause	Present Clause	Amended Clause
	Part-I 'General Conditions'		
1	2.2 (ii)(b)	PC / a device / Adapter conforming to standard of any international agencies like- ITU or IETF etc. in India to PSTN/PLMN abroad.	PC / a device / Adapter conforming to standard of any international agencies like- ITU or IETF etc. to PSTN/PLMN **within or outside India**.
2	2.2 (iv)	Addressing scheme for Internet Telephony shall only conform to IP addressing Scheme of Internet Assigned numbers Authority (IANA) exclusive of National Numbering Scheme / plan applicable to subscribers of Basic / Cellular Telephone service. Translation of E.164 number / private number to IP address allotted to any device and vice versa, by the licensee to show compliance with IANA numbering scheme is not permitted.	**Addressing scheme for Internet Telephony shall conform to IP addressing Scheme of Internet Assigned Numbers Authority (IANA) as well as National Numbering Scheme/plan as defined for Internet Telephony service. Translation of E.164 number to IP address allotted to any device and vice versa, is permitted.** ○ **ISPs providing Internet telephony services shall be allocated number resources from the earmarked Internet Telephony number resources in a block of 1000 numbers or it's multiple at a price prescribed by licensor or TRAI from time to time.** ○ **The Numbering Plan for the licensee will be as per applicable National Numbering plan. The Licensor reserves the right to modify the National Fundamental plan or its part thereof.**
3	2.2 (v)	The Licensee is not permitted to have PSTN/PLMN connectivity.	The Licensee is not permitted to have direct PSTN/PLMN connectivity. However Voice communication from IP device connected to ISP to a

		Voice communication to and from a telephone connected to PSTN/PLMN and following E.164 numbering is prohibited in India.	telephone connected to PSTN/PLMN and **vice versa is permitted via any of such licensed entity that are explicitly permitted to do so. At present NLD is permitted to facilitate termination of Internet telephony calls on PSTN/PLMN.**
4	2.2 (vii)	"….The Licensee shall ensure that Bulk Encryption is not deployed by ISPs…."	"….The Licensee shall ensure that **maximum 40 bit key length encryption shall be deployed by ISP for Internet telephony. ISP shall not deploy bulk encryption except for provision of Internet telephony."**
5	34.7	"The Licensee shall install necessary infrastructure in the service area with respect to Internet telephony Services offered by the Licensee for processing /routing / directing / managing / authenticating the internet telephony calls including the generation of Call Details Record (CDR)…."	"The Licensee shall **arrange for all necessary infrastructure** with respect to Internet telephony Services offered by the Licensee for processing /routing / directing / managing / authenticating the internet telephony calls including the generation of Call Details Record (CDR)…."

Note: Amendments as proposed above are indicative and not exhaustive in nature.

Annexure-VII

Abbreviations

AGR	Annual Gross Revenue
ANACOM	Autoridade Nacional de Comunicacoes
ARPA	Advanced Research Projects Agency
ARPU	Average Revenue Per User
BB	Broadband
BSO	Basic Service Operators
BWA	Broadband Wireless Access
CDMA	Code Division Multiple Access
CALEA	Communications Assistance for Law Enforcement Act
CMTS	Cellular Mobile Telecom Service
CPE	Customer Premises Equipment
CRTC	Canadian Radio-Television and Telecommunications Commission
CSP	Carriage Service Providers
ENUM	Telephone Number Mapping
DID	Direct Inward Dialing
DNS	Domain Name Server
DoT	Department of Telecommunication
DSL	Digital Subscriber Line
EC	European Commission
FCC	Federal Communications Commission
GSM	Global System for Mobile
IAP	Internet Access providers
ICRA	Italian Communications' Regulatory Authority
IDA	Infocomm Development Authority
IETF	Internet Engineering Task Force
ILD	International Long Distance
IANA	Internet Assigned Numbers Authority
IP	Internet Protocol
IPTV	Internet Protocol Television
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
ITSP	Internet Telephony Service Provider
ITU	International Telecommunication Union
IUC	Interconnection Usages Charges
LEA	Law Enforcement Agencies
LI	Lawful Interception
LDCA	Long Distance Charging Area
LDCC	Long Distance Charging Center (LDCC)
WGW	Media Gateways
MCMC	Malaysian Communications and Multimedia Commission

MVNO	Mobile Virtual Network Operator
NLD	National Long Distance
NPT	Norwegian Post and Telecommunications Authority
NTC	National Telecommunications Commission
NTP	New Telecom Policy
NVP	Network Voice Protocol
OFCOM	The Federal Office of Communication
OHD	Open House Discussion
PC	Personal Computer
PDA	Personal Digital Assistants
POI	Point of Interconnection
PSU	Public Sector Undertaking
PLMN	Public Land Mobile Network
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RIPA	Regulation of Investigatory Powers Act
SDCC	Short Distance Charging Center
SIP	Session Initiation Protocol
SMP	Significant Market Power
SS	Signalling System
SGW	Signaling Gateway
TDM	Time-Division Multiplexing
TEC	Telecom Engineering Centre
TRAI	Telecom Regulatory Authority of India
UASL	Unified Access Service License
USO	Universal Services Obligation Fund
URI	Uniform Resource Identifier
VANS	Value Added Network Service
VoIP	Voice over Internet Protocol
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WLL	Wireless Local Loop