Consultation Paper No. 11/2008

Telecom Regulatory Authority of India

(TRAI)

Consultation paper

on

Issues related to Internet Telephony

May 2008

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Content

PREFACE

Over the past decade, the telecommunications industry has witnessed rapid changes in the way people and organizations communicate. Many of these changes spring from the explosive growth of the Internet and from applications based on the Internet Protocol (IP). The present world scenario indicates that Internet has become a ubiquitous means of communication, and the total volume of packet-based network traffic has quickly surpassed traditional voice (circuit-switched) network traffic.

Technologies that use the Internet to deliver voice communications have the potential to reduce costs, support innovation, and improve access to communications services within developing countries and around the world resulting in reduced digital divide.

Use of Internet telephony for calling Public Switched Telephone Network (PSTN) / Public Land Mobile Network (PLMN) abroad has already generated competition in the International Long Distance (ILD) sector and enabled the reduction in tariff for the benefit of subscribers. Similar impact of opening of Internet telephony is expected in the National Long Distance (NLD) sector also. However, this will require examination of certain regulatory issues like interconnection, numbering, lawful interception, emergency number dialing, Quality of Service (QoS) etc.

In order to take forward meaningful examination of the relevant issues and to provide necessary platform Telecom Regulatory Authority of India has issued this Consultation Paper. The comments and other inputs provided by the stakeholders would enable the Authority in examining present licensing conditions and suitably addressing the impediments to facilitate Internet Telephony services to end users in country. The consultation paper is available on TRAI's website (www.trai.gov.in).

The stakeholders are requested to send their comments preferably in electronic format on the various issues raised in consultation paper by 9th June 2008. In case of any clarification/information, please contact Sh. S. K. Gupta, Advisor (Converged Network), Tel.No. +91-11-23217914, Fax: +91-11-23211998 or email at skgupta@trai.gov.in or guptask61@gmail.com

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Chapter-1
Introduction

1.1 Internet Protocol (IP)

1.1.1 Internet Protocol (IP) was designed to provide robust & resilient networks with scalability in reference to applications & number of users it can support. Deployment of IP Networks by telecom service providers across the world is widely favored. Consequently there is a surge in number of services which telecom service provider's can offer with the use of IP based networks. Data Services include Applications Assured Infrastructure, Local Area Network (LAN), Storage Area Network (SAN), Frame Relay, Asynchronous Transfer Mode (ATM) services, Multi-protocol Label Switching (MPLS), multimedia and voice services over a single IP infrastructure. IPSec service is offered for creating encrypted tunnels over the Internet for providing secured connectivity between multiple business sites. Managed Firewall services, an integrated combination of hardware & software are available for meeting Internet security demands. Hosted IP Telephony, Integrated voice and data capabilities are an inherent feature of our global IP VPN platform using MPLS technology to deliver assigned Class of Service and good quality voice Telephony.

1.1.2 Popularity of IP Networks therefore is increasing as indicated by tremendous rise in IP traffic. As per Cybermedia Center, Osaka University, IP traffic growth rate related to data traffic is 100% on year-to-year basis as compared to 8% growth of conventional TDM voice traffic. It is projected that in near future IP Based Networks will be favored by service providers as well as end-users.

1.1.3 Internet Telephony is one of the important IP based service driving its growth. This paper attempts to deliberate various issues related to provision of Internet telephony in India and seeks comments of stakeholder on need and timing to liberalise present regulatory

restriction as applicable to Internet telephony in existing Internet Service Providers (ISPs) licensing regime.

1.2 Definition of Internet Telephony

1.2.1 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."

1.2.2 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 or IP 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.

1.3 Drivers for Internet telephony

1.3.1 User-friendly devices, improved voice quality, convergence of networks, and reducing cost of offering of new services are some of the important drivers for the growth of Internet telephony. On the technological front, digitization, new coding techniques, increasing computing power, and development of universal IP standards, have made it possible to have ubiquitous low-cost converged multimedia devices. Convergence further helps service providers to use same

platform for offering new value added services resulting in reduction of service provisioning cost and increase in revenue.

1.3.2 A report published recently by analyst company Point Topic estimates that annual global revenues from retail IP telephony services grew from $1,834 million in 2005 to $6908 million in 2006. Western Europe alone, which has the largest number of IP subscribers, produced $2639 million in revenue. The Asia-Pacific region with almost the same number of subscribers (about 14.5 million) generated $1750 million, estimates. Monthly ARPU for North America VoIP (Internet telephony) subscribers stood at $20. Western Europe, South Asia and East Asia all came in at $15. In Asia Pacific and Latin America, ARPU stood at $10. It is also found that the more VoIP (Internet telephony) is offered as a part of a bundle of services, generating higher average monthly revenue. (Refer chart 1)

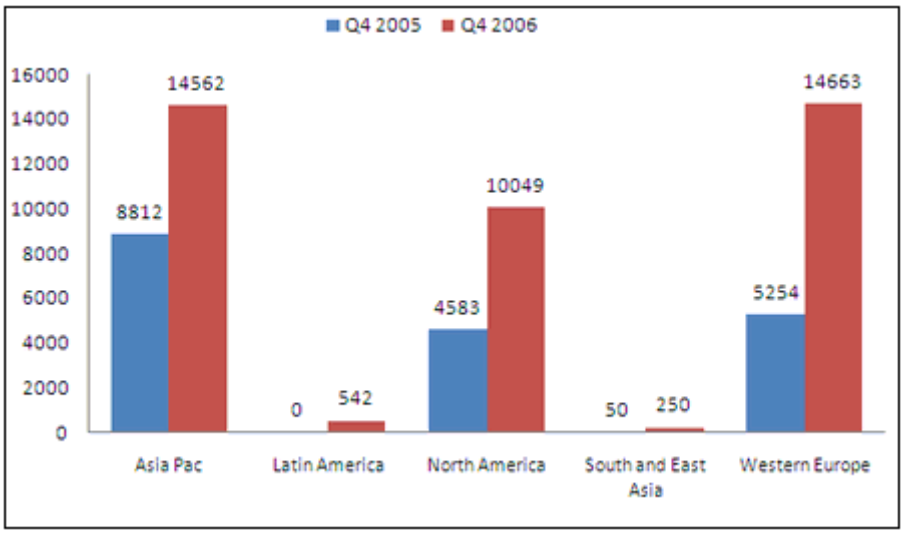


Chart 1: VoIP subscribers 2005-2006, (in 000s)

Source: Point-topic

1.3.3 Another report indicates that Voice over broadband remains the top application driving service providers to invest in Internet telephony and IMS networking equipment. Service providers spent more than $3.9 billion on Internet telephony and IMS equipment in 2007 representing growth of 19% over 2006. Spending on such

technology by service providers worldwide is projected to reach $8.4 billion in 2011. It is projected that IP Telephony equipment market is maturing. Sale of equipments such as session border controllers, media servers, and voice application servers, will generally grow faster for the next few years.

1.3.4 In its report on Trends in Telecommunication Reforms 2006 - Regulating in the Broadband World, ITU has also discussed various issues & approaches related to Internet telephony and concluded that it is an important opportunity for developing countries to provide cheaper voice and other services using IP Networks than traditional PSTN/PLMN services. This is likely to extend access to a larger number of citizens resulting in reduced digital divide.

1.3.5 Presently the broadband penetration in India is meager at 0.3 percent. One of the reasons for slow growth of Broadband is lack of perceived utility. Allowing PSTN/PLMN connectivity to ISPs may provide a cheaper option to subscribers for making domestic and International long distance calls and may act as a catalyst in boosting the broadband penetration in the country. Not only this, Internet telephony within country may also boost competition in National Long distance sector. As noted earlier while International Internet telephone calls are available at approx. Rs 1/- per minute to many parts of the world, the national call rates are as high as Rs. 2.75/- per minute.

1.3.6 Internet telephony has become popular, particularly for making International calls where call charges on PSTN/PLMN are comparatively high. Permission of Internet telephony for making international long distance calls in India has brought down the rates of international calls considerably and presently international Internet telephony calls to different parts of the world are available at Rs. 1/- to Rs. 2/- per minute. These rates are low as compared to international long distance voice call tariff through conventional PSTN/PLMN, which on an average is hovering around Rs. 7.20/- per minute.

1.4 Evolution of Government policies for Internet telephony

1.4.1 New Telecom Policy' 99 (NTP'99) envisaged that all technologies should be equally permitted for the benefit of consumers. However with regard to Internet telephony, the NTP'99 notes - "*The Internet Telephony shall not be permitted at this stage. However, the government will continue to monitor the technological innovations and their impact on national development and review this issue at an appropriate time.*"

1.4.2 Subsequently, as the Internet telephony started gaining popularity, Government allowed ISPs to offer Internet telephony Services with effect from April 1, 2002. The then existing ISPs were permitted to offer Internet telephony services only after signing the amended ISP license called Internet Service Provider (including Internet telephony) license. Provisioning of Internet telephony service did not entail any financial implications to ISPs (no additional entry fee and license fee) in the beginning. Initially Internet telephony was permitted only in limited way, as there were restrictions on the type of the technology and devices, which could be used. ISPs were permitted to provide Internet Telephony services through public Internet by use of Personal Computer (PC) or IP based Customer Premises Equipments (CPE) connecting the following:

- PC to PC: within or outside India
- PC in India to telephone outside India
- IP based H.323/ SIP terminal directly connected to ISP node to similar terminals, within or outside India.

Apart from this, voice communication to and from a telephone connected to PSTN/PLMN within country and use of E.164 numbering is prohibited in India.

1.4.3 Department of Telecommunication (DoT) imposed a license fee of 6 percent of Adjusted Gross Revenue (AGR) earned from Internet telephony by ISPs w.e.f. 1st January 2006. DoT has issued 128

Internet Telephony Service Provider (ITSP) licenses till Oct'07, but only 32 ITSPs have reported the commencement of Internet telephony services. The technologies permitted to provide Internet telephony was not user friendly and knowledge of Personal Computer (PC) was a pre-requisite to use the Internet telephony service provided by these ITSPs. Therefore in the beginning, Internet telephony with restrictive provisions on type of devices to be used, did not gain popularity. The subsequent technological developments brought in various user-friendly devices/ adapters to make Internet telephony calls, which were not permitted as per the license conditions prior to October'07.

1.4.4 Based on the TRAI recommendations, Government modified ISP licensing guidelines on 24.08.2007 and new license agreement was issued by DoT in October'07. According to new guidelines all ISPs were permitted to provide Internet telephony as per the terms and conditions prescribed in the license. Under new license conditions, a subscriber is allowed to use PC/a device/ Adapter conforming to standard of any international agencies like- ITU or IETF etc. to dial PSTN/PLMN abroad. However, Internet Service Providers are not permitted to have interconnection with PSTN/PLMN exchanges to provide Internet telephony within India. There is a demand from ISPs for opening of Internet telephony in the National Long Distance sector as well.

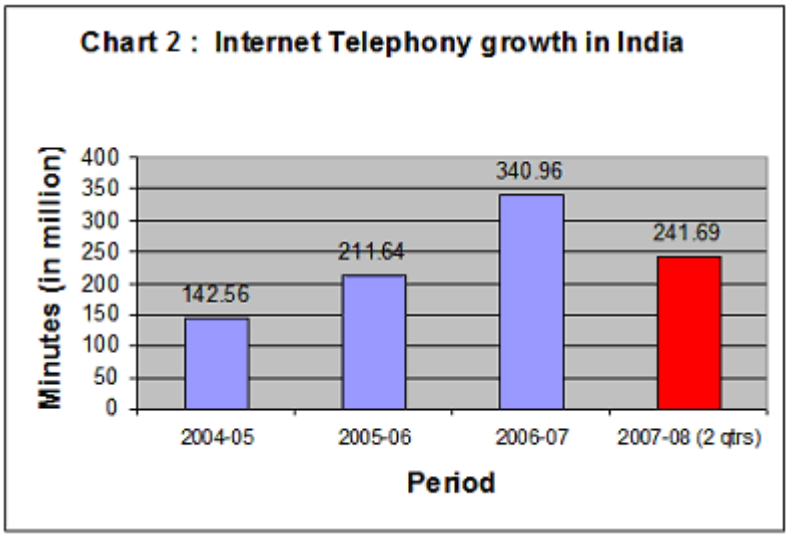
1.4.5 Unified Access Service Providers (UASPs) and Cellular Mobile Service Providers (CMSPs) were permitted to provide Internet telephony in March'06. However they have not started this service apparently due to ambiguity in the term Internet telephony as it is not defined in respective licenses resulting in uncertainty in scope of the service.

1.5 Traffic of Internet Telephony: Indian Scenario

1.5.1 It has been reported that in domestic sector also, some portion of voice traffic is carried using Internet Protocol on dedicated channels by service providers. This may result in considerable

savings; however such savings have not been reflected in the National Long Distance tariff pattern, as average National Long Distance call rates continue to remain in the price band of Rs 2.40 to Rs 2.75 per minute.

1.5.2 International Internet telephony market in our country grew by 15% in the quarter-ended September 2007. Total minutes of usage in year 2006-07 was 340.96 million minutes showing a growth of more than 50% on year-to-year basis (refer Chart 1). The status till September'07 confirms the continuation of this growth trend. Internet telephony service is likely to become more popular in near future as end users are now allowed to make Internet telephony calls without requiring a Personal Computer (PC) with the help of standard adapters.



1.5.3 International Long-Distance Operators (ILDOs) carried 3,528 and 10757 million minutes of outgoing and incoming voice calls respectively in 2006-07. Outgoing voice call minutes till September'07 were 2324 million. In same period, total 343.94 million Internet telephony minutes are reported. This indicates that Internet telephony minutes accounts for approx. 10-15 percent of total outgoing ILDO voice call minutes in 2006-07 and this ratio is expected to further increase in coming years. As per ITU estimates, internationally on an average 50 % of international voice call

minutes will be carried on IP Networks, and many long distance carriers world over may have an all IP Networks by 2008.

1.6 **Convergence and the present regulatory practices**

1.6.1 Traditionally regulatory approaches depend on the clear division between the different services and a one-to-one mapping of services to network. The increasing popularity of Internet telephony and availability of enhanced network capabilities are posing serious regulatory challenges. Dilemma is that the banning of such services will restrict the fruits of technological advancement to reach the common masses, and permitting these services under various licenses are raising issue of non-level playing field due to different regulatory levies. In present era of convergence, Technological neutrality must be hallmark of any regulatory framework. The very cornerstone of any enabling future regulatory environment should be dynamic, efficient and should encourage competition. Globally telecommunications are being shaped by rapid spread of broadband and wireless options. While diffusion of platforms and technology differ geographically, the retooling of regulatory policies to fit this reality is just beginning. Most of the present regulatory policies still reflect the pre-convergence era in which all the intelligence reside inside the network. This is contrary to the Internet centric architecture where the intelligence is at the edge of the network. In this context, challenge for regulatory policy ahead is to encourage seamless delivery of content and applications across the networks.

1.6.2 Although regulatory convergence across the sectors have not taken place in our country as yet, emphasis must shift from service specific network regulation to more forward looking service neutral regulation. Indeed Government policies and TRAI recommendations are largely successful in playing pivotal role to encourage competition in Indian Telecom sector however existing regulatory

framework is confronted with blurring boundaries among various licensing provisions and issue of level playing field across sectors.

1.6.3 TRAI is keeping a close watch on evolving scenario of telecom sector and at present solutions have to be worked out within existing framework with emphasis on service delivery platform. The regulatory efforts should be to extend fruits of advancement of technology to common man with much openness in present policy framework.

Chapter 2

Technical aspects of Internet telephony

2.1 IP Converged Network

2.1.1 Telecom Networks owned by carriers are undergoing rapid changes. The trends are in favor of replacing vertically separated networks by an all IP converged Network, which may further push towards migration to Next Generation Network.

2.1.2 Traditional telephony uses circuit-switching technology while VoIP uses packet switching. In circuit-switched networks, network resources are dedicated to the circuit 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. As such, packet switching is supposed to be a much more efficient and cost effective way of sending voice messages (data) including voice.

2.1.3 Fig 2.1 shows a basic PSTN network comprises 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. This Class-5 switch is further connected to Class-4 Switches placed at the end point of core network. A single signaling system (SS7) handles the signaling requirement of various interconnected switches.

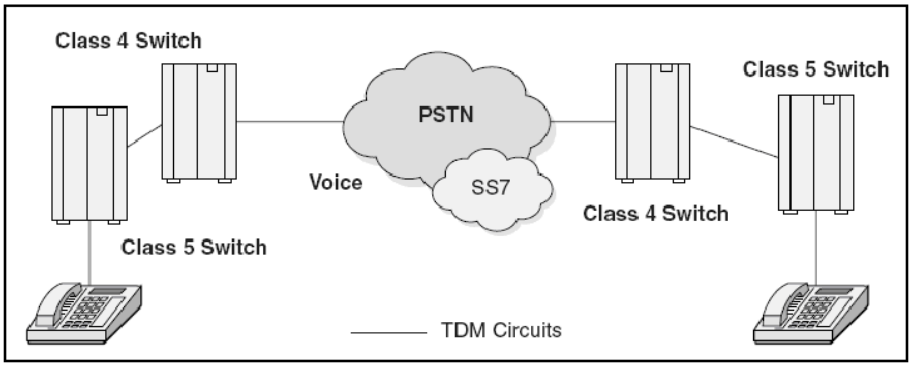


Fig. 2.1 Basic PSTN Network

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 IP packets to TDM and handle signaling requirement for both PSTN & PLMN. (Refer Fig 2.2)

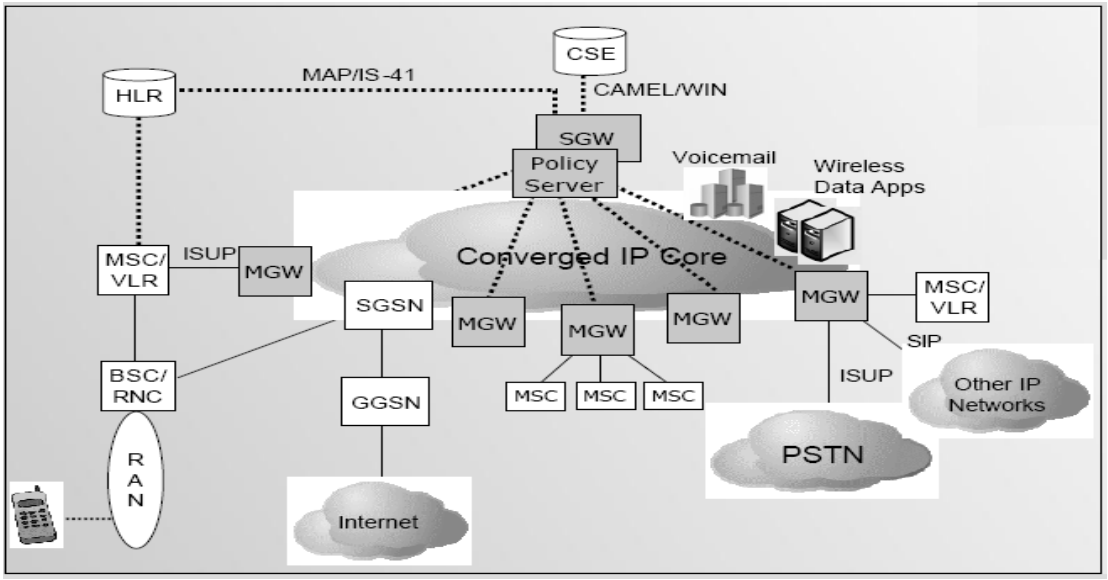


Fig. 2.2 Mobile carrier use of converged core

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, Secure

Communications project to demonstrate the feasibility of secure, high-quality, low-bandwidth, real-time, full-duplex (two-way) digital voice communications over packet-switched computer communications networks. However, actual growth of Internet telephony started in mid-90's. This was aptly supported by rise in deployment of IP Networks. Present service models indicate three main deployment scenarios for Internet telephony:

2.2.1.1 **PC-to-PC Internet telephony:** In this scenario, the calling and called parties both have computers that enable them to connect to the Public Internet (refer Fig. 2.3). The two correspondents are able to establish voice communication only by prior fixation, as both users have to be connected to the Internet at the same time and use VoIP-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 voice 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 Internet telephony software. This type of Internet Telephony is permitted under present ISP license.

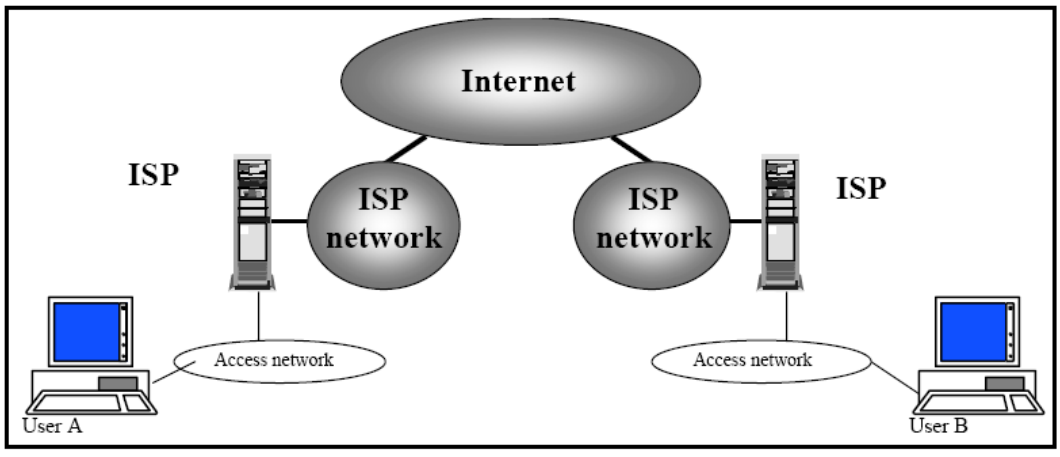


Fig. 2.3 PC-to-PC Internet telephony

2.2.1.2 **PC-to-Phone Internet telephony:** In this type of Internet telephony, user at one end connects his PC to Internet provided by an ISP while the other user 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 subscriber (User B). This gateway will handle all signaling relating to the telephone call at the called party end. ITSP are presently permitted to provide one-way PC-to-Phone service for International long distance outgoing calls only. An end user is allowed to make PC–to-Phone Internet Telephony calls only on PSTN/PLMN abroad.

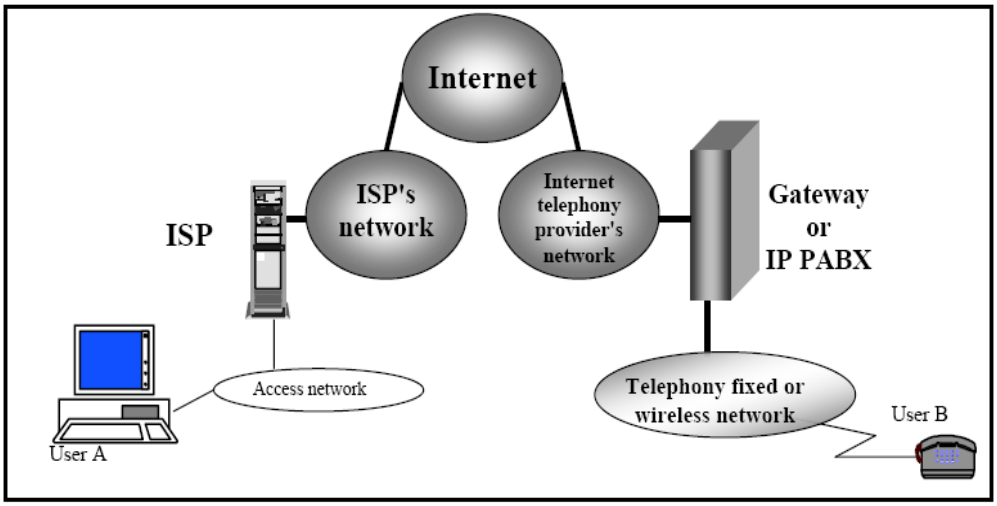


Fig. 2.4 PC-to-Phone Internet telephony

2.2.1.3 **Internet telephony using adapter boxes:** This mode of Internet telephony 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). Availability of 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. User connects normal phone instrument to such adapter, which is directly connected to a Broadband Internet connection. 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.

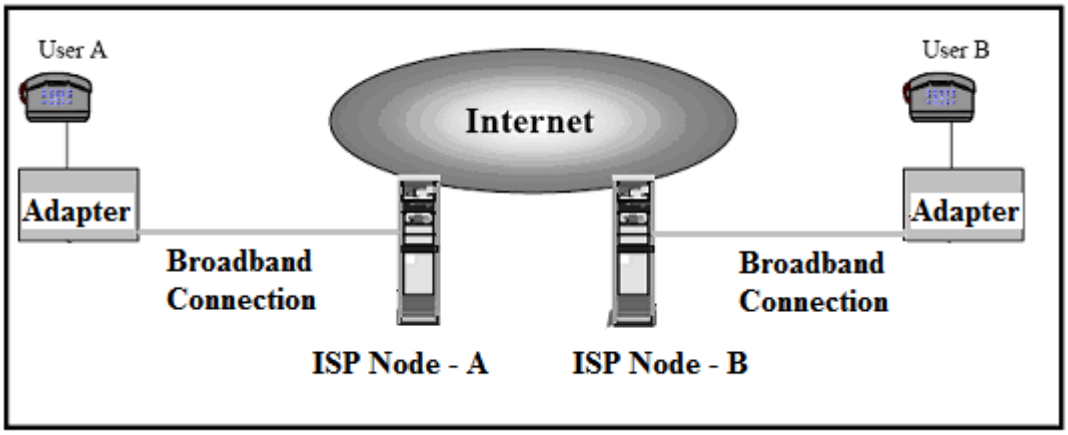


Fig. 2.5 Internet telephony – Use of Adapter

a) **Phone-to-Phone telephony using IP Network:** 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 an IP network in a way that is transparent to telephone users. This mode of Internet Telephony is over "managed" IP network, i.e. a network which has been dimensioned in such a way as to enable voice to be carried with an acceptable quality of service. This is normal telephone service and subscriber is not really aware of the technology being employed by the access service provider for putting through his call. Figure 2.6 below illustrates such a scenario. In this scenario, the gateways and managed IP

network could belong to different players or an integrated player.

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.

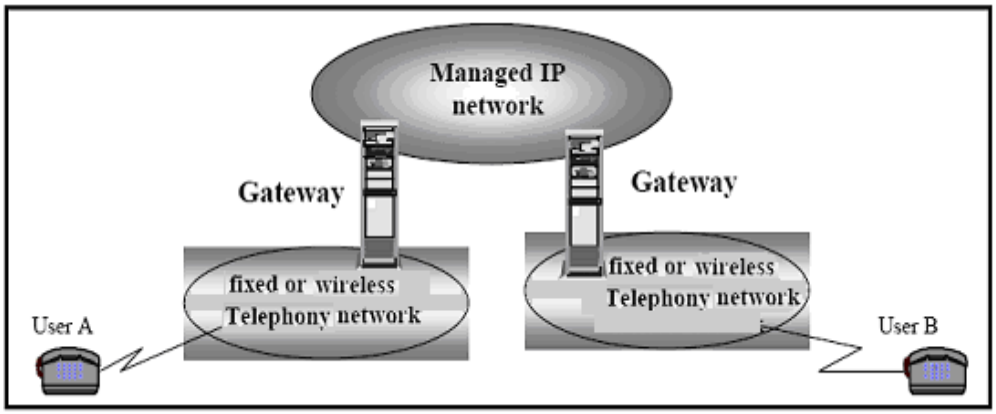


Fig. 2.6 Phone-to-Phone telephony using IP Network

2.3 **Quality of Service:** Quality of Service of an IP network used for telephony is the most 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.

Chapter 3

Regulatory Issues

3.1 As per the existing 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 is not permitted. Internet Service providers (ISPs) are demanding that they may be permitted to call PSTN/PLMN in India also as it is permitted in most of the countries. More over such permission may help to bring down call charges within the country also.

The growth of Internet telephony in India to call PSTN/ PLMN numbers abroad is slow but steady. Internet telephony service to call PSTN/ PLMN numbers within country has not been started by any of the service providers though some feel that UASL and CMTS licensees can provide such services. The growth of Internet telephony in National Long distance and International Long distance is steep, if we consider International scenario. This warrants in-depth analysis of present Internet Telephony regulatory framework in country to identify impediments so that any hurdle if exists can be addressed suitably to facilitate growth of Internet Telephony.

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. The Internet telephony is permitted to UASL and CMTS licensees as per clause 2.2 (a)(i) and 2.1 (a) of their license respectively:

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, the service itself was not defined in the license till recently. DoT on dated 09.04.2008 has defined Internet Telephony for UASL, CMTS and BSO licensees:

"Internet Telephony" Means "Transfer of message(s) including voice signal(s) through public Internet".

3.4 Rollout of Internet Telephony by UASL/CMTS did not pickup for want of clarity in the scope of Internet Telephony in their license till recently. Interpretation of scope of Internet telephony under UASL/CMTS was also being taken same as in ISP licenses. DOT clarification dated 09.04.2008 have defined the scope of Internet telephony for UASL and CMTS licensees; but more clarity on issues like numbering plan to be used to provide these services and Interconnection with other access licensees will be desirable. Voice telephone services being provided by UASL/ CMTS license at present either uses traditional TDM network or managed network using IP protocol. In managed network environment, generally IP protocol is used in core network to improve the bandwidth utilization efficiency. Hence in such cases subscriber does not come to know whether IP network is being used to process the call and as such there is no additional requirement of number allocation. When telephone service is provided through public Internet, it is generally termed as Internet telephony under unmanaged environment. In such cases, generally quality of service can not be ensured as it is dependent on Internet cloud and availability of bandwidth is not guaranteed. The general provision used at the subscriber premises is an Adopter/ IP devices to connect plain telephone instrument with Internet / Broadband.

This setup can originate a call to PSTN/PLMN without requiring any E.164 number assigned to the calling party. The caller can call the PSTN/ PLMN subscribers using their existing number if the two networks are properly interconnected. However if the caller have to receive a call on its adopter/ IP devices, it will require E.164 number allocation. The important issue of concern is whether such devices should be allocated E.164 number resource to receive incoming calls also? If so, whether such number resources should be discretely identifiable across all operators and are different than what is allocated to UASL and CMTS. Comments of the stake holders are invited on this aspect. Further, is there any issue relating to interconnection if existing UASL/ CMTS wants to provide Internet telephony as defined by DoT vide their clarification dated 09.04.2008. Comments of the stake holders are invited on this aspect also.

3.5 Internet Telephony is also permitted to Internet Service Providers (ISPs) under new ISP licensing conditions issued by government in October 2007. However ISPs are not allowed to make call to PSTN/PLMN subscribers as they are not permitted to have interconnection with PSTN/PLMN networks to terminate Internet telephony calls within the country. The scope of services as stated under the clause 2.2 of Part II of ISP License for provision of Internet Services is reproduced below:

Clause 2.2 (ii):

"*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).”***

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.***

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 The analysis of the above clauses indicates that clause 2.2 of ISP license mandates all Internet telephony calls to be routed through public Internet, though public Internet is not exclusively defined in the license. Public Internet is well understood and stands for open Internet clouds, but it may have restrictive meaning while providing Internet telephony calls within the country. Further, clause 2.2 of ISP license imposes restrictions on allocation of E.164 numbers/ private numbers to terminal/ handset used to make Internet telephony calls. Only IP addressing scheme confirming to IANA has been permitted. Here it is important to mention that all devices /adapters connected to ISP node must have static IP address assigned to it but type of IP address assignment (Public or Private) is not clearly spelt out. Additionally, interconnection of ISPs with PSTN/ PLMN network for provision of Internet telephony

service within country is not permitted. Internet service provider is also not permitted to have voice communication to and from a telephone connected to PSTN/PLMN.

3.7 Regulatory framework for Internet telephony has to be considered in view of convergence and other similar developments taking place across the globe. Worldwide, the regulatory trends and practices are supporting technological neutrality, competition and introduction of technological advancements in telecom sector. Several countries have opened up their markets further for new and cost effective services such as Internet telephony by creating conducive conditions. 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 alternative services to subscribers.

3.8 The issue of permitting Internet telephony to PSTN/PLMN within country by ISPs was considered during consultation process while finalizing recommendation on "Review of Internet services" sent to DoT on 10th May 2007. It was hoped that Internet telephony to PSTN and PLMN within country will be provided by the UASL and CMTS licensees and benefit of advancement of the technology will pass on to the subscribers. Such services are not rolled out by UASL/ CMTS licensees due to lack of clarity in licensing conditions. This necessitates re-examination of whole issue and discussions with stakeholders.

3.9 Allowing ISPs to provide Internet telephony within India will require deliberation on important issues such as Numbering scheme, Emergency Number Dialing, Lawful Interception & Monitoring, Commercial settlement of carriage charges etc apart from the issues as discussed above.

3.10 In a bid to identify the impediments for provision of Internet Telephony to PSTN/ PLMN within country and create conducive regulatory framework, TRAI has come up with this consultation

paper on “Issues related to Internet telephony”. Important issues are deliberated in paras to follow to seek views of the stakeholders:

3.11 **Level Playing field**

3.11.1 Traditionally access service providers carry voice calls under well-defined regulatory environment. On the other hand Internet telephony has evolved under ‘light touch regulation’. As a result, the licensing and other regulatory conditions are radically different for both these segments. This creates unequal conditions for traditional voice telephony service providers when compared with Internet telephony service providers.

3.11.2 Presently ISPs, UASL and CMTS licensees are treated differently under their respective licenses. The ISPs providing Internet telephony are paying revenue share @ 6% of Adjusted Gross Revenue (AGR) earned on provision of Internet telephony services. No revenue share is paid on revenues earned on Internet access. The entry fee is low for ISPs. In contrast, UASL and CMTS licensees providing Internet telephony are subjected to revenue share based on Adjusted Gross Revenue (AGR) which varies from 6% to 10% based on the circle of operation (6% for Category ‘C’ Circle, 8% of Category “B” Circle and 10% for Category “A” Circle). In addition, the entry fee is high as compared with that for ISPs. They are also required to setup well-defined subscriber grievance redressal mechanism as mandated by TRAI and to ensure QoS.

3.11.3 It is argued that non-uniform regulatory burden may disturb level paying field between UASL/ CMTS and ISPs licensees. The access providers are of the view to apply similar entry fee and regulatory burden to ISPs or any other licensee if they are permitted to provide voice telephony within the country using any methodology.

3.11.4 The table 3.1 gives the comparison of various licensing/regulatory burden at a glance:

Table 3.1: Comparison of regulatory levies among various licensees

Issues	NLD/ILD	UASL	Internet telephony by ISPs
Entry conditions	NLD – Rs. 2.5 Crores ILD – Rs. 2.5 Crores	> 100 Cr. For category A Circles	Rs. 20 lakhs for Category A Rs 10 lakhs for category B
Revenue share & USO contribution	6% of AGR	10/8/6% of AGR for category A/B/C service areas respectively excluding spectrum charges.	6 % of AGR on Internet Telephony service subject to minimum of Rs. 50,000/- and Rs 10000/- for category A & B licenses respectively.

3.11.5 From the above table it is clear that regulatory regime for access service providers and ISPs are not identical. This may be one of the concerns while deliberating the regulatory environment for providing Internet telephony within the country. The fruits of technological advancements must reach to common masses and to that extent regulations must be flexible and facilitative. Internet telephony has been permitted to ISPs in most parts of the world. If Internet telephony within country to PSTN/ PLMN is permitted to ISPs, Indian subscribers' may gain from technological advancement of this era fueling competition in telecom sector resulting in services at affordable price and with better quality.

3.11.6 The scenario world over, indicate that in most of the countries ISPs are under light touch regulation and regulatory levies imposed on them are low; still they have been permitted to provide Internet telephony (refer Annexure-A on International Experience). Many of the regulators have mandated ISPs to clearly inform their subscribers about quality of service before providing such services. It is also argued that opening up of Internet telephony will have positive impact on development of telecom services, Gross domestic Product (GDP) of the country and greatly benefit many who are not able to afford the same till now, apart from increasing competition and reducing prevailing price. Many also feel that Internet

telephony is an information service and therefore it is an exclusive domain of ISPs. There has been extensive debate globally on the classification of the Internet Telephony service with no conclusive results.

3.11.7 The phenomenon of "Convergence" is the driver in the triad technology, market and policy. In span of about 12 years, radical advances in technology, market institutions, forward looking government policies and regulatory policy backed with sinews of competition have transformed telecommunication sector. The need of the hour is to have a regulatory framework that foster innovation, investment and affordable access. Any forward looking analysis in the context of ongoing convergence must be technologically neutral, given the type of dynamic changes that may result from future delivery of services based on different technologies.

3.11.8 World over it has been prevailing practice to handle the non-facility based service providers with lighter regulation vis-à-vis facility based operators. The present international trend not only advocates removing hurdles for convergence but also advocate encouragement by regulators. Practices followed by European Union, US and several other regions confirm these arguments.

3.11.9 In view of above discussions it needs to be discussed whether ISPs to be permitted Internet Telephony within country & if yes, then the impediments to provide Internet telephony within our country to make calls to PSTN/ PLMN needs to be addressed. Identification of such impediments and possible solution shall be desirable in time bound manner. Views of the stakeholders are invited in this regard.

3.12 Interconnection and IUC regime

3.12.1 The interconnection and carriage charges are likely to play important role in success of Internet telephony to PSTN/ PLMN within country. The details of present interconnection & IUC

regime are placed at Annexure-II. The commercial model especially on per call charge basis will be important from subscriber point of view. Stakeholders are requested to give their comments on this issue.

3.12.2 One of the options to ensure interconnection to ISPs, who want to provide Internet telephony to PSTN/ PLMN within country, is to grant 'UASL license without spectrum' to such ISPs. Interested ISPs can pay additional entry fee and migrate to such license. TRAI's in its earlier recommendations on 'Unified Licensing Regime' dated 13th January 2005 & 'Review of License terms & conditions and capping the number of Access providers' dated 28th August 2007 has deliberated on this issue. Streamlining UASL licensing charges without spectrum will encourage ISPs to migrate to such license and open future opportunities for modernization and launch of various value added services like IP telephony.

3.13 **Numbering**

3.13.1 Numbering is the Public User Identity by which a subscriber is identified in the Network. In PSTN and PLMN this is a telephone User Resource Identifier (TEL URI) in E.164 format such as +91 761 203 4679 which is allocated to different service providers under provisions of National Numbering Plan (NNP) 2003 in accordance with their licensing conditions. E.164 numbering generally identifies the geographical location of the subscriber and the service provider providing such services.

3.13.2 Generally subscriber prefers to have E.164 format of numbering primarily due to ease of use and familiarity. Moreover, billions of the devices currently available on different networks use only numeric keypads. Hence E.164 numbers can easily be dialed using such devices. The fast growth of wireless services at an average rate of 8.0 million subscribers on monthly basis is putting increasing pressure on availability of numbering resources in E.164 format. This growth of subscriber is likely to suffice to

achieve 500 million telephones target by 2010 and will require sufficient number blocks of E.164 numbering. Though NNP'03 was designed to meet the challenges of multi-operator, multi-service environment for next 30 years without making any change; the fast growth have exhausted E.164 numbers. Presently only levels 7 & 8 are vacant which are under consideration for number allocation for wireless subscribers. Non-availability of number space may pose serious threat to the fast growth of telecommunication services in our country. In order to address this issue, recently a committee has been setup under the aegis of Telecommunication Engineering Centre (TEC) for exploring the possibility to meet future numbering requirement and changes if any in existing E.164 numbering structure.

3.13.3 Opening of the Internet telephony to call PSTN/PLMN may increase requirement of numbering blocks, as the Internet telephony subscriber will also receive incoming calls. This may add further to present pressure on numbering block requirements. As per the licensing conditions, allocation of E.164 numbers is not permitted to ISPs but success of Internet telephony is greatly linked with the ease with which a subscriber can dial a call and receive a call. Any non-familiar method to allocate addresses is likely to restrict the potential and popularity of Internet telephony. More over allocation of dedicated public IP address to individual device may also be difficult due to shortage of IPv4 address space. Dialing an IP address requires special type of telephone commonly known as IP Phones or dialers using PC or equivalent devices. These options are costly and may neutralize the price advantage of Internet telephony.

3.13.4 The available numbering allocation using E.164 format for wireline connection has to be looked a fresh. There are approx. 40 million wireline connections however number of blocks reserved for such purpose seems to be high. Re-allocation of the numbers for wireline subscribers may also be very difficult it as may require lot of

changes and may result in change of subscriber numbers also. Nevertheless solution has to be worked out in existing framework to identify numbering blocks sufficient to provide Internet telephony with in country.

3.13.5 Assuming that certain number blocks can be identified in NNP'03 for allocation to ISP for Internet telephony, there can be different combinations possible to allocate E.164 numbering in existing 10 digit frame work excluding NLD/ILD Access Code for the Internet telephony subscribers. One possible allocation follows:
(Area Code: 2 to 4 Digits) + (VoIP Code including carrier identification: 2 Digit) + (Subscriber Number: 4 to 6 Digits)

3.13.6 The advantage of E.164 numbering lies in its simplicity though intermediate Trunk Automatic Exchanges (TAXs) will have to do more complex digit analysis to cater for 139 operational ISPs. Requirement and remedial solution to provide E.164 numbering resources have to be examined to facilitate Internet telephony in a big way.

3.13.7 T**el**ephone **Nu**mber **M**apping (ENUM) is another globally adopted methodology for addressing the end devices in case of Internet Telephony. ENUM permits additional means for identifying users, enriching the user identification information, creating private number plans, introducing special billing arrangements (e.g. reverse billing, split billing, etc.) makes it suitable for Internet telephony-based solutions. The details of ENUM are available at Annexure-III.

3.13.8 The main argument against ENUM approach has been that it should not be seen as solution for existing crunch for E.164. ENUM will require allocation of atleast one E.164 number to each entity irrespective of services being offered to such entity. ENUM facilitate use of existing number for an entity to provide multiple services including Internet telephony but does not permit a service provider to use existing E.164 number allocated to an entity by

some other service provider. ENUM does not resolve problems associated with number portability also.

3.14 Emergency Number Dialing

3.14.1 Emergency Number Dialing basically refers to access to certain mandatory services such as Police (100), Fire (101) being provided to subscribers by the service providers. Under present PSTN based numbering, the calling location can be identified based on call origination number and routed to appropriate agency of that area.

3.14.2 This may not be the case in Internet telephony scenario where it may be difficult to process emergency service calls in absence of the location information. In case Internet telephony service is provided on fixed location and a fixed IP address is used, then such calls can be processed with ease using number translation and routed to appropriate agency. The problem becomes complex when Internet telephony is provided on devices having mobility or nomadic capability because it breaks the link between calling party and the location information. It can be suggested that access to emergency services can be enabled by routing calls to the appropriate (geographically decentralized) emergency service centers, and provide them with the appropriate location information. A Softswitch in this case may handle emergency number translation.

3.14.3 This type of system is claimed to be designed and have been put into service in some of the EU Member States. Though it serves the purpose to some extent but may not meet the requirement to access emergency numbers fully. In serious emergency situations, even conveying the location information on phone may not be feasible and therefore routing of such emergency numbers may preferably be automatic. The issue is being hotly debated world over. Some of the countries have gone ahead with Internet telephony services with clear instructions to their subscribers that

Internet telephony service cannot provide access to Emergency numbers. Comments of the stakeholders in this regard are invited.

3.15 Lawful interception and monitoring

3.15.1 Lawful Interception and monitoring is one of the prime requirements for security agencies. Such monitoring is feasible in present PSTN / PLMN network and at international gateways. The lawful monitoring of Internet telephony call using existing monitoring facilities will be a challenge due to very nature of packet based IP network. IP networks generally does not follow fixed route and prefer minimum cost based routing.

3.15.2 There may be possibility of monitoring the Internet telephony calls at Internet telephony gateway itself; however it will require installation of Lawful Interception equipment at each ISP interested to provide Internet telephony service within country. This may add some Capex for ISPs starting this service. Monitoring of International calls can be done at International Internet gateways. Similarly there may be a possibility to monitor the calls to PSTN/PLMN at terminating exchange however effectiveness of such monitoring will be concern.

3.15.3 The use of advance encoding and encryption techniques by Internet telephony providers can also pose challenge for lawful monitoring. Here it is important to recognize vital requirement for law enforcement agencies to monitor and intercept Internet based voice traffic; hence ISPs providing Internet telephony within country may have to ensure suitable encryption in coordination with concerned security agencies so that effective monitoring of all IP packets can be ensured.

3.16 Interoperability and Standardization

3.16.1 Another essential issue to be addressed is related to interoperability considerations and implications, when implementing "Internet telephony" in existing circuit-switched national networks. The ITU-T Recommendation H.323 is an

umbrella standard for specifying for an IP-based multimedia conferencing system. It refers to a couple of other standards, which specify signaling protocols, media coding and call control services. H.323 uses an evolutionary approach to VoIP, which offers a high degree of interoperability to legacy based telephony services. Drawbacks are its rather high implementation complexity and architectural problems concerning convergence of telephony and Internet services and lack of scalability and flexibility.

3.16.2 Various other protocols have been defined between Media Gateway (MG) to MG, Media Gateway Controller (MGC) to MG, MGC to Signaling Gateway (SG), and MG to SG. It is feared that devices using different protocols may not interoperate. Standardization as stipulated by IETF, ETSI, ITU will be required to ensure interoperability to provide VoIP-based enhanced services in order to ensure rapid development in the public interest.

3.16.3 Contrary to it, it is also argued that standardization may increase the cost of service provisioning and device. As a result, it is advocated that Internet telephony may not be regulated and be left to the choice of the service providers. The present cost of the devices is low and therefore may not require any protection to ensure interoperability. Views of the stakeholders are invited.

3.17 Quality of Service

3.17.1 Quality of speech in any communication service is an important consideration. Subscribers are accustomed to the PSTN/ PLMN voice quality and expect similar quality from Internet telephony also irrespective of the technology used to provide such services. Ensuring good voice quality will therefore be necessary for ISPs providing Internet telephony. Though Internet telephony standards do not prescribe minimum Internet access speed for good quality of service, it is generally perceived that broadband connection will be required to provide good speech quality. ITU-T Recommendation G.114 (5) defines maximum one-way latency as 150 ms for good

Internet telephony voice quality. This puts a restriction on round trip delay, packet loss, and speed of Internet access. 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.

3.17.2 The issue of consideration is whether there is a need to define QoS parameters for Internet telephony within country also or it should be left to service providers. Both the models are prevailing world over. In some countries all Internet service providers have to match QoS parameters as defined for PSTN/ PLMN whereas in some other countries no specific QoS have been defined. Service providers are required to appraise the subscribers about QoS before they subscribe to such services. Comments of the stakeholders are invited in this regard.

Chapter 4
Issues for Consultations

4.1 Whether Internet service provider should be permitted Internet Telephony services to PSTN/PLMN within India? If yes, what are the regulatory impediments? How such regulatory impediments can be addressed? Please give your suggestions with justifications. *(para 3.10)*

4.2 Whether allowing ISPs to provide Internet Telephony to PSTN/ PLMN within country will raise issues of non-level playing field? If so, how can they be addressed within present regulatory regime? Please give your suggestions with justifications. *(para 3.11)*

4.3 ISPs would require interconnection with PSTN/PLMN network for Internet telephony calls to PSTN/PLMN. Kindly suggest Model/ architecture/ Point of Interconnection between ISPs and PSTN/PLMN? *(para 3.12)*

4.4 Please give your comments on any changes that would be required in the existing IUC regime to enable growth of Internet telephony? Give your suggestions with justification to provide affordable services to common masses? *(para 3.12)*

4.5 What should be the numbering scheme for the Internet telephony provider keeping in view the limited E.164 number availability and likely migration towards Next Generation Networks? Please give your suggestions with justifications. *(para 3.13)*

4.6 UASL and CMTS operators are allocated number resources and permitted to provide Internet telephony including use of IP devices/Adopters. Whether such devices should be allocated E.164 number resource to receive incoming calls also? If so, whether such number resources should be discretely identifiable across all operators and different than what is allocated to UASL and CMTS to provide fixed and mobile services? Give your suggestions with justifications? *(Para 3.4)*

4.7 If ISPs are allowed to receive Internet telephony calls on IP devices/ Adopters, what numbering resources should they be allocated? *(para 3.13)*

4.8 Is it desirable to mandate Emergency number dialing facilities to access emergency numbers using internet telephony if ISPs are permitted to provide Internet telephony to PSTN/PLMN within country? If so, Should option of implementing such emergency Number dialing scheme be left to ISPs providing Internet telephony? Please give your suggestions with justifications. *(para 3.14)*

4.9 Is there any concern and limitation to facilitate lawful interception and monitoring while providing Internet telephony within country? What will you suggest for effective monitoring of IP packets while encouraging Internet telephony? Please give your suggestions with justifications. *(para 3.15)*

4.10 Is there a need to regulate and mandate interoperability between IP networks and traditional TDM networks while permitting Internet telephony to PSTN/PLMN within country through ISPs? How standardization gap can be reduced to ensure seamless implementation of future services and applications? Please give your suggestions with justifications. *(para 3.16)*

4.11 Is there a need to mandate QoS to ISPs providing Internet telephony to PSTN/PLMN within country? Please give your suggestions with justifications. *(para 3.17)*

Annexure-I

International Experience

5.1 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.

5.2 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.

5.3 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.

5.4 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.

5.5 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

5.6 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.

5.7 United State of America

1996 Telecom Act separated telecom services and information services and defined them differently· Traditional telecommunication rules are not imposed on information services (internet applications). There are two category of VoIP

- PC originated VoIP (e.g. Skype), which is not subject to regulation
- PSTN replacement VoIP (e.g. Vonage), for which emergency access and wiretapping are mandatory.

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.

5.8 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.

5.9 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.

5.10 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.

5.11 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.

5.12 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.

5.13 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.

5.14 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 can not 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.

Annexure-II

PRESENT INTERCONNECTION PRACTICES & IUC REGIME IN REFERENCE TO INTERNET TELEPHONY WITHIN COUNTRY

6.1 In the present licensing regime, interconnection points have been well defined based on the type of the call being made (call to PSTN, Mobile etc). Access providers have option either to have their own network spread across the licensing area or to have mutual agreement with BSO to carry their calls within the licensing area. Since most of Internet Service providers do not have their own IP network spread across the licensing area (Category "B" or Category "A" ISPs) and are presently providing Internet Services by leasing Internet connectivity from up stream Internet service Providers, interconnectivity issue becomes of paramount importance to provide Internet telephony within country. Following paras deliberate the existing interconnection regime and its likely impact on ISPs to provide Internet telephony calls to PSTN/PLMN within country.

6.2 **Existing PSTN Interconnection Scenario**

6.2.1 The existing practices including regulatory framework prescribe well laid down procedures for interconnection and handover of different types of calls.

- Any PSTN call has to be handed over to PSTN access service provider at SDCA level.
- Any PLMN call has to be handed over to the concerned Mobile operators at its Gateway Mobile Switching Center (GMSC) of L-I of BSO.
- In areas where the access service providers are unable to peer among themselves, the BSO network can be used to transit the calls.
- Both the peering partners must have TDM based interfaces at the Point of Interconnect (POI) locations.

- Traffic outside service area will be delivered either at the near end or far end.
    a. Near End: Call is handed over to NLDO immediately after origination at the pre-defined point within the service area.
    b. Far end: Call is carried on any National Long Distance (NLD) operator's network till the appropriate hand over point in other circle depending on type of the call and handed over to concerned operator for termination.

6.2.2 In case ISPs are permitted to provide Internet telephony calls to PSTN/ PLMN, they will require connectivity with all the PSTN service providers at each SDCA level to hand over PSTN calls appropriately. Alternately, ISPs can have mutual agreements with BSO and all PSTN calls are handed over to BSO at appropriate point to deliver to the concerned PSTN operator. In such case call carriage charges have to be mutually agreed with such BSO. Since most of the ISPs do not have their own network spread across the licensing area, routing calls using BSO network may be better option to start with. Fig. 6.1 shows direct connectivity between two operators at Short Distance Charging Area (SDCA) within a circle

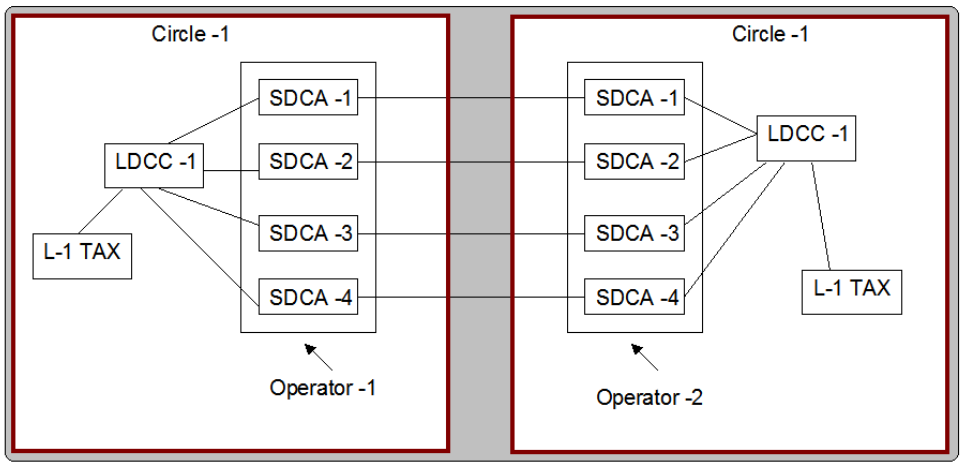


Fig: 6.1 Present PSTN Interconnection model at SDCA

6.2.3 ISPs will require similar network connectivity with PLMN operators at L-1 TAX of BSO/GMSC to handover mobile calls if they are permitted to provide Internet telephony to PLMN also. This means ISPs must have connectivity with all PLMN service providers at L-1 TAX of BSO/ GMSCs to handover PLMN calls. Alternatively, ISPs can again have mutual agreements with BSO and use their network to carry such calls up to GMSCs of concerned PLMN service provider. ISPs will have to have appropriate business model considering the spread of their network and commercial model.

6.2.4 For carrying the traffic outside the service area, ISP will require interconnection with National Long Distance operator to carry its traffic to respective GMSC for PLMN calls and L-2 TAX of the PSTN service provider for PSTN calls in other service areas across the country. At present only NLDOs are permitted to carry inter service areas calls. The main advantage to permit Internet telephony is to reduce long distance call charges. The likelihood of call charge reduction will be low if present restriction of carrying inter-circle calls through NLDOs is mandated. Therefore other alternative could be to carry such calls through Internet cloud/ IP network and handover it at appropriate entity in respective service areas. In such a case conversion of such IP calls to TDM format before termination in PSTN/ PLMN network will have to be done at appropriate point. As discussed earlier, since ISPs are not having well spread network, the terminating calls to other service areas have to be carried through NLDOs. NLDOs may not accept IP based calls, hence appropriate conversion etc have to be done by ISPs. Fig. 6.2 shows existing interconnection scenario with PLMN service providers.

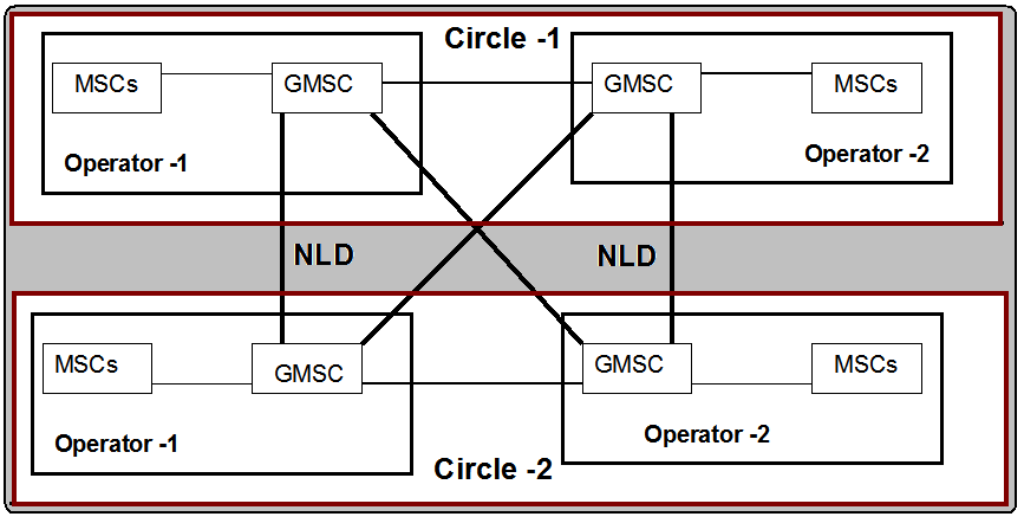


Fig: 6.2 Present Mobile Interconnection model

6.3 Role of Interconnect Exchange

One alternative to get over on issue of Interconnection among ISPs and PSTN/ PLMN service providers could be to mandate Interconnect Exchange and to handover all such calls between the service providers at Interconnect exchange. Such Interconnect exchange may also have facility for conversion from IP based calls to PSTN/ PLMN calls and vice-versa; facilitating routing of IP based calls. While such a framework may be required when IP based networks become more matured in India and many service providers start migration to NGN, the need and timing of mandating such facilities needs to be deliberated. Creation of such Interconnect Exchange and clearing house will have many other related issues like number of such exchanges in a service area, selection of agency/ agencies to setup Interconnect Exchange, financing and creation of such facilities, management of such facilities, ensuring QoS etc.

6.4 Required arrangement for connectivity of ISP to PSTN / PLMN

At present ISP licenses are given either for category 'B' (Generally Analogous to State boundaries) or Category 'A' (All India). There are ISPs having Category 'C' license (Generally City specific) who have not yet migrated to Category "B" or Category "A". In such a

situation, the interconnection scenario will be different for different category of licensees. The issues due to such structure are deliberated in paras to follow.

6.4.1 PSTN/ PLMN Connectivity with Category- C ISP

Class-C ISP is licensed to have Internet operation within Secondary Switching Area (SSA). When such ISPs are permitted to provide PSTN/PLMN calls using Internet telephony within country, they will require interconnectivity with PSTN/PLMN service providers in that SSA. PSTN/PLMN service providers will accept only TDM calls. Therefore such ISPs have to make their own arrangement to convert Internet telephony call to TDM format before handing it over to PSTN/PLMN service providers. This will require installation of VoIP Gateway in licensed area of such ISPs. Fig. 6.3 depicts the scenario.

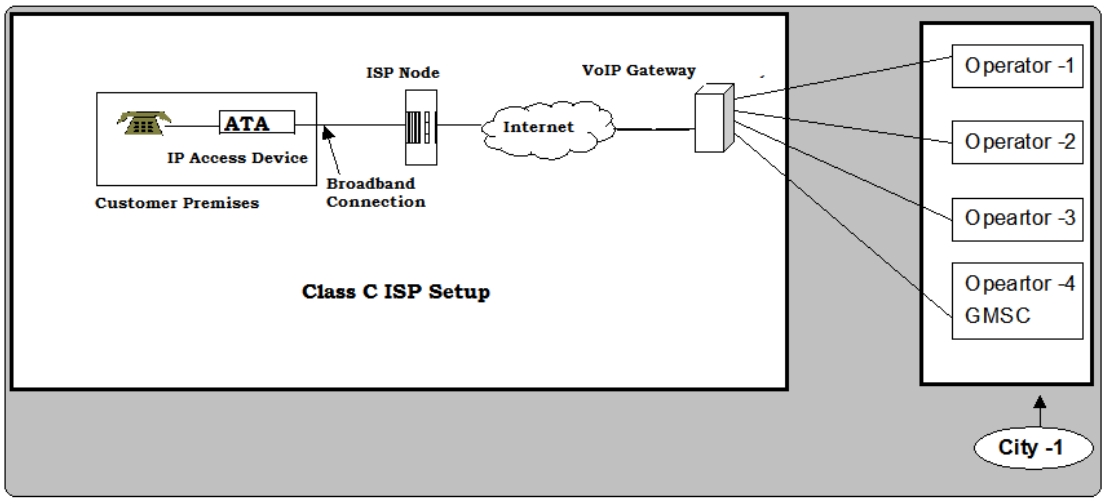


Fig: 6.3 Schematic diagram showing PSTN connectivity for Category-C ISP

The issue of connectivity to PSTN/ PLMN will arise again. ISPs can either have multiple lease lines to connect to PSTN/PLMN or fall back on BSOs. Taking multiple leased Lines (bound for each operator) will be costly, at least initially, as traffic to PSTN/PLMN to start with may be very limited.

Another issue of concern will be whether such ISPs can have lease line to GMSC outside their service area to carry terminating PLMN

traffic. If no, then only option to carry such calls will be through BSOs which may not be a commercially viable model.

6.4.2 PSTN/ PLMN Connectivity with Category- B ISP

Service area of category "B" ISP is Telecom Circle analogous to State boundaries. In this scenario again a VoIP Gateway has to be installed in licensed area of ISP. ISPs may require multiple Leased Lines (for each operator) to connect to different operators or route traffic through BSO. ISPs may like to carry inter circle traffic through Internet Clouds/ IP networks beyond their service areas. The scenario is depicted in Fig. 6.4 below:

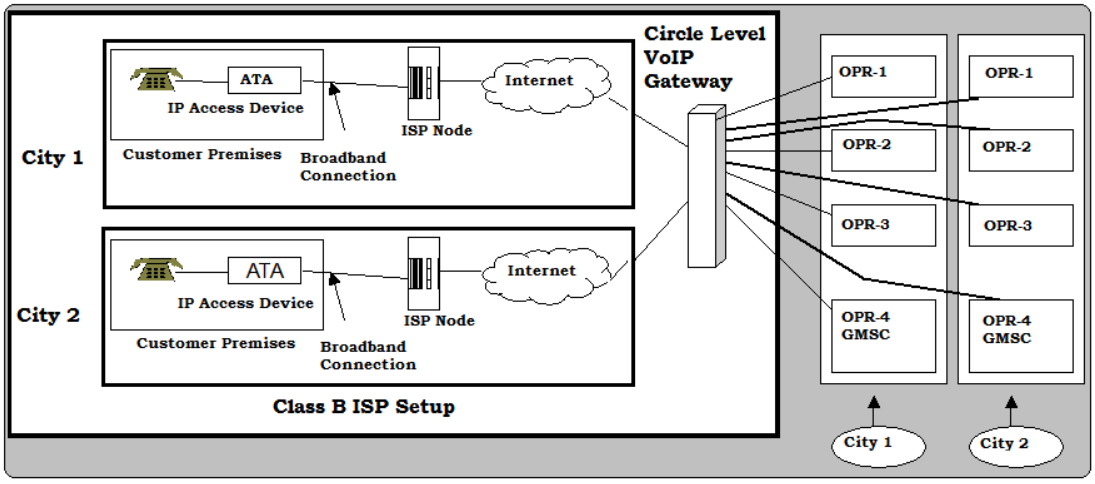


Fig: 6.4 Schematic diagram showing PSTN connectivity for Category-B ISP

6.4.3 PSTN Connectivity with Category- A ISP

Category-A ISP has an all India license. It may be possible that such ISPs desire to carry all Internet telephony calls across telecom circles without going through NLD operators. At present Inter-circle calls are being carried on the National long Distance licensee's Network. In case ISPs are permitted to carry Inter-circle calls, then it may impact NLD operators. The scenario is depicted in Fig. 6.5:

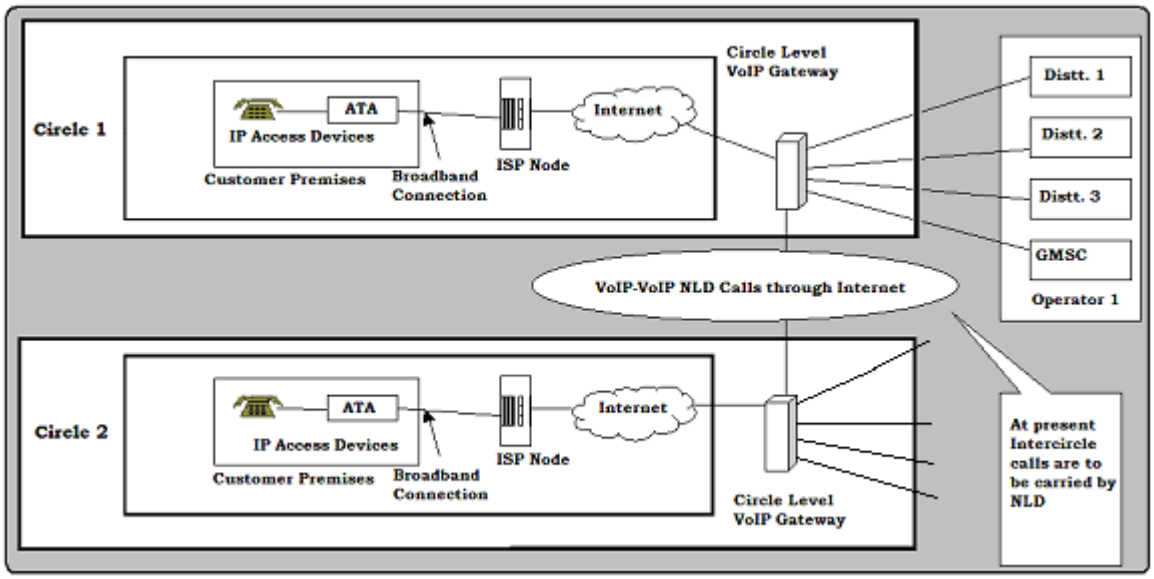


Fig: 6.5 Schematic diagram showing PSTN connectivity for Category-A ISP

6.4.4 In all above three cases peering with traditional PSTN/PLMN or BSO have to be based in TDM format requiring Media Gateway for IP to TDM and TDM to IP conversion. Signaling Gateways have to be used for SS7 transport over IP.

6.4.5 The routing of calls from PSTN/ PLMN to Internet telephony subscribers provided by ISPs will also be of concern. Since most of the present service providers giving PSTN/ PLMN services may not have direct point of interconnection with ISPs, they may also require routing of such calls through BSOs within their own service areas and may require suitable agreements. Since these ISPs providing Internet telephony may be connected to BSO (Presently BSNL only), service providers will require agreement with BSO (BSNL) who are providing interconnectivity to such ISPs for routing of calls to Internet telephony subscribers of ISPs. As discussed above, the BSO becomes the only common point to provide interconnection to provide Internet telephony calls to PSTN/ PLMN. The important issue of concern will therefore be, whether there is a need to prescribe some Reference Interconnect Offer (RIO) to facilitate interconnection with BSO within their own service area.

6.5 **Pricing structure under IUC**

6.5.1 Present IUC regime clearly defines carriage charges & termination charges per minute. While carriage charge has a ceiling of Rs 0.65/- per minute across the country, termination charges are fixed at Rs 0.30/- per minute irrespective of type of calls across networks. The most important objective of permitting ISP to provide Internet telephony calls to PSTN/PLMN within country may be lower tariff as compared to the tariff offered by regular access service provider for long distance calls within the country. The quality of this type of call may not be same as that offered by access service providers. Therefore impact of existing IUC regime on Internet telephony if permitted within the country requires examination. Viability of such business model for ISPs to provide domestic Internet telephony will be necessary.

6.5.2 We have already deliberated that ISPs may find it difficult to have direct connectivity with all PSTN/ PLMN service providers to start with and may have to depend on BSO. ISPs will therefore require commercial agreements with BSO to carry Internet telephony traffic apart from paying fixed call termination charges of Rs 0.30/- per minute to service providers. Since carriage charge has ceiling of Rs 0.65/- per minute, the commercial agreements of ISPs with BSO has to fit within with this upper ceiling. Such agreements depend on BSO business model and volume of the traffic ISPs can give to such BSO.

6.5.3 One alternative can be that ISPs interconnect with Category "A" ISPs to carry the Internet telephony calls and handover at appropriate point to NLDOs for termination of the calls. Since volume of such traffic will be significant due to aggregation of the Internet telephony traffic, the commercial agreements may be more effective and beneficial for carriage of such calls.

6.5.4 While cheaper calls using Internet telephony is of concern to subscribers and ISPs both, one can always argue that it is related to business model of ISPs. TRAI as regulator should at the most

create an enabling environment and leave the matter for the industry to compete. It is up to service providers to find out best business model and survive. This will ultimately benefit the subscribers.

Annexure-III

Telephone Number Mapping (ENUM)

7.1 Global practices adopted by different countries advocate use of Telephone Number Mapping (ENUM) being defined by Internet Engineering Task Force (IETF) in RFC3761. 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.

7.2 ENUM makes extensive use of the Naming Authority Pointer Resource Records (Defined in RFC 2915) in order to identify available ways and services for contacting a specific node identified through E.164 number. In nutshell, ENUM involves the following steps:

7.2.1 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.

7.2.2 Then 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).

7.2.3 Use of ENUM issues a DNS query on the FQDN created in step 1.

7.2.4 DNS returns a list of URIs that contains information about what resources, services, and applications are associated with that specific phone number.

7.2.5 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

a. VoIP call (e.g., h323: identity@server.xyz.in or sip: identity@sip.xyz.in)
b. A FAX call (e.g., fax: identity@fax.xyz.in)
c. E-Mail communications (e.g., mailto:identity@xyz.in).

7.3 Additional services can be developed in the 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.