

**BACKGROUND ISSUES PAPER***

This Background Issues Paper sets forth many of the key issues relating to the regulatory aspects of Internet Protocol (IP) Telephony and is intended to serve as the basis for discussions at the ITU IP Telephony Workshop, 14-16 June 2000, Geneva. It is intended to be read in conjunction with the suggested list of questions for discussion, available as document IPTEL/04.

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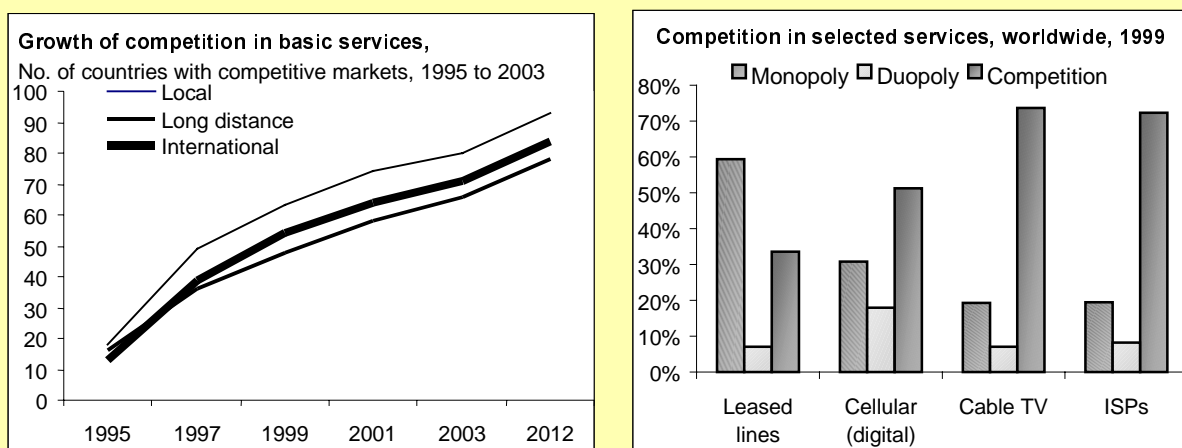
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1. INTRODUCTION

1. The Internet, and Internet Protocol (IP)-based networks, are increasingly being used as alternatives to the traditional circuit-switched telephone service. The many different ‘flavours’ of IP Telephony provide, to varying degrees, alternative means of originating, transmitting, and terminating voice and data transmissions which would otherwise be carried by the public switched telephone network (PSTN). In many countries it is now possible, using a standard telephone, to call almost any other telephone in the world by means of IP Telephony, for some or all of the route travelled by the call. These calls are mainly carried outside of the PSTN, and hence outside the regulatory and financial structures which have grown up around it.
2. Originally a curiosity among computer hobbyists possessing similarly-equipped personal computers (PCs), IP Telephony technology now represents a fully-fledged alternative to traditional circuit-switched telecommunication equipment and services. So-called ‘next generation telcos’ are building vast global networks, based around IP, on which voice service can be provided alongside data. While IP-based networks are optimised for the carriage of data rather than voice, they can nevertheless carry voice very competently and cheaply.
3. The most important threshold issue relating to IP Telephony concerns **definitions**. In this paper, “IP Telephony” is used as a generic term for the many different ways of transmitting voice, fax and related services over packet-switched IP-based networks. IP Telephony can be subdivided into two major groups: Internet Telephony and Voice-over-IP (VoIP), the difference being the nature of the underlying IP network. Even within these two broad groups, there is a potentially infinite number of ways to use IP technology to provide different services in different ways. Therefore, services are further classified according to the nature of the terminal devices used (e.g., computer or telephone). Section 2 suggests more specific definitions and gives a more detailed description of many of these diverse services.
4. While the emergence of IP Telephony is often associated with the rise of the Internet itself, it is important to appreciate that *IP Telephony often does not involve the public Internet at all* – but rather only its underlying technology, the Internet Protocol suite. These technologies are introduced in Section 3.
5. The days when IP Telephony could be ignored, and a meaningful distinction between voice and data maintained, are coming to an end. IP Telephony is happening almost everywhere and growing very quickly. Section 4 describes the economic impact of IP Telephony, and, in particular, its impact on public telecommunications operators (PTOs) and its relationship to the international accounting rate system.

Figure 1.1: Competition continues to grow, with Internet services leading the way

Percentage of international traffic open to competition, 1990-2012, and degree of competition in selected services, worldwide, 1999



Note: In Left Chart, the percentages for 1998 onwards are based only on those countries which have made specific commitments under the World Trade Organisation’s basic telecommunications agreement. Thus they most likely reflect underestimates of the true level of competition.

Source: ITU, “Trends in Telecommunication Reform, 1999”.

Box 1.1: France - Public consultation emphasizes need for technology-neutral regulation

France is one of the very few countries which have held wide-ranging public consultations on IP Telephony. In September 1999, the Autorité de régulation des télécommunications' (ART) published a news release which cited seven key opinions which had come out of this public process:

1. The regulatory treatment of IP Telephony should be harmonized as much as possible at the international level, and, in France's case, at least at the European level.
2. It is desirable that regulation be infrastructure and technology-neutral, and therefore that the same rights and duties apply to substitutable services, such as IP Telephony and traditional voice telephony. The rights and obligations of various parties should be, in general, in proportion to their investments.
3. With regard to the appearance of new services like IP Telephony, the major objective of regulation should be to support their sustainable emergence, by avoiding momentary reductions of tariffs unbalancing the market.
4. Certain contributions underlined the advisability of extending the principles of interconnection applicable to voice networks to data networks as well, due to their character of offering services to the public.
5. The attribution of numbering resources, making it possible to identify IP Telephony customers within the national numbering plans, offers an interesting prospect. In this area as well, number portability appear to be an essential asset.
6. The parameters influencing the quality of service of the various networks involved will have to be clearly known, and the end-user will need to know whom the operators of the various interconnected networks are.
7. The absence of directories presents significant difficulties for IP Telephony operators.

Perhaps the principal lesson of the consultation was the necessity of technology-neutral regulation: regulation must relate to services as they are perceived by the user, not to the technologies or infrastructures which support them. Identical services must be subject to the same regulation.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/france/index.html>>.

Source : Adapted from Autorité de régulation des télécommunications' (ART), "Telephonie Sur Internet: L'Autorité rend publics les résultats de l'appel à commentaires sur la téléphonie sur IP" (27 September 1999), <<http://www.art-telecom.fr/communiqués/communiqués/index-30-99.htm>>

6. IP Telephony is pushing telecommunication liberalization faster than policy-makers in many countries had planned. As Figure 1.1 shows, the telecommunication markets of ITU Member States have been progressively liberalizing over the past ten years, such that in 1999, more than 80 per cent of international telephone traffic originating in more than 50 countries was open to some degree of competition. While falling prices for international calls are now curtailing some of the attractiveness of IP Telephony, it is important to note that much of its early success can be explained by the lack of competition on a number of international routes, creating significant arbitrage opportunities.

7. IP Telephony is treated in widely divergent ways within ITU Member States, from being completely prohibited, to being licensed, to merely being another technological platform which can be adopted by operators. Section 5 discusses the different regulatory approaches to IP Telephony, and the methods used to categorize it within those regulatory structures. The significance of IP Telephony for universal service schemes, convergence policy, and international approaches to IP Telephony are considered. Finally, Section 6 explores possible avenues for future international co-ordination.

2. WHAT IS IP TELEPHONY?

8. It is essential to distinguish between the many different types of IP Telephony. All types of IP Telephony vary according to three characteristics: the type of **terminal devices** used, where **gateways** between IP networks and the PSTN are located, and the principal underlying **means of transmission**. A wide variety of services can be provided using different combinations of these three parameters (see Tables 2.1, 2.2, and 2.3).

2.1 Terminal devices and gateways

9. The most common way of classifying IP Telephony combines the first two of these three characteristics: the nature of the terminal devices used and the physical location of the gateways which must be employed to interconnect IP networks and the PSTN to provide end-to-end service. The gateway on the originating end of a call can logically be at the user terminal device, at an Internet Service Provider (ISP) or specialized IP

Telephony Service Provider (IPTSP), or in the central or end office of a PTO. Thus, the three most common types of IP Telephony are labelled: “PC-to-PC,” “PC-to-Phone,” and “Phone-to-Phone.”

2.1.1 PC-to-PC

10. **PC-to-PC Voice** was the first generation IP Telephony service, fuelled by the availability from 1994 onwards of low cost software that could, in many cases, be downloaded for free from the Internet. Users on both ends of a PC-to-PC ‘call’ require a personal computer (PC) equipped with audio capabilities, the same software, and an Internet connection. Calls generally have to be pre-arranged because there is no way of ‘ringing’ the other user, if he or she is not online at the desired time. PC-to-PC calling is well-suited to Internet applications such as “chat rooms,” where two or more parties can initially contact each other using text and data, and then choose to switch to voice. No gateway with the PSTN is required because such calls are never switched by the PSTN, and the principal underlying means of transmission is almost always the public Internet. Due to sound quality limitations and the awkwardness of its use, PC-to-PC Voice likely has very limited impact on traditional voice services. This type of software is available today from sites such as PhoneFree.com.¹

2.1.2 PC-to-Phone (or Fax)

11. The next step up from this is **PC-to-Phone Voice or Fax**, which became possible around 1996. The first-comers to the field were those companies already in the business of retailing low-cost telephony, such as call-back companies. For users, it meant an immediate expansion of the base of other users that could potentially be reached from a few tens of millions to the one billion or so telephone, fax and mobilephone users around the world. From the service provider’s point of view, PC-to-Phone calling is more complex than simple PC-to-PC calling because calls need to be billed and routing arrangements negotiated, including interconnect payments in the distant location where applicable. For that reason, many service providers restrict the service to a limited range of countries in which they offer service, or concentrate on the potentially large niche market of PC-to-Fax where quality-of-service requirements are not so demanding (because duplex communication is not a requirement).

12. Within the PC-to-Phone category, there are several different commercial services:

- **Free PC-to-Phone Voice** (see Box 4.1), which some IPTSPs offer either exclusively, or to attract customers for pre-paid services to a wider range of destinations. Examples include Dialpad.com and DeltaThree.com.
- **PC-to-Call Centre** service enables calling from PCs to a content provider’s call centre, allowing a degree of voice/data integration. For instance, a user could browse an e-commerce website, enter order information, and then choose the option of speaking to a real person to confirm the order or to query the details. ITCX’s “webtalkNOW!” service demonstrates the possibilities for integrating voice into e-commerce Websites.²

13. In PC-to-Phone IP Telephony, the conversion of speech into packets takes place on the originating user’s PC. The process is reversed at an IPTSP’s gateway server, which then dials the called party’s telephone number and, when a connection is made, starts sending the caller’s speech and transmitting the called party’s speech in the other direction.

2.1.3 Phone-to-Phone (or Fax-to-Fax)

14. **Phone-to-Phone Voice** is the most important segment of the market because it encompasses most commercial services. It has been commercially available since around 1997, and is the baseline for future development of IP Telephony. The reason is simple – people like to use a telephone to make phone calls. However, this third generation service requires significantly more investment to provide, since it requires originating and terminating gateways on the PSTN in, or close to, all locales where the service is to be offered. This has required IPTSPs to install their own gateways and enter into termination agreements all over the world, both with independent ISPs as well as established PTOs.

Box 2.1: Poland – New telecommunication law will permit Internet Telephony

Poland is in the midst of a transition in its IP Telephony policy. IP Telephony was initially banned as a form of illegal competition with the exclusive international licensee, Telekomunikacja Polska S.A. (TPSA). In early 2000, the telecommunications ministry informally reversed that position, pending new telecommunications legislation clarifying the situation.

Mirroring other countries, mobile operator PT Centrala (PTC) pioneered the routing of international long distance calls over the Internet. In February 2000, the Ministry granted PTC a temporary permission to use the Internet for outbound calls until the end of May 2000. New legislation is expected by that time.

Since TPSA's monopoly on international calls is set to last until 2003, this legislation will likely include some grounds on which Internet Telephony can be distinguished from the traditional voice service offered by the incumbent. It is not known whether PTC routes calls over the public Internet or a private IP Telephony network.

Source: Totaltele.com, <<http://www.totaltele.com/secure/view.asp?ArticleID=25860>>.

15. Phone-to-Phone services most closely approximate the traditional telephone experience and can display very good or very poor quality, depending on the nature of the network or networks over which packets are carried (see Table 2.1). While the Internet can be used as the underlying means of transmission for Phone-to-Phone calls, it is much more likely for these services to rely on closed, managed IP networks and formal billing relationships among gateways and carriers (see Section 2.2 below). In that respect, Phone-to-Phone VoIP services actually have very little to do with the Internet, but rather operate nearly in parallel to the global PSTN and its settlement rate system. China Telecom has taken a novel approach to bridging this chasm by negotiating specific accounting rates for terminating IP Telephony traffic.

16. To the user, the fact that a particular call travels for part of its journey via the Internet or another IP network is irrelevant, as long as the price is low and the quality is acceptable. For IPTSPs, the main motivation is to reduce costs, particularly on the international leg of a call (see Box 2.1). Fax-to-Fax services work in substantially the same way as Phone-to-Phone voice.

Table 2.1: Retail Phone-to-Phone Voice Services

Selected examples of different marketing approaches

Discount International Services via Access Numbers	Like other alternative or "dial around" long distance and international services, Phone-to-Phone Internet telephony and VoIP services require the user to dial a local access number to get a "second dial tone." After dialing the gateway server of an IPTSP, the user inputs an access code and then the destination phone number. Examples include Czech Telecom's "Xcall" service ³ and CLEAR's "CLEAR 0505" service. ⁴ Panasonic offers an "Internet phone" with a button by which the user can "select" (speed-dial) an IPTSP instead of his or her regular long distance or international provider.
Preselected Long Distance and International - Mobile	The most common implementation of Internet Telephony and VoIP as a preselected route for outgoing long distance and international calls is on mobile networks. Indeed, a good deal of pioneering use of IP Telephony technology was done by mobile operators, such as the Czech operator Radiomobil (See Box 4.2), which routes its international calls through a Global One gateway to its partner Deutsche Telekom's global VoIP network. (See the ITU-commissioned case study, "Colombia: IP Telephony and the Internet" ⁵ for a detailed examination of the use of IP Telephony by mobile operators in that country).
Calling Cards	In practice, most retail Phone-to-Phone Internet Telephony and VoIP services are marketed through pre-paid calling cards. Just as in the above scenario, the user dials the local PSTN access number of an IPTSP, is prompted to enter an account code, and then gains a second dial tone to dial the desired telephone number. Services of this type are offered by independent IPTSPs ⁶ all over the world, often without any indication to the user that the service is provided with Internet Telephony or VoIP.
Freephone Access	Specialized services such as IXC's "Borderless800" ⁷ give callers around the world access to toll-free (freephone) numbers in the US, which would otherwise be unavailable to them.

Source: ITU.

Table 2.2: Wholesale Phone-to-Phone Voice Services*Internet Telephony and VoIP services for the PTO and IPTSP*

Least-cost-routing	Just as many telecommunication carriers employ IP Telephony in their backbone networks, several operators sell IP capacity (often combined with termination services) as a least-cost routing solution for international calls. ⁸ Given the increasing prevalence of this type of transmission, many callers are probably already making IP Telephony calls without knowing it. Pulver.com's "Minutes Exchange" ⁹ acts as a "market maker" between parties originating and terminating IP minutes.
Call Termination	Hundreds of small companies, many related to established ISPs, offer international call termination in almost every country in the world (including many where IP Telephony is prohibited). Some of these firms are full-service clearinghouses and offer billing services as well. ¹⁰ The barriers to entry are low and so are the prices. See, for instance, the list of termination rates around the world available on the IPxStream Website, ¹¹ or that of Arbinet-TheXchange, where the prices quoted are often below the settlement rates which would otherwise apply. ¹² Just about anywhere the Internet reaches, IP Telephony minutes are being terminated on the PSTN.

Source: ITU.

2.1.4 Enhanced IP telephony applications

17. Beyond merely an alternative means of making long distance and international calls, IP Telephony technology enables a wide range of other services (see Table 2.3). Indeed, many industry analysts suggest that as international accounting rates and PSTN calling rates come down, these enhanced or "value-added" applications are going to be the main source of revenues for IPTSPs.

18. The flexibility of IP Telephony can be summed up in the term "XoIP," the optimistic industry acronym for "anything over IP." The basic IP Telephony technology can be extended to create limitless possibilities for the transmission of voice alone, or in combination with any other digitisable information. Drawing regulatory lines between what is voice, what is telecommunications, what is computing, and what is Internet will only continue to get more difficult. Regulators who try to delimit these boundaries will need to have a clear motivation for doing so.

Table 2.3: Enhanced IP Telephony Applications*Digitisation and packetisation enable endless opportunities for new services*

Enterprise Internal	The field of computer and telephone integration (CTI) aims to make voice, video, and data merely different applications running over unified IP networks. When combined with a private data network, CTI can provide worldwide voice service for closed user groups. When these networks happen to interconnect with local PSTNs, then they can function as "leaky PBXs," providing yet another way to terminate call minutes around the world.
Integrated voice/data (real-time)	Capitalizing on the ease of integrating digitised audio with other electronic media, new applications such as distant work collaboration allow real-time voice conversations between users looking at the same visual information, such as an architectural plan or a product catalogue. Images, text, and audio can be combined to produce a true multimedia experience, taking Internet chat to a new level of interactivity. In the first instance, the main market for this type of application has been in the field of pornography, where there is already a US\$ 2 billion market for telephone sex.
Integrated voice/data (messaging)	Where the exchange of voice signals need not be "live," other opportunities present themselves. Some early commercial applications are electronic greeting cards which can be created and delivered over the Web. In addition to graphics and "canned" music, the greeting can include a short recording of the well-wisher's voice. ¹³ Similarly, voice messages can be integrated into email messages, business presentations or educational materials. These are not necessarily examples of IP Telephony, but rather of "store-and-forward" computer technologies which have existed for several years.
Integrated voice/video	If integrating voice and data proves commercially successful, adding video would be the logical next step. IP technology enables very low-cost teleconferencing (albeit presently at low quality) over the Internet, using simple PC cameras. As technology and bandwidth improve, expect text, graphics, audio, video, and Web-style data to be integrated in creative and unpredictable ways.
Telemetry	Moving even further from traditional voice telephony is the emerging field of telemetry – the monitoring and reporting of just about anything, anywhere. Audio-enabled devices can monitor sound levels and transmit images from industrial installations, day care centres or babies' cribs.

Source: ITU.

2.2 Means of transmission

19. The distinction between Internet Telephony and VoIP turns on the third characteristic introduced above, the nature of the principal underlying means of transmission. The following definitions are offered as a means of interpreting the many different terms which are thrown about in this field:

- **Internet Protocol (IP) Telephony:** The transmission of voice, fax and related services over packet-switched IP-based networks. Internet Telephony and VoIP are specific sub-sets of IP Telephony:
 - **Internet Telephony:** IP Telephony in which the principal transmission network is the public Internet. (Internet Telephony is also commonly referred to as “Voice-over-the-Net” (VON), “Internet Phone,” and “Net Telephony” – with appropriate modifications to refer to fax as well, such as “Internet Fax”).
 - **Voice-over-IP (VoIP):** IP Telephony in which the principal transmission network or networks are private, managed IP-based networks (of any type). (Depending on the type of network, you can have “Voice-over-frame relay,” “Voice-over-cable,” and “Voice-over-DSL” or “VoDSL,” as examples).

Different types of IP Telephony can be identified according to the type of terminal used, where gateways are located, and the underlying transmission means. The major types discussed in the background paper are **PC-to-PC**, **PC-to-Phone** and **Phone-to-Phone**.

- The **Public Internet** (also referred to as *the* Internet): The global, public, IP-based meta-network created by the interconnection of many public and private IP-based networks.

20. The balance of this Paper employs the classifications of terminal devices, gateway locations and means of transmission introduced in this section. While the many different retail, wholesale, and internal services which can be provided by combining these three elements in different ways are often generically referred to as “Internet voice” or “VoIP,” it is important to identify the precise service being offered in any given case. The labels for these services introduced in this section are also used throughout the analysis presented here.

3. TECHNICAL ASPECTS OF IP TELEPHONY

21. This section is offered as an introduction to the basic technical aspects of IP Telephony. It is not intended to be comprehensive, and the reader is frequently referred to specialized sources of information available on the Web.

3.1 Packet switching

22. The most important concept in IP Telephony technology is **packet switching**. However, the significance of the difference between packet switching and circuit switching is probably not as great as initially proclaimed by the Internet community. As IP Telephony development has proceeded, the primary goal has been to replicate the functionality, reliability, and service quality of circuit-switched telecommunications networks, and to do so using a protocol suite which was not optimised to facilitate real-time communications. While Internet communication is indeed “connectionless” (that is, no unique end-to-end circuit is created and held for the duration of each call), current development trends seek to make IP Telephony much more connection-oriented than other types of IP communications.

23. Internet technology chops up electronic transmissions into packets of varying numbers of bytes. Each packet is given a ‘header’ or address label, and sent from one network node “towards” another. The packets are (theoretically) bounced along from one router to another, armed at each ‘hop’ with only enough information to get them safely to another router, where the process is repeated. By contrast, on circuit-switched networks operating under a protocol such as Signalling System 7 (SS7) a call is routed through a hierarchy of local, inter-urban and international switches to establish a circuit between caller and called party. In practice, in a digital network with use of data compression, the real differences between the two network types are becoming less and less significant (see Figure 3.1).

24. In fact, the key difference in methods is that telephone networks have been carefully engineered to provide extremely reliable, high-quality voice transmission, making real-time, two-way conversations possible from almost any two points on earth. IP networks, on the other hand, were originally designed for two-way, asynchronous (not real-time) *text-based* communication. A second difference lies in the way the services have traditionally been priced: on a per-minute usage basis for circuit-switched calls and on a flat-rate basis for IP traffic. The desire to make these two types of networks interconnect and interoperate without the user being able to tell the difference has prompted enormous research and development efforts in both the telecommunication and computer industries. IP Telephony is in many ways the embodiment of convergence, and may ultimately force both types of networks to change and grow more alike.

3.2 Gateways

25. The link between an IP network and a telephone network is called a **gateway**. This is the point at which voice signals become digitised and packetized, or at which digitised packets are converted back to voice. In the case of Phone-to-Phone IP Telephony (including calling card), the gateway is a server which customers dial, much as they might dial an ISP's server from their computer modem. The originating server prompts the user to input an account code and the desired telephone number, and then encodes the ensuing call into IP packets, each with a header directing it to another gateway server somewhere else, where the process will be reversed, and the IP call forwarded to an ordinary telephone. On the other end, the terminating server, which is located as close as possible to the called party's exchange, dials the called party's telephone number and, when a connection is made, starts sending the caller's speech and transmitting the called party's speech in the other direction.

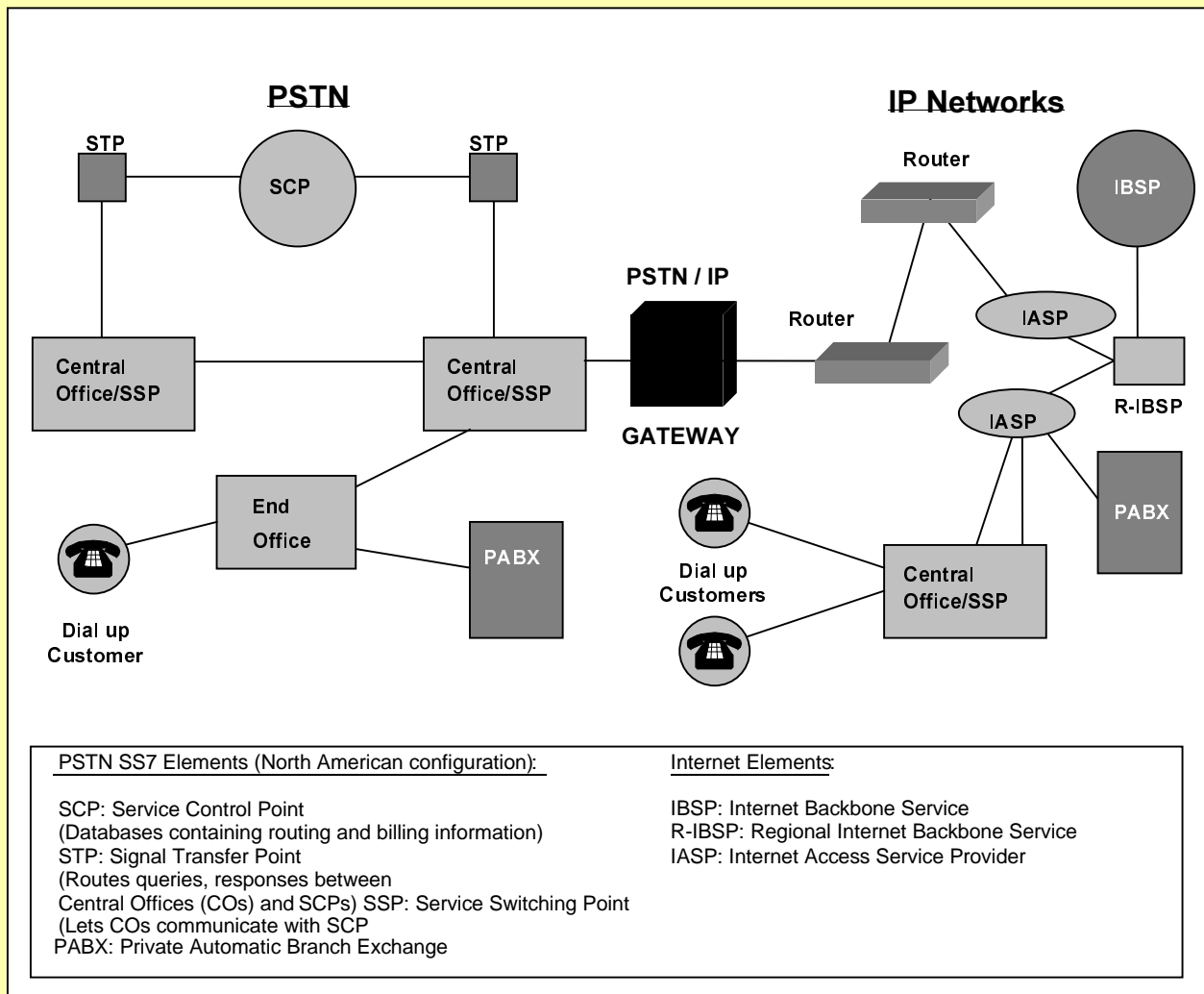
26. Gateways thus allow long distance or international calls to 'look' to the billing systems of PSTN operators at either end like local calls. Once again, it is important to note that not all originating gateways redirect PSTN calls onto the Internet, and not all terminating gateways receive calls from the Internet. Gateways can be connected to any kind of IP network, and, in the case of commercial IPTSPs like DeltaThree.com, the network in question is what the company calls "the world's largest network dedicated entirely to the transport of Voice over Internet Protocol" – that is, *not the public Internet*.

27. Many IPTSPs, however, *do* use the public Internet for some or all of their call routing,¹⁴ and this has appreciable consequences for call quality (see "Quality of service," below). Once on the Internet, the packets are forwarded, essentially like any other Internet packets, whether they carry text, graphics or video. When they reach the terminating gateway, the packets are 'dumped' onto the local PSTN. From this point on, a true Internet Telephony call and an IP Telephony call would be indistinguishable from the 'point of view' of the local telephone network.

28. Gateway operators prefer to locate their equipment in major metropolitan centres, where the largest number of PSTN subscribers can be reached with or can make a local call. If a gateway server must dial a long distance call to terminate an IP call, the cost savings otherwise available can be lost. Terminating gateway operators must generally pay for local access lines to the PSTN, which are frequently the same lines leased by ISPs, so that their dial-up Internet access customers can dial into their Web servers.

29. IP Telephony users who are connected to 'always-on' LANs do not dial into gateways. Instead, their networks are constantly connected to one or more gateways. On enterprise internal IP Telephony networks (see Table 2.3), calls may never pass through a gateway at all, remaining 'on-net' throughout their entire path.

Figure 3.1: Two different ways of doing the same thing
Gateways bridge PSTN and Internet architectures



Source: Adapted from TeleGeography, Inc., *Hubs and Spokes: A TeleGeography Internet Reader* (Washington, DC: 2000), p. 50, <<http://www.telegeography.com>>.

3.3 Quality of service (QoS)

30. While it has been technically possible to transmit voice telephone calls over IP-based networks for several years, their poor **sound quality** and inconvenience has prevented IP Telephony from threatening traditional voice telephone systems (see Box 3.3). There are, in general, two ways in which sound quality can be improved – special quality of service algorithms and more bandwidth. Massive amounts of research time and money are being put into enhanced routing research, while billions are being spent to increase the bandwidth capacity of global data networks. Each have the potential to make IP Telephony a viable commercial alternative to the PSTN, but are based on very different philosophies.

31. While distance has been said to be irrelevant to Internet transmissions, this is not strictly true. The speed of light imposes a physical limitation, and without the benefit of a dedicated fibre link from origin to destination, there are likely to be more hops involved. When the packets carry bits of an email message, delays of milliseconds or even seconds caused by such limitations do not make much difference. But when those packets carry bits of a phone conversation, the time delays can make normal telephone conversation awkward (see Box 3.1).

32. Under current Internet routing conditions, IP voice packets do have a small advantage over email and Web packets, but not much. Internet Telephony packets are not transmitted using the Transmission Control Protocol (TCP), but via another called User Datagram Protocol (UDP) (see Box 3.2).

Box 3.1: Switzerland – It all comes down to a few milliseconds

Internet Telephony and IP Telephony services are currently not subject to detailed regulation in Switzerland. However, as in those countries bound by the European Commission's directives on voice telephony and Internet voice services (which Switzerland is not), that situation could change if the services provided are considered "real time."

The key criterion in determining whether a certain type of IP Telephony constitutes public telephone service under the Swiss policy is whether the service is "transmitted through direct transport and switching of speech in real time." This comes down to a question of milliseconds. The authors of a recent article on the Swiss perspective on IP voice telephony explain the milliseconds issue well:

"So far, IP Telephony over the public Internet only provides usable communication with significantly impaired speech quality and end-to-end delays of over 450 milliseconds (ms) being likely to impact the overall conversational interactivity and causing a perceived deterioration of voice quality which is less than that of a GSM Full Rate Speed Coder (FR). Uncongested IP networks have the potential to provide a user experience similar to common wireless mobile telephony services (GSM FR), delays being up to 450ms. QoS-engineered IP networks might provide a quality similar to the PSTN and GSM Enhanced FR, but with increased delays of up to 250ms. Only QoS-engineered IP networks in Local Area Network (LAN) environments can provide a quality similar to or better than the PSTN, delays being only up to 150ms (see ETSI-TIPHON, TR 101.329 on General aspects of Quality of Service, p. 24)."

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/switzerland/index.html>>.

Source: Pierre-Yves Gunter and René Pfromm, "IP Voice Telephony – A Swiss Perspective," *World Telecom Law Report*, Vol. 3, No. 2 (February 2000), pp. 26-29.

Box 3.2: The life (and death?) of an IP Telephony packet

The genius of Transmission Control Protocol (TCP) is that it can automatically adjust the rate at which packets are transmitted to account for network conditions, such that in periods of network congestion, packets are made smaller and not sent out after each other as quickly. In this way, everybody's packets have about the same chance of being successfully routed across the same network. This is a function of the Internet traditionally having only one class of service – known as 'best efforts.' User Datagram Protocol (UDP) packets are a bit different to TCP packets. They refuse to be held back in favour of other packets, and are always sent out at the same rate.

UDP is used for Internet Telephony packets to minimize delay to some degree – at least to keep them from being slowed due to traffic conditions. UDP is normally used for simple network transactions, like Domain Name System (DNS) lookups and network management functions (SNMP). For this reason, it would be impractical to reprogram core Internet routers to block UDP packets, if this was desired. However, at an IPTSP or ISP's servers, this may be possible. All real-time voice and video applications running on IP have a "port number" over 1024 (a port is a program on a computer that receives or sends information for the computer – each port has a number in order to identify it). Port numbers from 0-1023 are for use by privileged services which are allocated certain numbers by Internet technical bodies. They are unchangeable by users. However, ports above 1024 can be set by anyone.

ISPs can use this fact as a straightforward way of guarding against IP Telephony traffic clogging up data lines. They can simply "drop" UDP packets with a port number over 1024, or monitor data streams and "shape" their traffic by treating such packets differently. However, once IP Telephony calls have been patched from IP networks onto the PSTN, they are almost impossible to detect. This makes it very difficult for national authorities to prevent IP Telephony calls from being terminated in their territories.

33. However, UDP only compensates for the Internet's single service class so much – and not enough to facilitate PSTN-quality phone calls. Research has been underway in the Internet industry for several years on ways to prioritise certain packets over others. Latency-sensitive transmissions, such as voice and video, need to be given priority over (slightly) more asynchronous services such as email and Web browsing.

34. Quality of service in IP networks and the public Internet will improve with innovations in routing protocols and improvements in the physical networks which carry IP traffic. One limitation which may take longer to ameliorate, however, is the poor quality of telecommunication infrastructure in developing countries. Even where IP infrastructure exists, congestion can be a major problem.

Box 3.3: Changing quality of service expectations?

It is widely believed (and mostly with good reason) that the clarity of sound on an Internet Telephony or VoIP connection is not as good as that of the PSTN. This fact has implicitly supported many permissive IP Telephony policies. The most important factor in sound quality is the degree of delay inherent in the transmission of speech, or whether voices appear to be transmitted instantaneously. While sound quality can be improved on closed IP Telephony systems, only the most well-provisioned and controlled networks can currently offer equivalent clarity of sound to that of an ordinary PSTN connection.

Consumer expectations of sound quality may be falling to the point that the lower quality of sound available on most IP Telephony systems is acceptable in exchange for a lower price. Mobile telephone service tends to suffer poor quality and occasional break-up of service. It is not by chance that the first major application of IP Telephony for preselected long distance and international carriage was in the mobile market, where quality expectations are already slightly lower than on the PSTN. With greater use of voice compression and speakerphones, even standard PSTN quality has deteriorated somewhat in recent years. For this reason, sound quality alone may not be a sensible basis on which to distinguish between unregulated IP Telephony services and regulated voice telephony services.

Under the Hungarian policy (see Box 5.1), service providers must inform their customers of the quality limitations of IP Telephony services but that appears to have had little impact on their popularity particularly among mobile users. While IP networks may never achieve the 99.999% reliability targets aimed at by fixed-line operators in developed markets, it may simply not matter as consumers in many countries, and particularly those in countries which have never had such high-quality service, have shown a preference for lower-cost services, even at the expense of sound quality.

35. Even in developed countries, the broad range of functionality available on circuit-switched networks is not yet available over the Internet, and some functions not even on closed VoIP networks. This is one reason why makers of IP Telephony hardware and software aim to provide products which actually integrate with the PSTN, instead of just laying on top of it. The enormity of this task appears to have dulled some of the early enthusiasm generated by IP Telephony. However, an enormous amount of work is being done in this area in many industry segments and fora, some of which is described under “IP/Telecoms Interworking,” below.

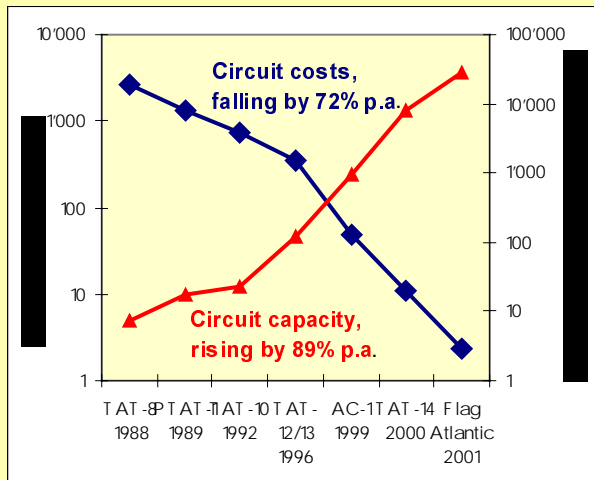
3.4 Bandwidth

36. The other basic means of decreasing latency in IP packet transmission is to increase the **bandwidth** of the network or networks employed. More bandwidth means less congestion, which in turn means less delay, and more natural voice conversations. Indeed, some observers argue that increasing available bandwidth is a far more practical means of speeding up the Internet than QoS, because it does not require coordinated action across the Internet.¹⁵ However, the Internet community is still trying to figure out how the providers of increased bandwidth, especially for transit, will be compensated for their contributions to overall Internet performance.¹⁶

37. The situation is much simpler with respect to private IP networks. More bandwidth, faster transmission, and better voice quality combine to produce satisfied customers for more of the time. Privately-operated bandwidth is therefore a key element in commercially-viable IP Telephony, and much more so at present than QoS. It is no accident that the rise of IP Telephony has coincided with the massive increase in available international bandwidth by means of fibre optic cable and satellite (see Figure 3.2). Ironically, IP Telephony (like Web browsing) is not nearly as lucrative a way of using that capacity as traditional voice telephony, particularly given the Internet’s predilection towards ‘free’ services. Nevertheless, the price of bandwidth is dropping tremendously, on most routes. For now, however, access to international IP bandwidth remains concentrated in large cities in developed countries (see Figure 3.3).

Figure 3.2: The boom in trans-Atlantic capacity

Trends in the availability of circuits on the trans-Atlantic route and on the average cost per voice path, 1988-2001



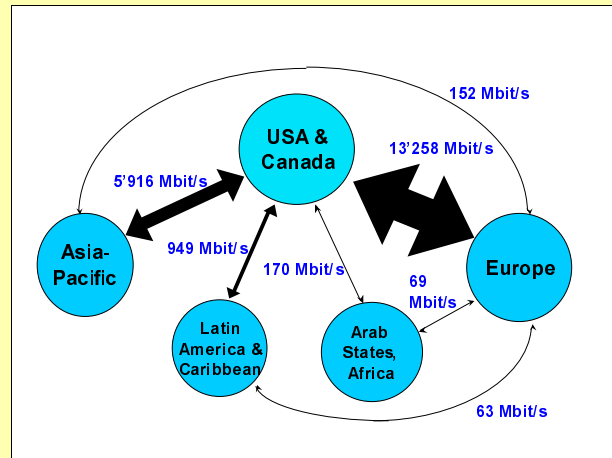
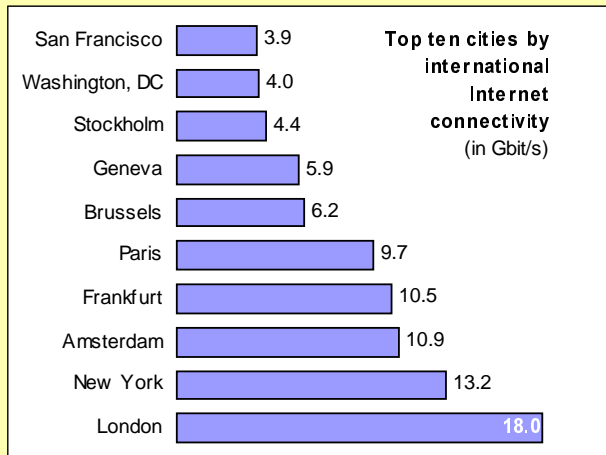
Transatlantic Cable System Total Capacity		Trans-pacific Cable System Total Capacity	
1990	24'570	1990	7'560
1991	24'570	1991	24'570
1992	62'370	1992	39'690
1993	85'050	1993	62'370
1994	160'650	1994	62'370
1995	251'370	1995	69'930
1996	311'850	1996	190'890
1997	372'330	1997	190'890
1998	795'690	1998	311'850
1999 est.	2'005'290	1999 est.	1'279'530
2000 est.	9'746'730	2000 est.	3'819'690
2001 est.	52'687'530	2001 est.	11'561'130

Note: "Circuits" are 56/64 kbit/s international circuit equivalents, as reported to the FCC. The "circuit cost p.a." is calculated by dividing the construction cost of the cable by the available number of circuits on the cable, their anticipated capacity usage (18%) and dividing by an expected working life of 20 years. Estimates are used for 1999, 2000 and 2001 for the right-hand table.

Source: Adapted from data supplied by FCC and TeleGeography Inc.

Figure 3.3: Top ten international Internet hub cities, and inter-regional Internet bandwidth

International bandwidth as of September 1999



Source: Telegeography Inc.

3.5 Standards and protocols

38. IP Telephony technical standards relate to every aspect of how an IP call is originated, transmitted, and terminated. In many ways, their development represents an attempt to replicate the PSTN, a system optimised for voice telephony, in the context of the Internet. This difficult process is not made any easier by vendor rivalries and the initial unfamiliarity of the Internet industry with how telecommunication systems work. For instance, Many IPTSP services rely on the billing capabilities built into the PSTN to levy charges from customers. However, the problem of lack of standards now affects the ability of IPTSPs to exchange traffic amongst themselves, and get paid for doing so.

39. Although not always well-coordinated, a great deal of work on technical standards is underway on several fronts (see Table 3.2). The nuts and bolts of IP calling are being hammered out in regional and industry bodies such as the European Telecommunications Standards Institute (ETSI) and the Internet Engineering Task Force (IETF), as well as at the global level in ITU-T study groups. Different protocols

aim to perform different portions of the process of setting up, controlling, transmitting, and terminating a phone call over IP networks and between IP networks and the PSTN.

40. ITU-T Recommendation H.323¹⁷ and related protocols have been the global standard for IP Telephony since version 1 was approved in October, 1996. Recommendation H.323 specifies terminals and equipment for multimedia teleconferencing between two and more parties on a packet based network. Related Recommendations, such as H.248, relate to media gateways (referred to in this Paper simply as gateways) which bridge IP networks of various types and the PSTN. Media gateway development is also under way in the IETF, most notably relating to the Media Gateway Control project (MEGACO) (see Table 3.1). Different vendors have committed to different protocols, some produce multi-protocol capable equipment, while the industry as a whole appears to be waiting for a dominant standard to emerge.

41. Another short-term barrier relates to the need for an expanded IP address space in the Internet's technical infrastructure. While the IETF has agreed on a new version of Internet Protocol, named IPv6, the Internet industry has been reluctant to implement it to date. To conserve existing IPv4 addresses, a practice known as "Network Address Translation" (NAT) is used. NAT slows down IP Telephony today because of the need to translate addresses at one or more stages. It is hoped that the conversion of the Internet's constituent networks to IPv6 will solve this problem, but movement in that direction continues to be slow.

Table 3.1: "Everything-over-IP" Standards, Protocols, and Vendor Fora

Standards for interworking among IP Telephony hardware and software and with the PSTN

Standards Body	URL	Major XoIP Standards/Protocols	Notes
International Telecommunication Union (ITU)	www.itu.int	T.120	Real Time Data Conferencing (Audiographics)
		H.320	ISDN Videoconferencing
		H.323	Video (Audiovisual) communication on Local Area Networks
		H.324	Video and audio communications over low bit rate connections such as dial-up modem connections
ETSI/TIPHON	www.etsi.org	OSP	Open Settlements Protocol provides XML-based IP traffic settlements
Internet Engineering Task Force (IETF)	www.ietf.org	SIP	Session Initiation Protocol enables voice over IP gateways and client end-points
		RSVP	Resource Reservation Protocol prioritizes packet traffic by use
		RTP/AVT	Real Time Protocol enables real-time transmission of audio and video (but doesn't promise it)
		MGCP	Media Gateway Control Protocol defines how different media (e.g., voice and video) will control data packets
		LDAP	Lightweight Directory Access Protocol provides a universal address database for networks
Industry Forum	URL	Membership	Notes
International Multimedia Teleconferencing Consortium (IMTC)	www.imtc.org	Founded 1993, currently 145 members	IMTC covers H.323 (and other ITU standards), iNow, and others
Softswitch Consortium	www.softswitch.org	Founded 1999, currently 50 members	Focused on SIP/MGCP and other internetworking technologies
Internet & Telecoms Convergence Consortium	itel.mit.edu	Academic/corporate	Covers technical, economic, and policy issues
Industry Initiative	URL	Founders	Notes
Interoperability Now! (iNow)	www.imtc.org/act_inow.htm	ITXC, Lucent, VocalTec	Standards-based IP telephony interoperability profile for vendors and service providers based on H.323
IP Call Detail Record Initiative (IPDR)	www.ipdr.org	Jerry Lucas and 19 charter members	Goal is to define record protocol for IP traffic exchange and billing and submit to standards bodies for discussion
VON Coalition	www.von.org	Jeff Pulver and 22 charter members	Seeks to keep IP services as unregulated as possible and educate consumers and the media about relevant technologies

Source: Adapted from TeleGeography, Inc., *Hubs and Spokes: A TeleGeography Internet Reader* (Washington, DC: 2000), p. 54, <<http://www.telegeography.com>>.

3.6 IP/Telecoms interworking

42. Most telephones are -- and will continue to be for several years to come -- connected to traditional circuit-switched telephone networks. IP Telephony services must be able therefore to accept calls originated on the PSTN, to terminate calls on the PSTN, and do it all seamlessly. Today, the most basic IP voice services accomplish this feat by means of gateways which simply convert and forward calls in one direction or another. Before IP Telephony can be a mass-market alternative to the PSTN, there must be much greater integration between the two. The initial enthusiasm of "free long distance on the Internet" appears to have been dulled by the reality of the immense complexity of duplicating a global telecommunications system.

43. Current research and development work, both into proprietary vendor solutions and open industry standards seeks to make telephony media-neutral, that is, equally functional and interoperable across many different types of physical networks, equipment, and control software (e.g., switches, routers, directories, signalling systems). This new phase of telecom and Internet interworking research has the same ultimate goal as the now-forgotten 'miracle' of the Internet -- allowing many different types of computers running different software to communicate end-to-end in the same language.

44. IP Telephony must still evolve significantly beyond simple voice transmission. IP networks that link to the PSTN via gateways are not generally capable of Intelligent Network (IN) functionality yet, such as calling party identification (indeed, on the Internet, guaranteed anonymity is often considered an advantage), nor can they interface seamlessly with standard PSTN signalling systems, such as Signalling System 7 (SS7). These advanced call control functions facilitate the advanced level of functionality to which telephone subscribers have become accustomed, and which form the basis for many premium rate and enhanced services. SS7-capable systems are available for private network environments, but may be several years off in the public Internet.

45. While IP Telephony technology must improve to match the sound quality and advanced functionality of the PSTN, there are several ways in which IP Telephony surpasses the functionality of traditional telephone networks. Value-added services such as integrated voice/data and enhanced messaging are frequently predicted to be the primary means by which IPTSPs will aim to compete with telecommunications carriers, rather than simple voice transmission.

46. The full range of ITU-T's IP/Telecoms Interworking activities are beyond the scope of this Paper.¹⁸ This work relates to how naming, numbering, addressing, and routing resources and systems will interoperate across different types of networks and terminal devices. For instance, how will wireless devices, which 'live' on IP-based data networks, reach and be reachable by traditional telephones? As another example, how will such devices be identified -- by device, or by user? Or both? Given that terminal devices are increasingly globally mobile, how can users be assured to have the same presence (i.e., numbers, capabilities) regardless of physical location? Finally, where will all this information be listed, so that it can be consulted automatically by routing systems from different types of networks?

Table 3.2: Global IP-based Networks

Current reach and projected expenditures on public and private IP connectivity around the planet

Carrier	Reach of IP-based facilities	Projected expenditures on IP facilities
Concert (BT and AT&T)	21 cities in 17 countries (number of countries to be doubled in early 2000)	\$4 billion (through 2005) ¹⁹
Equant	130 countries ²⁰	~
Teleglobe	102 countries, with 23 local Internet access nodes in 11 countries	\$5 billion (through 2004) (GlobeSystem initiative) ²¹
UUNet (MCIWorldCom)	114 countries ²²	~

Sources: Company press releases.

47. There are many other areas in which IP Telephony technology must still mature, such as security, authentication, emergency communications capability, and, most importantly from a commercial standpoint, financial systems such as statistical reporting, accounting, billing, and compensation. However, it is equally true that the PSTN must evolve if it is to compete in a world which is increasingly mobile and in which there are now many alternative providers of bandwidth.

3.7 An E.164 country code for IP Telephony?

48. It is now widely possible to originate calls using IP Telephony, but rare to terminate calls on IP networks. Rather, calls are generally terminated on the PSTN, so the called party can only use a terminal device connected to the PSTN. In order to make dialling an IP phone possible, a global numbering scheme needs to be devised.

49. One approach might be to assign a special country code for IP phones, one that has global coverage, and which could therefore be dialled from anywhere just as one would dial an international call today. Precedent for this exists in the form of E.164 numbers allocated to Universal International Freephone Numbers (UIFN) (800) or Global Mobile Personal Communication Services (GMPCS). Such a global resource would produce a very large number of phone numbers for IP Telephony devices or users, and no special carrier access code would be necessary to call via IP Telephony.²³ ITU-T Study Group 2 is currently considering a request to assign an international country code to IP Telephony services. The original request came from a number of operators collaborating in the ETSI TIPHON project. An E.164 resource “878 878” has been allocated for trials over a fixed period.

50. Assigning an E.164 code to IP Telephony services may have regulatory advantages as well, as countries which choose to regulate IP Telephony in a particular way could more easily identify this type of traffic.

3.8 Impact of IP Telephony on network architectures

51. In a remarkably short time, IP has become the platform of choice for new telecommunication networks. Vast global IP networks are being created to support Internet-style applications accessible from anywhere (see Table 3.2). Voice is indeed only one of the applications and services which these networks can carry. While this ‘hype’ often obscures the fact that the vast majority of telephony, radio, and television is still provided using conventional telephone, radio, and television networks, and will continue to be so for several years, there is a very strong trend towards an “IP in everything and everything on IP” world. The lure of a common platform for digital communications, and the expected costs savings, are proving to be very strong motivators indeed.

52. IP technology is already having an impact on network architectures. Many carriers use IP –based networks at the backbone level in their routing of calls. AT&T has famously announced it will purchase no more circuit-based switches, only IP-based routers and servers. The degree to which this trend is influenced by the regulatory distinction maintained in many countries between voice and data is a subject explored at some length in “Regulatory Aspects” below. In any event, despite the relatively low profile of IP Telephony at the retail level, its importance is steadily growing in telecommunication networks.

53. Since IP Telephony calls (like Internet traffic) are often transported over leased data lines – which are generally subject to lighter regulatory oversight than public voice circuits – they often bypass the PSTN and its associated statistical and financial structures. This issue becomes particularly significant in the case of cross-border and international traffic, where prices have traditionally been the highest and arbitrage opportunities the greatest. The issue of price arbitrage, one of the primary drivers in the early market development of Internet and IP Telephony, is explored further in Section 4.

4. ECONOMIC ASPECTS OF IP TELEPHONY AND IMPACT ON PTOs

4.1 Consumers, carriers and countries

54. The economic advantages of IP Telephony for **consumers** can be described very simply: it is invariably *cheaper* than the traditional alternative, especially for Internet Telephony (carried over the public Internet). If all other factors—quality, convenience, reliability, etc.—are equal, the choice to use whichever type of IP Telephony is cheapest is an economically rational one (see Box 4.1). For the moment, the other factors are not equal. Therefore consumers must generally make a trade-off between price and quality. In the medium-term it is likely that VoIP (over managed IP networks) will be equivalent in quality and reliability, and may in some circumstances be more convenient (e.g., for unified messaging), than traditional telephony. Thus price will be the main distinguishing factor.

55. For **carriers** however, the economics are much more complex. That is because incumbent carriers generally have existing revenue streams which they fear may be cannibalised by a shift to VoIP. Even if VoIP offers a cheaper alternative to substitute for those existing revenues²⁴, it may not be economically rational to move immediately towards providing telephony services over an IP platform. The speed of the transition will be dictated by:

- The regulatory environment (see Tables 5.1 and 5.2).
- The degree of competition the carrier experiences in its domestic and in foreign markets. The greater the level of competition, the faster the shift will be towards lower cost services.
- Whether a particular carrier is an incumbent or a new market entrant. New market entrants, with no legacy network to defend, are likely to be the first movers towards VoIP.
- The anticipated level of price elasticity in the demand for voice-based services. Where price elasticity is high, then the shift towards VoIP will be quicker.

The opportunities to develop enhanced services which combine voice with data and video services. Where the market is relatively sophisticated (e.g., high penetration of PCs, extensive business use of the Internet) then the shift to VoIP will be quicker.

56. In reviewing these different factors, it seems likely that the shift towards VoIP for telephony will occur earlier among carriers in developed markets than in developing ones.

57. For **countries**, the question of whether to permit or ban different forms of IP Telephony is a sensitive one. For countries in which the interests of regulators are aligned with those of consumers, it would appear to be Luddite to ban IP Telephony. There may be some scope for consumer protection legislation (for instance, to disallow misleading advertising or to encourage honest statements concerning anticipated level of quality on pre-paid services). But generally a liberal approach offers the best prospects for consumer welfare. A less liberal approach might be expected in countries where the interests of regulators are more closely aligned with those of the incumbent carrier (e.g., where the carrier is state-owned). Some carriers might restrict the offer of IP Telephony to a limited range of licensed carriers, reinforcing existing restrictions on market entry for voice communications. A more nuanced approach might be to permit (or even encourage) use of the Internet to carry outgoing international calls (thereby bypassing the accounting rate system) while insisting that carriers making incoming international calls pay the full inward settlement rate. Asymmetric policies of this nature are being applied in some developing countries with a view to maximising incoming settlement payments (see Table 4.1).

4.2 Size, substitutability and settlements

58. From an economic viewpoint, the significant questions to ask about IP Telephony are:

- (1) how large is the market?
- (2) to what extent is IP Telephony generating *new* traffic or is it substituting for that which already exists?
- (3) what impact is it having on the business models of existing carriers?

Box 4.1: “Free” IP Telephony?

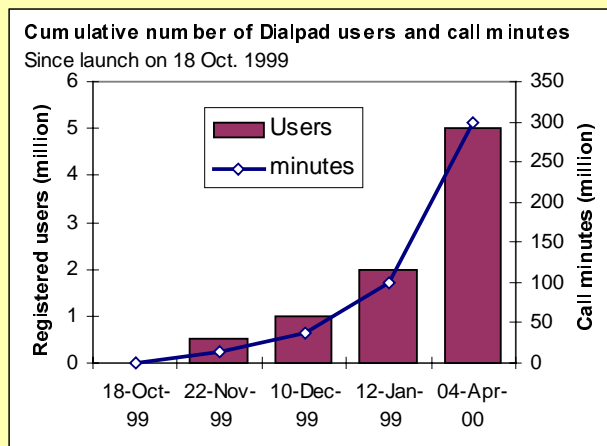
In October 1999, a company called Dialpad.com started advertising “free” PC to phone calls from PCs anywhere in the world to telephone subscribers in the United States. Within a few months, the regulatory agency in far-away Nepal had urgently faxed all ISPs in the country asking them to block traffic to Dialpad’s site. News travels fast on the Internet, and news about “free” services seems to travel even faster. Within a few months of launch, Dialpad had more than six million registered users and had carried some 300 million minutes of traffic (see Figure).

Dialpad’s strategy was not particularly new: Free World Dial-up project, for instance, was offering a “free” Internet Telephony service as long ago as 1995, relying upon volunteers in different countries to patch incoming calls to their local telephone network. But Dialpad offers a convenient, H.323-compatible service in which calls within the United States are delivered over a managed fibre-based VoIP network run by Genuity, a subsidiary of GTE, a major US telecommunications company. It is able to offer service for free by offsetting any interconnect charges which might be incurred (typically a few US cents per minute) against advertising revenue, both via audio and on the website. It also gains revenues from offering the application to ISPs to promote under their own brand.

Dialpad is not alone in this market. As the Table shows, there are many different companies that offer advertising-funded IP Telephony, with a recent trend towards enhanced services and applications (e.g., Internet call-waiting, integrated messaging etc). As awareness of such services grows, and their geographical coverage spreads (they are particularly popular in countries which have free local calls or very low interconnect charges for terminating calls) it will be hard for services which levy per minute usage charges to compete. The list of Web-based services which began as a priced service and ended up as free of charge is growing (e.g., free browsers, free e-mail, free website hosting).

Box Figure 4.1: IP Telephony wants to be free

Cumulative growth in Dialpad’s registered users and call minutes, October 1999-April 2000, and examples of different “free” IP Telephony applications and services



Type of “free” service	Example providers and coverage
PC to PC	Firetalk.com (International) Phonefree.com (International)
PC to Phone	Dialpad.com (US & Rep. of Korea) Deltathree.com (free for US & Canada) e001.com (Hongkong SAR & Singapore) hottelephone.com (US + 15 countries)
Phone to Phone	speak4free.com (US) I-link.com (US)
Enhanced services (e.g. voicemail, call waiting, call forwarding)	yac.com (UK and International) buzme.com (US) 2bsure.com (Asia-Pacific)
Fax	efax.com (US, UK)
Email to voice	T2Mail.com (Singapore & HK)

Sources: ITU, adapted from Dialpad.com, Pulver.com and company websites.

59. Looking first at the issue of **size**, market estimates vary widely:

- The market research company, IDC, estimates that the IP Telephony market generated traffic worth 2.7 billion minutes in 1999 and will expand to around 135 billion minutes, with revenues of US\$19 billion, by 2004;
- Deltathree.com forecasts that IP Telephony will generate around 16 billion minutes of international traffic in 2000 and will account for some 35 per cent of the total by 2005;
- Tarifica estimates that more than 40 per cent of all international calls will be carried over IP by 2004. Analysys thinks that it will reach 25 per cent by the same date.

60. One reason that the market estimates differ so much is because the studies use different definitions. Market forecasts, such as those put out by IDC, are based mainly on traffic reported by IP Telephony service providers (IPTSPs). They do not generally include traffic that is being carried over IP (for at least some of the route) by the major public telecommunication operators. This is particularly difficult to estimate. The Sema Group reports that some 60 per cent of public telecommunication operators believe that IP Telephony is capable of becoming the main means of telecommunication by 2004 and that one quarter of them believe that the majority of their voice traffic will be carried over IP by that date. Already, the number of international circuits which are used for leased lines (primarily for Internet use) outnumber those that are

used for the PSTN, especially on the busiest routes, for instance between the United States and Europe (see Figure 4.1). These figures suggest that, within a few years, a significant share of international telephony traffic will be carried over IP for at least part of its route.

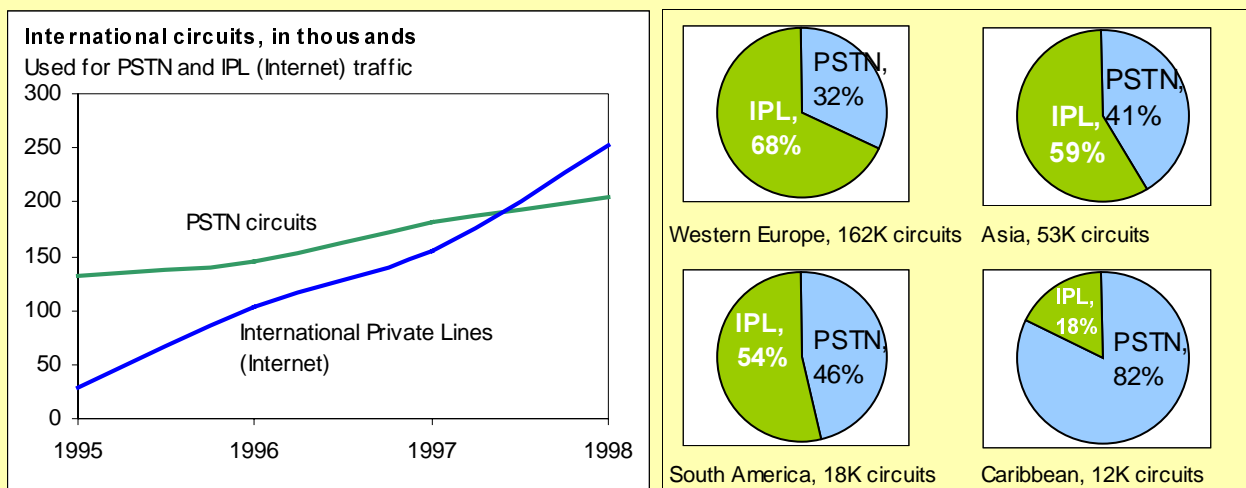
61. The issue of **substitutability** is more complex. Clearly, much of the traffic carried over PC-to-PC Internet Telephony will be “new” traffic, that would not otherwise have existed. Much of the discount traffic generated over PC-to-Phone services, especially that which is “free,” is also likely to be new traffic. But some of this traffic, and the vast majority of calls carried over Phone-to-Phone services, are likely to be calls that would otherwise have been made over the PSTN, and can therefore be regarded as substitute traffic. The cheaper prices generally available for IP Telephony may spur higher growth rates in traffic, where demand is elastic. But existing carriers will inevitably lose some market share.

62. In fact, the traffic statistics show a more complex picture. The growth rate in international traffic has recently slowed, starting in 1998 and continuing in 1999. Traffic originating in the United States had been growing by 20 per cent per year consistently since the mid-1980s then suddenly fell to just 8 per cent in 1998 despite the boom that the US economy was experiencing. It is hard to credit this slow down in growth. It is likely that the *real traffic* did in fact grow, but is not being reported by carriers because it is not passing through the accounting rate system.

63. The motivation for sending traffic outside the accounting rate system is to reduce the level of **settlements** that are due to partner countries. Under the international settlements system, the operator(s) in the country that originates a call have traditionally made a compensatory payment to the operator(s) in the country that terminate the call. Payments are made when traffic in one direction is greater than traffic in the return direction. The level of payment is based on bilaterally negotiated “accounting rates”. A net settlement payment is usually made on the basis of excess traffic minutes, multiplied by half the accounting rate (the accounting rate share, or settlement rate). Net settlement payments, primarily from developed countries, have grown larger as traffic flows have become less balanced. ITU estimates that, between 1993-98, net flows of settlement payments from developed countries to developing ones amounted to some US\$40 billion²⁵. The top ten net settlement surplus countries (i.e., which receive more money than they spend) are illustrated in Table 4.1.

Figure 4.1: IP capacity overtaking voice capacity

Number of international circuits used for private lines (Internet) and PSTN traffic, worldwide, 1995-98, and in selected regions, 1998



Note: Based on international circuits reported to the FCC.

Sources: ITU, adapted from FCC.

Table 4.1: Top ten net settlement surplus countries*As measured by estimated net settlements from the rest of world, in US\$ million, 1998*

Country	Outgoing traffic 1998, million minutes	Incoming traffic 1998, million minutes	Imbalance (outgoing minus incoming)	Imbalance as % of total traffic	US settlement rate, 1998 (US cents per minute)	Estimated net settlement, 1998 (US\$m)
India	436.2	1'498.8	-1'062.6	-54.9%	64.0	<i>680</i>
Mexico	1'307.6	3'060.5	-1'752.9	-40.1%	35.0	<i>620</i>
Philippines	286.4	681.2	-394.7	-40.8%	36.5	505.0
China	1'711.5	2'400.0	-688.5	-16.7%	70.0	<i>480</i>
Pakistan	87.5	640.4	-552.9	-76.0%	60.0	<i>330</i>
Viet Nam	56.0	334.0	-278.0	-71.3%	55.0	<i>240</i>
Lebanon	70.0	300.0	-230.0	-62.2%	85.0	201.3
Egypt	127.3	475.3	-348.0	-57.8%	87.5	<i>150</i>
Poland	602.4	1'144.4	-542.0	-31.0%	65.0	<i>145</i>
Dominican Rep.	157.5	730.5	-573.0	-64.5%	10.5	<i>130</i>

Notes: Figures shown in italics are estimates. All other figures are as reported by the countries concerned. The methodology used for estimation of net settlement is as follows: Where the country reports this indicator, it is calculated as incoming payments minus outgoing payments; where the country does not report this indicator, it is estimated by multiplying the traffic imbalance for each country by its settlement rate to the United States during 1998.

Sources: ITU/TeleGeography Inc. "Direction of Traffic Database", FCC.

64. Operators that send more traffic than they receive have an incentive to develop alternative routing procedures. They do this to avoid having to make settlements based on above-cost accounting rates and instead pay interconnect fees at local call rates or below. This is one reason for using international IP backbones instead of PSTN circuits to deliver traffic. Analysis of individual country's traffic data appears to confirm that this is happening to an increasing extent. The settlement rates between the United States and Argentina and Colombia on 1 March 2000 stood at 27 and 32.5 US cents per minute respectively. Increasing volumes of traffic from US carriers have been routed outside the accounting rate mechanism, for instance via the Internet (see Figure 4.2) or via refile through other countries. In the case of Argentina, estimated bypass traffic amounts to almost the same as the total reported volume of traffic on the route to the United States in 1998 (i.e., just over 200 million minutes). In the case of Colombia, where call-turnaround was historically less significant, estimated bypass traffic amounts to around 160 million minutes (Figure 4.2; see the country case study for more details²⁶). The losses incurred from bypass traffic by Argentina and Colombia were over US\$ 60 million for each country, at 1998 settlement rates.

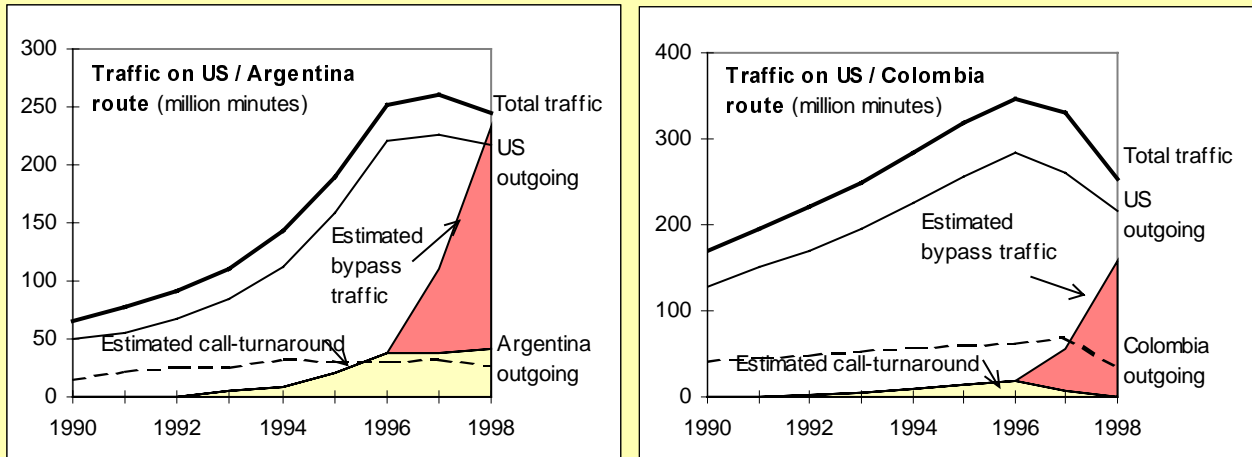
4.3 Impact on the Public Telecommunication Operator

65. The major impact of IP Telephony on Public Telecommunication Operators is likely to be loss of income from international calling, both direct (loss of collection charges) and indirect (loss of settlement payments). But arguably this would happen even without IP Telephony. Markets for international calling are shrinking in value as, on the one hand, prices fall precipitously, while, on the other hand, traffic is routed on least cost routes and settlement rates are forced closer to costs. Operators in developing countries may be better advised to embrace IP Telephony, and bear the consequences of reduced per-minute revenues from long-distance and international services, than to risk missing the opportunity to develop revenues in future growth areas.

66. The public telecommunication operator of the future may "own" the customer, in terms of providing billing and customer care support, and may "own" the local network, in terms of providing origination and termination of calls. However, the operator of the future is unlikely to be able to "own" or control the types of application that the customer chooses. Operators have traditionally used profitable long-distance and international services to cross-subsidise the functions of network access and local calling. In an increasingly competitive market, such hidden cross-subsidies can no longer be sustained.

Figure 4.2: Where did all that traffic disappear to?

Traffic balance on routes between US and Argentina and between US and Colombia, including estimates of call-turnaround and bypass traffic



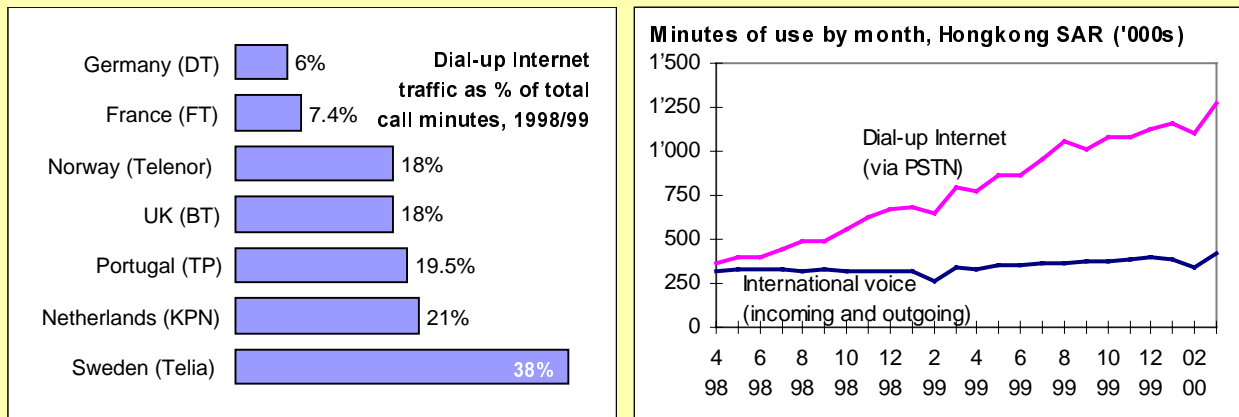
Note: "Estimated call-turnaround" traffic is the volume of traffic on a particular route that has been re-routed so that it appears that it is coming from the United States. This includes call-back, calling card and home-country direct traffic. It is estimated by applying the ratio between incoming and outgoing traffic that applied before 1992 to the subsequent traffic balance. "Estimated bypass traffic" is the volume of traffic on a particular route which is estimated to be rerouted via a least cost route (e.g., refile) or outside the accounting rate mechanism (e.g., via the Internet) such that it is not reported in official traffic statistics. It is estimated by comparing the projected growth in the total volume of traffic on the route, based on trends before 1996, with what actually happened after that date.

Source: ITU "Americas Telecommunication Indicators," ITU/TeleGeography Inc. "Direction of Traffic" Database.

67. VoIP and a thousand other variants on discounted calling mean that calls will follow whichever route is cheapest. Future operators will need, instead, to ensure that their local access networks are self-financing. This will require substantial and urgent tariff rebalancing to bring the price of local and international calls much closer together. The good news is that, while VoIP may bypass certain parts of a carrier's operations, where the price structure is not cost-oriented, it will not take away the need for local networks. Indeed, insofar as VoIP as a new "killer application" makes access to the Internet even more popular, it will actually increase the volume of local calls and the demand for second lines. Already, in some economies, as much as a third of all local calls are to the Internet and around 15 per cent of all local lines are used primarily for Internet access. Furthermore, dial-up Internet access is on a steeply rising curve while international traffic growth is slowing down (Figure 4.3).

Figure 4.3: Dial-up Internet traffic contributing to carrier revenue streams

Dial-up Internet traffic as a percentage of total traffic, selected European carriers, 1998/99, and trends in dial-up Internet traffic and international traffic, April 1998 – March 2000, Hongkong SAR



Note: Left chart shows dial-up traffic as a percentage of local traffic for Germany (T-Online only), Sweden and UK (BT only); of national traffic for France and Norway, and of total traffic for Norway, Portugal and UK. The data is valid for 1998 for France, Germany, Netherlands and UK and for 1999 for the other countries.

Source: Carrier annual reports, OFTA (www.ofta.gov.hk).

Box 4.2: Czech Republic – Licensed providers of all kinds offer Internet Telephony and VoIP

The Czech Republic has been the site of several legal disputes over the regulatory status of IP Telephony. The incumbent operator, Czech Telecom (formerly SPT Telecom), complained to the Czech Telecommunication Office (CTO) in 1998 that mobile operator Radiomobil was offering international long distance service in violation of Czech Telecom's exclusive licence for such services until 1 January 2000. The CTO agreed and suspended the service in November 1998.

Radiomobil had originally announced the service as the first ever commercial mobile IP Telephony service. Once users dialled a special access number, their call was converted to IP packets and routed to GlobalOne's gateway. From there it was carried by Deutsche Telekom (a major Radiomobil shareholder) to another gateway nearer the called party. Until enjoined by CTO, the service offered lower-cost (albeit lower quality) international long distance to subscribers to the Radiomobil's Paegas GSM service.

The CTO changed its policy effective 1 August 1999 to allow certain classes of operators to provide most forms of Internet Telephony. ISPs, mobile operators, and Cesky Telecom itself are now offering discount international calls using IP Telephony. Several PC-to-Phone services offer cheap international calling, and mobile operators can route their outbound international calls through either Internet Telephony or VoIP. The incumbent Czech Telecom's "XCall" service enjoys special status, for the time being, as the only licensed Phone-to-Phone IP Telephony service accessible on the fixed line network. Users dial a special access code, the destination country code, and the telephone number. Calls are billed afterwards on the fixed-line telephone bill.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/czechrep/index.html>>.

Sources: InternetNews.com, <http://www.internetnews.com/intl-news/print/0,1089,6_39251,00.html>; US Office of Telecommunications, "IP Telephony Market Information for Czech Republic as of October 1999," <<http://infoserv2.ita.doc.gov/ot/VoiceOve.nsf/>>.

5. REGULATORY ASPECTS OF IP TELEPHONY

5.1 Where does IP fit?

68. Where does IP Telephony 'fit' into telecommunication regulatory regimes? How should the rights and obligations of its providers compare with those of other telecommunication service providers? What status should be afforded different types of IP Telephony? Should Internet Telephony, VoIP, and PSTN voice traffic be treated the same way, or differently? Should it make a difference whether or not the provider of IP Telephony services has a licence to provide conventional voice services? If so, why?

69. This section attempts to categorize the ways in which IP Telephony is treated under many of the world's telecommunication regulatory regimes (5.2 and 5.3), and goes on to consider the impact of IP Telephony on universal service schemes (5.4). The demands of convergence, and the need for unified, technology-neutral communications policy are analysed (5.5). The various approaches to the regulatory status of IP Telephony are then synthesized into a model regulatory "decision tree" (5.6) and finally, possible routes for harmonised international approaches to the subject are explored (5.7).

70. In addition, the IP Telephony policies of several countries are summarised in numbered boxes: Poland (2.1), Switzerland (3.1), Czech Republic (4.2), Hungary (5.1), European Union (5.2), USA (5.3), Canada (5.6), and Nepal (5.8).

5.2 Current approaches to the regulatory status of IP Telephony

71. Current regulatory treatment of IP Telephony ranges from complete prohibition to unconditional permissibility. Different countries have taken widely differing approaches, often related to different prevailing market conditions and degree of liberalization. It is important to note that it is voice telephony *service*, delivered by means of Internet or IP Telephony, which is most frequently the subject of policy, not IP *technology* itself.

Box 5.1: Hungary - Keep the sound (quality) down, okay?

While many jurisdictions have implicitly used the inferior sound quality of Internet and IP Telephony as the basis for a regulatory distinction between voice telephony and Internet data, Hungary has gone one step further and made sound quality the *explicit* distinction. Indeed, Hungary's VoIP policy may be the most direct and detailed in the world. The policy, released on 22 July 1999, applies to all telecommunications service licensees and licence applicants, including previously-licensed Internet Service Providers (ISPs) and would-be Internet Telephony Service Providers (ITSPs).

Since the incumbent MATÁV's exclusive rights (until 31.12.2001) to carry international public long-distance voice telephone traffic can only be by-passed if the established speech connection qualifies as a "non-public-voice-telephony" connection, the Hungarian policy imposes sound quality limits to prevent IP Telephony from serving as a perfect substitute for PSTN voice services.

If voice telephony service is provided by means of transmission of speech signals in a "customary" (circuit-switched) way in any section of the domestic Public Switched Telephone Network (PSTN) or Public Land Mobile Network (PLMN) (except for leased lines), to qualify as a non-public-voice-telephony connection, those speech signals must meet a series of conditions. They must be differentiable from customary voice telephony service as follows: the service provider must (in addition to other minor requirements, such as using only type-approved equipment): (1) ensure a minimum 250 millisecond (ms) average delay of speech signal transmission between the terminal devices; (2) not guarantee that the loss of speech packets causing short interruption of speech will be less than 1%, and; (3) draw users' attention to the quality parameters which differ from those of public voice telephony when publicizing the service. Services which use a PSTN or PLMN number as an originating gateway to the Internet are also covered by these requirements (e.g. freephone numbers or calling card access numbers). Calls originating on leased lines are not affected.

Hungary has a vibrant IP Telephony services market, with 14 service providers licensed under this policy as of early 2000, including ISPs, incumbent carriers, and mobile operators. IP Telephony licensing has been successfully used as a way of diversifying the Hungarian market for international voice telephony in advance of its full liberalization. Presumably IP Telephony will be treated as simply another platform for providing public voice telecommunication services once the market is fully liberalised.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/hungary/index.html>>.

Sources: Communication Authority, Hungary, "Information for telecommunications service licence applicants intended for voice telephony usage of Internet" (22 July 1999), <<http://www.hif.hu/voipdir3.htm>>, and "Regulation of public fixed telephone services and VoIP (Voice over Internet Protocol) in Hungary", <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/hungary/index.html>>.

Table 5.1: "Are any Internet services prohibited?"

Answers of responding countries to this question in ITU-D 1999 Regulatory Survey

"Yes"	"Yes - IP Telephony" (and/or "IP Fax")	"Yes" (with specifics given)	"Yes" – except for existing licensee(s)	No answer, but call-back prohibited
Côte d'Ivoire	Albania	Burundi (Telephony on Internet – VoIP)	Bulgaria (to 31.12.2002)	Afghanistan
Latvia	Bahrain	Cyprus (Fax, Voice)	Estonia (to 31.12.2000)	Chad
Madagascar	Botswana	Israel (No basic telephony, fax or wireless services)	Ghana (to 2003)	Congo (DPR)
Mauritania	Cuba	Mexico (IP Telephony and Internet Video-conferencing)	Philippines (test period)	Croatia
Zimbabwe	Jordan	South Africa (Voice over IP)	TFYR Macedonia	Eritrea
	Mauritius	Turkey (Voice over the Internet)	<i>Argentina</i>	Guinea
	Nepal	Kenya (Internet telephony)	Uganda	Jamaica
	Pakistan		<i>Egypt</i>	Kuwait
	Panama		<i>Colombia</i>	Lebanon
	Slovakia			Malaysia
	Thailand			Morocco
	Venezuela			Qatar
	Viet Nam			Senegal
	Yemen			Syria
	<i>India</i>			United Arab Emirates
				Zambia

Notes: Countries indicated in *italics* did not respond to this survey, but fall into the categories indicated.

In addition to the 80 ITU Member States plus Hongkong SAR listed on Tables 5.1 and 5.2, an additional 109 ITU Member States either do not have IP Telephony policies or have not reported them.

Source: Adapted from ITU World Telecommunication Regulatory Database; ITU. For complete list of responses to ITU-D survey, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/99survey/index.html>>.

Box 5.2: European Union - If it's not real-time, it's not voice telephony

In May 1997, the European Commission released a draft policy statement concerning voice on the Internet under Directive 90/388/EEC on competition in the markets for telecommunications services. Following public consultation, this document evolved into its January 1998 "status notice," formally titled "Status Of Voice Communications On Internet Under Community Law And, In Particular, Under Directive 90/388/EEC."

Under Article 1 of Directive 90/388/EEC, "voice telephony" means: "The commercial provision for the public of the direct transport and switching of speech in real-time between public switched network termination points, enabling any user to use equipment connected to such a network termination point in order to communicate with another termination point."

The subject of the status notice was whether Internet Telephony can be considered as voice telephony, or rather whether it falls into the category of services liberalised under Directive 90/388/EEC. The status notice gives four criteria which an Internet voice service would have to meet to be considered voice telephony: (1) the service is the subject of a commercial offer; (2) is offered for the public; (3) provides service to and from public switched network termination points; and (4) involves direct transport and switching of speech in real time.

The most important of the status notice's four criteria is the issue of whether the service is "real-time." Since Internet Telephony signals generally involve several conversion steps and face unpredictable traffic conditions, and as a result suffer levels of delay not generally experienced with circuit-switched telephony, they are not considered by the European policy to meet this criterion. IP voice services could be subject to relevant regulatory schemes in EU countries once the "real time" threshold is met (and/or when the service provider claims it is met in its advertising).

Much like the April, 1998, FCC "Report to Congress" in the United States, the notice demonstrated an awareness that IP voice technology was improving quickly, and noted that the situation must be kept under review. The review process called for in the status notice was commenced in November, 1999 and the results were released in a communication to the European Parliament and Council on 26 April 2000. Since Internet voice was not mentioned in that Communication, it would appear that the EU countries are comfortable with the terms and effect of the status notice for now.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/eu/index.html>>.

Source: European Commission, "Status of Voice Communications on the Internet Under Community Law and, in Particular, Under Directive 90/388/EEC," Official Journal, No. C6, 10.1.1998, p.4, <<http://europa.eu.int/comm/dg04/lawliber/en/voice.htm>>.

Table 5.2: Countries which specifically permit IP Telephony

Depending on whether speech transmission is "real-time" or not, normal voice regulation may apply to varying degrees

Permitted unconditionally (exempted from international settlements regime)	Permitted if not real-time (not considered voice telephony)	Permitted. If real-time, subject to light conditions (notification/registration may be required, other basic provisions of voice regulation)	Permitted. If real-time, treated similarly to other voice telecommunications services (licensable, subject to more extensive provisions of voice regulation)
USA	EU Countries Hungary (if delay =>250ms) Paraguay (Fax only) <i>Peru</i>	Czech Republic (except Phone-to-Phone by other than incumbent) Hongkong SAR Japan New Zealand Poland (Phone-to-Phone by mobile operators only, temporarily) Singapore Switzerland	Australia Canada Korea (Rep.)

Notes: Countries indicated in *italics* did not respond to this survey, but fall into the categories indicated.

In addition to the 80 ITU Member States plus Hongkong SAR listed on Tables 5.1 and 5.2, an additional 109 ITU Member States either do not have IP Telephony policies or have not reported them.

The 15 countries of the European Union are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

Sources: OECD 1999 Regulatory Overview of the Telecommunications and Broadcasting Sectors (<<http://www.oecd.org/dsti/sti/it/cm/act/regulatory.htm>>); ITU.

72. Many countries, particularly developing ones, do not specifically prohibit IP Telephony but most likely do not allow it because no forms of competition with incumbent carriers are permitted in the majority of these countries. It is possible, however, as a practical matter, that IP Telephony (or at least PC-to-Phone services) may be permitted in these countries because it is not considered voice telephony at all, and therefore not a competing service. However, reliable, reasonably high-speed access to the Internet is required for tolerable PC-to-Phone service, and this is often not available in developing countries. Termination of international calls is the much more significant aspect of IP Telephony in developing countries (see Section 5.7 below)

73. Tables 5.1 and 5.2, based on available data, do not include all countries because a majority of ITU Member States simply *do not have* specific IP Telephony policies. IP Telephony may be either permitted *de facto* or prohibited in these countries.

74. Under the WTO General Agreement on Trade in Services, signatory governments have generally agreed not to introduce any new categories of reserved services, but may interpret how services fit into existing categories. As these markets are progressively liberalized, IP Telephony services will likely fall more and more into liberalised areas of telecommunication markets over time. In these markets it is often only universal service funding schemes which render regulatory classifications necessary (see Section 5.4 below).

Box 5.3: USA – IP Telephony looks like a telecommunications service, but is not regulated like one

There is currently no explicit regulation of any form of IP Telephony in the United States, at either the state or federal level. The US Federal Communications Commission (FCC) has ruled that Phone-to-Phone IP Telephony (both true Internet Telephony and VoIP) appears to be functionally equivalent to PSTN voice telephony. However, these services are not covered by telecommunications regulation.

In May, 1996, America's Carriers Telecommunication Association (ACTA) filed a petition before the FCC requesting that it classify as telecommunications carriers those companies that offer Internet Telephony-facilitating software. At the time, IP Telephony considered primarily of the PC-to-PC flavour.

Although the FCC did not immediately respond to the petition, the issue of IP Telephony was considered extensively in a review of universal service, called for in unrelated legislation,. This process resulted in the Federal-State Joint Board on Universal Service's "Report to Congress," released on 10 April 1998. That process did not result in regulation of Phone-to-Phone services because, the FCC said, it lacked a complete record on particular service offerings. After speculating about future proceedings in which the FCC would have to face these issues head-on, the FCC made these remarks about the international aspects of the issue:

"We recognize that our treatment of phone-to-phone IP Telephony may have implications for the international telephony market. In the international realm, the Commission has stated that IP Telephony serves the public interest by placing significant downward pressure on international settlement rates and consumer prices. In some instances, moreover, IP Telephony providers have introduced an alternative calling option in foreign markets that otherwise would face little or no competition. We continue to believe that alternative calling mechanisms are an important pro-competitive force in the international services market. We need to consider carefully the international regulatory requirements to which phone-to-phone providers would be subject. For example, it may not be appropriate to apply the international accounting rate regime to IP Telephony."

The issue of IP Telephony regulation in the United States returned to the fore in May 2000 with the passage in the House of Representatives of a bill (HR 1291) intended to pre-empt the FCC from imposing special access charges relating to dial-up Internet sessions. One clause of the bill, which would still have to be passed by the Senate before becoming law, states: "Nothing in this subsection shall preclude the Commission from imposing access charges on the providers of Internet telephone services, irrespective of the type of customer premises equipment used in connection with such services." This appears to have been an afterthought in a bill otherwise focused on keeping Internet access in the US free of per-minute charges. Even though the FCC has not revealed any intention to impose specific charges related to "Internet telephone services," the bill has the US IP Telephony industry lobbying hard against its passage in the Senate.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/usa/index.html>>.

Source: Federal-State Joint Board on Universal Service, "Report to Congress, (10 April 1998), <http://www.fcc.gov/Bureaus/Common_Carrier/Reports/fcc98067.html>; ITU.

Table 5.3: Examples of IP Telephony alliances involving PTOs from countries in which IP Telephony is “prohibited”

Existing licences for international services interpreted to permit outgoing and/or incoming IP Telephony

Operator	Country	IPTSP Alliance Partner	Description of Relationship
Telecom Egypt	Egypt	eGlobe	Developing VoIP services in Egypt. Covers both incoming outgoing traffic but mainly the former at present. Telecom Egypt markets the service via ISPs which gain some 10 per cent of revenues generated
CAT	Thailand	iBasis	CAT to route outbound international voice and fax calls over the iBasis Network. iBasis' partner Hatari Technologies will route customers' calling card voice and fax traffic over the iBasis Network to destinations around the world
Government of Albania	Albania	Crys-Tel Telecommunications.com	Crys-Tel to install VoIP gateways and fax port hubs to handle Internet, voice, data and video communications in the Balkan region

Sources: ITU and IPxStream (<<http://www.iptelephony.org>>).

75. Most national IP Telephony policies specifically refer to Phone-to-Phone services. PC-to-Phone services tend to be prohibited in countries which prohibit IP Telephony generally, while they tend to be permitted without conditions in countries which permit some or all forms of IP Telephony. This is why PC-to-Phone services are not specifically referred to in Tables 5.1 and 5.2. Calling card services are rarely treated separately in policy, but rather rolled in with other forms of Phone-to-Phone service, since the difference is more one of marketing and billing than technology.

76. It should also be noted that, for many countries, information simply is not available as to whether incumbent operators are employing IP Telephony or not, and if so, whether by right of their existing licences, or under special authorization. Some PTOs may simply assume that their international franchise allows them to use IP Telephony, should they decide to pursue it as a cost-saving measure, or to offer a discounted service. In this respect, several PTOs from countries which prohibit IP Telephony have announced international IP Telephony alliances with IPTSPs such as DeltaThree.com, ITXC, and Net2Phone (see Table 5.3). Those schemes which have been publicly announced may be only the tip of a much larger iceberg. Many more PTOs in liberalised countries have entered into similar arrangements.

77. An important issue of competitive equity arises when monopoly operators, which are also ISPs (in competitive markets), offer cheap telephony services which they are in a unique position to offer, compared to other, independent, ISPs (e.g., Swisscom's "Blue Window" before 1998). This advantage may prove to be a "killer application" for the affiliated ISP, hence extending monopoly power into new areas.

78. In some countries, mobile operators are given special rights to use IP Telephony to route international calls, allowing them to bypass the incumbent's international gateway.

- In Uganda, full-service operators UTL and MTN (which are not yet ISPs, but plan to become so) can offer IP Telephony, while mobile operator Celtel, which is also an ISP, is not permitted to provide IP Telephony.
- In the Czech Republic, mobile operators can use "the Internet telecommunications network" to route international calls, despite an early claim by incumbent Czech Telecom that doing so violates its exclusive franchise for international calls.
- Mobile operators in Poland currently enjoy the same privilege, in advance of a new telecommunications law which is expected to liberalize IP Telephony more widely.

5.3 Regulatory distinctions

79. In countries which have specific IP Telephony policies, it is possible to identify a number of distinctions which are used to separate IP Telephony from other, usually reserved or licensed, telecommunication services. In making the determination as to whether a particular service constitutes ordinary voice telephony, a number of different regulatory distinctions are employed, alone and in combination, by many countries around the world. Table 5.4 lists several of these criteria, while Boxes 5.4 and 5.5 focus on two of the more common ones.

Box 5.4: Voice or data?

The most important regulatory distinction in many countries is whether IP Telephony constitutes voice or data. The voice/data distinction is largely arbitrary, since IP Telephony services can achieve a level of functional equivalence to traditional telephony services, making the use of packets instead of electronic pulses irrelevant. In fact, in the case of digital networks, traditional telephony can also be viewed as data transmission, at a certain level. Still, the voice/data distinction is used as a definitional tool to implement policy -- or frequently the lack of a specific policy.

The Internet has been treated in most countries as something other than traditional telecommunication. The trend has been in favour of little or no regulation of Internet services, even while traditional voice services are subject to extensive (though generally decreasing) regulation. The key is that Internet traffic is considered data traffic, even though in some forms (e.g., dial-up Internet sessions), the bits actually pass over regular public voice circuits. When voice became one of the services which can be provided over the Internet, the argument for treating it differently was that it is simply another form of Internet data. Hence the regulatory advantage of Internet Telephony -- being treated as something other than voice, even though voice is the actual service being offered (particularly in the case of Phone-to-Phone service).

As more and more voice becomes data, it may become necessary to devise a more sophisticated distinction than voice/data to differentiate between those voice services which are regulated in one way and those regulated in another, if at all.

Box 5.5: Real-time?

Excerpt from ITU-T Recommendation G.114 (2.96 revision) (One-way Transmission Time)

“[T]he ITU-T *recommends* the following limits for one-way transmission time for connections with echo adequately controlled (see Note 1) according to Recommendation G.131 (*Stability and Echo*):

- **0 to 150 ms:** Acceptable for most user applications (see Note 2).
- **150 to 400 ms:** Acceptable provided that Administrations are aware of the transmission time impact on the transmission quality of user applications (see Note 3).
- **above 400 ms:** Unacceptable for general network planning purposes; however, it is recognized that in some exceptional cases (see Note 4) this limit will be exceeded.

NOTES

- 1 The use of echo control equipment that introduces other impairments, such as speech clipping and noise contrast, may have to be controlled in order to achieve acceptable transmission quality.
- 2 Some highly interactive voice and data applications may experience degradation for values below 150 ms. Therefore, increases in processing delay on connections with transmission times even well below 150 ms should be discouraged unless there are clear service and application benefits.
- 3 For example, international connections with satellite hops that have transmission times below 400 ms are considered acceptable.
- 4 Examples of such exceptions are unavoidable double satellite hops, satellites used to restore terrestrial routes, fixed satellite and digital cellular interconnections, videotelephony over satellite circuits, and very long international connections with two digital cellular systems connected by long terrestrial facilities.”

Table 5.4: The fuzzy line between public voice telecommunication and everything else*Typical regulatory distinctions adopted in selected countries*

Nature of distinction	Explanation	Countries in which the distinction is relevant
Real-time?	Can the service provide instantaneous, two-way (or “full-duplex”) transmission of speech? If not, the service is often not considered voice telephony, but rather a store-and-forward or messaging service. The latter are often considered “value-added” or “enhanced” services and are therefore traditionally subject to little or no public regulation. The difference between real-time and store-and-forward may be measured in milliseconds as a technical matter, but is usually undefined in policies (except Hungary – see Box 5.1).	EU (see Status Notice) Hungary Switzerland
Phone-to-Phone?	Can an ordinary telephone be used as the originating terminal device? This feature can make IP Telephony appear to be a substitute for traditional service in the eye of the consumer (whether or not a carrier access code must be dialed).	Canada EU (see Status Notice) Switzerland
Where IP/PSTN conversion takes place (i.e., whether there is a service provider)	In Phone-to-Phone services, the initial conversion of speech from circuit-switched mode to IP mode takes place on the premises of a service provider of some kind, particularly in the case of calling card services. In PC-to-PC and PC-to-Phone services, the initial conversion takes place at the user’s PC, such that there is often not a service provider located in the same country as the user, which is usually a precondition for effective regulation.	Canada
PSTN Use?	Does a given IP Telephony call ever “touch” the PSTN? If it does not, but goes from a private data network to an IP gateway and then over international Internet links, then the PSTN has not been “used.” Regulation relating to basic telephony often focuses on the local access network. If that network is not used, then the service in question may not be considered a basic telecommunication service.	Canada Hungary Czech Republic EU (see Status Notice)
Stand-alone Commercial Offer To The Public?	Are IP Telephony services offered in the originating country for the use of the public, and provided as a standalone commercial service with the intention of making a profit? These criteria eliminate services for closed user groups (such as enterprise networks) and services to which voice transmission is ancillary, such as video telephony, or other multimedia services, such as networked video games.	EU (see Status Notice)
Priced/Billed?	“Free” services, such as Dialpad.com, aim to make a profit from advertising, and from ISPs which promote the service. Thus, it may not collect any revenue in all the jurisdictions where the service is used. This can make domestic regulation of such a service very difficult. Other services can be either pre-paid (e.g., calling cards) or post-paid (e.g., discount access numbers, such as Czech Telecom’s “XCall.”)	USA Korea (Rep.) Singapore Hongkong SAR
True Internet Telephony or VoIP?	Only North American policies distinguish between the Internet and other IP networks as the underlying means of transmission for IP Telephony calls. It can make the difference between a service being characterized as an Internet service, or simply another form of resale, provided by means of a different technological platform.	Canada USA
Originating or terminating?	It is somewhat surprising that few IP Telephony policies refer to <i>terminating</i> international calls via IP Telephony, yet this is the primary form of the business in developing countries. Since developing countries tend to have higher than average accounting rate levels, there is a greater incentive to use IP Telephony as a form of bypass of the accounting rate systems (see Section 4). While there may not appear to be much IP Telephony business activity in a particular country because it is not advertised, international IPTSPs have more than likely already struck deals with local ISPs to terminate calls for them outside of the accounting rate structure maintained by the incumbent PTO(s).	(n.a.)

Source: ITU.

5.4 Impact of IP Telephony on universal service schemes

80. IP Telephony can present serious challenges to those telecommunication regulatory regimes which redistribute funds from one segment of the market to another in order to subsidize prices in the latter. In many countries, particularly developing ones, revenues from outgoing international telephone calls charged at above-cost rates and net settlements made for incoming calls subsidize domestic network development and basic local access. In both cases, associated revenues may be reduced if calls can be originated and terminated by means other than traditional operators and services.

81. The asymmetrical regulation of voice and data services naturally creates an incentive for arbitrageurs to develop the capability to treat voice as data, and thereby avoid the regulatory obligations associated with voice traffic, in particular contributions towards implicit cross-subsidies or explicit universal service funds.

Box 5.6: Canada - Voice is voice is voice...

In Canada, the advent of IP Telephony came *after* the liberalization of the long distance telecommunications market, not before, as in many other countries. Instead of trying to ban or restrict IP Telephony, Canada simply incorporated certain types of IP Telephony into its universal service funding regime, beginning in 1997.

Under the current regime (presently under review), providers of interexchange (long distance) services must report their total minutes carried and pay per minute to the local exchange carrier (LEC) which provisions the circuit used to provide the service. As early as May 1997, Canada's telecommunications regulatory authority, the Canadian Radio-television and telecommunications Commission (CRTC), ruled that providers of Phone-to-Phone voice telephony, where the Internet is the underlying transmission facility, should contribute just like any other form of voice telephony.

In the face of repeated challenges, CRTC confirmed this policy in January 1998, and again in September 1998, when it released a detailed decision setting out a comprehensive IP Telephony regulatory regime (Order CRTC 98-929).

The CRTC ruled that "PC Voice" (referred to in this Paper as PC-to-PC and PC-to-Phone) is not subject to the contribution regime, but "PSTN Voice" (i.e., Phone-to-Phone) is. Contribution must be paid per minute on any Internet access line which allows PSTN Voice calls to be originated or terminated.

This classification method focuses on where the conversion of calls (either originating or terminating) from traditional voice signals to IP format takes place. In general, if that conversion process takes place at the caller's premises, the call is considered PC Voice. If it happens elsewhere, such as the Internet gateway servers of an ISP or IP Telephony calling card service provider, the call is PSTN Voice. Those offering such services must register with the CRTC as resellers and make contribution payments, even though the facilities used are not resold voice circuits, but rather Internet access links.

For more detail, see <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/canada/index.html>>.

Source: Telecom Order CRTC 98-929, In the matter of Proposed New Contribution Exemption Regime for Internet Service Providers, Telecom Public Notice CRTC 97-37, 3 November 1997 (PN 97-37) (17 September 1998), <<http://www.crtc.gc.ca/archive/Orders/1998/O98-929.htm>>.

This can make offering international services profitable for small carriers, or give larger carriers crucial cost savings in extremely competitive markets.

82. At its most basic, the question is: Should calls on one technological platform be treated differently from calls on another. This is particularly true where there is extensive integration between the two types of networks and calls are passed back and forth. At that point, asymmetry must be justified on grounds other than technological or quality differences. In some countries, the difference is often justified as a means of encouraging the development of the Internet (e.g., China), or as a way of increasing the number of choices for long distance services available to citizens in advance of full liberalization (e.g., Hungary).

83. Certain universal service funding schemes present the possibility of competitive inequities, where only some providers of functionally equivalent services are "taxed" in respect of those services, while others are not, based solely on the technological platforms which they employ. Worse, it creates incentives for those operators that have traditionally paid into universal service funding schemes to switch to alternative platforms, reducing even more the volume of traffic on which payments are payable.

84. While a policy of permitting relatively unregulated provision of "Internet Telephony" may be designed to encourage the development of the Internet in a particular country, the focus of such a policy may be suspect if most commercial IP Telephony traffic does indeed travel over private IP networks, and not the public Internet. IP Telephony is being used more and more to offer functionally equivalent services without the regulatory burdens associated with providing traditional voice telephony. While this is good for competition, and therefore good for consumers, it can render universal service schemes increasingly unsustainable, where such policies depend on distinctions between voice and data traffic.

85. The universal service funding schemes of Uganda and Nepal offer creative solutions to this problem. In both countries, ISPs are required to be licensed and to contribute a small portion (1-2 per cent) of their revenues to universal service funds. These funds are intended to be allocated through competitive tendering. In this way, the possible cost advantage enjoyed by ISPs is somewhat lessened because universal service charges cannot be avoided.

86. Where universal service schemes are not dependent on different classifications of traffic, nor on the routing of traffic through particular facilities or operators, the main impact of IP Telephony is usually on the revenues of incumbent operators and their tariff structures (see Section 4). On the other hand, the projected cost benefits of IP networks suggest that developing nations could use IP to enhance access to basic

telecommunications. Particularly under schemes in which subsidies are provided on a competitive tendering basis, such as in Chile, Colombia, Guatemala and Peru, these cost savings (if indeed they are borne out), could provide significant opportunities for extending access. IP Telephony can be combined with wireless technology to serve rural and remote areas in new ways. ITU-D Study Group 2's Rural Application Focus Group is currently studying the development of wireless IP-based technologies for rural areas.²⁷

87. Increasing access to the Internet may already be a policy goal in some countries, and low-cost long distance and international voice services can be easily added to email and Web services available at community telecentres. Such services would by definition not compete with the incumbent's existing business, and can be used as an interim strategy to provide easy and affordable access to those without a phone in their home.²⁸

5.5 Convergence and communications policy

88. Technology analysts have been suggesting for several years that all forms of electronic communications will eventually merge into one. In recent years, IP appears to have emerged as the unifying platform. While it will be many years before such unified networks are widespread, this is definitely the direction in which communications is headed. With telecommunication carriers and broadcasters entering each others' markets in many countries (theoretically doubling the number of access platforms for each type of service), regulatory structures the world over are being pressured to adapt. The Internet emerged in this nascent era of convergence and regulators continue to struggle to determine where it "fits."

89. The Internet is now forcing countries to develop a convergence policy. Ironically, the political undesirability of being perceived as "regulating the Internet" has resulted in inertia, rather than new policies. Internet Telephony is often allowed, officially or not, because of the political undesirability of a government appearing to regulate the Internet. This has contributed to some of the regulatory asymmetries noted above. Where the policy goal is to allow an alternative to existing telecommunications services, without actually licensing competitors, the result is asymmetry, but more importantly, lower prices for consumers. Convergence demands the development of a coherent, cross-platform voice policy where technological neutrality is sought in regulation, as the submissions to the French public consultation urged (see Box 1.1).

90. One of the key issues in local telecommunication markets which have been opened to competition has been the terms for interconnection among all local service providers. It is conceivable that one day IPTSPs may seek the benefits of licensed local provider status, such as interconnection rights, numbering resources, and access to essential facilities such as directory listings. IP Telephony rides on top of the PSTN, in the sense that calls are sometimes originated and almost always terminated on the PSTN, but is not fully integrated with it. The question of whether the public interest *requires* that ISPs (and IPTSPs) interconnect with each other, as in Chile, may also arise in the near future.

91. Access to unbundled elements of the "local loop" is considered essential for the introduction of alternative means of local access to communication networks. While full local loop unbundling is currently required in relatively few countries, it is seen as an important step in the evolution of markets from monopoly to competition everywhere. Unbundling allows new entrants to access customers and provide services to them before, or instead of, constructing all of the necessary facilities. It allows different networks to interconnect and exchange traffic, and, most importantly, makes it all appear seamless to the end-user.

Box 5.7: European Commission recommends unbundled access to the local loop

The European Commission Recommendation on Unbundled Access to the Local Loop of 26 April 2000 recommends that the fifteen EU Member States adopt measures to mandate, by 31 December 2000, fully unbundled access to the copper local loop of 'notified operators' (public fixed network operators designated by national regulatory authorities as having significant market power) under transparent, fair and non-discriminatory conditions. Incumbent fixed-line operators would have to provide anyone, including their competitors, with the same facilities as those which they provide themselves or their affiliated companies, on the same terms and time schedules, priced on a cost-oriented basis. Allowing collocation of equipment and the rental of facilities to connect it are also to be required.

Source: Commission Recommendation C(2000)1059 on Unbundled Access to the Local Loop, 26 April 2000, <<http://www.ispo.cec.be/infosoc/telecompolicy/en/Main-en.htm>>.

92. In the future, convergence may require a wider view of local loop regimes to include various types of IP Telephony providers, perhaps driven by the interests of the IPTSPs themselves. At that time, it would be necessary to consider whether IPTSPs (whether dominant or not) should be required to offer interconnection, number portability, emergency services, and access to subscriber listings, for example. In many ways, local competition has proven to be the most complex regulatory undertaking yet in liberalized economies, and the integration of Internet and IP-based services with incumbent and new entrant circuit-switched networks will make the local environment even more complex. However, these steps are essential to the introduction of competition in the "last mile," which is what will finally make convergence real for the consumer.

5.6 Classifying IP Telephony

93. If a country requires a voice regulatory structure, then arguably the goal should be to make it as technology-neutral as possible. On this basis, functionally equivalent services should be subject to similar regulatory requirements, unless other policy imperatives require otherwise. With this goal in mind, Figure 5.1 is a composite "decision tree" based on a number of different IP Telephony policies, where the objective is to identify services which are functionally equivalent to traditional PSTN voice service. If a particular service reaches the last box on the decision tree, it can be considered functionally equivalent to traditional PSTN voice service. Before this last stage is reached, there are many intermediate stages where there may be near-equivalence to PSTN voice.

94. After putting a particular service through the decision tree in Figure 5.1, if that service does reach the last box (appears to be functionally equivalent), then a further question might be posed: is the principal underlying means of transmission:

- the public Internet?
- an IP network other than the public Internet?
- the PSTN?

95. Should it matter? Only the presence of external factors, such as a desire to encourage the development of IP networks, or, conversely, to conserve restricted access to the PSTN, would suggest that it does matter. Should any services which reach the same point in Figure 5.1 be treated differently? While technology may have provided a bright-line distinction between services in the past, that, of course, is no longer the case.

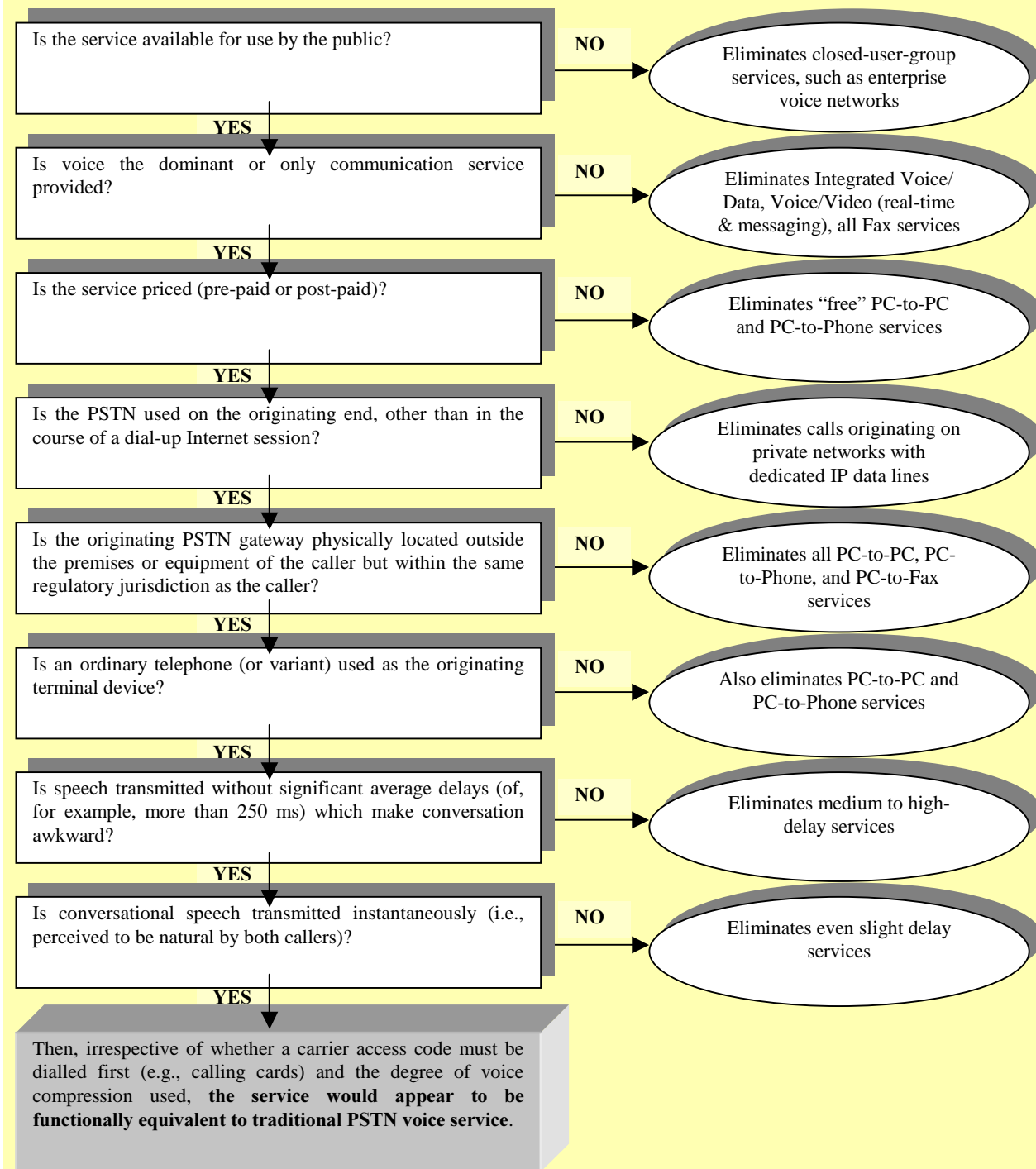
5.7 Implications of IP Telephony for developing countries

96. One form of IP Telephony which is not specifically dealt with in the decision tree in Figure 5.1 is international call termination. The questions posed in Figure 5.1 all focus on the originating end of IP calls because, as a matter of sovereignty, it is the only end of an IP call which a government can attempt to regulate on its own. However, IP Telephony is experienced in developing countries primarily as an incoming service. That is, foreign carriers bring in low-cost IP Telephony traffic and callers in the foreign country may or may not be aware their call is routed over IP.

97. In this scenario, citizens of the developing country do not benefit directly from a permissive IP Telephony policy (or lack of enforcement of a prohibition). Rather, it is the foreign consumers who benefit from cheaper calls and the foreign carriers which benefit from lower costs. Thus, consumers and operators in developing countries which prohibit outgoing IP Telephony tend not to gain from the spread of IP Telephony to nearly the same degree as consumers and operators in developed countries, particularly those where international IP bandwidth is cheap.

Figure 5.1: Testing the functional equivalence of IP Telephony and PSTN voice services

Which IP Telephony services most closely resemble traditional PSTN voice?



Source: ITU.

Box 5.8: Nepal: Two faces of IP Telephony – origination and termination

VoIP is illegal in Nepal as it is seen as impinging upon Nepal Telecommunications Corporation's (NTC) international voice service monopoly. While the regulator, the Nepal Telecommunications Authority (NTA) takes a neutral view on the matter, arguing that IP Telephony is almost impossible to block, the policy-making body, the Ministry of Information and Communications (MoIC), has obliged the NTA to make clear to domestic ISPs that VoIP is illegal. In January 2000, NTA sent a notice to all ISPs instructing them specifically to block the Dialpad IP Telephony service which offers free calls to the United States and other destinations (see Box 4.1). The ISPs duly contacted their user base to inform them of NTA's notice. However, given that Fax-over-IP ("FoIP") is liberalised (requires a license), and that it is virtually impossible for ISPs to distinguish between incoming voice and fax traffic, it would be surprising if the ISPs were able to comply with this ruling. Indeed, some cybercafés still openly advertise VoIP on their websites.

The main usage of VoIP may not be for outgoing traffic from Nepal but rather incoming international calls. While it is difficult to obtain concrete evidence, it appears to be the case that a growing proportion of incoming international voice traffic is coming in over IP and then breaking out into the PSTN locally. This service is relatively easy to provide since VSAT data services were liberalised in mid 1999. More than 5 MB of VSAT capacity is available to private ISPs. One person interviewed for an ITU case study described being offered tens of thousands of US dollars to provide a locked room in which a gateway linking incoming international voice over IP calls to the PSTN could be located. This particular offer was refused, but others may not have been so circumspect. Given that the lines rented by ISPs are likely to show large volumes of incoming traffic, it would be relatively easy to hide incoming voice traffic, worth around a hundred times more per minute than the IP data and fax traffic with which it is mixed.

Thus the position on VoIP becomes hard to justify. The MOIC is blocking outgoing VoIP while being unable to block incoming VoIP. Thus Nepal is suffering twice over: NTC is losing out on valuable incoming net settlements, while Nepalis are losing out on the chance to make low-cost foreign calls.

Sources: "NTA Bans VoIP," The National NewsMagazine, 28 January - 3 February 2000; ITU Country Case Study of Internet diffusion in Nepal, available at: <<http://www.itu.int/ti/casestudies/nepal/nepal.htm>>.

98. IP Telephony thus presents a dilemma for developing countries, especially for their incumbent PTOs (see Box 5.8):

- On the one hand, it promises to reduce the price of international telephone calls, for instance, enabling residential customers to make calls to relatives living abroad which might otherwise be too expensive, and enable business customers to participate more effectively in the global marketplace.
- On the other hand, IP Telephony could be viewed as a Trojan Horse, which threatens to undermine the pricing structure of the incumbent PTO and undercut its profitable business in originating and terminating international calls. IP Telephony might also threaten the ability of the PTO to invest in extending the domestic network and meeting its universal service obligations.

99. Both arguments hold some truth. IP Telephony does indeed present a major challenge to developing country PTOs, but one which they should embrace rather than ignore.

5.8 IP Telephony puts downward pressure on IDD charges

100. Simply by providing an alternative means of making long distance and international calls, the various forms of IP Telephony can be expected to constitute another factor pushing down the cost of international direct-dialed (IDD) telephone calls. Indeed, within a particular country, it may serve the ultimate purpose of enhancing consumer welfare whether it is permitted or not (at least in net originating countries). The pressure is strong, because if traditional settlement structures can be avoided then IP Telephony brings the cost of an international call closer to the cost of a local call.

101. It is this effect of the emergence of IP Telephony which may be causing many countries to either "turn a blind eye" to it, or refuse to define and regulate it as public voice telephony. It remains to be seen what real impact the various forms of IP Telephony are having on PTO IDD revenues. On many routes, vigorous price competition among PTOs is driving the cost of regular voice services down so low as to make lower-quality or inconvenient services less attractive, particularly those which require the advance purchase of calling cards and the dialing of extra digits or carrier access codes. As discussed in Section 3, due to this intense competition, the days of IP Telephony as a standalone business proposition may be numbered on all but a few high-priced international routes. Instead the future of IP Telephony may lie in closer integration between the PSTN and Web-based services.

5.9 Perspectives on IP Telephony

102. IP Telephony can be viewed in many ways: as a short-term means of bypassing established accounting and settlement structures; as a “techie” fad with little long-term staying-power; as an Internet-led attack on the PSTN; or as merely another platform for the provision of voice communication services. To many analysts, fledgling IP Telephony applications are merely the tip of the iceberg – an indication of the potential for unified services provided in an open, IP-based architecture.

103. IP Telephony is no longer a fringe service lying outside the telecommunication world. Recently, Telstra of Australia and Gambia Telecommunications Company (GamTel) both entered into agreements with ITXC, an American IPTSP, to exchange international IP Telephony traffic.²⁹ In May 2000, iBasis, another IPTSP, announced that its network was to be interconnected with that of Concert, owned by BT and AT&T, allowing the exchange of IP Telephony traffic between customers of the two companies.³⁰

104. These kinds of alliances between PTOs and IPTSPs, and among IPTSPs, are being announced at a startling pace all over the world (see Table 5.3) and many more likely remain undisclosed. Clearly, both IP Telephony technology and IP Telephony operators are being embraced by the traditional telecommunication industry worldwide. Some of these arrangements fall within the boundaries of existing financial and regulatory structures, but many do not. To the extent that IP Telephony is becoming an alternative method of carrying and terminating international voice traffic, existing financial and regulatory structures need to evolve to address it.

6. CONCLUSION

6.1 Services and applications

105. This paper has shown some of the problems that have confronted regulators around the world in trying to deal with IP Telephony. It could almost be said that no two countries have taken the same approach. Some regulators have tried to ban it, some to encourage it and many have still to make up their minds. The predominant attitude has been one of “wait and see”. They are fearful that, by developing a regulatory regime too soon, their deliberations will be quickly overtaken by future technological innovation. Dealing with IP Telephony has forced regulators to ask that most basic of questions: “what exactly are we trying to achieve?” However, in a growing number of countries, such as Egypt and the Gambia, the incumbent operator is not waiting for the regulator to decide and is making its own exclusive deals to deliver VoIP traffic.

106. To date, the policy of the largest single group of countries has been to prohibit IP Telephony, sometimes as a specific policy, but mainly as a consequence of blanket prohibitions on competition with monopoly operators in any form. These countries also tend to prohibit call-back services. The next-largest group of countries generally permits incoming and outgoing IP Telephony because it is not considered voice telephony, and therefore not competition for licensed operators. A smaller group permits certain forms of IP Telephony, subject to minimal conditions set out in specialized policies. A handful of countries permits all forms of IP Telephony, but subjects providers of such services to the same regulatory requirements as other telecommunication service providers.

107. It is not surprising that IP Telephony has confounded traditional regulatory frameworks. Most regulators have viewed voice as a telecommunication “service” and the Internet as a computer “application”. Thus they have applied carrier-specific regulation to the former while the latter has been largely unregulated, or afforded only generic regulation. IP Telephony is a crossover between the two. It can be provided from one computer to another (suggesting it is a computer application), but it can also be provided from one telephone to another, without a computer (suggesting it is a telecommunication service).

108. In this paper, the terms “Voice-over-IP” and Phone-to-Phone” have been used to describe the version of IP Telephony that is closest in nature to a voice “service”. It has been shown that, if current trends continue and the technology matures as expected then—probably within five years and certainly within ten—a majority of voice traffic around the globe will be carried over IP-based networks. Indeed, it will be today’s telephony traffic—Voice-over-Circuit-Switched-Networks—that might be sufficiently unusual to warrant its own acronym (“VoCSN” perhaps). These trends suggest that VoIP should be treated like a service. However, it has also been demonstrated that there will be an infinite range of variations on real-time

and non-real-time voice built into other applications, be they messaging, browsing or communication. That would suggest VoIP should be treated like an application. So the problem confronting regulators is not going to get any easier and it is certainly not going to go away. Ultimately, it may be necessary to review the regulatory framework itself to take account of the convergence that the Internet is forging.

6.2 Avenues for international co-ordination

109. The purpose of the ITU IP Telephony Workshop is to create a forum for the discussion of the regulatory and policy issues raised by IP Telephony. The background information prepared to assist the discussion includes this issues paper, a suggested list of questions, a Website of relevant documentation and a series of country case studies. The Workshop is, in a sense, an end in itself. But it is tempting to see whether any convergence can be achieved among the diverse range of views likely to be expressed. Without wishing to prejudge the debate, it is suggested that a number of possible avenues for possible international co-ordination may arise from the debate. For instance:

- Might it be possible to establish a **common set of definitions** to cover the various forms of IP Telephony (e.g., Internet Telephony, Voice over IP) and the ways in which it is used (e.g., real-time or delayed; PC-to-PC, PC-to-Phone, Phone-to-Phone)? Such a common set of definitions could assist national regulators and ITU Study Groups in their future work.
- Are there issues where **international co-ordination** may be required to augment regional and national debate? For instance, is international co-ordination required over the question of setting aside an international country code (E.164 numbering resource) for IP Telephony or over the sharing of country-specific information concerning gateways or interconnect arrangements between the Internet and the PSTN?
- Are there areas where it would be beneficial for countries to **share experience and advice** with other countries, perhaps at a lesser level of economic growth or market openness, or where issues have not yet arisen?
- Are there opportunities for **international comity**, such that a regulator in one country might seek to ensure that the operators or applications providers regulated in that country do not trespass against the laws laid down by a regulator in a different country. Given that, in many examples of IP Telephony, the location where the patching between the PSTN and the Internet takes place is outside the home country of the user, is there scope for more co-ordination of information, queries and complaints between countries?
- Do any countries stand out as providing **best practice** for the regulatory approaches they have adopted to IP Telephony? Equally, are there any particular carriers whose implementation of an IP-based network is likely to be future-proof? If so, are there any lessons that can be drawn more globally?

110. If there are possible avenues for future international co-ordination on IP Telephony issues, then:

- **Where** should that co-ordination take place? For instance, at the ITU, the WTO, the OECD, or in other international or regional bodies?
- **What form** should the co-ordination take? Might it be helpful, for instance, to hold a future World Telecommunication Policy Forum on this topic? Should regional workshops be convened?
- **When** would be the best timing for any future events?
- What is the best format for **exchange of information**? Should the Website prepared for this event be continued and updated?

111. Like many of its Member States and Sector Members, the ITU is still trying to understand better the implications of IP Telephony. The ITU is relying upon its membership and from other experts in the telecommunication sector and the Internet community for good advice on how to proceed.

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- ¹ <<http://www.phonefree.com/>>.
- ² <<http://www.webtalknow.com/>>.
- ³ <<http://www.telecom.cz/set.php3>>.
- ⁴ <http://www.clear.co.nz/about/media-releases/release.ptml?FROM=index.ptml&ID=11&row_start=6>.
- ⁵ <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/colombia/index.html>>.
- ⁶ Examples include: DeltaThree.com (based in New York, NY, USA), <http://deltathree.com/unified_signup/signup_calling_cards.asp>; Incomtel (based in Moscow, Russia), <<http://www.incomtel.ru/>>; and Pan EC Technology Corp. (based in Taipei, Taiwan ROC), <<http://www.pan-ec.com.tw/>>.
- ⁷ <<http://www.itxc.com/borderless800.html>>.
- ⁸ Least-cost-routing services offered by discount service providers often use a hybrid mix of different technologies on different routes, according to what is cheapest, where, and when. A press release relating to CLEAR New Zealand's "CLEAR 0505" retail discount calling service describes the method also used by wholesale least-cost-routing operators: "Ordinary voice calls are transmitted via ATM (asynchronous transfer mode) to a switch in Los Angeles, which then directs the call on the cheapest available route to its eventual destination, where it is converted back into an ordinary voice call. The cheapest available route might mean sending the call using voice-over-IP, voice-over-ATM or traditional calls."
(<http://www.clear.co.nz/about/media-releases/release.ptml?FROM=index.ptml&ID=11&row_start=6>.
- ⁹ <<http://www.min-x.com/>>.
- ¹⁰ See, for example, Concert Global Clearinghouse, <<http://www.concert.com/clearinghouse/>>; Telia Clearinghouse Services, <<http://clearinghouse.telia.com/>>; NTT Communications Clearinghouse Service, <<http://clearinghouse.ntt.com/>>; iBasis, Inc., <<http://www.ibasis.net>>; GRIC Communications, Inc., <<http://www.gric.com/>>; and ITXC, <<http://www.itxc.com>>. A complete list of IPTSPs and clearinghouses is hosted by IPxStream at <<http://www.iptelephony.org/GIP/providers/index.html#settle>>.
- ¹¹ <<http://www.iptelephony.org/GIP/popshop/tshop/index.html>>.
- ¹² <<http://www.arbinet.com/>>.
- ¹³ See, for example, Blue Mountain Arts Voice Messaging, <<http://www.bluemountain.com/eng/voice/>>.
- ¹⁴ Such as Dialpad.com, <<http://www.dialpad.com>> and Callrewards, <<http://www.callrewards.com/>>.
- ¹⁵ See Odlyzko, A.M., "The current state and likely evolution of the Internet," presented at IEEE Globecom '99, <<http://www.research.att.com/~amo/doc/globecom99.pdf>>; and Huston, G., "Quality of Service: Fact or Fiction?" The Internet Protocol Journal (Cisco) (March 2000), <http://www.cisco.com/warp/public/759/ipj_3-1/ipj_3-1_qos.html>.
- ¹⁶ See, generally, McKnight, L.W. & Bailey, J.P., eds., *Internet Economics* (Cambridge, MA: MIT Press, 1997).
- ¹⁷ For more information about Recommendation H.323, see <http://www.itu.int/itudoc/itu-t/rec/h/h_323.htm> or one of the primers on the H.323 series available on the Internet, such as the "Webforum" of the International Engineering Consortium at: <<http://www.webproforum.com/h323/topic01.html>>. On its comprehensive list of IPTSPs of all kinds, IPxStream indicates whether or not each service is H.323 compatible or not: <<http://www.iptelephony.org/frame/providers.html>>.
- ¹⁸ See ITU-T's IP/Telecoms Interworking Web pages, <<http://www.itu.int/ITU-T/ip-telecoms/ip-telecoms.htm>>.
- ¹⁹ <<http://www.concert.com/whoweare/factsfigures.asp>>.
- ²⁰ <<http://206.66.251.66/news/20000511-16128.htm>>.
- ²¹ <http://www.teleglobe.ca/eng/digital_arch/digital_cont1u.html>,
<http://www.teleglobe.ca/eng/index_digital.html?framecontent=1>.
- ²² <http://www.wcom.com/about_the_company/corporate_overview/UUNET_fact_sheet/>.
- ²³ For more detailed information on the assignment of an E.164 code for IP Telephony, see Sugino, I., "Addressing System for Internet Telephony," Masters Thesis, Massachusetts Institute of Technology, June 1999, <<http://rpcb.mit.edu/Pubs/Theses/isao.doc>>.
- ²⁴ See for instance Weiss, M. & Hwang, J. (1998) "Internet Telephony of Circuit-Switched Telephony: Which is cheaper?" at: <<http://www2.sis.pitt.edu/~mweiss/papers/itel.pdf>>. Their analysis suggests an approximate cost of US\$1.058 per month per subscriber cost for providing IP Telephony compared with US\$1.70 for traditional telephony, a 38 per cent saving.
- ²⁵ See, for instance, analysis in ITU/TeleGeography Inc. "Direction of Traffic: Trading Telecom Minutes", ITU, Geneva, October 1999, 347 pp, available at: <<http://www.itu.int/ti/publications/DOT99/index.htm>>.
- ²⁶ See <<http://www.itu.int/osg/sec/spu/ni/iptel/countries/colombia/index.html>>.
- ²⁷ See <<http://www7.itu.int/itudfg7/>>.

²⁸ See the information on public Internet access centres in Peru in the ITU-commissioned case study available at <http://www.itu.int/osg/sec/spu/ni/iptel/countries/peru/index.html>.

²⁹ See ITXC Corp., news releases, “ITXC and Gambia Telecommunications Company in Pact for Domestic and International Internet Telephony,” 24 March 2000, <http://www.itxc.com/PRA119.html>, and “ITXC Corp. and Telstra Interconnected,” 10 May 2000, <http://www.itxc.com/PRA127.html>. ITXC markets a standalone piece of equipment called a “SNARC” which allows facilities-based carriers anywhere to interconnect with ITXC and offer VoIP (referred as Internet Telephony) without owning or managing their own gateways. The equipment is colocated at the carrier’s switch site but remains the property of ITXC. See <http://www.itxc.com/snarc.html>.

³⁰ iBasis, Inc., news release, “Concert Global Clearinghouse and iBasis Announce Interconnection of their Internet Telephony Networks: Leaders in VoIP To Exchange International Voice and Fax Traffic, Leverage Combined Footprint to Broaden Global Reach,” 15 May 2000, <http://www.ibasis.net/News/pr05152000.htm>.