1. SUMMARY

1.1 Internet Protocol (IP) Telephony is rapidly reaching the top of the agenda for the telecommunications industry worldwide. The possibility of transmitting voice over IP-based networks, with all its challenges and associated opportunities, such as voice and data integration, constitutes a milestone in the convergence of the communications sector.

1.2 The key issue that has gained the attention of policy-makers, regulators, and industry alike is the fact that the Internet, and other IP-based networks, are increasingly being used as alternatives to the circuit-switched telephone networks.

1.3 **[[Note very small percentage of voice traffic that is now VoIP. Eliminate speculative forecasts about growth of VoIP.]]** As of late 2000, more than three-quarters of international traffic originated in countries in which the provision of IP Telephony is liberalised. Furthermore, the majority of IP Telephony now travels over managed, private IP networks as opposed to the public Internet. Major international Public Telecommunication Operators (PTOs) have announced that they will migrate all their international traffic onto IP platforms. For instance, Cable & Wireless is spending more than US$2 billion on a global IP network. It plans to use voice over IP (VoIP) to deliver some 900 billion minutes of calls in the year 2006 compared with just 675 million in 1999. It estimates that VoIP technology will allow it to carry calls at a quarter of the cost of doing so over a conventional, circuit-switched network.[1]

1.4 Market forecasts project that IP Telephony will account for between 25 and 40 per cent of all international voice traffic by the year 2004. Worldwide, the volume of traffic on IP-based networks already far exceeds the voice traffic that travels over the public switched telephone network. Consequently, even for those countries that nominally prohibit IP Telephony, it has become nearly impossible to ignore it.

1.5 Yet, not all IP Telephony services are the same nor are they treated in the same way by governments and industry around the world. From a definitional point of view, for example, it is important to differentiate the various forms that IP Telephony can take. **[[Revise definitions to focus on the most generic form: VoIP]]** In this report, "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 VoIP, the difference being the nature of the underlying IP network: the former using primarily the public Internet while the latter utilises managed, private IP-based networks. Even within these two broad groups, there is an almost infinite number of ways to use IP technology to provide voice-related services.

1.6 Furthermore, from a regulatory point of view, IP Telephony is treated in widely divergent ways among ITU Member States. **[[Emphasize that most governments have refrained from adopting restrictive policies]]** In some countries, governments have used the definitional tools to allow the delivery of IP Telephony services to the public in spite of the existence of market exclusivity of the incumbent over basic voice telephony. In some others, the service is completely prohibited, in others it is licensed and promoted, while in some, IP is treated as just another technology that can be adopted by PTOs.

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[1] See "Cable & Wireless announces the industry's largest VoIP migration programme", 2 October 2000, at: http://www.cablewireless.com/news.asp?NewsId=66.

1.7 The rise of IP Telephony across the globe—regardless of the way it is delivered and the regulatory regime under which it operates—has, nevertheless, profound implications for consumers, industry, and national administrations.

1.8 **[[expand to include benefits of promoting infrastructure development, closing the digital divide, new applications, greater competition]]** For consumers, IP Telephony offers potentially much cheaper long-distance and international telephone calls compared with the alternative of using a circuit-switched fixed-line or mobile network. These cost savings may, at least, partially offset the usual loss of quality. IP Telephony may also offer consumers advanced services integrating voice and data, such as merged World Wide Web and voice services (e.g., "click-to-talk").

1.9 For PTOs, the potential cost advantages of IP Telephony are more complex to calculate. That is because incumbent PTOs have existing revenue streams that they fear may be cannibalised by a shift to lower-priced IP Telephony, particularly given the investment required to add IP Telephony capability.

1.10 **[[Focus separately on the issues of bypass of accounting rates and universal service]]** Given that IP Telephony calls are mainly carried outside of the PSTN[2]—and hence outside the regulatory and financial structures which have grown up around the PSTN—it is argued that, for incumbent PTOs in developing countries, IP Telephony threatens to undermine not only current revenue streams but also existing universal service programmes aimed at extending networks and services in unserved or underserved areas. **[[Eliminate negative language in favor of a neutral discussion. Discuss opportunities offered to PTOs by VoIP. Many PTOs see VoIP as a way to generate more and different types of revenue streams (calling cards, origination, click-to-talk, etc) and are investing in their own networks or leasing services for a growing number of IP carriers. PTOs are thus using VoIP to help them better adjust to the transition to more competition and globalization. PTOs, especially in developing countries, are also creating alliances with small and large global VoIP companies to rapidly become global players, such as accessing immigrant communities abroad and providing immigrant-home country traffic and services.]]**

1.11 As a first step to address some of these complex and interdependent economic and regulatory challenges and opportunities posed by IP Telephony and its likely impact on ITU Member States and Sector Members, the ITU held an IP Telephony Workshop in Geneva from 14-16 June 2000. Some 34 experts from 21 different ITU Member States participated in the meeting, at the invitation of the Secretary-General, representing a range of regulatory and policy-making agencies, PTOs, IP Telephony Service Providers, equipment vendors, academic institutes and others. The documents presented at that meeting are available at: http://www.itu.int/iptel/.

1.12 Section 2 of this Report looks at technical aspects of IP Telephony. Section 3 discusses the different policy and regulatory approaches that Member States have taken to IP Telephony, and its significance for universal service schemes and convergence policy. Section 4 deals with the economic aspects of IP Telephony and its impact on PTOs. The Report offers, in Section 5, a set of reflections on international coordination and possible co-operative actions to assist Member States and Sector Members.

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2 The term PSTN (public switched telephone network) is used in this document as a synonym for traditional circuit-switched telephone networks offered by Public Telecommunication Operators (PTOs), as well as Integrated Services Digital Networks (ISDN), and Public Land Mobile Networks (PLMN). Generally with convergence, today's telecommunications networks and transport technologies are increasingly complex and difficult to categorize.

2. TECHNICAL ASPECTS OF IP TELEPHONY

Introduction

2.1 A fundamental shift has been occurring in the telecommunications industry—a shift that is arguably as important as that from the telegraph to the telephone or from the mainframe to the personal computer. That change is a shift from traditional PSTN *circuit-switched* voice networks to *packet-switched* data networks, using Internet Protocol (IP) technology. For the most part of the last century, voice traffic was predominant. Today voice represents an ever-diminishing percentage of overall telecommunications traffic when compared to data. One result is that support for IP-related technologies is now a strategic element in the design, development and use of telecommunication networks. It also means that most PTOs are aggressively implementing IP technologies in their networks.

2.2 IP Telephony is possible over any data network using the Internet Protocol, which includes the public Internet, corporate Intranets and most Local Area Networks (LANs).

IP Telephony standards activities

2.3 Telephone networks have been carefully engineered to provide extremely reliable, high-quality voice transmission, making real-time, two-way conversations possible between 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. While Internet communications are typically "connectionless" or "stateless" (that is, no unique end-to-end circuit is created and held for the duration of a particular session), current IP Telephony developments seek to imitate the more connection-oriented, PSTN circuits, rather than other types of IP communications. In other words, the touted differences between packet-switching and circuit-switching are becoming increasingly blurred. During the last few years, the desire to make these two types of networks interconnect and interoperate, without the user being able to tell the difference, has prompted enormous technical research and development efforts in both the telecommunication and computer industries. In this respect, IP Telephony is the embodiment of convergence and will force both types of networks to mutate and become more alike.

2.4 It should not be surprising that IP Telephony standards development represents, in many ways, attempts to replicate long-established technical practices in the PSTN, such as call set-up and tear-down, Intelligent Network (IN) services and guaranteed quality of service. Although not always well coordinated, a great deal of work on technical standards for IP Telephony is underway in many industry and regional bodies as well as in conventional standardization bodies such as the European Telecommunications Standards Institute (ETSI), the Internet Engineering Task Force (IETF) and the ITU Telecommunication Standardization Sector (ITU-T).

2.5 Of course, most telephones are—and for several years to come will continue to be—connected to traditional circuit-switched telephone networks. IP Telephony services must be able therefore to accept calls originating on the PSTN, to terminate calls on the PSTN, and to do it all seamlessly. Today, the most basic IP voice services accomplish this by means of *gateways*, which can convert and forward calls in one direction or another. However, 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 transparent interconnection with the PSTN infrastructure.

2.6 Current research and development work, both into proprietary vendor solutions and open industry standards, seeks to make telephony more *media-neutral*, that is, equally functional and interoperable across many different types of physical networks, equipment, and control software (e.g., switches, routers, signalling systems). The first generation IP Telephony services that linked to the PSTN via gateways were not capable of Intelligent Network (IN) functionality, such as calling party identification (indeed, on the Internet, guaranteed anonymity is often considered an advantage), nor could they interface seamlessly with 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. Recognizing this, the latest generation of IP Telephony standardization activities has focused around improving gateway architectural components linking PSTN and IP networks. These include two key facilities, namely:

Media gateways: This device performs simple encoding and decoding of analogue voice signals, compression, and conversion to/from IP packets.

Media gateway controllers: This device contains call control intelligence and analyses how calls are to be handled and performs functions similar to the SS7 network in the PSTN environment. It needs to understand various signalling systems such as SS7 and GSM in order to ensure interconnectivity with the PSTN.

2.7 An example of a *media gateway* protocol is the ITU-T H.323 series of Recommendations. The H.323 series are a set of multimedia standards for networks that do not provide guaranteed Quality of Service (QoS), including IP-based networks, most LANs, and the public Internet. The scope of the H.323 series is very broad and supports point-to-point and multipoint multimedia conferencing, call control, multimedia and bandwidth management, as well as interfaces between different network architectures. The current ITU-T H.323-related work plan includes the release of Version 4.0 (planned for approval in November 2000) and a large number of Annexes that include, *inter alia*, support for improved security, new signalling, user and service mobility, and QoS. The H.323 series has proven to be successful in the IP Telephony Service Provider marketplace.

2.8 Although the H.323 series was originally intended to standardize both the *media gateway* and *media gateway controller* architectural components, it was somewhat less successful in the latter case. After several incarnations, a competing simpler industry effort called MGCP (Media Gateway Control Protocol) was developed that "decomposed" media gateway controllers from media gateways. In order to address divergent industry efforts and meet the broadest set of requirements, the Internet Engineering Task Force (IETF) and ITU-T decided to collaborate closely and jointly produced a new single protocol called H.248 (ITU-T name)[3] and Megaco (IETF name). H.248/Megaco defines a master/slave protocol to control media gateways that can pass voice, video, facsimile and data traffic between PSTN and IP-based networks. H.248/Megaco supports various "packages" that interface with conventional PSTN switches and Intelligent Network (IN) services, with plans to support a range of existing signalling protocols including ISUP (SS7 Signalling Protocol), GSM and others.

[[Describe industry-lead efforts such as SIP, as examples of how industry on its own is dealing with many standards and QoS issues].]

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[3] Approved in June 2000.

Quality of service (QoS)

2.9 Quality of service is at the core of voice telephony and, as such, is often the focal point of the IP Telephony debate. There are many aspects to quality, including reliability, throughput and security. However, it is the perceived poor transmission quality of voice delivered over the current public Internet that explains why Internet Telephony is often not considered as carrier-grade service. While it has been technically possible to transmit voice telephone calls over IP-based networks for years, poor sound quality and inconvenience have prevented IP Telephony from threatening traditional voice telephone systems. There are, in general, two ways in which this quality can be improved—implementing quality of service support and increasing available bandwidth. Massive amounts of research time and money are being put into enhanced and prioritized routing or switching research, while billions of dollars are also 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.

2.10 When IP packets carry bits of an email message, delays of milliseconds or even seconds caused by inherent limitations of the Internet do not make much difference. But when those packets carry pieces of a telephone conversation, these time delays can accumulate and make normal conversation unintelligible and impractical. Research has been underway in the Internet industry for several years on ways to prioritise certain packets over others. One recognized solution is that latency-sensitive transmissions, such as voice and video, are given higher priority over asynchronous services such as email and Web browsing.

2.11 Therefore, a considerable amount of research has gone into allowing for different classes of service for different kinds of traffic. In an integrated network where different types of traffic compete for resources, priority should generally be assigned to real-time traffic. Class of service differentiation is already a well-known feature of ATM networks, which grew out of broadband ISDN standardization. A lot of work has gone into developing technologies to implement the same features in an IP environment including various IP over ATM architecture schemes, the Resource reSerVation Protocol (RSVP), Real Time Protocol (RTP) and Layer 3 Switching (Tag Switching and Multiprotocol Label Switching or MPLS).

Bandwidth

2.12 The other basic means of decreasing latency in IP packet transmission is to increase or "over-dimension" 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 the available bandwidth is a far more practical means of speeding up the Internet than is enhancing QoS, because it does not require coordinated action across Internet services providers.[4] In this regard, debates over the principles of Internet peering, transit and interconnect demonstrate that there are still a wide range of views on how bandwidth providers should be appropriately compensated for their contributions to the overall performance and capacity of the Internet.

2.13 The situation is much simpler with respect to private managed IP networks. More bandwidth, faster transmission, and better voice quality combine to produce satisfied

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[4] See Odlyzko, A.M., "The current state and likely evolution of the Internet," presented at IEEE Globecomm '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>.

customers for more of the time. Privately operated bandwidth is therefore typically 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 massive increases in available international bandwidth by means of fibre optic cable and satellite. Ironically, IP Telephony (like Web browsing) is not nearly as lucrative a way of using that capacity as traditional voice telephony, particularly given the predilection of Internet users towards 'free' services.

Numbering

2.14 [This section should not only present the options for numbering, but also the threshold issue of whether any action on numbering issues relating to IP Telephony is necessary.] One of the technical challenges raised by the ever-closer integration between circuit-switched and packet-switched networks concerns how to address calls that pass from one to the other. Generally, it is assumed to be desirable that an integrated global subscriber access plan exists. For example, the same ITU-T E.164 telephone number would reach a subscriber regardless of whether IP-based or PSTN network technologies are used. Indeed, the concept of being "technology independent" suggests that any global numbering/addressing plan should be abstracted as much as possible from underlying lower layer technologies.

2.15 It is now widely possible to originate calls from IP address-based networks to other networks, but it is currently rare to terminate calls from other networks to IP address-based networks. Rather, calls are generally terminated on the PSTN, so the called party can only use a terminal device connected to these networks. In order to access a subscriber on an IP address-based network, some sort of global numbering/addressing scheme across both PSTN and IP address-based networks needs to be developed and implemented.

2.16 ITU-T Study Group 2 (SG2) is currently studying a number of possible options whereby users in IP address-based networks can be accessed from/to PSTN users. As one of these options, SG 2 has temporarily reserved, for test purposes, a part of the E.164 numbering resource 878 878 for an IP-based implementation of Universal Personal Telecommunication (UPT) services.

2.17 Another potential approach to the integration of different subscriber access systems in the PSTN and IP address-based networks is the ENUM protocol. The ENUM protocol is the result of work of the IETF's Telephone Numbering Mapping working group[5]. The charter of the ENUM group is to define a Domain Name System (DNS)-based architecture and protocol for mapping an E.164 telephone number[6] to what are known as Uniform Resource Identifiers (URIs)[7]. A relatively stable standard-track version of the ENUM protocol has recently been published as RFC 2916[8]. URIs are strings of characters that identify resources such as documents, images, files, databases, email addresses or other resources or services in a common structured format. The most commonly known types of URI are Uniform Resource Locators (URLs) which are used to locate resources using the World Wide Web. For example http://www.itu.int/infocom/enum/ is the URL for the ITU website providing an overview of ENUM activities.

2.18 **[[Alternative views on this issue should be presented as well]]** Because E.164 numbers typically start with country codes, they implicitly have implications of

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5 http://www.ietf.org/html.charters/enum-charter.html

6 http://www.itu.int/itudoc/itu-t/rec/e/e164.html

7 http://www.ietf.org/rfc/rfc2396.txt

8 http://www.ietf.org/rfc/rfc2961.txt

sovereignty (geographic country codes) that, in turn, are associated with national Administrations responsible for numbering policies. This, along with the inherent monopoly of DNS zones, suggests that it is appropriate that national or regional policy-makers for integrated numbering plans (or other designated governmental authorities) at the "country code level" decide how ENUM-related services are to be managed or sub-delegated in subordinate DNS zones. Currently, discussions of these issues are ongoing between ITU-T Study Group 2 and the IETF. The view of ITU-T Study Group 2 is that administrative entities, including DNS administrators, should adhere to the applicable tenets of pertinent ITU Recommendations, e.g., E.164, E.164.1, E.190, and E.195, with regard to the inclusion of the E.164 resource information in the DNS.

[[Discuss how IP technology and VoIP allow people to talk and access information on the Internet through different and potentially cheaper devices than a computer.]]

[[Discuss the use of VoIP with mobile networks. This is an area of great technical innovation and offers important options for developing countries.]]

3. POLICY AND REGULATORY ISSUES FOR IP TELEPHONY

Introduction

[[The Introduction should: (i) acknowledge the limitations of the available information about government policies; (ii) acknowledge the extent to which the Internet and IP-based data networks have grown and added to consumer welfare without the imposition of telecom regulation (iii) give prominence to the fact that most countries have refrained from adopting policies that prohibit or restrict the offering of VoIP; (iv) include among the questions asked ones that address whether the imposition of legacy telecom regulation on VoIP is needed or productive for consumer welfare; (v) emphasize the risks of attempting to regulate technology that is highly dynamic and at an early stage of development and deployment; and (vi) separate the issue of bypass from the issue of universal service.

[The ITU's role relative to policy issues, particularly in the context of a WTPF, is appropriately limited to information exchange and should not be prescriptive.]]

3.1 IP Telephony is treated in widely divergent ways within ITU Member States, from being completely prohibited, to being licensed, to being regarded as merely another technological platform that can be adopted by PTOs. This section discusses the different policy and regulatory approaches that Member States have taken to IP Telephony, and the methods used to categorize it within those frameworks. The significance of IP Telephony for universal service schemes, convergence policy, and cross-border issues are also considered.

3.2 Where does IP Telephony "fit" within telecommunication regulatory regimes? How should the rights and obligations of its providers compare with those of traditional telephony providers, many of whom are subjected to common carriage regulations and universal service commitments? What status should be afforded to different types of IP Telephony? Should Internet Telephony, VoIP, and PSTN voice traffic be treated the same way, or differently? Should IP Telephony providers hold a license as most traditional voice telephony carriers do?

3.3 To explore these questions, this section attempts a rough categorization of the different ways in which IP Telephony is presently treated in many Member States and

provides illustrative examples of different national approaches. As background, the tables in Annex B classify certain Member States according to their responses to an ITU regulatory questionnaire. **[[These tables appear to contain inaccurate information about the policies of at least some countries. Information about government policies should be included only if it is more fully documented, with appropriate citations to applicable laws and regulations. Also, the column on callback (while it is documented) is not relevant to the discussion.]]**

The general picture

[[The list should be reordered to reflect the predominant approach, which has been to refrain from adopting policies that limit deployment]]

3.4 At present, three broad national approaches emerge:

- First, there are countries that permit IP Telephony, either with or without a license.
- Second, there are countries that prohibit it, either directly or by inference.
- Lastly, there are countries where the situation is uncertain or the issue remains to be formally addressed

~~{3.5 }~~**[3.5 [Describe the limitations of the available information about government policies. Note that there can be a variance between official policies and official practice; some countries that have an official policy restricting VoIP have in practice permitted it to be deployed, and vice versa.]]** This latter group is probably the most numerous. Countries have taken widely differing approaches, often related to different prevailing market conditions and degrees of liberalization. It is important to note that it is the service component, i.e., voice telephony *service* delivered by means of the Internet or IP-based networks, which is most frequently the subject of policy, not IP *technology* itself. **[[Regulations in some countries deal with VoIP differently depending on whether the service is provided to consumers or on a wholesale basis to other carriers.]]**

3.6 Many countries that have retained telecommunication monopolies do not specifically prohibit IP Telephony. However, it is likely that they would not allow any company other than the incumbent PTO **[[or a company hired by the PTO]]** to provide it. 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. Hungary is an example of a country where IP Telephony has been defined by the regulatory authorities in such a way as to fall outside the legal monopoly of the fixed-line voice incumbent. However, reliable, reasonably high-speed access to the Internet is required for tolerable PC-to-Phone service, and this is often not widely available in developing countries. Consequently the issue of termination of incoming international calls is the more significant aspect of IP Telephony for many developing countries.

[[Add a section entitled "Refraining from Regulation," that describes the rationales for not prohibiting or restricting VoIP at least at this time, including: (i) importance of Internet infrastructure development (including closing the digital divide and referencing Y.110 (June 1998), which contains excellent language about the benefits of the development of the global internet); (ii) encouraging innovation; (iii) consumer benefit from lower cost service and added competition, including more universally available service; (iv) difficulty of enforcement (e.g. definitional issues of "phone" and "enhanced service"); (v) de minimis traffic; (vi) quality of service inadequacies; (vii) prematurity; and (viii) the fundamental disparity between IP networks and applications, which have

grown out of a market environment, and circuit-switched networks, which have developed in a monpoly environment.]

License restrictions

3.7 Licensing is one of the principal means by which telecommunications authorities address the question of IP Telephony. Terms and conditions in existing licenses can be interpreted as either prohibiting or permitting such service offerings by new market entrants. Indeed, in non-competitive markets, the license of the incumbent operator may be viewed as precluding new market entrants from offering IP Telephony. On the other hand, a few countries expressly license PTOs to provide IP Telephony. **[. [Mention ambiguity of licenses and government policies, citing Egypt Telecom example]]**

Regulatory distinctions

[[Pull this discussion into the "Refraining from Regulation" section.]]

3.8 In countries that have policies on IP Telephony, 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, or should be classified with, traditional voice telephony, a number of different regulatory distinctions are employed, alone or in combination, by many countries. Among the most commonly-used distinctions are voice versus data, and quality of service. These, and other distinctions, are discussed below.

Type of service

3.9 Most national IP Telephony policies specifically refer to Phone-to-Phone services. PC-to-Phone services tend to be prohibited in those countries that prohibit IP Telephony generally, while they tend to be permitted without conditions in countries that permit some or all forms of IP Telephony. Calling-card services are rarely treated separately in policies. Rather, they are rolled in with other forms of Phone-to-Phone service, since the difference is more one of marketing and billing than technology. It should also be noted that, for many countries, information simply is not available as to whether or not incumbent PTOs are employing IP Telephony, 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. For instance, Telecom Egypt concluded exclusive agreements to offer IP Telephony within Egypt in 1999 without seeking clarification as to whether this was covered by its license.

Voice or data

3.10 **[[Discuss the limitations of trying to distinguish between Phone-to-Phone and other services, including (i) the absence of any rational basis for such a distinction, (ii) the discriminatory effect on those that are not wealthy enough to have access to a PC; and (iii) the increasing difficulty of distinguishing between PCs and phones.]]** Another, and perhaps the most important regulatory distinction in many countries, is whether IP Telephony constitutes voice or data. The voice/data distinction is a matter of judgement. IP Telephony services can, in some cases, achieve a level of functional equivalence to traditional telephony services, making the means of transmission irrelevant to the user. Still, the voice/data distinction is used as a definitional tool to implement policy; thought not always with the best outcomes. For instance, in Nepal, data VSAT (very small aperture terminals) services are liberalized but not voice VSAT. The net result is that outgoing IP Telephony

traffic can be blocked, but incoming packetised voice, which is converted to PSTN voice once it arrives in the country, cannot.

3.11 The Internet has been treated in most countries as something other than traditional telecommunications. The trend has been in favour of little or no regulation of Internet services, even while traditional voice services are subject to extensive (albeit increasingly targeted) regulation. The reason is that Internet traffic is considered, for regulatory purposes, as 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 applications that 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 functionality being offered.

[[Retail vs. Wholesale/Carrier-carrier

Some regulators allow VoIP providers to be treated differently depending on whether or not they provide service directly to consumers/end-users versus wholesale/carrier-to-carrier service providers.]]

Mode of network transmission

3.12 **[[Note that, in many countries, data networks have been permitted to operate in a market-based environment with little if any regulatory oversight or consumer demand for such oversight.]]** Policies may also vary depending upon where IP/PSTN conversion takes place (i.e., whether there is a service provider) or whether the PSTN is used at all. In Phone-to-Phone services, the initial conversion of speech from circuit-switched mode to IP mode generally 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 no requirement for a service provider to be located in the same country as the user. Commercial presence is usually a precondition for effective regulation in a particular country.

3.13 Another case is where a given call does not use the domestic PSTN, but goes from a private data network to an IP gateway and then over international Internet links. Thus the local 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 in fact be considered a basic telecommunication service at all.

3.14 In North America, policies generally distinguish between the Internet and other IP networks as the underlying means of transmission for IP Telephony calls. This 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.

Quality of service

3.15 Another means to distinguish IP Telephony is the notion of whether it provides "real time" communications, similar to traditional telephony. This is a technical measurement that asks whether the service provides 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 to be "value-added" or "enhanced" services, which have traditionally been subject to little or no regulation. The difference between real-time and store-and-forward may be measured in milliseconds as a

technical matter, but is usually left undefined as a legal matter. **[[Consumers benefit from having increased choice by being able to pay different prices for different quality calls.]**

3.16 Since IP Telephony signals, transmitted over the public Internet, 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 might not be considered to meet the criteria of "real time" communications. Typically, communications that are not considered to meet the standard of "real time" are regulated more lightly, or not at all, as value-added services. However, improvements in IP Telephony may reduce the delay to a point at which such communications could reasonably be considered to be "real time". Furthermore the delays involved in IP Telephony might typically be as good if not better than those experienced in satellite telephony, and the sound quality may be comparable with mobile telephony. Thus technical quality of service measurements that are defined to exclude IP Telephony may also unintentionally exclude other types of voice telephony from regulation. **[[Note the inconsistency of regulations that allow live Internet-radio and other types of voice-services to be unregulated while regulating live voice telephony.]]**

3.17 ITU-T Recommendation G.114 (2.96 revision) (One-way Transmission Time) establishes the following technical parameters for satisfactory telephony:

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

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

Functional equivalence

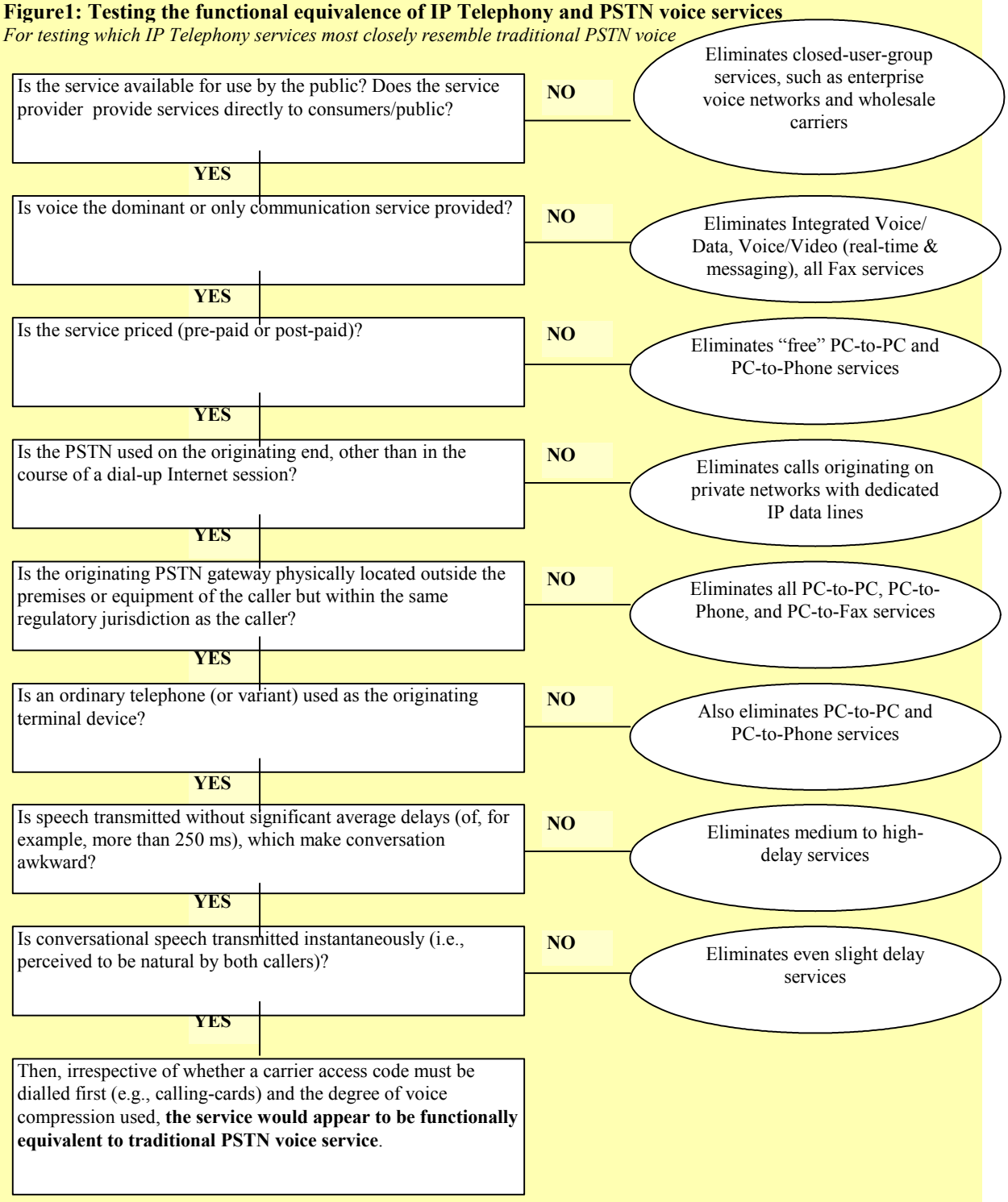
[[Any functional equivalence test begs the fundamential question of whether regulation is appropriate. Other factors should also be considered, including whether the service is provided directly to consumers or to other carriers and whether advanced services are available.]]

3.18 Functional equivalence is a regulatory concept used by some countries to link all or some of the above criteria in developing a policy as to whether some forms of IP Telephony should be treated on the same basis as conventional switched telephony. The premise for this approach, if the goal is to make the regulatory framework technology-neutral, is that similar services should be treated in a similar way.

3.19 On this basis, functionally equivalent services should be subject to similar regulatory requirements, unless other policy imperatives require otherwise. In determining "functional equivalence", policy-makers can look at such criteria as the quality of service, the nature of the service, the transmission networks used and such other factors as whether the service is offered to the public. Where the type of IP Telephony service under review is such that an ordinary telephone can be used as the originating terminal device, the service is offered to the public, the PSTN is involved at some point and there is an acceptable technical level of call quality, then there is a sound basis for concluding that it is functionally equivalent to traditional telephony. Figure 1 shows a possible decision path for establishing or assessing functional equivalence.

Figure1: Testing the functional equivalence of IP Telephony and PSTN voice services

For testing which IP Telephony services most closely resemble traditional PSTN voice



Source: ITU.

Special categories

3.20 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 for incoming or outgoing calls, or both. Other countries restrict the right of mobile operators to offer or provide IP Telephony.

Impact of IP Telephony on Universal Service schemes

[[This section should be divided into two pieces, one addressing bypass and the other addressing universal service. The bypass section should not take for granted that above-cost prices for international traffic is necessarily used to support infrastructure development or universal service. It also should emphasize that the pressure to bypass will exist as long as prices for international traffic are above costs, regardless of whether VoIP is regulated. Moreover, bypass itself is a larger topic both well beyond the scope of this policy forum, and one that only recently was addressed by the WTSA, and any further examination of these questions should come only following ample experience with any new policies or Recommendations.]

The universal service section should emphasize (i) that, because VoIP is cheaper than traditional telephony, it can be an effective way to increase telephone penetration and connectivity; and (ii) that VoIP will promote needed investment in telecoms infrastructure throughout the developing world, particularly the development of IP-based networks.]

[Discuss the potential impact of new IP devices on increasing access and lowering costs for consumers to talk and to access Internet content. These will be cheaper than computers and phones and may enable interaction with information in a format that is more accessible to those that are illiterate.]]

[[Compare the costs of building a circuit based network versus an IP network. These cost differences may make universal service much cheaper to obtain in the future]]

[The universal service section should recognize that IP Telephony, in fact, results in contributions to countries' universal service funding program because of its use of private lines.]

3.21 IP Telephony can be an important issue for telecommunication regulatory regimes that 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, together with net settlements levied on incoming calls, are used to 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 from traditional PTOs and services.

3.22 The asymmetric regulation of voice and data services naturally creates an incentive for arbitrageurs to develop the capability to treat voice as data. The main purpose is to bypass the PSTN and thereby to avoid the regulatory obligations associated with voice traffic, in particular contributions towards implicit cross-subsidies or explicit universal service funds, or both. This can make offering international services profitable for small PTOs, or give larger PTOs crucial cost savings in extremely competitive markets. This incentive is particularly high where outgoing traffic exceeds incoming traffic and/or where universal service obligations are significant.

3.23 A permissive policy towards Internet Telephony may be designed to encourage the development of the Internet in a particular country. However, such a policy may be questionable in light of the fact that most commercial IP Telephony traffic travels over private IP networks, and not the public Internet at all, for quality reasons. **[[The existence of private networks spurs demand for public interconnecting networks.]]** Such a policy would do little or nothing to increase Internet access, while facilitating the bypass of universal service funding schemes designed to increase the accessibility of the very telephone lines most often required to access the Internet in the first place. **[[This argument needs to include the fact that the Internet and VoIP tends to increase use of private lines, which itself may contribute to universal service funding. Perhaps the paper should note that the U.S. has taken this position in its domestic regulation. Moreover, the existence of competition to dominant PTOs may itself promote increased penetration and connectivity.]]**

3.24 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 and subject to challenge, where such policies depend on distinctions between voice and data traffic. In a few countries, providers of IP Telephony that is equivalent to other forms of telephony are required to contribute to universal service funds. Canada is one such country, where a test of functional equivalence is applied. Thus, a basic question is whether calls on one technological platform (e.g., IP, Frame Relay or ATM-based) should be treated differently from calls on another when it comes to universal service obligations.

3.25 Increasing access to the Internet is a policy goal in many countries, and low-cost long distance and international voice services can be easily added to the range of Internet services already available at community telecentres. Such services would not necessarily compete with the incumbent's existing business, and could be used as an interim strategy to provide easy and affordable access to those without a telephone in their home.[9]

Special issues for developing countries

[[This seems to belong with the bypass section.]]

[Include examples from China and elsewhere where PTOs and others have used Internet/VoIP networks to rapidly build domestic networks at a fraction of the time and cost of traditional networks. A lighter regulatory licensing regime would ease/foster more of these networks being built.]]

3.26 One aspect of IP Telephony that has particular implications for developing countries is that of international call termination. This is because IP Telephony is experienced in developing countries primarily in the form of incoming telephone calls. That is, foreign PTOs bring in low-cost IP Telephony traffic to developing countries and neither the caller in the foreign country nor the user receiving the call are aware their call is routed over an IP-based network.

3.27 In this scenario, the developing country does not benefit directly from a permissive IP Telephony policy (or lack of enforcement of a prohibition). Rather, it is the foreign PTOs that benefit from lower costs and these savings may be passed on to their customers. Thus, consumers and PTOs in those developing countries whose governments have acted to prohibit

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9 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>.

outgoing IP Telephony tend not to gain from the spread of IP Telephony to nearly the same degree as consumers and PTOs in developed countries, particularly those where international IP bandwidth is cheap and IP technology is widely available.

3.28 IP Telephony thus presents a dilemma for developing countries, especially for their incumbent PTOs:

> 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 that might otherwise be too expensive, and enabling business customers to participate more effectively in the global marketplace.
>
> On the other hand, IP Telephony could be viewed as a threat 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.
>
> **[Put additional pros and cons. Such as the benefits of increases in traffic and network usage as well as increased ability of PTOs to tap into new markets outside their country. CAT's calling card service is one such example.**
>
> **Also mention how new IP devices will offer cheaper and easier access to Internet content (voice interactive networks, etc).]**

3.29 It is somewhat surprising that few IP Telephony policies refer to *terminating* international calls via IP Telephony, yet this is the primary form of this business in developing countries. Since developing countries tend to have relatively higher accounting rate levels, there is a greater incentive for their developed country correspondents to use IP Telephony as a form of bypass of the accounting rate system. While there may not appear to be much IP Telephony business activity in a particular country, because it is not advertised, international IPTSPs (IP Telephony Service Providers) may have already entered into deals with local ISPs (Internet Service Providers) or other private companies with "leaky" private corporate exchanges to terminate IP calls for them on the local PSTN. This would allow the traffic to pass outside of the accounting rate structure maintained by the incumbent PTO(s). Preliminary research suggests that this is very common all over the world.

Convergence and IP Telephony

[[This may be the best place to elaborate on (i) the fundamentally different regulatory regimes that have grown up around and continue to characterize IP-based packet networks and circuit-switched networks and (ii) the principle that the growth of IP-based networks provides an opportunity to reduce regulation generally instead of an imperative to impose legacy telecom regulation on the new technology.]

3.30 Technology analysts have been suggesting for several years that all forms of electronic communications will eventually merge into one platform, and in recent years IP appears to have emerged as the unifying platform. With PTOs and broadcasters entering each others' markets in many countries, and mobile operators considering shifting to an IP platform as they develop third generation systems, regulatory structures the world over are being pressured to adapt.

3.31 One of the key issues in local telecommunication markets that have been opened to competition has been the terms for interconnection among all local service providers. It is conceivable that some 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. This is already the case, for instance, in the United Kingdom. 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 may also arise in the near future. In Chile, for instance, IPTSPs are required to offer interconnection.

3.32 An important aspect of this issue is access to unbundled elements of the "local loop". While full local loop unbundling is currently required in a relatively small, though growing number of countries, it is seen as an important step in the evolution of markets from monopoly to full competition. Unbundling allows different networks to interconnect, to exchange traffic and, most importantly, makes it all appear seamless to the end-user.

3.33 In many ways, local competition has proven to be the most complex regulatory undertaking yet in liberalized telecommunication markets. The integration of Internet and IP-based services with incumbent and new entrant circuit-switched networks will make the local environment even more complex. Far from making regulation irrelevant, this complexity makes effective telecommunication regulation more important than ever. The inherently international nature of the Internet, in turn, will make international cooperation on such matters essential.

Cross-border issues

3.34 The treatment of Phone-to-Phone IP Telephony may have implications for the international telephony market. IP Telephony may serve the public interest in the originating country by placing significant downward pressure on international settlement rates and consumer prices. In the terminating country, it may serve to introduce an alternative calling option even though policy-makers have otherwise decided to restrict or prohibit competition. In addition, these IPTSPs may benefit from a lighter regulatory approach than that imposed on incumbent PSTN operators. Where a permissive approach in the originating country conflicts with clear and restrictive policies in foreign markets in which the services are terminated, it might be useful to have a means to resolve such difficulties.

3.35 More generally, consideration could be given as to the extent, if any, to which some forms of IP Telephony should be subject to international agreements and procedures, such as the numbering plan or conventions on routing traffic and settling accounts, that apply to traditional international telephony.

3.36 IP Telephony may also be considered as part of a broader process of deploying IP-based networks around the world. IT is unlikely to be cost effective to develop IP-based networks solely for the carriage of voice, but rather as part of a strategy to develop a full-range of Internet services. For countries that would seek partners to build such networks, then issues for creating favourable market conditions for investment and installation of IP-based networks need to be addressed.

4. ECONOMIC ASPECTS OF IP TELEPHONY AND ITS IMPACT ON PUBLIC TELECOMMUNICATION OPERATORS

[[Reorganize around a discussion of the economic motivations of service providers deployment of VoIP, including (i) added revenue from deployment of IP-based networks

for which there is substantial demand; (ii) potential for enhanced services that require voice capability; (iii) lower-cost deployment and effect on teledensity; and (iv) bypass of accounting rate regimes]]

The market opportunity

[[Insert information about the current size of VoIP traffic, including its size relative to that of circuit-switched networks, showing that VoIP remains small in relation to global traffic. Insert information about the magnitude of existing investment in legacy networks.]]

4.1 From an economic viewpoint, IP Telephony raises a number of key questions. Foremost among these is: how big is the market opportunity that IP Telephony creates? **[[Eliminate outdated and overly speculative estimates; provide valid cites to source materials; note the tremendous difficulty of predicting the pace of change]]** Market estimates vary widely:

> The market research company, *IDC*, estimates that the IP Telephony market generated 2.7 billion minutes of traffic 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;
>
> In China alone, the Ministry of Information Industry (MII) has estimated that the IP Telephony business will be worth some US$12 billion by 2004. **[[Does this include domestic and international traffic?**
>
> **Include data/estimates on the potential of domestic, in-country traffic. This is a major market and IP can play a key role in this.]**

4.2 Most studies show that the main use of IP Telephony at present is for international traffic rather than for domestic long-distance or local traffic. The United States is currently the main source of IP Telephony traffic. **[[This is extrapolating mainly from the experience of the U.S. where domestic prices are very, very low. In countries where there has been less experience with competition and where domestic call prices are high and there is limited domestic infrastructure, the potential for domestic IPTSPs is great and could help lower domestic prices, increase network usage, and increase network buildout since IP networks are cheaper and faster to build.]]**

4.3 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-based networks (for at least part of the route) by the major PTOs. This is particularly difficult to estimate. The *Sema Group* reports that some 60 per cent of PTOs 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. **[[This survey data indicates nothing other than what people are guessing]]**

Already, the number of international circuits that are used for leased lines (primarily for Internet use) outnumber those that are used for the PSTN. On the busiest routes, for instance between the United States and Europe, international PSTN circuits in use are declining in number.

~~{Costs and prices~~

~~}~~**[[MARKET, SERVICES AND PLAYERS:**

Include separate sections describing the ITSP market place, structure products and players. VoIP markets, services and players are very different than the traditional telco market. The discussion for example, should examine the difference between PC-to-Phone, phone-to-phone, retail/wholesale, service providers as well as the revenue impact of new services, such as calling cards and other IP services. It should also examine how alliances between ITSPs and traditional PTOs can help relatively small PTOs transition to more competition and increase their global footprint and help the PTOs focus their limited resources on their domestic or targeted markets/users. These alliances also entail substantial cross-training and increase of knowledge of developing country PTOs of cutting-edge IP knowledge/expertise.]]

Costs and prices

4.4 A second economic issue raised by IP Telephony relates to the cost savings it might offer. For **consumers,** IP Telephony is invariably *cheaper* than the traditional alternative (PSTN telephony) especially for calls originating in non-liberalised markets or that are carried over the public Internet. For instance, in Hungary, where consumers have had a choice of using IP Telephony since 1999, the price advantage over standard PSTN calls ranges between 20 and 50 per cent per minute. If all other factors—quality, convenience, reliability, etc.—are equal, the choice to use IP Telephony is an economically rational one. For the moment, however, the other factors are not equal. In Hungary, for instance, IPTSPs would be regarded as breaching the monopoly of the incumbent, *Matav*, if the average delay of voice transmissions was less than 250 milliseconds or if packet loss was less than 1 per cent. Therefore consumers must generally make a trade-off between price and quality. Willingness to make that trade off will generally depend on price sensitivity:

> Consumers in low income countries, or in low income families in developed countries, will be more inclined than other less-price-sensitive consumers to choose IP Telephony, where it is available;
>
> Residential consumers may be more inclined to use IP Telephony than business users for whom transmission quality and reliability are more important.

4.5 For **PTOs**, the potential cost advantages of IP Telephony are more complex to calculate. That is because incumbent PTOs have existing revenue streams, which they fear may be cannibalised by a shift to lower-priced IP Telephony. In the case of Hungary quoted above, the initial pressure to offer IP Telephony came from mobile service providers that saw the opportunity to bypass *Matav's* monopoly on carrying international calls, although *Matav* itself is now an IP Telephony service provider.

4.6 The precise nature of the cost advantage to PTOs offered by IP networks is the subject of much debate. It will depend, for instance, on:

Whether a particular investment in IP is as a new-build network, or as an upgrade or overlay to an existing network. The incentive to choose IP will be greater for new, or substantially new, networks. For instance, in Senegal, where existing networks serve just over 1 per cent of the population, *Sonatel* plans to migrate its existing core network to an IP backbone by 2004 and to offer both voice and data services over the same integrated IP network.

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 IP Telephony. In China, for instance, *China Netcom*, a new market entrant which is based around the Ministry of Railway's network, is building a voice over IP network which will cover 15 cities and include some 9'600 kilometres of fibre optic cable by the end of 2000. The use of IP has allowed *China Netcom* an earlier entry into the market than might otherwise be the case.

The extent to which value-added services are being offered. In economies such as Hongkong SAR and Singapore, where local call charges are free (bundled into the access charge), new market entrants are offering value added services that allow, for instance, voice users to retrieve their email (*T2mail.com*) or voicemail and fax communication services (*2Bsure.com*) over an IP platform.

4.7 In reviewing these factors, it seems likely that the pressures to shift towards IP Telephony will be different in economies at different states of development and with differing degrees of market competition:

In countries where **prices for international traffic are high**, the main opportunity for voice over IP will be for price arbitrage of simple voice transmission. In many of these countries, outgoing IP Telephony is banned. Thus, the main form of IP Telephony is incoming traffic. Even though this may be no more legal than for outgoing traffic, it is harder to detect and block. In Nepal, for instance, incoming PSTN traffic fell from 29 million minutes in 1998 to 22 million in 1999 during a period when outgoing international traffic grew from 20 to 25 million minutes. It is thought that at least part of the decline in recorded incoming traffic is due to the fact that PTOs are bringing their traffic into the country as a packetised voice in an Internet traffic stream to VSATs (very small aperture terminals) and then breaking the calls out into the PSTN locally.

In countries where **prices for international traffic are falling**—for both retail (consumer) and wholesale (settlement) rates—VoIP traffic may already be playing a role in promoting price competition (as, for instance, in Hungary or Thailand) or in providing an alternative to the services of the fixed-line incumbent (as, for instance, in Colombia). However, a critical factor is how easy it is for subscribers to use the service. In Peru, for instance, the success of IP Telephony was partly based on the availability of a telephone-like device (Aplio) that could use either IP networks or the PSTN for establishing calls.

In countries where **prices for international traffic are already low**, due to the effects of competition, IP Telephony is likely to be important for reasons other than price arbitrage. The market opportunity for IP Telephony is likely to lie, on the one hand, in the prospects of value-added integrated services for users and, on the other hand, cost reductions for PTOs. As an example of the former, in the United Kingdom, *yac.com* offers a service for personalised numbers and automated call forwarding via the Internet. As an example of the latter, the *BT/AT&T* joint venture, *Concert*, is building a new managed IP-based global network to deliver services, such as electronic commerce and global call centres, to link

some 90 cities worldwide. Even though the required investment is of the order of US$1 billion per year, an integrated IP network is considered to offer the most cost-effective solution for handling multiple traffic streams**[.**

Insert some thoughts on impact on domestic traffic, especially in developing countries.

Substitutability] ~~{Substitutability}~~

4.8 A third economic issue raised by IP Telephony is the issue of substitutability between services. Clearly, much of the traffic carried over PC-to-PC Internet Telephony will be "new" traffic, which would not otherwise have existed on the PSTN. Much of the discount traffic generated over PC-to-Phone services is also likely to be new traffic, especially that which is offered "free of charge", for instance by companies such as *DialPad.com* or *phonefree.com*. 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 could 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 PTOs will inevitably lose some market share.

4.9 One of the main motivations for PTOs to route traffic via IP-based networks is to reduce the level of settlements that are due to partner countries. Under the international settlements system, the PTO(s) in the country that originates a call has traditionally made a compensatory payment to the PTO(s) in the country that terminates 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, during the 1990s, net flows of settlement payments from developed counties to developing ones amounted to some US$50 billion[10]. PTOs 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 interconnection fees, based on local call rates or below.

Impact on public telecommunication operators

4.10 In developing countries, and especially those with high international call charges, the major impact of IP Telephony on PTOs is likely to be a potential loss of income from international calling, which is both direct (loss of collection charges) and indirect (loss of settlement payments). In the case of Sri Lanka, for instance, incoming international traffic streams have fallen from some 16 million minutes to just 9 million minutes per month and the estimated loss to the incumbent operator, Sri Lanka Telecom Ltd., is around US$2 million per month. At least some of this lost traffic is thought to be due to IP Telephony and Sri Lanka Telecom has initiated court action against those companies that it believes are using IP Telephony to carry incoming traffic.

4.11 Arguably erosion of monopoly power on over-priced international routes would happen anyway, even without IP Telephony. Markets for international calling are shrinking in

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10 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>.

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. PTOs 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 generate revenues in future IP-related growth areas. There are a growing number of PTOs that have chosen to offer lower priced IP Telephony services~~(,)~~ **[on their own or by entering into agreements with ITSPs, as a strategy to regain traffic lost to high prices and other providers or as a way capture new revenues from increased traffic and/or net services.]** even though this may ~~(cannibalise)~~ **[affect]** their existing revenue streams. These PTOs include *Telecom Egypt*, *GamTel* (Gambia), *Matav* (Hungary) and *CAT* (Thailand). **[These PTOs are acting intelligently to try to adapt to lower prices and trying to generate new revenue sources – it is in their self-interest to follow this strategy. PTOs should be encouraged to follow suit.]]**

4.12 In more competitive markets, where prices for international calls have already come closer to costs, the impact of IP Telephony on PTOs is likely to be less significant. IP Telephony is just one of many options for discounted calling. PTOs will route traffic over whichever route is cheapest, and customers will choose PTOs according to their ability to combine low cost calling with value-added services.

4.13 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, it is unlikely to be able to "own" or control the types of application that the customer chooses, and IP Telephony might be better viewed as an application rather than a service. PTOs have traditionally used profitable long-distance and international services to cross-subsidise the functions of network access and local calling. In increasingly competitive markets, such hidden cross-subsidies can no longer be sustained. Future PTOs will need, instead, to ensure that their local access networks are largely self-financing. This will require substantial and urgent tariff rebalancing to bring the price of local and international calls much closer together.

4.14 While IP Telephony 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 IP Telephony is a new "killer application", and 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.

4.15 Over time, the price arbitrage opportunity for IP Telephony on international routes may disappear, but other opportunities are expected to emerge. For instance, in many European countries, rates for the termination of calls on mobile networks are widely believed to be out of line with costs[11]. Routing calls to mobiles via IP networks may offer a solution to bypass these high prices. Similarly, countries that maintain many different call zones for domestic traffic, based on distance, may find that these are unsustainable in an IP-based world. Competition will drive prices closer to costs and, where IP Telephony offers the lowest cost alternative, it will be the preferred solution.

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11 See the discussion of this issue in the ITU Workshop on Fixed-Mobile Interconnection, available on the ITU website at: http://www.itu.int/interconnect.

[Discuss the positive impact of ITSPs building gateways around the world on reducing US-centric Internet traffic and increasing intra-regional traffic flows as gateway-to-gateway billing and other services are provided.]