Final Report for the European Commission

IP Voice and Associated Convergent Services

Contract 02/48582

Analysys

28 January 2004

IP Voice and Associated Convergent Services

Final Report

Contents

0 Executive summary

This document is the final report on a study by Analysys on Internet protocol (IP) voice and associated convergent services for DG Infosoc, European Commission (EC). Its target audience is within National Regulatory Authorities (NRAs) and governments. The report identifies and explains the important issues associated with the transition from the existing circuit-switched public switched telephone network (PSTN) to IP packet-switched networks for the provision of voice and associated convergent services. These issues encompass regulation, technology, economics and the structure of the telecoms market.

IP voice and associated convergent services

Carrying voice and associated convergent services, such as instant messaging over IP networks, sits at the intersection of two very different markets: the traditionally regulated telephony market and the traditionally unregulated data services market. There is currently uncertainty in the minds of market players and regulators about the way in which these IP-based services should be regulated, and in the market outcomes that will result.

The use of IP networks to carry voice and associated convergent services is of great importance for everyone who uses voice and data communications. The use of IP technology has already had substantial effects on the traditional telecoms industry, for example in the use of voice over Internet protocol (VoIP) to bypass international interconnect arrangements and provide cheaper voice calls. This is only the beginning: it is possible that the entire PSTN will be replaced with a new network based on IP, which will have significant implications for equipment supply, investment requirements and the range and cost of services offered. However, this transition will inevitably take several years, due to a number of factors:

- equipment replacement cycles (within corporates and telecoms network operators)
- broadband access network deployment
- take-up of broadband Internet access by end-users
- attractiveness of the new VoIP service offers (which is strongly affected by existing competition within the voice calls market).

The impact of these factors will vary by country. European countries with competitive voice calls markets and limited broadband access networks may see slower growth in VoIP and convergent services than countries where voice call prices are relatively high and broadband access is being actively exploited (e.g. Japan). Existing regulation, such as PSTN interconnect arrangements, will also have substantial effects on the pace of adoption of IP technology. (e.g. the USA).

We can already see differences in service take-up and the service provider business models being used, with take-up occurring more rapidly outside Europe, particularly in Japan, with more than 5 million subscribers in January 2004. In our opinion, these differences between countries do not mean that VoIP is failing in Europe, or that major changes in regulatory policy are necessarily required – but they do indicate very different market conditions. Nevertheless, there are some important regulatory issues affecting VoIP and convergent services that need to be considered.

Regulation

Telecommunications services in the EU are governed under the 2003 Regulatory Framework (the New Regulatory Framework (NRF)). Within this framework, electronic communications services (ECS), such as VoIP, are divided into a number of different categories:

- private ECS (such as networks for closed user groups)
- public ECS (such as broadband Internet access)
- publicly available telephony service (PATS) (a subset of public ECS).

Each of these is regulated, to a lesser or greater degree:

- Private ECS providers are subject to general conditions of authorisation. These conditions are usually extremely limited, e.g. ensuring that equipment does not interfere with other networks.
- Public ECS providers are subject to additional general conditions of authorisation. Most of these conditions are (in effect) concerned with consumer protection.
- PATS providers are subject to additional general conditions over and above those of the public ECS providers. Again, most of these conditions are (in effect) concerned with consumer protection.
- Players with significant market power in defined relevant markets are subject to ex-ante remedies.
- Ex-post competition law remedies remain an option if anti-competitive behaviour is observed in any market.

Significant issues arising from this study

Some VoIP and associated convergent services do not fit within the NRF, either because they are not within the definition of a "service provided for remuneration" (they are genuinely free, such as some peer-to-peer services, or are self-provided) or else they are argued to be information society services. These are all legal points that will ultimately be determined by the courts.

Other VoIP and associated services do fit within the NRF, but in a number of instances it is not clear which categories or definitions should be applied to them. We believe that there is a need for greater certainty as the chosen categories and definitions will have significant implications for the evolution of the market, across the European Union (EU) and within each Member State. The areas to be addressed include:

- definition of PATS
- location independence and emergency access
- network integrity.

Other potentially significant issues that merit consideration include:

- potential pressure on national numbering plans
- potential issues arising from extraterritorial service providers.

Definition of PATS and access to emergency services

Almost all publicly-available, paid-for IP voice and associated convergent services will be public ECS. Very few providers, (possibly none in the short to medium term), of these IP voice and associated convergent services will have significant market power. However, some publicly-available IP voice and associated convergent services will be regulated as PATS. The key question is, therefore:

How do we decide which voice and associated convergent services are PATS, and hence subject to similar regulation to (and considered as part of the same market as) existing, non-dominant PSTN service providers?

The main issue concerns emergency services. The Universal Service Directive defines PATS as providing access to emergency services, and requires providers of PATS, amongst other obligations, to provide access to emergency services. Whether or not a particular VoIP service is PATS, therefore, has important implications for the provider of the service (because this impacts how the provider will be regulated), and it also affects the public, because it affects the provision of emergency service.

In principle, there are two choices regarding the interpretation of the definition of PATS:

- Narrow definition: Any VoIP provider that does not offer access to the emergency services is not PATS (and, therefore, not subject to the specific conditions imposed upon the providers of PATS). Any VoIP provider that does offer access to the emergency services (and calls to telephone numbers) is PATS, and therefore subject to all of the conditions imposed. Although clear and simple, this is likely to be a disincentive to provide access to the emergency services, and may have significant implications for public safety as VoIP becomes more widely adopted.

- Broad definition: Any VoIP provider that provides a service in direct competition with (and as a substitute for) the PSTN is PATS (and therefore subject to the full range of obligations imposed on PATS providers). However, this could lead to the imposition of the full obligations of being a provider of PATS on many VoIP services that are not equivalent to the PSTN. Furthermore, rigorous application of this broad definition

could require some types of service provider to supply something they are incapable of providing.

It is not obvious what approach should be taken.

Classifying whether a service is PATS is a serious issue for regulators. The Finnish regulator, Ficora, recently determined that the VoIP offer of TeliaSonera (Sonera Talkband, 'Puhekaista') was PATS, and was therefore obliged to provide all the facilities required of PATS (including: having the ability to make international calls using the 00 prefix; to have a phone bill; to be able to prevent publication of the number in directories; to be able to block certain numbers from calling the number; and to be able to withhold the number when making calls). In determining that the service was PATS, Ficora used a narrow reading of the Universal Service Directive – the client uses a phone number, which follows national standards and allows the client to make and receive telephone calls in their own country, and have access to emergency services.

This issue also affects the market reviews currently being undertaken by the NRAs. As defined by the EC, Retail Call Markets 3–6 and Wholesale Markets 8–10 are PATS. As the process of economic market definition, by its very nature, seeks to include substitute products, certain VoIP services will be considered potential substitute services within many of these relevant markets. In the market reviews, therefore, a broad definition is used. However, this is not necessarily a strong argument for using a broad definition when deciding which services should have to meet the obligations of PATS.

There may be ways in which this issue could be avoided altogether. For example, VoIP operators could be treated in a similar way to mobile operators as regards conditions relating to the quality of access to emergency services, as long as the reduced call quality was made very clear to end users. However, we should be wary of setting a precedent that might apply to other networks in an unforeseen way (e.g. the future replacement of the PSTN).

There is no easy answer on this point, and we suggest that NRAs and the EC may wish to form a working group to consider how to resolve it.

Location independence and emergency access

If VoIP service providers do provide emergency services access, it may be of a reduced quality as a result of the location independence of VoIP technologies. In contrast to the existing PSTN, a VoIP service provider cannot necessarily supply the emergency services with the address that users are calling from (a user may, for example, be calling from a public wireless LAN (WiFi) hotspot rather than from home).

End users will need to be made aware that the quality of emergency services provided on a VoIP connection will be lower if calling from a public WiFi hotspot, if using corporate internal networks, or if the VoIP provider is not accurately informed of an individual's location. However, it seems feasible for VoIP service providers to provide a reasonable form of access to the emergency services, which is at least as good as that provided by existing mobile networks (i.e. those facing a similar issue mapping caller location for the emergency services).

We, therefore, recommend that the NRAs consider how the limitations on emergency services should be made clear to end users.

Network availability in cases of disaster

Providers of PATS at fixed locations are required to ensure the availability of services (including access to emergency services) in the case of force majeure and catastrophic network breakdown (Universal Service Directive, Article 23).

Some PATS providers using VoIP might be unable to meet the obligations for network availability in cases of force majeure (for example, if certain major Internet routers were under a major electronic or physical attack). Again, as in the case of emergency service access, under a broad definition of PATS, some types of service provider might be obliged to supply something they are incapable of providing.

Restating the requirements for resilience and availability may be useful, but we recommend against any relaxation of this requirement for VoIP providers of PATS, because it is

possible that all the fixed networks (including the current incumbents) will eventually use VoIP. Relaxing the requirement might have a small implication now, but over time, would cause a significant change in the availability of the telephony network in disaster situations.

We suggest that the required network integrity is considered further by the EC and by Member States.

Possible pressure on national numbering plans

As yet, there is no consensus on what numbers within national numbering plans ought to be used for VoIP. In principle, it is desirable for VoIP subscribers (and therefore VoIP service providers) to have access to all number types, including geographic numbers. Various services, that cannot reasonably be considered to be PATS (e.g. second lines provided over IP) will probably need access to geographic numbers to be successful.

It is also possible that, once electronic number mapping (ENUM) is deployed, telephone numbers will be used for additional purposes (e.g. as a form of digital identity). Such uses will create additional pressure on numbering ranges.

However, there may not be enough numbers within the numbering plans of some Member States to allow access to certain types of numbers (such as geographic numbers) for a large number of new service providers, and for new services (such as virtual numbers). We recommend that NRAs consider whether additional numbering ranges should be allocated for use by new services enabled by VoIP in order to avoid pressure on existing numbering ranges.

Possible issues arising from extraterritorial service providers

One outcome of moving to an IP-based network is that certain network facilities, such as the resolution of names (e.g. uniform resource identifier (URI) into IP addresses can be provided from a different country. This country may even be outside the EU and therefore

not subject to the NRF. Not all facilities will be extraterritorial: some, such as PSTN gateways, are still likely to be within the country for both technical and economic reasons.

If there were ever to be a problem requiring regulatory intervention (and we emphasise that so far, this has not been the case), regulators do have tools with which to regulate the provision of such services, which can be considered 'associated facilities' within the NRF. Nevertheless, it may be difficult to apply these remedies to companies that are in another jurisdiction.

Furthermore, if a service provider's network assets are based in a different country from the user (and/or controlled by a different legal entity) this may make it more difficult to ensure continued network and service availability. It is, therefore, an open question whether the need for resilience will (as a result) affect the technologies and system architectures adopted by PATS providers.

These issues are familiar in e-commerce and Internet communications services, but will now appear for the first time in the voice services market.

We recommend that NRAs and Member States explicitly consider whether extraterritorial provision of domestic or EU voice services (or components within these services) merits any modification or extension to current policy.

Other issues

There are a number of other potential issues that arise for regulators from the move towards IP voice and convergent services.

These issues merit attention, but in most cases, will not necessarily cause serious or immediate harm to the deployment of IP voice and associated convergent services.

Such issues include:

- whether VoIP services on fixed networks are provided "at a fixed location"
- treatment of free services

- treatment of self-provided services
- designation of associated facilities
- clarifying control of access to end users
- impact on lawful intercept
- interconnect to the PSTN
- interconnect to other VoIP service providers networks
- the possibility of commercial barriers erected by access operators
- security issues
- effects on universal service obligation (USO) funding
- changes to regulatory costing.

We believe that regulators have appropriate powers to deal with these issues in a timely way through monitoring market developments, reviewing, clarifying and developing policy, and building on existing knowledge, although some further harmonisation of the approach to these issues at a European level may be appropriate. We suggest that it would be useful for NRAs' annual reports to include a short summary of the evolution of the VoIP market in their country.

Conclusion

A transition to IP voice and associated convergent services is taking place. The NRF is suitable for handling this transition, but it would be best to address a number of issues before they become significant blocks to future market development.

- The most significant issue is whether – and under what circumstances – VoIP is classified as PATS (with all the attendant obligations, of which the most important are access to emergency services and network integrity). Early clarification of the policy in this area would prevent confusion amongst service providers and between Member States.
- Location and emergency access is an issue that requires clarification. It may not be possible to provide the location of a caller making an emergency call using VoIP; how users are made aware of this or what other steps are needed to provide such location information are matters that merit further consideration.

- VoIP services may not be as robust as the existing PSTN voice service. The degree to which a network carrying voice calls is expected to be available may need further consideration, especially as any relaxation of requirements could have greater implications in the long run, as more and more voice is carried over IP networks.
- The existing national numbering plans could prove wholly inadequate if VoIP users (and hence service providers) require large numbers of geographic and other types of numbers. The NRAs should consider the implications of such a development now, as numbering requires relatively long-term planning.
- VoIP makes it possible to provide domestic or EU-wide voice services (or components of those services) from other countries. We recommend that the Member States and the NRAs explicitly consider whether this merits any change to current policy.

The transition to IP voice and associated convergent services is proceeding more slowly in Europe than in other parts of the world, and at varying rates in different EU Member States, because of variations in market conditions. Nevertheless, the underlying global trend is clear: more and more voice traffic will be carried over IP networks, and in the process a new range of services will emerge, supported, in some cases, by new network equipment.

This transition is likely to be as profound as the shift from analogue to digital communications, and to generate similar opportunities for service providers and for the economy as a whole. It is important that NRAs and policy makers are fully aware of the potential of IP voice and associated convergent services, and that they clarify the outstanding issues identified above so as to ensure that the transition is driven by efficient and competitive markets.

1 Introduction

This document is the final report on a study by Analysys on IP voice and associated convergent services for DG Infosoc, European Commission. Its target audience is within NRAs and governments. The report identifies and explains the important issues associated with the transition from the existing circuit switched PSTN to IP-packet switched networks in providing voice and associated convergent services. These issues encompass regulation, technology, economics, and the structure of the telecoms market.

1.1 Report objective

It is now possible to offer a wide variety of voice services based on Internet technologies. However, carrying voice over IP networks sits at the intersection of two very different markets: the traditionally highly regulated telephony market and the traditionally unregulated data services market. At the same time, there is an NRF for telecommunications within the EU. In the minds of market players and regulators, there is currently considerable uncertainty about the way in which these IP-based services should be treated under the NRF, and in the resulting market outcomes. This document aims to reduce some of this uncertainty and bring readers to a common level of understanding of the issues arising from this generational shift in the technology supporting voice telephony and the changed regulatory environment.

1.2 Report structure

A variety of services are considered within this report, from traditional PSTN-equivalent voice services to new services that are entirely data-based, such as instant messaging (IM).

This range is so wide that it is difficult to determine the issues raised by looking at the market as a whole. Consequently, we have divided our work into two main areas that examine distinct sections of the market, and have adopted different approaches to our investigation:

- In the first (Chapter 2) we consider five different voice services spanning the full range of services and service provider business models, and look at each of these in turn.

- In the second (Chapter 3) we examine convergent data services, and look at instant messaging as an example from which we draw both specific conclusions about instant messaging and more general conclusions about convergent data services as a whole.

- In both of these chapters, we look at each service in detail, how it is likely to be used, track its potential evolution, examine likely business models, and discuss the regulatory issues that may arise. We believe that the approach we have adopted will highlight the most important issues to be faced by regulators regarding voice and associated convergent services in the migration to IP-based technologies.

The final section (Chapter 4) draws conclusions for regulators about the application of the NRF in the light of these more detailed chapters.

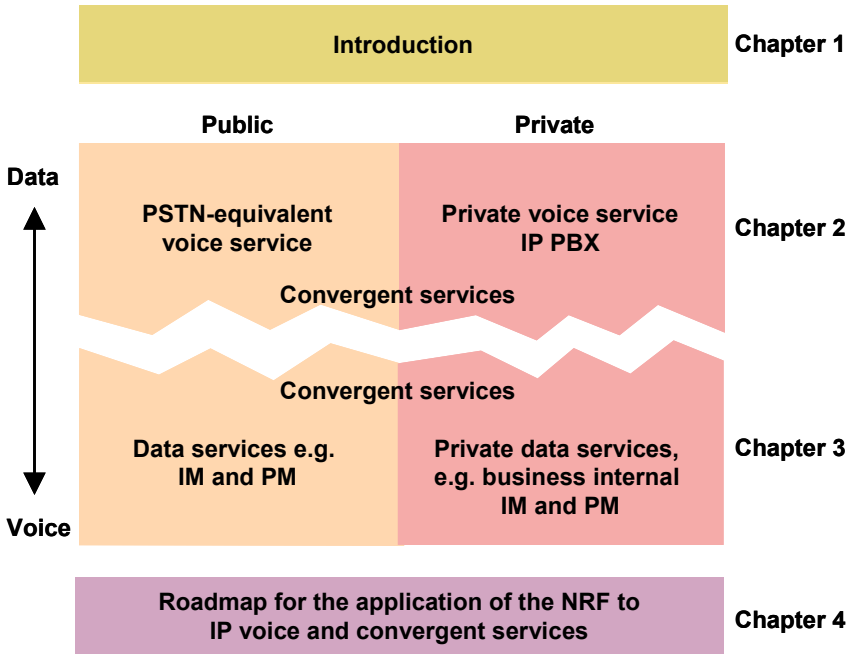

Exhibit 1.1: *Document structure [Source: Analysys]*

We also include two annexes, which contain supporting material that is useful for the reader.

As a part of this study, over the past year we have conducted a large number of interviews with relevant players, including: regulators, service providers, end-user organisations, and equipment vendors. Where the interviews are particularly relevant, either because they give strong support for our arguments or because they hold strongly opposing views, we have referenced comments as footnotes.

Definitions

- Internet protocol (IP) – the communications standards used by the Internet (strictly, only the Internet networking protocol, but commonly used to include a whole related set of protocols).

- VoIP – following the lead of the useful International Telecommunication Union (ITU) World Telecommunication Policy Forum (WTPF) report, 'VoIP' is used here as a generic term for the conveyance of voice, fax and related services, partially or wholly over packet-switched, IP-based networks.

- PSTN – again, following the lead of the WTPF report, public switched telephone network (PSTN) is used 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).

For more definitions, see the glossary in Annex B.

1.3 Making money out of VoIP and convergent services

The ability to carry voice over IP networks can be used to make money in several ways:

- services are/could become cheaper to provide than traditional circuit-switched network services (e.g. in the wholesale voice market)
- arbitrage opportunities are exposed by the different market structure of the IP market and telephony market (e.g. for international voice traffic)
- enhancements can be offered to existing services (e.g. by being able to route fixed network calls according to the called party's current location)
- completely new services can be offered (e.g. the ability to speak to fellow players in a multi-user game).

1.4 The importance of IP voice and convergent services for regulators

Just from the few examples above, it is apparent that there can be significant changes in the telecoms market as a result of using IP:

- low barriers to entry in these service markets give an opportunity for larger numbers – and a more diverse type – of service provider

- there can be a decoupling of calls from access, giving rise to longer, more complex value chains
- the service provider may be in a different country or indeed outside the EU
- service quality may be lower or less reliable than the PSTN (at a reduced cost)
- access to 'lifeline' or emergency services (112 / national emergency numbers) could be affected
- location independence – including international location independence – is available even in fixed calls
- growth in demand for numbers can result in congested numbering plans
- encryption of VoIP calls and the complex, multiple-player value chains may affect the usefulness and timeliness of the data intercepted and the location at which lawful interception is possible
- the net cost of the USO could be increased by the existence of additional competition in the long-distance market. If there are explicit USO funding mechanisms (e.g. levies on revenues), these could also be affected by migration of voice traffic to peer-to-peer, IP-based services (where there may be no revenue and no record of a 'call')
- operators may be dependent on access to new kinds of facilities such as presence information services – some such services might not fall within the definition of an ECS, and therefore not be covered by the NRF, while others may be covered as associated facilities
- considerable changes are anticipated within the core switching network of the PSTN, and there will be complex interactions with the existing arrangements for interconnect
- the economics of VoIP are strongly dependent on availability of access that is always on and has a very low incremental cost per bit. Many broadband tariffs fulfil these requirements. Mobile tariffs are unlikely to offer a very low cost per bit, and as a result, fewer viable business models for the use of IP telephony exist for mobile access.

1.5 How VoIP and convergent services are treated within the NRF

In the NRF, services are classified as follows:

- services that are not ECS, and thus not within the NRF (e.g. information society services, amongst others)
- ECS

- public ECS (a subset of ECS)
- PATS (a subset of public ECS).

It may be useful to express this variety of services as a continuum, as illustrated in Exhibit 1.2.

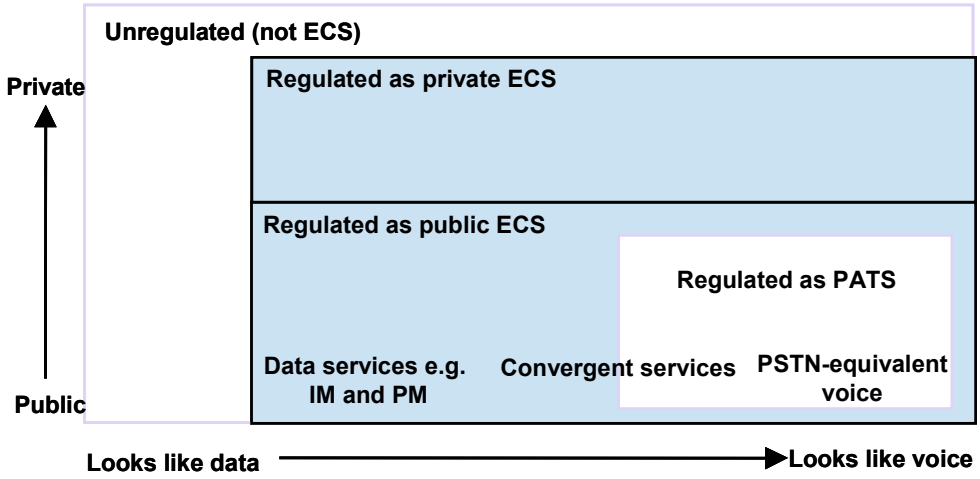

Exhibit 1.2: *Illustration of service categories within the NRF [Source: Analysys]*

1.5.1 The regulatory impact of VoIP and associated convergent services

The changed nature of the technology has market, commercial, and regulatory implications. For example, as a result of the use of IP technology to carry voice:

- the structure of existing relevant markets could change, making certain regulatory remedies inappropriate or infeasible
- VoIP might decouple things that are currently closely linked within the telephone network (such as addressing and network access). New relevant markets might be required as a result.
- there are component services used within VoIP and convergent services that are, arguably, not covered by the NRF because they are not ECS, but are information society services. These services might alternatively be regulated as associated facilities.

- proportionate regulation might require actions not explicitly foreseen when the NRF was drafted, e.g. it might be necessary to impose new types of obligation on players whose offerings are associated facilities.

1.5.2 Harmonisation

The entire thrust of the NRF is to increase harmonisation in the approach to telecoms regulation across Europe. Some degree of harmonisation in the approach towards VoIP would be desirable as:

- this would discourage 'forum shopping' by service providers looking to take advantage of major differences in regulatory stance.
- VoIP offers the possibility of new services and lower costs – such benefits could be delayed or lost in some countries as a result of differences in regulatory approach between countries.

2 Voice telephony

2.1 Introduction

The structure of this chapter is as follows:

- description of the service (Section 2.2) and how it works (Section 2.3)
- discussion of the impact of different access devices (Section 2.4)
- discussion of how this service is likely to be used and how it works as a business (Section 2.5)
- examination of the potential impact of this service and where the benefits are likely to arise (Section 2.6)
- consideration of the barriers to commercial deployment of this service (Section 2.7) and issues relevant to regulators (and, in particular, the NRF) (Section 2.8)
- the impact of growth in the VoIP market (Section 2.9)
- conclusions regarding voice services (Section 2.10).

This chapter provides a detailed examination of the regulatory options available to NRAs. It should not be assumed that, simply because we discuss these remedies, we are in favour of their use.

2.2 IP voice services

There is a wide variety of potential IP voice services, technologies and business models. Within this section, we distinguish between five different types of VoIP:

- self-provided consumer (DIY)
- independent of Internet access ('Vonage')

- provided by broadband access service provider ('Yahoo! BB')
- corporate internal use on business LAN/WAN
- carrier internal use.[1]

2.2.1 Self-provided consumer (DIY)

There is no service provider in this model. With an IP connection and a VoIP-enabled device (e.g. a soft phone application on the user's PC) the user can place calls to other technically-literate users with similar equipment, over the public Internet, and for 'free' (if the user has a flat-rate Internet access plan). Incoming calls require that the user's PC is on, connected to the Internet, and that the relevant application is available.

The motivation for the end user is a lower price – in fact, zero, at the margin. The end consumers save money, typically only using the DIY VoIP service for long distance or international calls.

This service is not a replacement for telephone service because it cannot be used for PSTN calls.

It is unknown how many users exist for this type of service. Skype, a recently launched peer-to-peer service, has claimed 6 million downloads of its client software (January 2004[2]).

2.2.2 Independent of Internet access ('Vonage')

In this model the user enters into a commercial agreement with an IP telephony company, independent of an ISP, which uses a gateway to connect to the PSTN.

[1] We are grateful to Andrew Entwistle of New Street Research for suggesting this categorisation.

[2] Source: Skype.

With an IP connection and a VoIP-enabled device (e.g. a soft phone application on the user's PC), calls can be placed to other VoIP users and to the PSTN. Providers include Vonage, Packet8 and Net2Phone. In the USA, such operators already have over 100 000 subscribers.

For the end user, the motivation is a lower price (and access to new services such as virtual numbers).

For the service provider, this business model offers, in effect, a direct alternative to indirect access as a means of originating telephone calls. End users are charged a retail rate, and the gateway operators and/or telecoms network operators pay each other cost-oriented termination and/or origination payments, depending on the numbering ranges and types of call. The major differences from the carrier-selection market are:

- the origination of traffic is paid for by end users to their Internet service provider (ISP) (their IP-access payment), so calls can be offered at rates which are slightly lower than carrier selection (because there are no origination charges, although the service provider has the cost of providing the gateway)
- the technology used means that it especially appeals to end users who have broadband (or at least flat-rate, always-on) connections
- users can be offered free, on-network calls without exposing the service provider to financial risk.

This business model also offers the service provider an opportunity to sell new services, such as:

- 'main line' replacement services, offering a near-PSTN equivalent service, but perhaps with slightly different functionality (e.g. no calls if there is a power outage)
- 'second line' services where there is an explicit loss of some functionality, such as:
  - offering outgoing calls only
  - having a non-geographic number, so calling the IP device is expensive
- additional value-added services which, in addition to all the 'standard' ones such as call waiting, call barring, voice mail, redirect and three-way conference, offer:
  - additional numbers for incoming calls only ('virtual numbers')
  - access to emergency services.

There is also a wide variety of tariffs, from unlimited local and national calls to a low per-minute charge. Many of these services have some kind of minimum spend per month (a "number rental" element).

2.2.3 Provided by broadband access service provider ('Yahoo! BB')

In this model the user enters into a commercial agreement with an IP telephony company (also the user's Internet access and broadband access service provider), which uses a gateway to connect to the PSTN. This kind of service provider is in control of the end-to-end network and can, therefore, offer service quality guarantees.[3]

We would consider VoIP provided by a cable network that did not have an existing PSTN access offer over copper pairs (e.g. StarHub Cable Vision (SCV) in Singapore) to be within this category. Such providers will use VoIP in a way that is unfettered by commercial concerns about cannibalisation of existing PSTN revenues.

With an IP connection (from the same service provider in this business model) and a VoIP-enabled device (e.g. a soft phone application on a PC, or an analogue terminal adaptor (ATA) and a telephone), a user can place calls to the PSTN and other VoIP users. For the end user, the motivation is a lower price;[4] for the local access provider, VoIP offers a low cost revenue opportunity.

Yahoo! BB in Japan is one such provider. Such providers are rare in Europe, where, although unbundled local loops and line sharing are available, they have not proved a great success. In addition, a relatively small fraction of the population can buy broadband access (e.g. digital subscriber line (DSL), which is not controlled at the wholesale level by the incumbent PSTN operator or cable operator.

[3] An interviewed alternative broadband network operator refers to this point.

[4] An interviewed broadband network operator agrees.

Although this business model can be provided by service providers that buy wholesale broadband access as a bitstream service from the incumbent, offering VoIP in this way does not (yet) appear to be attractive to existing broadband Internet service providers.

The prime service offered is a fully featured, main line replacement service (although the main line often still exists because line sharing is used to provide the DSL service), offering a near-PSTN equivalent service with very inexpensive calls. There may be some different functionality from a standard telephone line e.g. no calls via IP if electrical power fails, or outgoing calls only to the PSTN, or (alternatively) perhaps a non-geographic number, so calling the IP device from the PSTN is expensive. Access to emergency services (e.g. 112 / national emergency number) may also not be provided.

Alternatively, there can be additional services which offer additional numbers for incoming calls only (virtual numbers), in addition to all the 'standard' services such as call waiting, barring, voice mail, redirect and three-way conference.

Tariffs typically offer free calls to other subscribers of the same network and a low per-minute charge to the PSTN and other VoIP subscribers. Many of these services have some kind of minimum charge per month (a 'number rental' element).

2.2.4 Corporate internal use on business LAN/WAN

In this case, a business uses IP-enabled private branch exchanges (PBXs) to provide in-house telephony on the LAN and WAN. There is no service provider in this model (though the system management may be outsourced). For clarity, if this were provided as Centrex, we would consider it as carrier internal use.

For the end user, the motivation is a lower cost and access to new services.

The services offered are those of a full-featured private branch exchange (PBX).

It is unknown what fraction of corporate voice networks have switched to VoIP. One interviewee suggests that less than 10% of multinational corporates use VoIP.

2.2.5 Carrier internal use

Some international fixed operators already use IP for much of their traffic. Indeed, Telegeography reports that 12% of all international voice traffic is carried over IP.[5] The reason for this is that international termination (settlement) rates were considerably out of line with underlying costs and IP technology offered a simple way to bypass the existing termination regime (effectively, by 're-filing' the traffic as local or national traffic rather than international). The motivation for the end user is a lower price. The motivation for the operator is an arbitrage between the cost of IP access and the price of international termination.

Due to cost savings, national fixed and mobile operators will, over time, migrate towards using IP to carry voice traffic in their core networks.[6] There will also be a progressive movement towards the use of IP in the edges of the network. Some small operators (such as BT in Spain) are already IP-based. For those with large and widely-dispersed existing networks, the timescales for this migration are long and even the earliest ('first movers') are only just starting this transition. Due to increasing maintenance costs, large national incumbents such as Deutsche Telekom will only convert when its circuit switched network needs replacing. It will also wait until the (overall) cost of maintaining a converged IP network is less than separate circuit switched and packet switched networks.[7] The motivation for the operator is a cost saving. The end user may see some benefits, but these are not certain or necessarily required.

Mobile operators will move to offering an IP-based universal mobile telecommunications systems (UMTS) service if they upgrade their third-generation (3G) networks to the Third Generation Partnership Project 3GPP release 6 standard. Again, the motivation for the operator is a cost saving and the ability to offer additional services. The end user may also see benefits, but these are not certain or necessarily required.

[5] An interviewed VoIP provider agrees.

[6] An interviewed large vendor agrees.

[7] An interviewed incumbent operator refers to this point.

2.3 Technical basis for VoIP

2.3.1 Introduction

Different types of VoIP have different technical architectures. This section illustrates the logical connections that are required in each of the five models.

- self-provided consumer (DIY)
- independent of Internet access ('Vonage')
- provided by broadband access service provider ('Yahoo! BB')
- corporate internal use on business LAN/WAN
- carrier internal use.

In our examples, User A, who is on net, is calling User B. The actual technical architectures that can be used are varied (e.g. session initiation protocol (SIP) or ITU standard H.323, with or without intermediate proxy servers of gatekeepers, etc.) and, as a consequence, the following figures are illustrative. The options chosen are intended to be representative of the variety of solutions in current use, and to include a range of network elements.

2.3.2 Self-provided consumer (DIY)

This is the case in which users set up their own calls using client software they have installed. The address server is not strictly necessary, as IP addresses could be exchanged by some other means, e.g. email or IM.

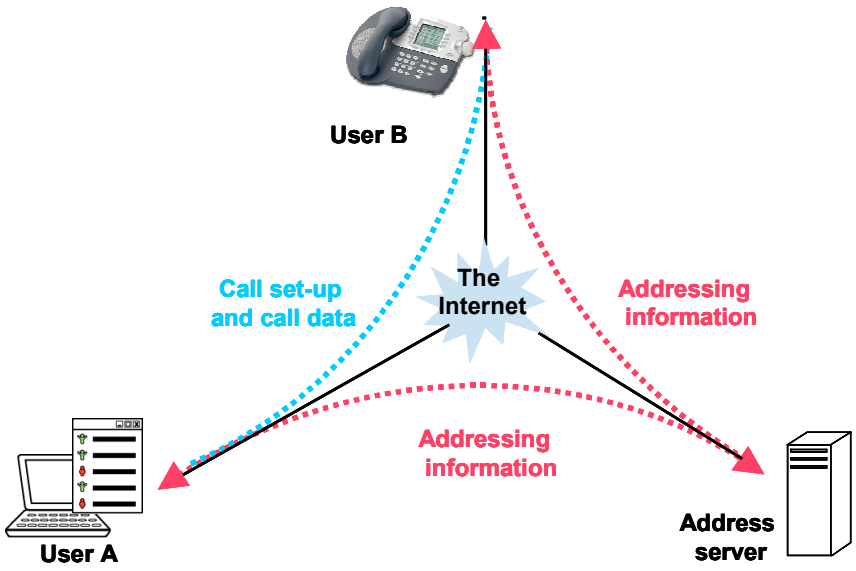

Exhibit 2.1: *DIY architecture. Note: this can also be done with no servers at all [Source: Analysys]*

2.3.3 Independent of Internet access ('Vonage')

This business model offers a SIP service over the Internet to broadband users. In Exhibit 2.2, the broadband User A has a VoIP phone, while User B is on the PSTN so both calls and signalling are translated in the gateway. In practice, the signalling gateway may be separate from the call gateway.

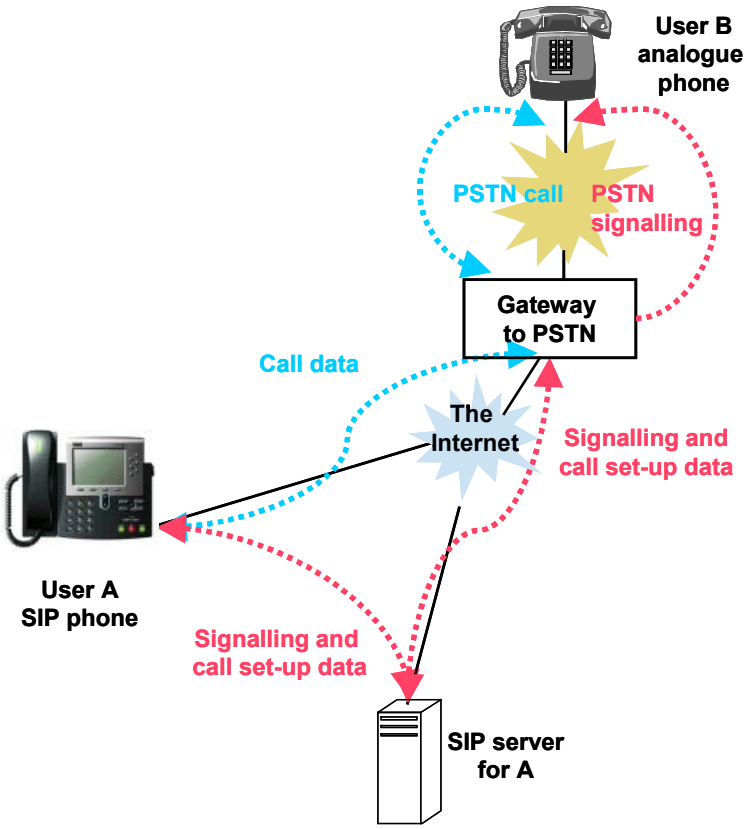

Exhibit 2.2: *'Vonage' model: SIP call to another IP user. Note: On-net calls are similar to broadband access service provider case. There are many other possible configurations [Source: Analysys]*

2.3.4 Provided by broadband access service provider ('Yahoo! BB')

In this case, the access provider is connecting users to its VoIP network by providing analogue terminal adapters (ATAs) so that users can continue to use their existing phones. Both users are on-net and using the same SIP server. If one user were on the PSTN, the situation would be similar to the previous case, but using the access provider network instead of the Internet.

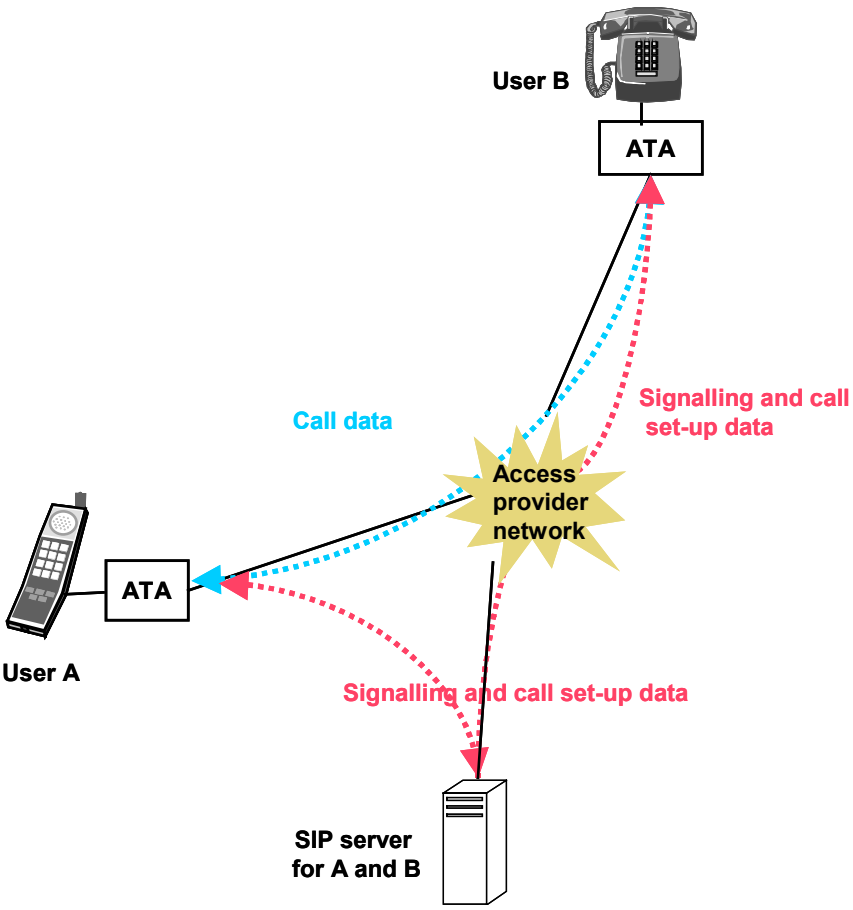

Exhibit 2.3: *'Yahoo! BB' model: SIP call to another IP user. Note: this will also use a gateway for connection to the PSTN and can use additional SIP servers [Source: Analysys]*

2.3.5 Corporate internal use on business LAN/WAN

In this instance, the call is between two sites, one of which has an IP PBX that uses internal VoIP call processing, and the other is a traditional digital PBX connected to the IP network through a gateway. Most corporate systems are currently based on H.323, and require gatekeeper and gateways to connect the end users, although this equipment may have other names (such as 'call manager'), or the IP PBX may be software running on a router.

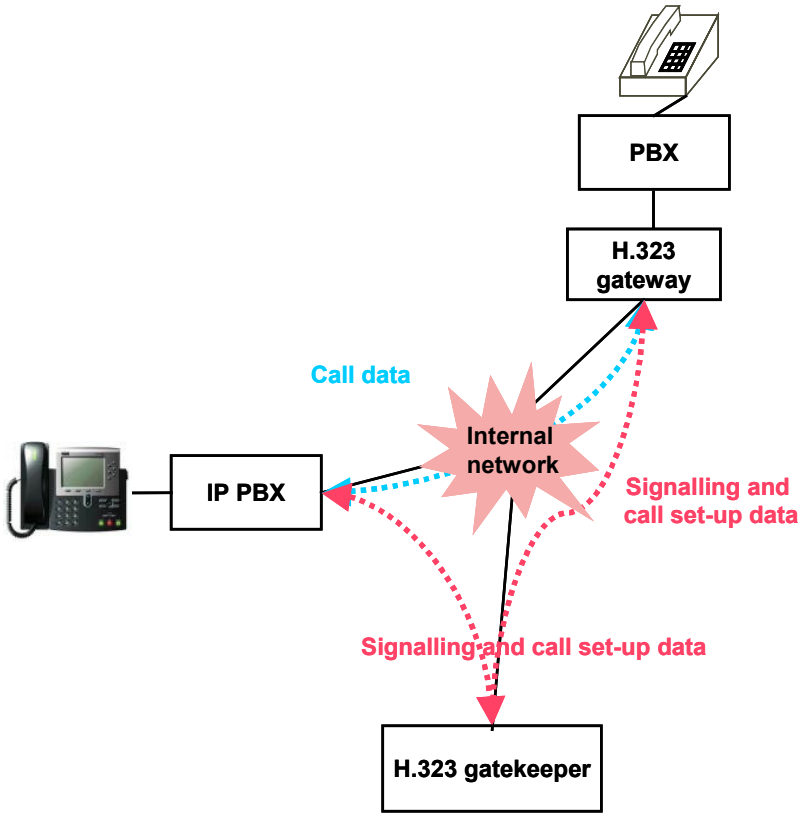

Exhibit 2.4: *Corporate internal use on business LAN/WAN. Note: many other configurations are possible [Source: Analysys]*

2.3.6 Carrier internal use

In this example, the carrier is replacing its circuit switches with softswitches – equipment intended to slot into a network in place of existing PSTN switches. A softswitch will usually include SIP servers, H.323 gatekeepers, and media gateway control protocol (MGCP) to manage the network. The user's analogue phone is connected via a gateway, which replaces the local concentrators used in the circuit switched network. Carrier VoIP networks are currently predominantly based on H.323.

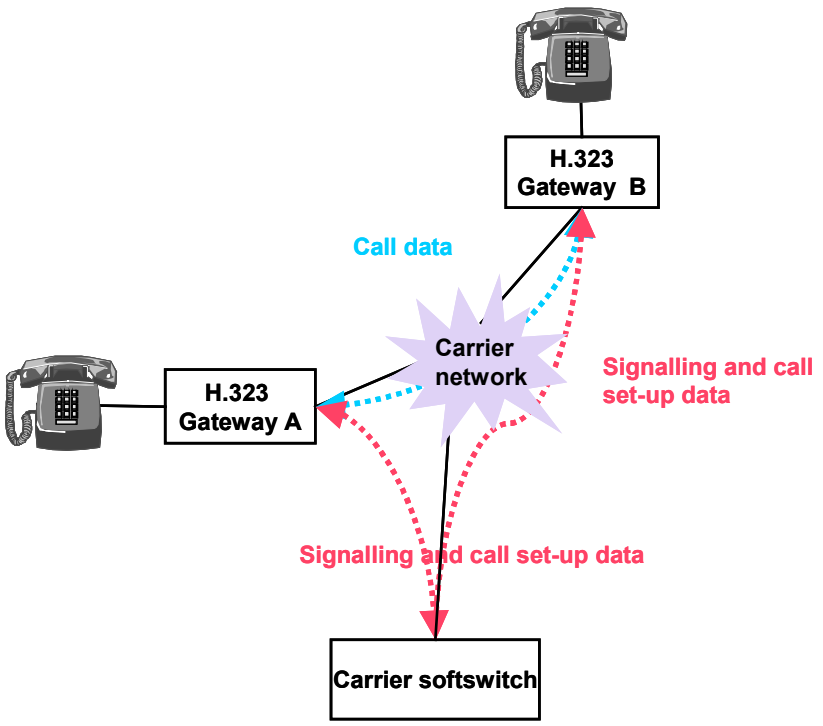

Exhibit 2.5: *Carrier internal use model. Note: this is a very simple case – many others are possible [Source: Analysys]*

2.3.7 VoIP standards

In order to build IP telephony networks, that can work together, and to prevent network operators being locked into single-vendor systems, standardised protocols are needed to ensure that user terminals and gateways from different vendors can communicate. A protocol is the language that is used to ensure this communication in and between networks. The original breakthrough for IP telephony was ITU's development of the H.323 protocol standard for real-time conferencing over packet networks. Other protocols have subsequently come into use. There are three, main competing protocols:

- H.323
- MGCP – often as an adjunct to H.323
- SIP.

These protocols, which also support the other multimedia services such as video and text chat, are described very briefly below. For a more detailed description we recommend commercial textbooks such as *IP Telephony: Packet Based Multimedia Communications Systems* (Hersent, Gurle and Petit).[8]

H.323

Related to the ISDN family of standards, H.323 was designed for voice on the LAN, and is focused on session control. Most of the VoIP gateways and gatekeepers that are currently available are based on H.323. It is a complex standard because of its original purpose (support for conference calls), and because additional features have been added to make it work better on the WAN. H.323 is likely to be used for a long time, but the future looks more promising for SIP.

MGCP

Designed for the LAN, H.323 was found to be inadequate for full-scale public telecoms networks, and it soon became apparent that H.323 did not provide enough control for the network operators needing to manage large volumes of simultaneous calls. Additional signalling protocols for VoIP were developed to provide this scalability. MGCP and its standardised equivalent, H.248 (or 'Megaco'), were developed to provide centralised control of the media gateways from softswitches (the equivalent of central switches in the PSTN).

SIP

SIP is an Internet Engineering Task Force (IETF) standard developed from the hypertext transfer protocol (HTTP) Web standards. Like H.323, it focuses on session control, and is often used within softswitch architectures for signalling. It can be used alongside MGCP or H.248 within a softswitch, or it can provide full control to the end user for independent call

[8] Published by Addison Wesley 2000, ISBN 0-201-61910-5.

set-up. SIP has some key advantages, one of which is that the process of call set-up is much simpler than in H.323. SIP is also a text-based protocol, which makes it very easy for developers to work with.

The SIP protocol suite includes support for presence notification and management, which can be used for: instant messaging, providing additional conferencing features, and enhanced voice services.

SIP is particularly good for providing rich desktop features, because of the ease with which it can be integrated with other software. Session initiation protocol for telephones (SIP-T) has been developed to meet telecoms service providers' billing requirements. SIP has also been adopted by the 3GPP as the technology to support multimedia on 3G mobile networks.

SIP and H.323 compared

Both SIP and H.323 now offer support for the features required by service providers, which largely relate to inter-working with the signalling system 7 (SS7) signalling protocol used in the PSTN. Generally, there is a reasonable level of support for SS7 in H.323 equipment, particularly for information transfer between service providers. But there is, perhaps, inadequate support for user features, such as call divert. As mentioned above, the SIP protocol includes support for presence and instant messaging, which results in greater functionality for users. Exhibit 2.6, below, compares the key characteristics of H.323 and SIP.

	H.323	*SIP*
Number of call set-up messages	15	5
Support for calling line identification (CLI)	Y	Y
Support for multimedia	Y	Y
Support for presence	N	Y
Support for IM	N	Y
PSTN signalling (SS7) support	Y	Y

Exhibit 2.6:

Comparison of H.323 and SIP

[Source: Analysys]

2.4 Access devices

While most of the current services are offered to users with fixed broadband connections, and a few services are used with narrowband connections, this is likely to expand in future to include:

- limited mobility – WiFi-enabled (personal digital assistants) PDAs and dual-mode mobile handsets using the fixed network via WiFi
- full wide-area mobility – access via IP connections on enhanced second generation (2.5G) and 3G mobile networks.

In future, carrier internal use of VoIP within the fixed network will eventually mean that analogue narrowband phones are connected to an IP network. To the user, the device they see will be unchanged, as will the basic services offered.

Self-provided consumer (DIY)

At the moment, fixed broadband connections are mostly used because they are always on, (which is particularly important for receiving calls) and the incremental price per bit to end users is zero or very low.

DSL Internet access providers often use line sharing to provide consumer products. This means that the 'DSL + DIY' end user will still have to pay a PSTN line rental. As a result, there is little possible financial saving in line rental, although there is also a 'lifeline voice'

backup available using the PSTN line, which is exchange-powered, works in a power blackout, and supports analogue phone calls to emergency services.

This kind of service is very unlikely to be used by businesses with multiple lines. The low quality and inability to call to and from the PSTN makes it unattractive to businesses in general, except perhaps for internal communications.

Because cable modem providers do not generally tie the cable modem and telephony service together commercially (although there may be a small saving in taking both), it is feasible to use a cable modem connection plus a DIY service as a telephony replacement, saving the PSTN line rental. However, the self-provided model cannot interface to the PSTN, as there is no service provider to provide a gateway. As a result, we expect that DIY users will keep a PSTN connection and only use their DIY connection for some long distance and international calls.

Fixed narrowband dial-up users can use this model as a substitute for international calls. Here it is possible to use a dial-up Internet connection to make an IP-to-IP call more cheaply than a PSTN-to-PSTN call, as the additional cost of the local dial-up call can still be less than the saving in per-minute rates.

However, calls to many international destinations now have much lower prices as a result of IP technology being used for the international wholesale market, which means that using an alternative PSTN carrier (e.g. a calling card service provider) may now be only marginally more expensive than a 'DIY+dial-up IP' solution for many destinations[9] (because the DIY solution may involve two retail telephone calls to ISPs, one at each end). The PSTN also gives a superior solution because it is not necessary to know that remote users are already online in order to contact them.

Independent of Internet access ('Vonage')

At the moment, fixed broadband connections are mostly used in this type of model because they are always on (which is particularly important in order to receive calls) and the

[9] An interviewed specialist software vendor also refers to this point.

incremental price per bit to end users is zero or very low (so the price a user pays for the call is only what is paid to the VoIP gateway operator).[10]

The user interface can either be a PC application with a microphone and headset, or a traditional PSTN telephone with an ATA (a piece of electronic hardware which interfaces between an VoIP network (on Ethernet) and a traditional telephone).

DSL Internet access providers often use line sharing to provide consumer and low-end business ADSL products. This means that the residential 'DSL+ 'Vonage' end user will still have to pay a PSTN line rental. As a result, there is little possible financial saving in line rental by using VoIP, but on the other hand, as in the previous DIY example, there is also a 'lifeline voice' backup available using the PSTN line, which is exchange-powered, works in a power blackout, and supports analogue phone calls to emergency services.

Business users with multiple PSTN voice lines can make substantial savings on line rental by consolidating several voice lines into a single broadband subscription and a VoIP subscription with multiple lines (or numbers). This will probably use an integrated access device (IAD), providing multiple voice lines and a data connection in a single integrated modem. In practice, this type of use will be actively or passively resisted by the local access provider (e.g. by making its ADSL bitstream access products unattractive for this kind of use, with high contention ratios and low upstream speeds), as it seriously threatens the provider's line rental revenues in the small and medium-sized enterprise (SME) sector. As the service provider is not in control of the broadband access network for this service type, it either needs to take more control of the network by building more of it (i.e. become a new entrant access provider, as discussed below) or complain about the services offered and try to get regulatory intervention (e.g. creation of a bitstream product allowing control of contention ratio and upstream speed, which would give many of the advantages of control with lower up-front costs).[11]

Because cable modem providers do not generally tie the cable modem and telephony service together commercially (though there may be a small saving in taking both), it is

[10] Two large vendors interviewed also agree.

[11] Arguably, Datastream, in the UK, is one such bitstream product, although it has, as yet, been bought by few service providers.

feasible to use a cable modem connection plus a 'Vonage'-type service as a telephony replacement, saving on PSTN line rental. On the other hand, there is no service in the event of a power failure and there is limited upstream bandwidth on cable modem systems, which means that VoIP call quality may be low at peak usage periods. This may be sufficient for some users.

Fixed dial-up users will probably only use VoIP of this kind for international calls or other situations where they face extremely high charges (e.g. in hotels[12]). It is possible to use a dial-up Internet connection to make an IP to PSTN call more cheaply than a PSTN-to-PSTN call, as the additional cost of the local dial-up call can still be less than the saving in per-minute rates. However, as previously noted, many international destinations now have much lower prices as a result of IP technology being used for the international wholesale market, which means that using an alternative PSTN carrier (e.g. a calling card service provider) may now be a similar price to a 'Vonage' + dial-up solution.

Provided by broadband access service provider ('Yahoo! BB')

Fixed broadband connections are used as access links. They are always on (which is particularly important if you wish to receive calls) and the incremental price per bit to end users is zero or very low. Users usually only pay the service provider for the off-net termination.

DSL providers such as Yahoo! BB often use line sharing to provide consumer products. This means that the end user will still have to pay a PSTN line rental charge. As a result, there is little possible financial saving in line rental. As in the previous cases, there is access to emergency services available as a backup.

Business users with multiple PSTN voice lines can make savings on line rental by consolidating several voice lines into a single broadband subscription and a VoIP subscription with multiple lines. This will probably use an IAD providing multiple voice lines and a data connection in a single integrated modem. The service provider is in control

[12] An interviewed VoIP service provider also mentions this point.

of the broadband access network for this service type and will use this as a valuable marketing advantage with respect to the 'Vonage'-type providers.

We would consider VoIP provided by a cable network that did not have an existing PSTN access offer over copper pairs (e.g. SCV in Singapore) to be within this category. However, this is a rare exception, because cable modem technology is rarely used by new entrants:

- cable operators usually have their own PSTN voice services to offer (SCV being a rare exception)
- unbundled access to frequencies on cable networks is not generally available, though it has been considered as a regulatory option in a number of countries.

Corporate internal use on business LAN/WAN (IP PBX)

This type of VoIP service covers a variety of architectures including:

- IP phones on the LAN/WAN talking to an IP PBX (which may or may not link to other IP PBX)
- existing phones using IP analogue terminal adaptors on the LAN/WAN, talking to an IP PBX (which may or may not link to other IP PBX)
- existing phones talking to an IP PBX linked to other IP PBX over the WAN.

Links from the IP PBX to the PSTN will either be:

- similar to existing links to the PSTN (e.g. primary rate integrated services digital network (PR-ISDN)

or

- IP links to an IP-based solution (e.g. 'Vonage', 'Yahoo! BB' or carrier internal use solution).

In the past, incumbent telecoms operators have prevented corporates from carrying traffic through their WAN and terminating it on the local PSTN at a remote node.[13] For example,

[13] An interviewed international organisation for corporate users.

if a user had a WAN from Cape Town to Berlin, and wished to call a Cape Town PSTN number from Berlin, the user could not have routed the call via the WAN and paid only for a local call within Cape Town. In the EU, this restrictive practice has already been removed. However, corporates may still be hampered by rules imposed by non-EU state operators (typically within unliberalised telecoms markets).[14]

Carrier internal use

In this option, fixed and mobile narrowband and broadband access network connections are used in exactly the same way as for existing services.

The end-user connection can appear to be the same as existing systems. At the same time, direct IP connections can be provided for some customers (e.g. using either leased lines or a DSL solution). The traffic is either IP (e.g. direct from a soft phone) or is converted to IP at the edge of the carrier's network. The location of this conversion is dependent on the network architecture chosen: it may take place at the local concentrator or exchange, for example.

The tariffs will reflect current PSTN tariffs. The incremental price per minute to end users will be small, but appreciable.

Usage from a WiFi device

The ability to use VoIP over WiFi creates a new class of telephony solution midway between the fixed PSTN and the wide area mobile network offered by global system for mobile communications (GSM) and UMTS. Dual-band phones which, in effect, use least-cost routing (WiFi if available, second generation (2G)/3G if not) will be used. These may be used in all of the models (i.e. DIY, 'Vonage', 'Yahoo! BB', corporate internal use and carrier internal use).

[14] An interviewed large, multi-national corporate and systems integrator refers to this point.

Whatever the model, use in hotspots, at work, and at home will create small (but arguably significant) revenue threats to mobile operators. The threat from WiFi to mobile operators is small because:

- the area covered by WiFi is – and will remain – tiny because the WiFi cells are small compared to those of 2G and 3G wide-area technologies and the backhaul, even on consumer DSL links, is costly
- dual mode WiFi and 2G/3G devices will not be commonly used for at least three to five years
- end users will use their dual mode WiFi and 2G/3G devices more and more (e.g. to the exclusion of their desk phones) and the wide area mobility providers will gain some traffic from this that will, to some extent, offset losses to WiFi
- mobile operators compete against this kind of use by bundling minutes into the subscription, reducing the cost of incremental in-bundle traffic.

Usage from a mobile phone

This can refer to two possibilities:

- ability to route voice calls over an IP data connection provided by a mobile phone
- 'native' use of IP by the mobile phone to provide voice services.

There is no 'Yahoo! BB' model here, unless new wide-area, data-only mobile technologies can be cheaply deployed. The difference between fixed and mobile markets is that new mobile providers such as the new entrants in the 3G market are as attached to end-user voice revenues as existing 2G operators, and cannot afford to price calls very cheaply. Access to spectrum is a major constraint, as is the cost of the number of base stations required.

The four business models for VoIP that can, therefore, exist in the case of mobile phone access are:

- self-provided consumer (DIY)
- independent of Internet access ('Vonage')

- corporate internal use on business LAN/WAN
- carrier internal use (either by fixed service providers to try to get back into the mobility market, or in a defensive fashion by mobile operators).

The ability to route voice calls over an IP data connection provided by a mobile phone is of significant concern to mobile operators because:

- any reduction in average revenue per user (ARPU) is very material in terms of current debt positions – substitution by any means, including VoIP over WiFi, would reduce ARPU
- operators do not wish to become purely providers of IP access – they want to be able to charge by the value obtained, not a flat rate per bit sent and received.[15] In the past, the mobile operators have been successful in pricing certain services at a very high price per-bit (e.g. short message service (SMS). Operators would like to be able to charge different amounts per bit for voice traffic and for other services such as general Internet browsing. Ramsey pricing implies that they should look to price services with a low price elasticity of demand at a high price and vice versa.

Models for using VoIP on a mobile network, other than carrier internal use, are somewhat hampered because they depend on:

- **the ability for a user to choose what client software to use**. In practice, this limits the user to a PC or PDA with a mobile phone data connection (the basic handsets sold by the network operator will certainly not allow users to install new client software). In addition, many low-end phones do not support general packet radio system (GPRS) (this is a weak form of price discrimination, attempting to encourage business users to buy more sophisticated phones).
- **getting IP packets to the required destination** (i.e. in and out of the mobile network). The DIY and 'Vonage' models need access to the Internet; the corporate internal use model needs access to the corporate intranet. The mobile operator GPRS connections may be 'walled garden', which would at first sight prevent such use – though it may be possible to get around this via a GPRS link to a corporate virtual private network

[15] An interviewed mobile operator agrees it may be seen as a threat.

(VPN) or via dial-up access to a remote access server (RAS) with access to the Internet.

- **an economic case**. This is highly dependent on the mobile operator's data tariffs and voice tariffs. For example, mobile operators that offer free access to 'freephone' numbers (e.g.0800) are vulnerable to becoming no more than providers of network access, but they are already exposed to similar risks from calling card-based indirect access providers (who can offer freephone numbers as access numbers, etc.). It is very unlikely that using a VoIP service provider of any kind, or even DIY, will be cheaper for the user than just calling directly using the carrier's own services, with the possible exception in the case of international calls or calls to non-geographic numbers.

The potential threat to customer ownership and revenue make it unsurprising that mobile operators:

- are cautious in their use of and pricing of end-user IP
- are (in some cases) operating walled gardens and not connecting to the Internet.

In terms of service functionality, business users might appreciate having all their fixed phone functionality on their mobiles,[16] and that might mean that there are some areas in which a voice-over-IP solution might be attractive, even if it were somewhat more expensive. However, there are already mobile VPN offerings for major corporates that provide much of this functionality, so even here the likely take-up is small.[17]

The threat to voice revenues is, therefore, somewhat small, as long as the price per bit for IP and voice are similar. IM on IP on GPRS is arguably a much greater threat (SMS is a much higher price per bit than voice).

[16] An interviewed large vendor agrees with this point.

[17] An interviewed mobile operator estimates less than 5% of the total coms market will be wireless VoIP in 2013, and most of this will be enterprise use.

2.5 How VoIP works as a business

2.5.1 Introduction

Different types of VoIP have different business models. The figures below illustrate the commercial relationships and payment flows that are required in each of the five models.

- self-provided consumer
- independent of Internet access ('Vonage')
- provided by broadband access service provider ('Yahoo! BB')
- internal use on business LAN/WAN
- carrier internal use.

User A is calling User B in all our examples.

A number of these illustrated roles are optional and/or dependent on the structure of the IP access market being used (e.g. whether there is an IP access product sold by an ISP or directly by the access operator) and/or the structure of the PSTN access market (e.g. whether there is carrier selection or pre-selection indirect access and/or wholesale line rental). Our examples are illustrative: it would be futile to try to enumerate all possible flows, and all possible relationships, in a document of this size.

2.5.2 Self-provided consumer (DIY)

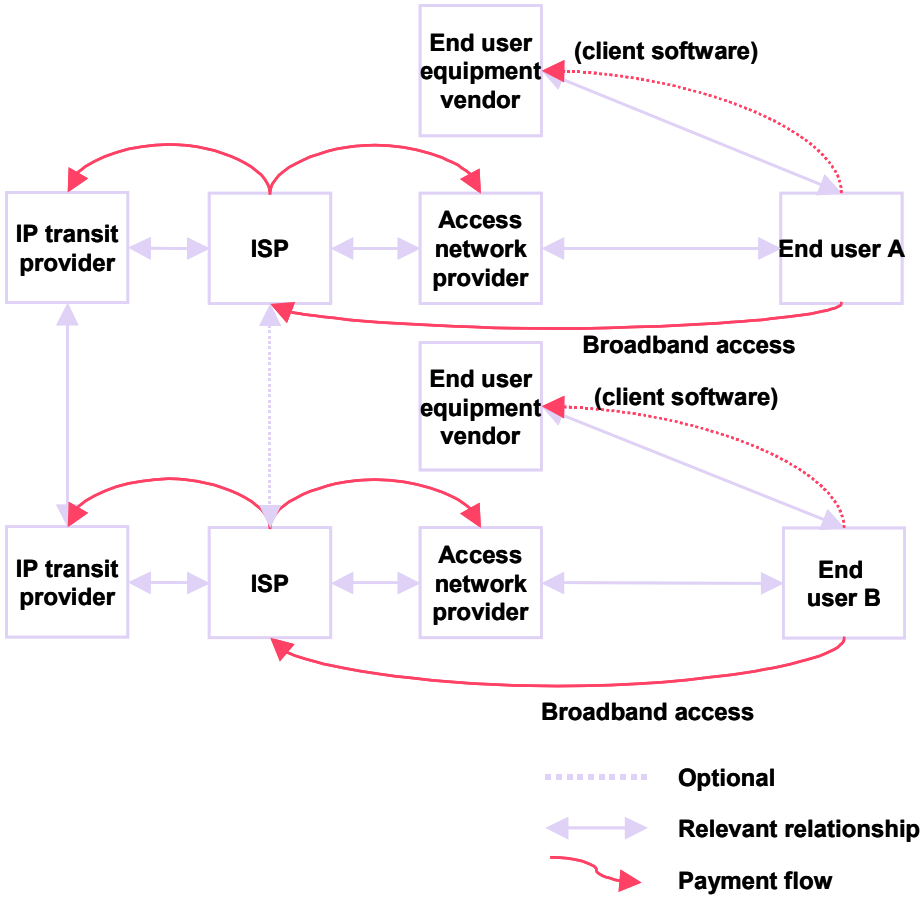

Exhibit 2.7: *DIY model: the value chain and payment flows for IP-to-IP calls [Source: Analysys]*

In this model each user is a 'peer' and carries his or her own costs. The users are connected via the Internet; neither is using the PSTN.

2.5.3 Independent of Internet access ('Vonage')

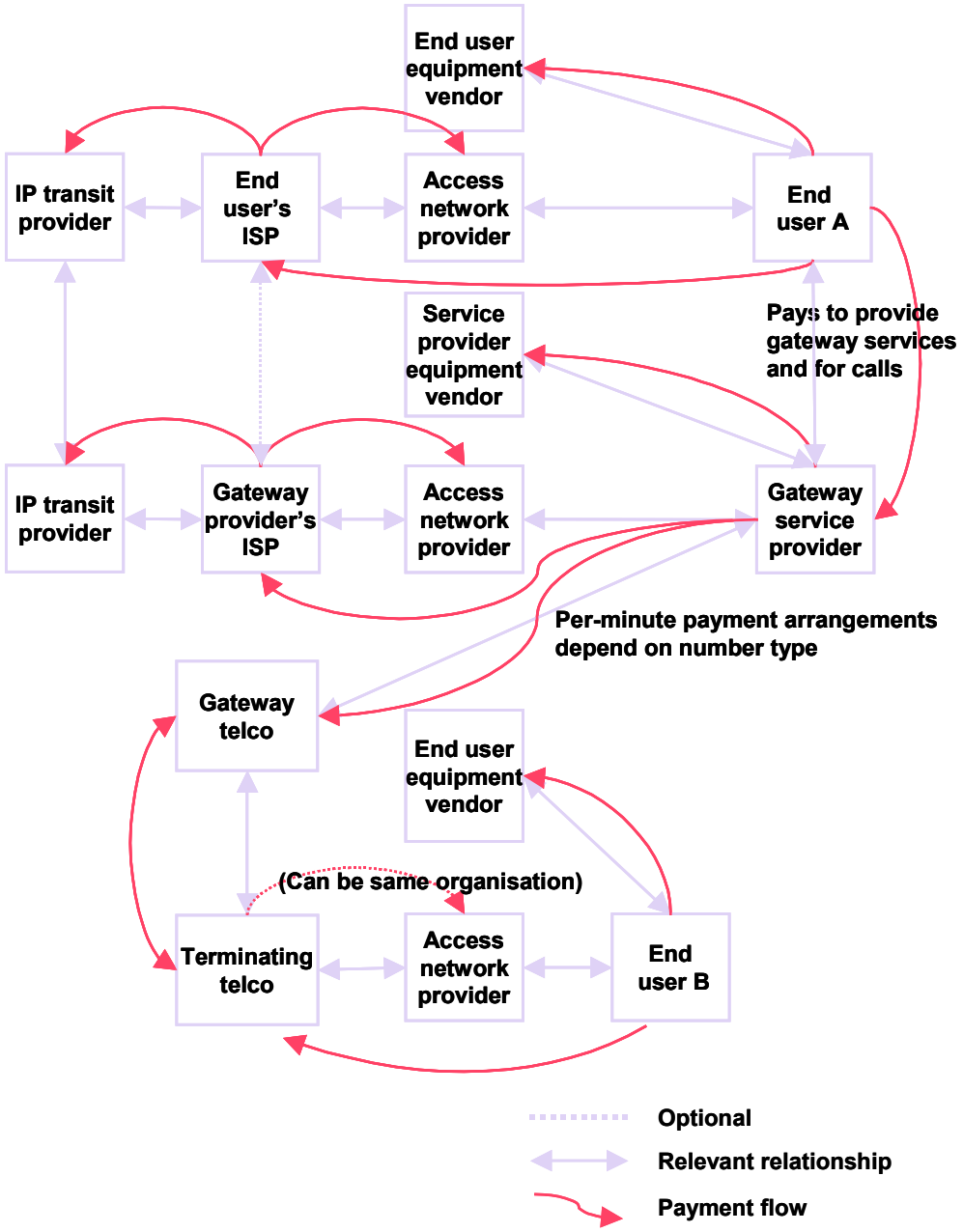

Exhibit 2.8: *'Vonage' model: the value chain and payment flows for IP to PSTN calls [Source: Analysys]*

In this model, User A is calling User B who is on the PSTN. User A will have to pay a retail charge for calls to the PSTN, part of which will be used to pay the termination

charges of User B's telecoms network operator. User B pays for line rental and might ultimately have to pay to receive the call (e.g. if roaming abroad on a mobile network, or if the number called was a non-geographic number).

2.5.4 Provided by broadband access service provider ('Yahoo! BB')

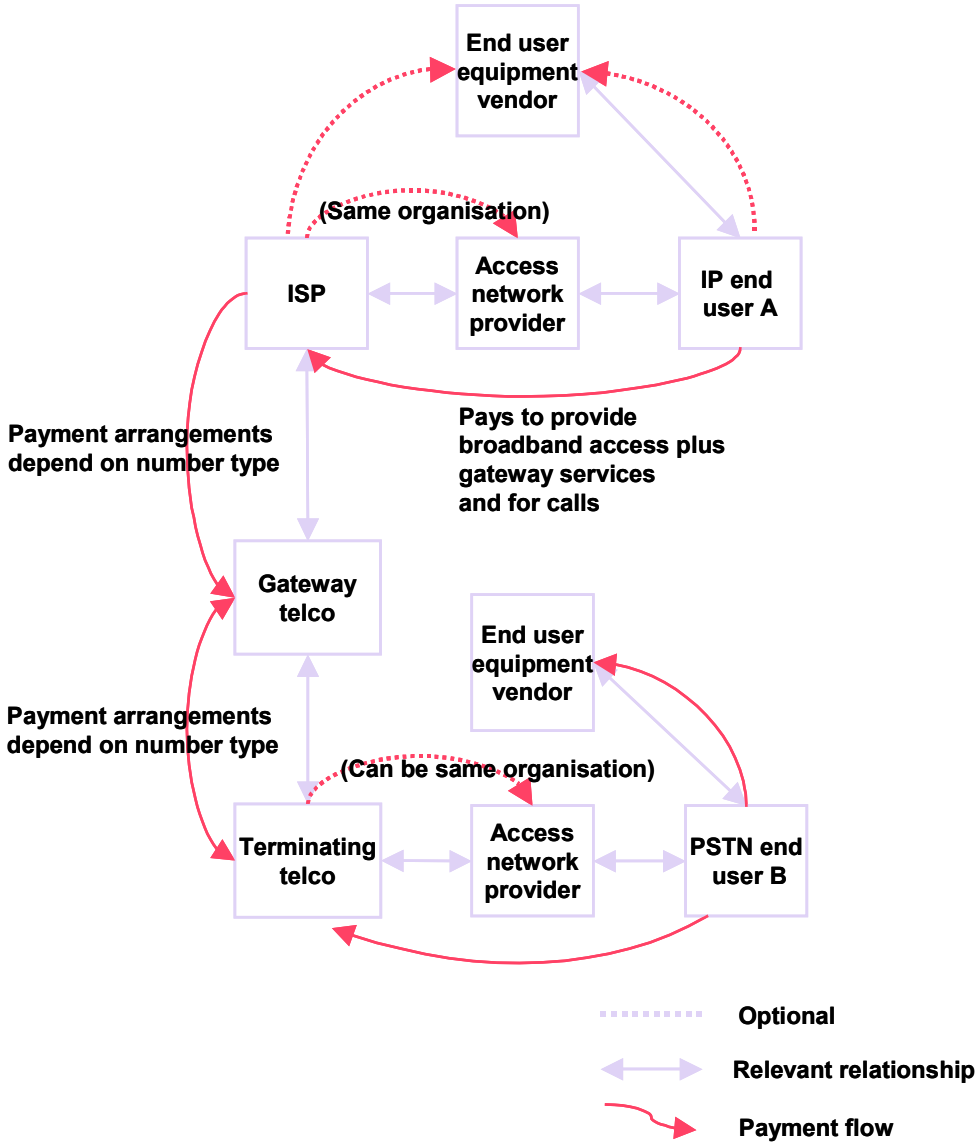

Exhibit 2.9: *'Yahoo! BB' model: the value chain and payment flows for IP to PSTN calls [Source: Analysys]*

In this model, as illustrated, User A is calling User B, who is on the PSTN. User A will have to pay a retail charge for calls to the PSTN, part of which will be used to pay the termination charges of User B's telecoms network operators. User B pays for line rental and might ultimately have to pay to receive the call (e.g. if roaming abroad on a mobile network, or if the number called was a non-geographic number). As shown in Exhibit 2.10, the number of parties involved can be much smaller in this model.

2.5.5 Internal use on business LAN/WAN

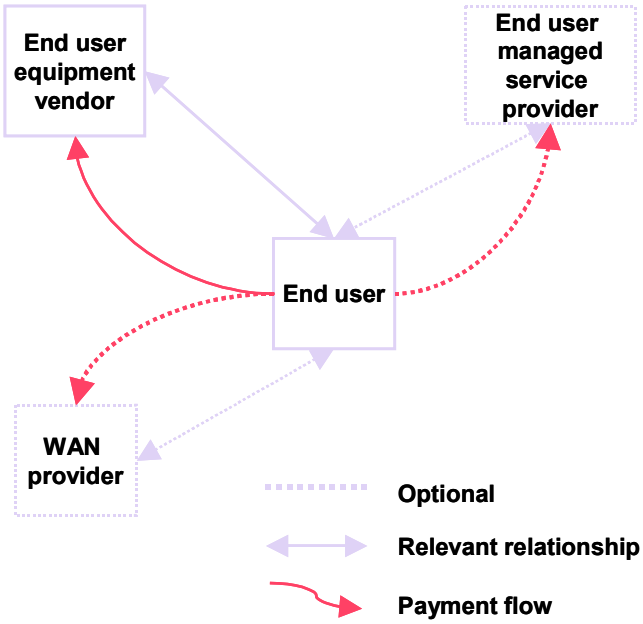

Exhibit 2.10: *Internal use on business LAN/WAN model: the value chain and payment flows [Source: Analysys]*

In this model, User A and User B both work for the same organisation. User A is calling User B on the corporate telephone network. Much of the cost is carried by the end-user organisation directly purchasing LAN and other IP equipment. The WAN element is optional, as is any external management service for the VoIP on the LAN and WAN.

Any connection to the PSTN needed by the end user (to connect the PBX to the PSTN) would be bought as a service from another supplier (either a PSTN supplier or a VoIP supplier using one of the other VoIP business models) and is outside the scope of this service.

2.5.6 Carrier internal use

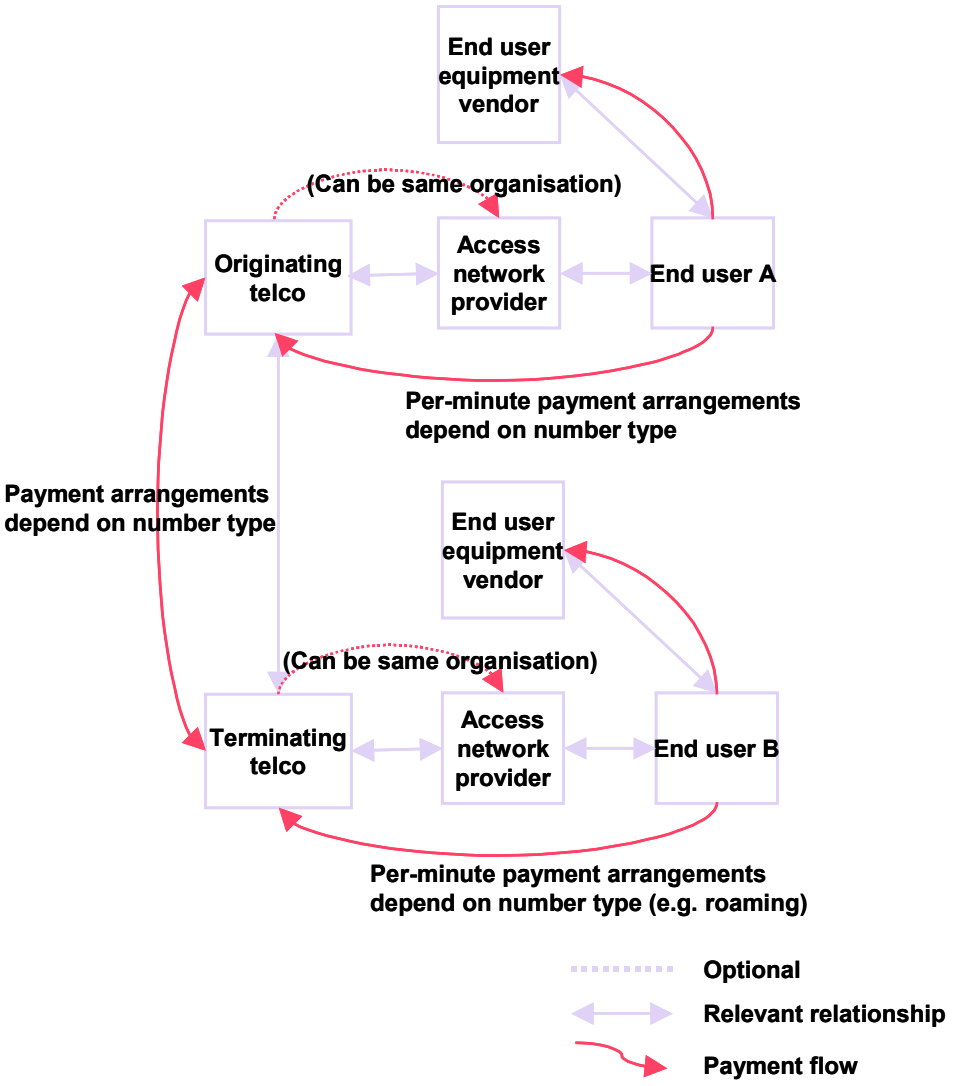

Exhibit 2.11: *Carrier internal use model: the value chain and payment flows for carrier model calls [Source: Analysys]*

In this model, User A and User B are on the PSTN, but the call uses IP technology. This model is, in effect, identical to the existing PSTN business model, at least until the point where the interconnect between the two telecoms network operators can be via an interconnect using VoIP. At this point, the commercial model for the interconnect payments could be renegotiated (e.g. as VoIP 'peering', which would be a 'bill and keep' arrangement).

2.6 The potential impact of VoIP on the telecoms market

In this section, we discuss the impact of each of the business models:

- self-provided consumer (DIY)
- independent of Internet access ('Vonage')
- provided by broadband access service provider ('Yahoo! BB')
- corporate internal use on business LAN/WAN
- carrier internal use.

2.6.1 Self-provided consumer (DIY)

The total revenue of this kind of service is restricted to:

- charges for the client software
- other services which can be sold on (e.g. advertising).

Arguably, Microsoft, Apple, and the proprietary Unix vendors could make some money by either selling voice applications or by bundling them as part of the paid-for operating system and gaining market share as a result. Apple, for example, currently charges USD29 (EUR25) for iChatAV.

Nevertheless, independents such as Skype can reach many millions of downloads of its free software very rapidly. Whether these users can be turned into a revenue stream remains to be seen.

Such independents can, of course, become a service provider and sell addresses and PSTN gateway services – but this moves them into the 'Vonage' category, described below.

2.6.2 Independent of Internet access ('Vonage')

The existence of this kind of service puts pressure on prices offered by PSTN voice providers. There are relatively low barriers to entry; anyone with a gateway, an interconnect link, and some E.164 telephone numbers (for incoming calls from the PSTN) can offer this service. The remaining barriers to entry are those relating to advertising and customer service – and there are cost benefits to having interconnect in a large number of places.

Analysys's general hypothesis is that, in European markets with competitively priced voice services (e.g. where indirect access is available, and/or where the incumbent has responded with bundles offering 'free' calls), it will be almost impossible for end users to justify buying broadband simply to obtain cheaper calls. PSTN suppliers have designed their tariffs so as to be able to keep both very low and very high spending customers. For example, the traditional PSTN companies now have tariffs that offer unlimited bundled minutes or offer a maximum price for calls (e.g. EUR0.09 for an hour. [18] In Italy, telecoms operator WIND offers a flat-rate PSTN service for EUR38, less than FastWeb's equivalent VoIP service (EUR41 per month plus EUR140 installation).

In the USA, where the structure of PSTN termination is quite different and it is possible to terminate calls at very low cost, Vonage faces a rather different situation. As a result, it can afford to offer unlimited usage national calling plans at relatively low risk. Even here, Vonage has fewer than 100 000 subscribers, which is a small number, even as a fraction of the 6.9 million US customers with a broadband connection.[19]

It may be efficient for users of WiFi-enabled PDAs to use this type of service as a cheaper form of mobile access when within a WiFi hotspot. Mobile operators compete against this

[18] An interviewed large international corporate user appears to agree with this point.

[19] Source ITU.

kind of use by bundling minutes into the subscription, reducing the cost of incremental in-bundle traffic. VoIP over WiFi use within office buildings will almost certainly be transformed into PSTN access by the building's IP PBX (business users are probably more concerned with quality of calls than marginal cost savings).

It will rarely be cheaper to use this form of service when on a mobile phone. As a result, Analysys expects that the impact of this type of service will be relatively small and will be confined to use for:

- **fixed users** – international calls (or calls to other broadband users, especially if they are on the same service provider) for people who have bought broadband access for other reasons; it is possible that this service will be used by cable modem customers as a substitute for a telephone line
- **WiFi users** – some use for calls to fixed networks, from within hotspots (because in this case it is cheaper than a mobile phone and more convenient than a fixed payphone)
- **mobile users** – only in very rare circumstances.

2.6.3 Provided by broadband access service provider ('Yahoo! BB')

The existence of this kind of service puts pressure on prices offered by PSTN voice providers. Unfortunately, there are relatively high barriers to entry in this category: building access networks is expensive, even if local loop unbundling/line sharing is available at low per-user cost. Each main distribution frame (local telephone exchange or concentrator) visited needs infrastructure (a DSLAM, a backhaul leased line, space, power, cooling, etc.), and many hundreds of these need to be built to cover a sizeable fraction of the population.

FastWeb in Italy is one such provider, (as is B2 in Sweden). The additional gateway, an interconnect link, E.164 numbers (for incoming calls from the PSTN) advertising, and customer service are similar to the Vonage case discussed above. This network is built to sell triple-play bundles of voice, Internet, and video distribution. For businesses, the triple play is voice, Internet, and VPNs.

Although it is possible to offer voice services using a bitstream access service, it cannot offer the triple play (bitstream services offered by incumbents are generally only suited to Internet access and a single VoIP connection).

In Analysys's hypothesis, customers must want at least two of the three to find the service bundle attractive. Yet again it will be almost impossible to justify buying broadband simply to obtain cheaper calls (even in Japan, where NTT's rates are high).[20]

In this model, where the local access provider is the service provider, a WiFi device offers no savings (though it may offer increased utility to the end user). Within a WiFi hotspot, quality cannot be guaranteed (as the hotspot access is, in general, not through a specified access provider), therefore, in this case, there is little difference from the WiFi / 'Vonage' model discussed above. Again, it may be efficient to use this type of service as a cheaper form of mobile access when within a WiFi hotspot.

Possible reasons for not offering a WiFi roaming service include:

- security implications over and above those that apply when the user is attached directly to the service provider's access network when allowing roaming use – in this case, the access provider will want to be sure that the end user is well authenticated to prevent theft of resources (interconnect, prepaid minutes, etc.)
- the lack of ability to guarantee quality, which might affect the ability to offer access of an appropriate level of quality to the emergency services. This issue is discussed more widely in Section 2.8.3.

In Japan, there are over 5 million subscribers for the two major companies using this model, Yahoo! BB and Fusion.[21] This huge success can be attributed to the fact that these ISPs (or group of ISPs in the case of Fusion) have extensive broadband access networks (line sharing is very cheap in Japan, and unbundled fibre from NTT is available to the MDFs). However, in Europe (and to some extent the USA), the situation is very different, and there are very few new entrants of this type (e.g. FastWeb). It is the lack of new entrant

[20] An interviewed systems integrator agrees with this point.

[21] November 2003.

service providers, which control the access link (sufficiently to offer triple play) in most European countries that will make this segment small.

The impact of this type of service will, therefore, be confined to use for all calls (local, national, international, non-geographic, and calls to mobile) for those few end users that have access to new-entrant broadband access networks and who have a need for fast Internet or video services. Some of these users will use WiFi roaming services.

2.6.4 Corporate internal use on business LAN/WAN

While replacing separate voice and data networks with a single, converged network makes sense, it is more difficult to justify replacing an existing, circuit-switched PBX infrastructure and desk telephones with IP phones.[22] Consequently, the migration will occur slowly over the next one or two equipment replacement cycles (say over the next 10–15 years). [23]

Analysys's view is that this migration will generally be cautious and slow, due to the following reasons.

- It is true that a VoIP solution can offer new services, but while some unique, new services are enabled (for example, presence-aware routing), many of the service users' needs in the short term can be provided as add-ons to existing circuit-switched systems, including:
  - click-to-dial
  - unified messaging (voice mail, fax storage, email, SMS, etc.) using the email inbox as the message store.

[22] An interviewed association for multinational users and a financial organisation both agree. An interviewed says "(while) the technology has reached maturity, the cost-of-ownership model has not" Consequently, the migration will occur slowly over the next 1 or 2 equipment replacement cycles (say over the next 10–15 years).

[23] An interviewed large vendor says 5–10 years; an interviewed systems integrator says that 30–40% of large enterprises have started investigations or pilots.

- Many organisations barely use the advanced features of the systems they already have (three-way conference calls, call back, follow me (remote redirection) etc.). Thus, in some cases, there is little momentum to change to a packet-switched system purely from a new services perspective.[24] Consequently, cost savings are the main reason for internal deployment of VoIP in business.

- Customers appreciate that their existing services (especially if provided as managed service or as Centrex) are very reliable, and are currently nervous of the reliability of IP telephony provided on their own infrastructure. This is compounded by the risk associated with linking voice networks to data networks such that if the IP router fails, internal communication ceases. The additional cost of adding telephony-class resilience to small IP networks can be such that the circuit-switched PBX option can remain the most cost efficient in some cases (for example, to improve resilience, all routers and hubs would need uninterruptible power supplies, all WAN access links and all key servers need duplication, etc.). Over time, much of this data network resilience will be provided in any case, as data communications becomes more critical to businesses.

- Operational cost savings of VoIP solutions, such as a greatly reduced cost of office and telephone moves and additional lines (arising from the location independence of IP), are very useful, but are not large enough to drive spending ahead of the natural equipment replacement cycle.

2.6.5 Carrier internal use

As stated by certain interviewees (e.g. a VoIP provider, considerable amounts of international voice traffic are carrier by VoIP wholesale carriers, and some new entrant national voice operators (such as BT in Spain) are already IP-based.

For those with large and widely dispersed existing networks, the timescales for this migration are long, and even the earliest first movers are only just starting this transition. Some independent analysts believe that this process has only just started for some, but that

[24] An interviewed VoIP service provider agrees with this point.

for most, it will not start until 2006, and that it will not be completed until around 2010. Others say the process could take longer – over the next 20 years.[25]

2.6.6 Conclusion

The introduction of VoIP has already had some substantial effects, notably in the area of international voice connectivity. Other effects are potentially much larger, but they are correspondingly slower,[26] as they depend upon: equipment replacement cycles (within corporates and telecoms network operators), competitive broadband access network operator deployments (for the 'Yahoo! BB' model), the take-up by end-users of broadband Internet access (for DIY, 'Vonage', and 'Yahoo! BB' models), and the attractiveness of the new VoIP service offers which is strongly affected by existing competition within the voice calls market ('Vonage' and 'Yahoo! BB' models, and carrier internal use to some extent).

European countries with competitive voice calls markets and few, new-entrant, broadband-access networks may see substantially different outcomes to those in markets with radically different broadband network deployments (such as Japan) and markets with existing PSTN interconnect arrangements (such as the USA). Many such differences are already appearing.

2.7 Barriers to commercial deployment

We divide the issues that provide potential obstacles to the success of VoIP into issues relating to all forms of public VoIP:

- technical barriers erected by access network providers
- location independence/emergency services access (including access via corporate networks)
- lawful intercept

[25] An interviewed specialist hardware vendor and a specialist software vendor say 20 years; An interviewed incumbent operator thinks it will take 8–10 years to achieve once started, and may not be cheaper than PSTN until 2010 or beyond.

[26] An interviewed large vendor thinks the voice market will be the preserve of existing players for some time to come, but that the eventual destination of an all-IP network is inevitable.

- numbering
- interconnect to the PSTN
- interconnect to other VoIP service providers' networks
- technical standards for interconnect
- security
- control of standards
- control of end-user devices
- bundling of retail services
- control of access to data on end-users (e.g. billing, location, presence, authentication).

We also address an issue relating to only some forms of public VoIP:

- discriminatory behaviour (technical or commercial) by access network providers / ISPs.

These represent either potential 'choke points' that might allow players to attempt to exert power over other market players, or issues that might merit clarification by regulators.

Other potential choke points identified within the recent next generation networks (NGN) report[27] can either be mapped to those included in the list above or are not relevant in the case of voice or associated convergent services (e.g. control of digital rights management (CDRM) systems, except as discussed in Annex A.5.4, below.

2.7.1 Technical barriers erected by access network providers

In common with a large number of services based on IP, operators of the access networks are in a position to block access to specific services because these services use specific user datagram protocol (UDP) and transmission control protocol (TCP) port numbers (e.g. port 80) and can often use specific IP addresses.

[27] "Regulatory implications of the introduction of next generation networks and other new developments in electronic communications" Devoteam Cullen, 16 May 2003.

As a result, an ISP could block the application by setting its firewall to refuse traffic to or from certain UDP and/or TCP ports, or by blocking traffic to or from specified IP addresses (e.g. those which resolve to aol.com, etc.). Keeping customers within a walled garden is a strategy that has often been tried within Internet services (including mobile Internet services), but without a great deal of commercial success. Nevertheless, some mobile phone operators are again trying to achieve this (3, for example).

There are also other, more complex, ways in which a service could be damaged without stopping all the traffic, such as setting artificially low rate caps on throughput to certain addresses or ports, (or indeed, artificially increasing latency on certain routes). While such measures may require additional hardware and/or software to implement them, they are not impossible. ISPs have been known to apply similar measures in order to combat 'abusive' use of the Internet access service (e.g. in contravention of any end-user contractual limits, persistent downloading or uploading of very large files / persistent use of video streaming, degrading the experience of other users).

A non-dominant provider is unlikely to block access to specified addresses or ports because customers will go elsewhere. Within the NRF, it is clear that it would be considered abuse of a dominant position if a dominant access provider were to do this in an unreasonable way (as opposed to acting to protect its network, etc.). Recital 6 of the Access Directive says:

In markets where there continue to be large differences in negotiating power between undertakings, and where some undertakings rely on infrastructure provided by others for delivery of their services, it is appropriate to establish a framework to ensure that the market functions effectively. National regulatory authorities should have the power to secure, where commercial negotiation fails, adequate access and interconnection and interoperability of services in the interest of end-users. In particular, they may ensure end-to-end connectivity by imposing proportionate obligations on undertakings that control access to end-users. Control of means of access may entail ownership or control of the physical link to the end-user (either fixed or mobile), and/or the ability to change or withdraw the national number or numbers needed to access an end-user's network termination point. ***This would be the case for example if network operators were to restrict unreasonably end-user choice for access to Internet portals and services.*** [emphasis added]

It is possible that mobile network operators may argue that they have insufficient capacity and wish to block access to certain applications or addresses on this basis (indeed, some are already using this argument on GPRS networks in other countries, although not in Europe).

Users can get around many such blocks, e.g. by using ports which are normally used by other applications such as HTTP, and indeed, the applications are now often designed to do this in order to be able to work through corporate firewalls with much more restrictive policies than typical ISPs.

2.7.2 Location independence and its impact on emergency services access

IP access services break the link between address and physical location, which is assumed by the traditional fixed telephone network (the physical location served by a fixed line can be unambiguously identified).[28] This assumption is of critical importance to the emergency services, that can (for example) attend emergencies where callers cannot identify themselves and their location because they are too ill, or too young.

This is not a new issue: mobile telephony services suffer in a similar way. Even with location identification systems (and these are not yet deployed in many networks), the end user cannot be precisely located.

End users will need to be educated that the quality of access to emergency services provided on a VoIP connection will be lower if they do choose to use their VoIP connection at more than one location, or do not inform their VoIP provider of their address accurately. However, as long as this is done in a pragmatic manner, it seems feasible for VoIP service providers to provide a reasonable form of access to the emergency services that is, at least as good at that provided by existing mobile networks. **Consequently, it might be argued that relevant VoIP operators should be treated in a similar way to mobile operators, with regards conditions relating to the quality of access to emergency services, as long as the reduced quality was made very clear to end users.**

[28] An interviewed large vendor, incumbent operator and an international organization for corporate users agree this is an issue.

Recital 36 of the Universal Service Directive says:

It is important that users should be able to call the single European emergency number '112', and any other national emergency telephone numbers, free of charge, from any telephone, including public pay telephones, without the use of any means of payment.

It is, therefore, highly desirable that VoIP providers provide emergency services, even on services marketed as second lines – simply because the end user may not realise that this particular telephone is not one with access to emergency services.

In the USA, some VoIP providers, such as Vonage, positively encourage their customers to sign up to access to emergency services. To do this, it is necessary for users to provide their address details, and to state that they understand that the emergency service centre contacted will be that for the address specified (and will thus be incorrect if the user is using Vonage service whilst at a different address).

This issue is linked to the definition of PATS as discussed in Section 2.8.3.

Emergency service access in corporate networks

For the corporate internal use of VoIP, the reliability of emergency service access (e.g. 112) for end-users using VoIP on the LAN is a potential issue. There is an echo of the UK regulator Ofcom's position on the definition of PATS here – see Annex A.2.2 (a service can be public voice telephony if "*the service provides the customer's sole means of access to the traditional circuit switched PSTN").* Workarounds such as additional copper pair wiring to each main area of the building and dedicated 'red' PSTN phones for emergency service access would dramatically increase the costs of VoIP solutions.

Again, a pragmatic approach is required: not all in-building telephone systems are of the same reliability as traditional wireline PBX, for example, large-scale in-building digital European cordless telecommunication. DECT deployments. **It may be useful for regulators to make the required level of reliability of provision of emergency services access via corporate internal networks clear.** This might, for example, distinguish between the required standard in large public buildings, such as hospitals, and a standard

for private offices where all telephone users can be better informed of the system and its characteristics.

2.7.3 Lawful intercept

General authorisation for providers of ECS may include conditions enabling legal interception.

A key question in the case of VoIP providers is the location or locations in the network where it is practical to intercept the call data.

An IP to PSTN call must pass through the gateway and could be intercepted at one of at least four places in the call path:

- the access provider network
- the ISP (if different to the access provider)
- the gateway provider, at the gateway
- the terminating telecoms network operator.

Interception at the gateway (or indeed in the (terminating) telecoms operator network) would allow existing interception systems to be used (which is attractive in the short term). Interception at the access provider or ISP would allow the interception of all data including IP to IP calls. This ability to intercept all kinds of IP traffic makes interception at the access provider or ISP attractive in the longer term, because it would be more 'future-proof'.

IP to IP calls are even more difficult to intercept than IP to PSTN calls (as discussed above) because they do not necessarily pass through the IP telephony provider's facilities (in a call using SIP, the call set-up data does traverse the SIP proxies, but the actual call data does not. Similarly, calls using H.323 may not pass through a gatekeeper, though they can be forced to do so if required).

Suitably configured session border controllers can enable lawful interception of certain VoIP calls (at the expense of having to route the traffic through the service provider's network) by routing a copy of the traffic to a third party. Alternatively, the access network

provider can capture a copy of all the traffic (including that which is peer-to-peer and does not traverse the network of an IP telephony-service provider).

Nevertheless, there is a fundamental problem with this choice between different locations for intercept: the different market players all wish to avoid the costs of providing legal interception facilities and would all prefer it to be done elsewhere. As a result, it may be necessary for the legal agencies themselves to make the decision as to where they wish to intercept the traffic and to oblige all forms of ECS provider to assist them, as required.

Some form of harmonised approach between legal interception agencies (e.g. location of intercept, format of intercept) would help minimise the cost to service providers (in that equipment manufacturers would have a larger market to address with common equipment and pan-national service providers might be able to use common systems).[29]

Regardless of how the network is configured, IP to IP calls suffer from a major legal intercept problem: end users are able to use strong encryption to encrypt the call relatively easily (e.g. by setting up a private VPN).[30] Making such encryption illegal in itself is, in effect, impossible. Businesses already rely on it for conducting business over the Internet. VoIP client software (such as Skype) already uses strong encryption (256bit Advanced encryption standard (AES) in the case of Skype).

As a result, the intercepting authorities will lose some of the advantages they currently gain from lawful interception, wherever the criminals are able to make encrypted calls:

- Brute force decryption is available to the legal authorities, but takes substantial time and resources (and is probably infeasible if the encryption is of high enough strength). This delay will prevent timely use of the information to prevent crimes.

[29] An interviewed specialist hardware vendor and a VoIP provider agree. An interviewed large vendor reports that ETSI is working on these standards.

[30] Interviews with a standard organisation and a VoIP provider refer to this point.

- Even if there are legal obligations that can force the users to subsequently disclose the encryption keys, with severe penalties for non-compliance, the 'surprise' element of legal interception will be lost.

The loss will affect different areas of law enforcement differently, but major criminals (e.g. terrorists, drug smugglers) may be the first to use encrypted end-to-end communications. Even the general public will use encryption if it is easy to use and built into the major VoIP client software.

2.7.4 Numbering

This section examines a number of issues concerning the impact of VoIP on numbering, including:

- what numbers to use
- geographic numbers
- risk of exhaustion of geographic numbers
- restricting access to geographic numbers
- number portability.

A separate study for the EC has recently reported on numbering, naming and addressing , which covers some of these issues in more detail.[31]

A point of interest is how a VoIP call can be set up. The user's equipment will need the address of the recipient:

- calling the PSTN, we need the called party's 'telephone number' (or E.164 number).
- calling a VoIP user from a PSTN phone, we need to be able to dial their number on a PSTN phone (so the IP device needs to be associated with an E.164 number too) – but in this case, the gateway needs to be able to resolve this into an IP address, possibly via

[31] 'Final Report for the European Commission September 2003 on Policy Implications of Convergence on Naming, Numbering and Addressing'.

an intermediate stage based on a URI (a SIP address or via ENUM). ENUM[32] can allow us to translate standard telephone numbers (E.164 numbers such as that of Analysys: +441223460600) into IP addresses, SIP uniform resource identifier (URI) such as james@analysys.com (which can be further converted into IP addresses), etc.

- calling a VoIP user from an IP device, some kind of user name or URI is used (e.g. a SIP address or an ENUM address).

There are many reasons for using a name, such as a URI, and not using IP addresses directly to set up VoIP calls:

- IP addresses are very hard to remember
- IP addresses may change on a session-by-session basis for users, using systems based on dynamic IP addresses (DHCP) – very common for consumer Internet access
- network address translation (NAT) systems may also affect the external IP address.

Therefore:

- access to IP addresses is required. In some countries, large-scale use of IP telephones might require deployment of IPv6 to enable sufficient IP addresses, but this is not an issue in Europe.
- access to E.164 numbers is key to being able to receive calls from the PSTN on an IP phone. Without E.164 numbers, although calling an IP phone is possible:
  - it is more effort (e.g. dial an access number and then use additional digits to indicate the called extension)
  - it might not work for all users (e.g. fax machines might not be able to store sufficient digits in their memory)
  - it would mean that calling party ID and other features would be likely to be broken, in particular for calls from the IP phone to the rest of the PSTN.

Currently, E.164 numbers are controlled by national regulators who allocate rights of use to operators. Third parties may be involved (e.g. in the USA, Neustar administers the database of allocations). Number portability obviously complicates this, because the numbers can move between operators.

[32] Richard Stastny's paper on ENUM, "Convergence of numbering", 11th CEPT conference, is an excellent basic introduction.

The Framework Directive will ensure that all providers of ECS (such as VoIP service providers) have access to numbers, as follows:

(Framework Directive, Article 10) Member States shall ensure that adequate numbers and numbering ranges are provided for all publicly available electronic communications services. National regulatory authorities shall establish objective, transparent and non-discriminatory assigning procedures for national numbering resources.

National regulatory authorities shall ensure that numbering plans and procedures are applied in a manner that gives equal treatment to all providers of publicly available electronic communications services. In particular, Member States shall ensure that an undertaking allocated a range of numbers does not discriminate against other providers of electronic communications services as regards the number sequences used to give access to their services.

What numbers to use

There as yet is no consensus on what numbers within national numbering plans ought to be used for VoIP. There are several basic choices – we draw on examples from France:

non-geographic numbers

- personal number codes (e.g. prefix 087)
  - premium rate (e.g. prefix 089 series)
  - national rate (e.g. prefix 0825)
  - local rate (e.g. prefix 0810)
  - free to caller (e.g. prefix 0800)
  - (or a new class specific to VoIP, recognising the location independence of IP networks)

geographic numbers (e.g.01 prefix)

- genuinely reflecting the customers location (all current geographic numbers)
- quasi-geographic numbers that do not reflect customer location.

Different countries have (so far) made different choices.

In principle, it is desirable for VoIP subscribers (and therefore VoIP service providers) to have access to all types of number. It is obviously attractive for the VoIP numbers to be comparable to 'normal' geographic numbers for residential users, because residential users normally have such numbers, and they and those calling them expect the (local) calls to be very cheap. Businesses may appreciate access to non-geographic numbers.

The main differences between numbers relate to the charges faced by other PSTN users to call the VoIP user. A PSTN call to a local number is usually very cheap (e.g. EUR0.07 per minute); a call to a personal number can be expensive (e.g. EUR0.54 per minute). Mobile and indirect access calls to non-geographic numbers can also be very expensive (e.g. not in bundled minutes on mobile tariffs, or charged at a high rate).

Geographic numbers

If geographic numbers are to be used for VoIP, then it is arguable that it would make sense to offer geographic numbers that related to the physical location of the gateway used by the VoIP service provider for originating/terminating the traffic to/from that customer. In that way, the wholesale termination payments and retail tariffs would be in line (a PSTN operator charging a local rate for a call to a +33 1 (Paris) number does not want to have to pay a tandem termination rate because the gateway is in Bordeaux).

Because large blocks of numbers are already allocated to existing operators, either sub-allocations need to be acquired from existing operators or new numbers need to be made available from the national numbering plan for VoIP operators. Vonage has acquired numbers in many US states from existing operators (some competing operators were not happy about this); the French operator Free uses non-geographic local rate numbers (087x) for its service. The French operator 9TELECOM uses geographic numbers (like Vonage) as 'quasi-geographic numbers' (i.e. while they look like geographic numbers, they no longer actually reflect customer location).

Risk of exhaustion of geographic numbers

The fact that barriers to entry are quite low for VoIP operators, (and that, therefore, the number of operators can be large), and the great ease with which VoIP operators can offer multiple numbers (e.g. one phone, one fax) and additional virtual numbers (like the virtual number service offered by Vonage, which is designed to allow friends of Vonage customers to call them without paying long distance charges) may increase pressure on the existing national systems for number allocation.

These systems are already under pressure, and so-called conservation measures have been introduced in many code areas, which mean that numbers are under strong pressure and are much more carefully managed (e.g. allocated in smaller blocks). Even allocating numbers in smaller blocks can carry significant costs for telecoms network operators if it is done in a widespread fashion, as they may need to modify or upgrade switches to cope with the additional size of the relevant routing tables.

In the worst case, if every VoIP subscriber had not one but three geographic numbers (phone, fax, and a virtual number for callers in another city), demand for numbers would outstrip current supply in many areas and there would have to be major changes in the numbering system, which would cause significant cost for:

- telecoms operators and service providers
- directory providers
- end users (reprinting stationery, advertising new numbers, reprogramming fax machines, etc.).

It is also possible that, once ENUM is deployed, telephone numbers will be used for additional purposes (e.g. as a form of digital identity). Such uses will create additional pressure on numbering ranges.

NRAs will need to consider whether new numbering ranges should be developed for use by new services enabled by VoIP in order to avoid strong pressure on existing numbering ranges. For example, data only (e.g. fax, modem) and 'virtual' geographical numbers could be restricted to a new set of geographic prefixes which mapped directly to the existing geographical voice prefixes (though such a solution may not work in some

countries' numbering plans, where all initial digits have already been allocated). This would allow VoIP services to be main voice line replacements and still use the existing geographic code ranges, while minimising additional pressure on scarce resources coming from the new services.

While it might be useful for end-users to know that a given number was a VoIP number from the code used (if, for example, call quality was going to be lower, or the call was going to cost a different amount, as in the case of calls to mobiles in calling party pays (CPP) countries), VoIP service providers may prefer to have codes that are indistinguishable from existing codes in order to prevent originating operators from price discrimination (e.g. calls to VoIP numbers might be charged at a higher rate).

An alternative that has been considered is the use of quasi-geographic numbers (e.g. an unused prefix in the geographic parts of the numbering plan, or a geographic prefix which used to be used but has been withdrawn in the past). This would, however, break the link between a local code and a local charge rate for the call (in that all calls would be national rate) and might lead to confusion in the minds of consumers.

It would still be necessary, in either case, to ensure that existing operators were prepared to route to these new number ranges and charge in a similar way to their existing tariffs (or at least reasonably). Article 5 of the Access Directive offers a means to enforce interconnection, though the threat of use may be as important; arguably using Article 5 would be considered excessive if it were only aimed at few operators charging a high tariff for calling certain numbers (e.g. calls to IP). We discuss commercial obstacles again in Section 2.7.13, in the context of access providers.

Restricting access to geographic numbers

Restricting access of VoIP providers to certain types of numbers is a potential issue for regulators.

The conditions that may be attached to rights of use for numbers (specified in the Authorisation Directive) do not give NRAs the explicit power to do this, because they limit

the conditions to be in conformity with the relevant parts of the Universal Service Directive.

Nevertheless, NRAs have duties towards the "effective and efficient use of numbers" (Authorisation Directive Annex, C2), and giving a large number of operators access to geographic numbers may cause substantial costs within the industry and elsewhere (to end users, for example).

It might be considered an option to give geographic numbers only to providers of PATS. For example, it has been considered whether access to geographic numbers is an implied part of offering PATS (as access to non-geographic numbers is an optional service which may be provided – the definition states *"and in addition may, where relevant, include one or more of the following services: ... and/or the provision of non-geographic services").* We consider this a weak argument for restricting access to geographic numbers as the wording appears to intend to refer to selling non-geographic numbers for inbound calls.

However, various services which are in no way PATS (e.g. second lines provided over IP, etc.) may need access to geographic numbers to be successful. This is because, for example, teenagers use mobiles a lot: therefore, many incoming calls will be from mobiles, and VoIP service providers will want these calls to be in-bundle or cheap to encourage service take-up, etc. As a result, all forms of number will need to be made available to VoIP service providers.

Regulators will need to make some difficult decisions in this area.[33]

European Telecommunications Standards Institute (ETSI) TISPAN[34] clearly comments on the recent report mentioned above, including the overall strategic situation regarding numbering naming and addressing.[35]

---

[33] Interviews with a VoIP service provider, an incumbent operator and an international organisation for corporate users all agree it is an issue in some countries; an interviewed VoIP service provider says it is not an issue in Scandinavia.

[34] TISPAN combines the work of the former ETSI bodies SPAN on fixed network standardization and Telecommunications and Internet Protocol Harmonization Over Networks (TIPHON) on VoIP-based networks into one committee.

Convergence of naming, numbering and addressing will result in an ever-increasing need to consider the strategic value of naming, numbering and addressing in the changing market place.

- *Careful management and a wide appreciation of both technical and policy aspects that occur through the use of these resources is critical.*
- *While accepting there are many existing and future challenges in the area of naming, numbering and addressing, and that there are aspects that demand on going attention, nothing is radically wrong at this point in time. Despite the hype, there are currently no apparent roadblocks towards convergence from a NNA (Naming, Numbering, Addressing) perspective.*
- *Continued vigilance and co-operation by all the involved parties is critical if benefits from converged technologies are to be realised.*

Number portability

Within the Universal Service Directive, providers of PATS have to support number portability (Article 30).[36]

The general conditions of authorisation, though aiming to produce the same effects (implementing the EU Directives) are (naturally) different in different countries. For example:

- In the UK general conditions, providers of public ECS who have been allocated numbers in the national numbering plan are subject to additional general conditions. These specifically include number portability, for example.
- In the Irish general conditions, a class of providers of electronic communications networks (ECNs) and ECS are subject to additional conditions if they are obliged to notify ComReg under Regulation 4 of the Authorisation Regulations (this class of providers can be changed by ComReg, but is roughly equivalent to those providing

[35] Response and comments on the 'Final Report for the European Commission September 2003 on Policy Implications of Convergence on Naming, Numbering and Addressing'.

[36] An interviewed standards organisation specifically mentions regulation of number portability as being inhibiting to VoIP.

publicly accessible communications networks or services). These include a clause which states:

– *The Authorised Person must at all times comply with the National Numbering Conventions in force from time to time in respect of numbers allocated from the national numbering scheme, as well as any special conditions that ComReg may attach to specific numbers from time to time.*

It can be argued that the Irish approach gives more flexibility to the regulator and rather less regulatory certainty (for example, it is unclear whether providers of public ECS will have to provide number portability; ComReg may determine that this is or is not required).

VoIP providers can, if they wish, operate without telephone numbers (if they do not wish to offer inbound calls from the PSTN). However, calls to the PSTN offer greater utility to end users if there is a return number to call (for example, services using caller ID such as caller ID display and "call the last caller back" will work) that is, if VoIP providers use phone numbers.

2.7.5 Interconnect to the PSTN

In the short term, current PSTN interconnect arrangements will be used to interconnect VoIP gateways to the PSTN.

In these agreements, the price paid for termination services (either payments to the PSTN operator, or payments from the PSTN operator) depends on the routing of the call. Termination payments are typically dependent on the number of tandem exchanges involved in terminating the call:

- double tandem (2)
- single tandem (1)
- local (0).

These termination payments make up part of the service provider's call carrying costs and are then partially reflected in the retail call tariffs.

In the future, as in the past, there are likely to be some considerable disagreements between operators over interconnect. Issues that are likely to arise as a result of VoIP include:

- If PSTN traffic falls, (e.g. as a result of large amounts of voice call origination moving to IP) how should the interconnect prices change to reflect the incremental costs of providing interconnect?

- If it is not obvious how the call will be routed by the IP-based operator, what termination rate should be paid? This relates to the issue of so-called "reciprocity in termination rates", the approach to which varies quite widely across Europe. In one approach interconnecting operators are paid according to the route that the call would have taken within the incumbent network; in others, they are paid a rate that reflects the average traffic mix that they terminate in the incumbent network. New services can create new issues here.

  - The 'virtual numbers' offered by Vonage allow each subscriber to have a 'local' geographic number for incoming calls only. Consequently, the caller only pays for a local call (and logically speaking, in this case the originating telephone company should only have to pay for local termination – based on the apparent address – irrespective of the actual point of interconnect). An approach based on the route that the call would have taken within the incumbent network to reach the actual final address would be incorrect in this case, as would an approach based on the VoIP provider's traffic terminated in the incumbent network.
  - If new geographic numbering ranges were to be made available for VoIP services, then new retail tariffs and interconnect arrangements would be required (e.g. Should these new geographic numbers be considered as equivalent to existing geographic numbers in retail tariffs? How should these calls be considered in interconnect terms?)

2.7.6 Interconnect to other VoIP service providers' networks

In the long term, as more operators move towards voice networks based on IP, there will be a need to interconnect these networks. This issue is just starting to be addressed.[37] We distinguish between several different possibilities for the commercial interconnection of different providers networks:

- Case A: calls to subscribers of the same service provider (no inter-service-provider 'interconnect').
- Case B: VoIP calls to subscribers of a different service provider, which route from IP to IP via a PSTN gateway using PSTN interconnect arrangements. These calls necessarily use E.164 numbers.
- Case C: calls to subscribers of a different service provider using some form of VoIP to VoIP interconnect.

Case A: no inter-service-provider interconnect

Conceptually, this case is simple, the retail tariff is entirely in the hands of the service provider: no commercial boundaries exist to complicate the position.

The service provider does not necessarily require any additional devices to control access to the network or 'police' usage; collection of call data may also be unnecessary if flat-rate tariffs are used.

Even if the end-users have private IP addresses, there are no address resolution issues (because in this case the calls are internal to the service provider's network). This occurs in carrier internal use, and potentially, in use in corporate internal use in business LAN/WAN.

[37] An interviewed incumbent operator and a specialist software vendor refer to this point.

Case B: IP to PSTN and back

In effect, this case is identical to the IP to PSTN case discussed in the previous section, with a couple of additional points:

- Repeated transit through gateways will degrade call quality by increasing latency and may also degrade speech quality (depending on the codecs used). In the very long term, there will be a need to avoid such multiple PSTN to IP conversions. This may interact with other issues, for example, number portability. In a complex case for number portability, a non-geographic number, which has been ported to a geographic number, which itself had been ported, could result in a single call traversing nine different networks. The resulting latency of an IP to PSTN to IP conversion at each of these boundaries would be unacceptable.
- This option is only available where the called party has an E.164 number.
- Commercially this option is straightforward, but it forces the operators to adopt similar tariff structures to the PSTN because they will be paying termination payments. The provision of the gateways is also expensive for the operators.

When the incumbent operator changes to an IP-based network, it is possible that it will do so ahead of other operators, or that other operators will wish to maintain SS7 interconnect links for an extended period, creating its own difficulties:

- If the incumbent operator changes technology or network architecture (e.g. removes local switching elements), should the costs of keeping the interconnect links fall on the interconnecting operators?
  - If the PSTN operator were to move to using VoIP, then should a gateway be provided at each existing point of interconnect? This would be inefficient (in that much of the traffic ought to be exchanged as IP, and the additional protocol conversion will degrade call quality by for example increasing latency) and costly.
- Operators who receive more in PSTN termination payments than they spend (typically, operators with large dial-up ISPs as customers) will be keen to retain this source of net revenue for as long as possible. This is very likely to cause disputes between operators and NRAs will, in such cases, need to use their powers under Article 5 of the Access Directive to resolve such disputes.

Case C: VoIP to VoIP interconnect

This is the most interesting and most far-reaching case for how IP-to-IP telephony will work, because it is key to the operation of a competitive market in IP telephony, and because we believe that (in the long run) all voice networks (in particular, the incumbent's PSTN network) will be IP based.

There are a number of technical and commercial models that may be adopted for interconnecting VoIP services. Commercially, we can see that there are two interconnection models, distinguished by whether those terminating calls must pay to do so:

- (reciprocal) settlement-free VoIP termination, which might be called 'VoIP peering'
- (reciprocal) paid-for VoIP termination, which might be called 'VoIP termination'.

We fully expect some operators to adopt a mix of models, and for this mix to change over time.

The retail services could be either 'free' (per minute) or paid-for (e.g. per unit capacity, or per call set-up, or per call minute, or a combination): interconnect pricing only determines the structure of the wholesale market, and limits retail prices.

There are two viable models because:

- Not all VoIP customers will have public IP addresses. For example, they might be part of an upgraded incumbent's PSTN network, which consisted of conventional analogue phones connected to the IP network at the local exchange. The ability to route calls to these customers can be controlled by their access network provider. Mobile GPRS access network providers are in a similar position.

- Service providers need not freely translate addresses for incoming calls. Competition among service providers may mean that such restrictive practices are not favoured, or indeed likely, but they are possible. This control gives service providers the means to extract payment for this service if they so desire.

Why will a 'peering' model not prevail as in the case of the Internet?

In normal Internet access (such as Web browsing), it is often difficult to identify the initiator of the data transfer without considerable effort, and the data transfer is asymmetrical and 'bursty'. Keeping track of the bits and trying to associate them with "who caused them to be sent" is in essence unfeasible. In such a situation, a 'calling party pays' model is not a viable solution, and a capacity-based interconnect model (peering or transit) is favoured, even though it prevents us segmenting the market more effectively.

Voice calls are different. In the case of a voice call, it is possible to distinguish who initiated the call, and the traffic is roughly symmetrical and at a relatively constant rate. In such a situation, a calling party pays model is an efficient solution (identifying the party to bill and working out what to charge for is relatively easy and inexpensive). As a result, it is possible to segment the wholesale (and retail) markets by charging different amounts for different services (e.g. by time of day). A capacity-based interconnect solution is feasible, but may prevent effective segmentation of the wholesale market (e.g. with a capacity based solution, it is not possible to charge more for termination in the busy hour).

Who will adopt which model?

The settlement-free case could be adopted unilaterally by individual carriers. Indeed, unless they take action to prevent such calling, service providers selling SIP addresses to customers with always-on IP connections (e.g. broadband customers) implicitly adopt such a model (unless they in some way restrict the access to the SIP address translation).

Nevertheless, some providers (particularly traditional carriers) will still charge, if they can. As a hypothetical example, if in Japan Fusion and NTT were interconnected, and Fusion did not charge NTT for IP termination, NTT could still charge Fusion for the same IP call in reverse (as long as it can control the admission of traffic onto the network or the address translation). As a result, NTT would be in a position to profit (without changing its retail prices, it would be able to retain what it would have paid Fusion in termination had it been a PSTN operator). This would be another example of the "monopoly of termination of calls to customers on your own network"(callers cannot choose on which network to terminate a

call to a given person), which is why Relevant Market 9 is defined as "call termination on individual public telephone networks provided at a fixed location".

Even if a low quality VoIP-to-VoIP link via the Internet is free, some service providers may be able to charge money for a wholesale VoIP-to-VoIP service justified by its higher quality. Users could choose to make calls either via the paid-for (higher quality) or (potentially) free (no guarantees) routes. However, in order to do provide the controlled quality, (and in the absence of sophisticated session by session quality of service (QoS) control in most networks) the call would have to route directly through the service provider network, and the service provider would need links of guaranteed quality to other VoIP service providers. As there are other weak links in the chain, particularly in the access network, access providers integrated with VoIP service providers ('Yahoo! BB' and carrier internal models) have a particular advantage in this area.

In summary, the options we see as being adopted by different types of VoIP carrier are as follows:

VoIP service type	*Interconnect to other networks*
Self-provided consumer (DIY)	No PSTN interconnect. For IP to IP, VoIP peering is used.
Independent of Internet access ('Vonage')	PSTN interconnect via gateways. For IP to IP, VoIP peering will be used. It is difficult to justify the additional price of VoIP termination services in this case given the service provider's lack of control of the access network.
Provided by broadband access service provider ('Yahoo! BB')	PSTN interconnect via gateways. For IP to IP, it is difficult to tell which model will prevail. Either VoIP peering or VoIP termination may be offered.
Internal use on business LAN/WAN	By definition, this use is internal. Although these networks connect to the PSTN they buy retail voice services from a carrier and are not buying interconnect. Businesses may link via VoIP peering to business partners via VPN/extranet
Carrier internal use	PSTN interconnect via gateways. For IP to IP, VoIP termination is the likely model. VoIP peering (with conditions) may be offered.

All interconnect options can run in parallel

The settlement-free case could also run in parallel with a paid-for termination model if the service provider can distinguish the source of the incoming call and recognises that it has agreed settlement free termination. These commercial agreements would be similar to IP peering agreements between ISPs and might impose some restrictions on the nature of traffic (and provide for improved service levels, some kind of quality of service guarantees, etc.). In order to police this access, the network needs to use some kind of session control functions.

Session border controllers offer one way in which such a higher quality VoIP to VoIP service might be implemented (essentially, these would allow individual sessions to be routed on an alternative route). See Annex B.2 for details of the facilities offered by session border controllers and how a guaranteed VoIP to VoIP service could be implemented.

At this stage, regulators need only monitor the emergence of these new forms of interconnect, bearing in mind that interconnect disputes are almost certain to arise.

2.7.7 Technical standards for interconnect

Responsibility for VoIP service interconnection standards

Under the NRF, the EC can publish recommended standards in the Official Journal (OJ), and may ask Comité Européen de Normalisation (CEN), Comité Européen de Normalisation Électrotechnique (CENELEC), or ETSI to create new standards. The EC may, under certain circumstances, make the implementation of certain standards and/or specifications compulsory.

If no standards have been published within the OJ, international standards or recommendations adopted by the ITU, International Standards Organization (ISO), or International Electrotechnical Commission (IEC) shall be encouraged by NRAs. Interestingly, the IETF is not mentioned in this part of the Framework Directive, though

this does not mean that the IETF standards are necessarily not going to be adopted (e.g. via ETSI).[38]

VoIP service interconnection is an area within which standards are lacking.[39] In particular, there is not an industry consensus or understanding of how to achieve (in practical, technical terms) a level of service quality sufficiently equivalent to the circuit switched PSTN over an IP network, specifically in situations where the traffic passes over several operators' networks.

All IP QoS mechanisms involve additional standards, and may also involve additional equipment cost, and additional management, so there will be questions of degree and practicality. There is also an array of standards available (e.g. DiffServ, Multi Protocol Label Switching (MPLS) and a variety of opinions concerning how these scale and how best to deploy them.

Many IP QoS mechanisms, such as DiffServ, give statistical guarantees that might be adequate in practice (as long as they are deployed and configured correctly). Alternative QoS mechanisms that are capable of end-to-end guarantees (such as IntServ) have, in the past, been found to be too expensive to implement for the benefits offered and cheaper and less capable systems have been preferred as a result. MPLS may be the answer, according to some commentators.

The service providers, network operators, equipment manufacturers, standards organisations, and regulators will need to collaborate to ensure that suitable technical solutions for carrier-scale VoIP to VoIP interconnect exist, on a timescale which matches carrier deployments of VoIP to replace their existing circuit switched PSTN. These efforts will need to examine:

- The level of end-to-end quality required for PATS (blocking within the network, speech quality, probability of premature call termination, etc.).

[38] An interviewed large vendor thinks that the market will provide for the required standards.

[39] An interviewed regulatory organisation and alternative mobile and fixed operator agree; an interviewed standards organisation refers to additional work currently under way.

- The protocols to deploy to meet this (or how to interwork between different operator's protocol choices: not all operators will wish to deploy the same codecs, the same bandwidth per connection, the same type of transport network (e.g. MPLS) or network topology (e.g. how many hops?)).
- The operational inter-network management and coordination necessary for making this work.
- Commercial frameworks for these interconnects.

TISPAN is the ETSI core competence centre for fixed networks and for migration from switched circuit networks to packet-based networks with an architecture that can serve in both. It is responsible for all aspects of standardisation for present and future converged networks, including the NGN and including, service aspects, architectural aspects, protocol aspects, QoS studies, security-related studies, mobility aspects within fixed networks, using existing and emerging technologies.

The fact that these technical standards are not yet fully worked out is not necessarily a problem, given the timescales on which carrier-scale implementations will be required (estimated 2006–10). Nevertheless, regulators and the Commission should encourage and observe this work. If suitable standards are not available, early users of VoIP will continue to use existing PSTN standards for interconnect.

Quality of service standards for VoIP services

There are quality standards for voice services that are PATS. The only relevant standard mentioned in the NRF (Universal Service Directive, annex III) is:

ETSI EG 201 769-1: Speech Processing, Transmission & Quality Aspects (STQ); QoS parameter definitions and measurements; Part 1: Parameters for the voice telephony service required under the ONP Voice Telephony Directive 98/10/EC

We note that ETSI has published many more standards on similar topics and that the ITU is also active in this area.

2.7.8 Security

As we have already noted, IP telephony involves a collision between the traditional IT / Internet model and the telephony world.

- In the IT world, viruses or other security risks can cause loss of data, loss of time, or loss of valuable information to a criminal party, but rarely cause theft of currency (except perhaps in the case of IT security of banks).
- In the telephony world, security risks can, in addition to loss of resources, cause immediate and direct financial losses, for example, by incurring call charges on behalf of unwilling parties.

Historically, the PSTN was relatively secure. Only a few companies were interconnected, they were all staffed by trained telecoms engineers who were motivated to keep the system secure, the end-devices were extremely 'dumb', the centralised exchanges themselves were highly proprietary computer systems (well understood only by their manufacturers), and the network was protected by at least some physical security (locked buildings, locked cabinets, etc.).

This did not stop 'phreakers' from trying to use signals through the handset to obtain free phone calls (in one notorious incident, BT had to turn off tone dialling in its entire pay phone network, as a result of an ingenious use of hand held tone diallers). Fraudsters have also targeted mobile prepay systems and used forged phone cards to make calls to premium rate numbers operated by accomplices.

By comparison, the Internet is insecure.[40] A huge number of companies and devices are interconnected:

- The end-user devices are not (in general) physically secure or supported by trained engineers.
- The end-user devices are relatively capable, and are mostly well-known computer systems (PCs run one of a very small number of operating systems, almost all of which have well known vulnerabilities). Mobile handsets are, however, more secure by

[40] An interviewed large vendor agrees with this point.

design and their vulnerabilities (if any) more obscure (many details of the handsets are still proprietary and only available under commercial non-disclosure agreement (NDA).[41]

- The core routers are protected by physical security (locked buildings, locked cabinets, etc.), but have been subject to a number of attacks through their management protocols.

The results of this insecurity may be seen in the continuous series of viruses and worms, and countermeasures: patches to applications and operating systems and anti-virus updates. Service providers in direct control of the access network ('Yahoo! BB' and carrier internal use) have slightly fewer worries in this regard than, operators who are dependent on using the public Internet (e.g. 'Vonage').

End users who are buying telephony services, however, will still expect their calls to be secure[42] and their bills accurate. This is not just a matter for those operators providing PATS; providers of ECS are also obliged to have accurate bills (though they may not be obliged to have these billing systems audited, etc.), and end user data privacy is protected by national data protection laws and in particular, the Directive on Privacy and Electronic Communications (2002/58/EC). Under the Directive, Recital 20 states (emphasis added)

Service providers should take appropriate measures to safeguard the security of their services, if necessary in conjunction with the provider of the network, and inform subscribers of any special risks of a breach of the security of the network. Such risks may especially occur for electronic communications services over an open network such as the Internet or analogue mobile telephony. ***It is particularly important for subscribers and users of such services to be fully informed by their service provider of the existing security risks which lie outside the scope of possible remedies by the service provider. Service providers who offer publicly available electronic communications services over the Internet should inform users and subscribers of measures they can take to protect the security of their communications for instance by using specific types of software or encryption technologies.*** *The requirement to inform subscribers of particular security risks does not discharge a service provider from the obligation to take, at its own costs,*

[41] An interviewed mobile operator refers to this point.

[42] An interviewed specialist software vendor agrees with this point.

appropriate and immediate measures to remedy any new, unforeseen security risks and restore the normal security level of the service. The provision of information about security risks to the subscriber should be free of charge except for any nominal costs which the subscriber may incur while receiving or collecting the information, for instance by downloading an electronic mail message. Security is appraised in the light of Article 17 of Directive 95/46/EC.

A considerable amount of effort is, therefore, being expended developing standards to build a service that meets users' needs and expectations for privacy (and lawful intercept), user authentication, and guarantees about quality of service, accurate billing, etc. on IP networks in general, and the Internet in particular. It is impossible to describe these wide-ranging activities in detail in a high-level document such as this: interested readers should examine the ETSI TISPAN technical committee Web site.[43]

2.7.9 Control of standards

Service providers or other organisations may be in a position to control various standards used within the network (e.g. access to presence management, codecs, etc.). As a result, it would be possible for them to either deny access to essential intellectual property (in order to keep all or some competitors (by discrimination) out of the market), or to obtain monopoly rents on their intellectual property.

Many of these concerns are hypothetical, and alleviated by the fact that it is possible to use different technological solutions within the network. There is, in effect, a competition between codecs, for example, which means that license fees are indeed reasonable. What might be more damaging would be a patent that the owner was able to enforce well after the relevant standard had become widespread in its use.

In cases where there was a significant problem, the Access Directive (Article 12(e)) gives regulators strong powers regarding intellectual property licensing in cases where there is SMP. Access Directive Article 10 also gives powers to mandate non-discriminatory access in cases where there is significant market power (SMP).

[43] Source: http://portal.etsi.org/portal_common/home.asp?tbkey1=TIPHON

We do not believe that there are significant risks in this area.

2.7.10 Control of end-user devices

Some service providers and operators may have more control of the end-user device. For example:

- The access provider can control the end-user hardware used (e.g. by bundling it into the access subscription).

- The ISP has a channel to the customer, who may be asked to install a customised browser, firewall, etc. Therefore the ISP can easily ask the end user to install additional software (e.g. VoIP client software).

- For PC or PDA users, the hardware supplier has an opportunity to bundle software with the device. The computer operating system supplier also has an opportunity to bundle software with the device. The PC hardware vendors and operating system (OS) vendors (specifically, Microsoft) have historically been opposed over these issues.[44]

- Mobile operators can control which devices are able to use the full set of network functions (e.g. Vodafone Live requires specific software on the handset). Operators can also try to prevent 'their' security identity module (SIM) cards being used in other devices (e.g. 3) and lock handsets to only use their network. These measures are taken for commercial reasons:
  - in the case of 3, to avoid paying roaming fees to 2G operators (and to make sure that the customer has the option to use the new 3G services)
  - in the case of handset locking, to recover the subsidies on subsidised handsets.

End-user devices (and software within those devices) used for communications services are potentially within the scope of the regulatory framework (as associated facilities, if in no

[44] A major part of the Microsoft anti-trust case related to Microsoft's licenses with the hardware manufacturers (the original equipment manufacturer (OEM) restricting their ability to customise the desktop and the software boot sequence.

other way). As such, regulators do have powers under the Access Directive, as discussed extensively elsewhere.

The Universal Service Directive, Article 17.2 prescription on "unreasonably bundling services" may also apply in the case of operators with significant market power.

Additional powers exist in the Radio and Telecommunications Terminal Equipment (R&TTE) Directive (Directive 1999/5/EC), which allows for the EC to introduce various further requirements for terminals (used wholly or partly for PATS) so as to meet the needs of the market and the public at large, including:

- interworking with other apparatus via the network
- avoidance of harm to the network
- safeguards for privacy and personal data
- avoidance of fraud
- access to emergency services
- facilitating use by the disabled.

Accordingly, the interworking provisions could potentially be used if a choke point was developing in the area of end user devices. Yet again, whether the service is considered PATS is of importance.

Although it is possible to construct hypothetical risks, we do not believe that there are significant risks in this area at this time.

2.7.11 Bundling of retail services

It is possible that these services will be bundled with other retail services (such as Internet access from the same ISP). This would only be an issue if the service provider were to have significant market power and able to force end-users to buy additional services that they did not require.

We do not think that any providers of IP voice and convergent services will have significant market power in the currently defined relevant markets in the short term.

Nevertheless, within the NRF, it is clear that bundling of retail services by a provider with significant market power could be considered abusive, and regulators have powers to prevent it (Universal Service Directive, Article 17.2: "unreasonably bundle services").

We do not believe that there are significant risks in this area.

2.7.12 Control of access to data on end-users (e.g. billing, location, presence, authentication)

Service providers and network operators may be able to obtain commercial advantages by withholding information about the end-users, such as authentication, location, presence information, and billing (or equivalently, prepay subscription) data from competitors. Much of this information is held in central databases, and access to the information in these databases may be argued to be an 'associated facility' (as discussed in Section 3.7.1, below). As such, regulators may have the ability to intervene, if required.

We expect that access to much of this data will be available on commercial terms, subject to the provisions of the relevant data protection legislation. However, the example of presence management data in the IM and PM shows that this is not necessarily the case, so there are potential risks that will need to be monitored.

The Access Directive (Article 12 (a, e, g, and h)) gives regulators relevant powers regarding these issues, specifically mentioning access to facilities for intelligent network (IN) services, facilities for mobile roaming, and access to open source software (OSS) or other similar software systems (amongst other items). These powers can be used in cases where there is SMP. Article 5 powers may also exist, as we have previously discussed.

2.7.13 Issues relating to only some forms of VoIP

For some VoIP business models, where the access provider is not the service provider the local access provider could use the access network itself as a choke point. The barriers erected could be technical, commercial, or both. The business models where this applies are:

- self-provided consumer
- independent of Internet access ('Vonage')
- provided by broadband access service provider ('Yahoo! BB') in certain cases, where the service provider uses a wholesale bitstream access service controlled by another telecoms operator.

Technical barriers erected by a local access provider

In common with a large number of services based on IP, operators of the access networks are in a position to block access to VoIP services because these services use port numbers that can easily be identified. As a result, an ISP could block the application by setting its firewall to refuse traffic to or from certain UDP and/or TCP ports, or by blocking traffic to or from specified IP addresses (e.g. those which resolve to aol.com except on the www port 80, etc.).

Only operators with a voice service to protect are likely even to consider such a move. Those who would be most affected are:

- incumbents whose ISPs or wholesale DSL access products are a significant fraction of the market
- mobile operators.

As already noted, the NRF considers that attempts to block access to certain IP services by an operator with SMP would be abusive.

Commercial barriers

Commercial pricing choices that remove the incentive to use VoIP are much more likely. There is nothing (other than competition) to stop operators who have a vested commercial interest from making VoIP commercially unattractive by, for example, making the price per bit so high that voice services cannot be profitable.

This is, in effect, impossible for broadband access providers, (given the very low incremental price per bit on almost all wholesale DSL tariffs).

Alternatively, this will be particularly relevant for mobile operators, who have a limited amount of network capacity, and are, as a result, much more concerned about, and wary of, flat-rate pricing for data services.

Mobile operators could set their retail tariffs to make VoIP unattractive by, for example, setting the IP price per bit to be the same as an off-net telephony call.[45]

While VoIP service providers may not like this, the mobile operators have a perfectly valid economic point: Ramsey pricing. It generates more value to charge customers with a low price elasticity more and customers with a high price elasticity less. Voice customers are prepared to pay more per bit than Web browsers; SMS customers are prepared to pay the highest price per bit.

A strategy that charged the same price for all data access would be safe and easy to explain to customers, but it would not be economically optimal, because it would suppress demand for mobile data. So setting the data "price per bit" to be the same as an off-net telephony call would not be economically optimal, in a Ramsey pricing sense.

An optimal strategy would require charging a different price per bit for different services, but this may not be efficient for other reasons (it may be too costly to achieve or too difficult to explain to customers) or, indeed, technically feasible. Reasons why it may be technically difficult or expensive to achieve include:

- VPNs – customers with the ability to use VPNs can hide the content of their traffic from the access operator
- Applications exist which use well-known ports (such as port 80, usually used for Web browsing) for other purposes (e.g. Skype, which uses port 80 for voice). Therefore, port numbers alone do not allow us to distinguish the application.
- Proxy servers between the end-user and the Internet (which would in effect block access to applications not supported by the proxy server) may be expensive to deploy at the required scale.

[45] In fact, they could go slightly lower than this with little risk, because a gateway operator would have termination charges to pay in many cases, so could still not compete.

We expect that mobile operators will use a combination of:

- retail data prices that are (overall) comparable to the off-net voice "price per bit"
- cheap tariff packages that are more restricted in their access to the Internet (e.g. walled garden only)
- more expensive tariffs aimed at business users that offer unrestricted access to the Internet (VPN, etc.)
- technical means, such as proxy servers and firewalls to enforce these differences between the tariffs.

None of these are either illogical or in themselves unreasonable. Competition should ensure a wide variety of tariffs and services. Naturally, if there was an abuse of dominance in this area, ex-post competition law remedies are be available.

If mobile operators charge a different price per bit for different access services, why should fixed access operators not be allowed to do so likewise? The answer is, in effect, that there is very little competition in the fixed access network for a great number of users. So considerations of SMP in relevant markets (specifically, Relevant Market 12: Wholesale Broadband Access) are important here. In practice, either by competition for those who have it, or as a result of ex-ante intervention, there will be a bitstream access service, which allows ISPs to offer a fixed Internet access service, which does not charge a different price per bit for different services.

2.8 Issues relevant to regulators

In this section we look at issues that arise from VoIP within the NRF, such as:

- VoIP services as ECS
- when is a self-provided service a private ECS
- definition of publicly available telephony service
- extraterritorial service providers
- impact on the relevant markets recommended by the EC.

2.8.1 VoIP services as ECS

Under the NRF, an ECS means:

A service normally provided for remuneration which consists wholly or mainly in the conveyance of signals on electronic communications networks, including telecommunications services and transmission services in networks used for broadcasting, but exclude services providing, or exercising editorial control over, content transmitted using electronic communications networks and services; it does not include information society services, as defined in Article 1 of Directive 98/34/EC, which do not consist wholly or mainly in the conveyance of signals on electronic communications networks.

A VoIP service, unless it is not a *"*service normally provided for remuneration*"*, meets the above definition, and is an ECS.

Free services

It is unclear, though it seems very likely, that a peer-to-peer application such as Skype, which is available for free download and has no ongoing subscription charges, is not a "service normally provided for remuneration" at all. If it is not a "service normally provided for remuneration" then it is not subject to the NRF. For example, it would not be subject to the General Conditions of Authorisation.

Even an application using paid-for software could be exempt because there is a distinction within the EC Treaty between goods and services: it seems possible that a peer-to-peer system using paid-for software (a good rather than a service) is still arguably not a service.

The issue of the status of a given service is a legal one and, as such, the courts will ultimately decide.

However, Analysys believes that it is unlikely to be an issue of major importance, as a gateway to the PSTN will be needed to make the service a useful one. If a gateway to the PSTN is offered, then it will need to be paid for (because PSTN termination is not free) and

the use of the gateway (and other services bundled with it) will almost inevitably become a "service provided for remuneration" and will be subject to the NRF.

Categorisation of VoIP services under the NRF

Electronic communications services are further divided into a number of different categories under the NRF.

- private ECS
- public ECS
- PATS (a subset of public ECS).

Each of these is regulated, to a lesser or greater degree:

- Private ECS providers are subject to general conditions of authorisation in each country in the EU.
- Public ECS providers are subject to additional general conditions of authorisation in each country in the EU. Most of these conditions are (in effect) concerned with consumer protection.
- Some conditions apply only to a subset of public ECS (e.g. providers of public ECS with numbers in the national numbering plan have additional obligations, such as number portability).
- PATS providers are subject to additional national general conditions over and above those of the public ECS providers.
- Beyond this, dominant players in defined relevant markets in each EU state are subject to ex-ante remedies.
- Ex-post remedies remain an option.

The different VoIP business models will be in different categories under the NRF.

- **Self-provided consumer services** will probably not be considered to be subject to the NRF (i.e. will not even be private ECS)
- **Independent of Internet access ('Vonage')** will be public ECS, and could be PATS (though the lack of guarantees about access network quality means that they will be

unable to provide highly assured services for access to emergency services, for example – an issue discussed in much more detail below)

- **Provided by broadband access service provider ('Yahoo! BB')** will be public ECS, and can be PATS in some circumstances.
- **Internal use on business LAN/WAN** might be a private ECS, if it is provided as a managed service (but not if it is Centrex, which would be carrier internal use).
- **Carrier internal use** will be public ECS, and are almost certain to be PATS. Some carriers might choose to try to avoid being PATS providers.

The next sections discuss:

- whether a self-provided service is a private ECS
- when a service is a PATS.

2.8.2 When is a self-provided service a private ECS?

It is unclear, though it seems very likely, that a self-provided service is not a "service provided for remuneration" at all. If it is not, then it is not subject to the NRF. For example, it would not be subject to general conditions of authorisation.

The fact that paid-for equipment and software are used may be irrelevant, as these are goods, and there is a distinction within the EC Treaty between goods and services.

It is possible that within a major corporate, there might be a telecoms division that is 'paid' by internal transfers of money from other divisions. This could be considered a private ECS. Even if, in some cases, these services are considered as private ECS, then this is unlikely to be a significant issue because the general conditions of authorisation for private ECS are not very restrictive.

2.8.3 Definition of publicly available telephony service

Within this section we look at a number of topics that are all related to the issue of which VoIP services should be considered PATS, including:

- whether inbound-only services are PATS
- the importance of access to emergency services within the definition
- network integrity requirements
- whether VoIP services on fixed networks are provided "at a fixed location"
- proposed approaches.

Introduction

The NRF (Universal Service Directive) defines PATS as:

A "publicly available telephone service" means a service available to the public for originating and receiving national and international calls and access to emergency services through a number or numbers in a national or international telephone numbering plan, and in addition may, where relevant, include one or more of the following services: the provision of operator assistance, directory enquiry services, directories, provision of public pay phones, provision of service under special terms, provision of special facilities for customers with disabilities or with special social needs and/or the provision of non-geographic services.

VoIP can therefore be PATS if it is *"a service available to the public for originating and receiving national and international calls and access to emergency services through a number or numbers in a national or international telephone numbering plan"*.

Any VoIP service with any form of gateway to the PSTN[46] certainly allows the public to originate and receive national and international calls through a number or numbers in a

[46] We expect that services that do not have a gateway are unlikely to be very successful, due to the enormous network benefits of access to the universal PSTN.

national or international telephone numbering plan. Some of these services with gateways will offer access to the emergency services. Other uses of VoIP are not PATS.

This definition, in our view, may need clarification in some areas.[47]

Some operators may offer outgoing calls only as a means of avoiding becoming a provider of PATS. Others may decline to offer access to emergency service. We discuss these issues below.

The reason this is an issue is that providers of PATS are subject to additional regulation over and above providers of public ECS under the Universal Service Directive. These conditions are quite significant and include:

- all necessary steps to maintain proper and effective functioning of network and access to services (provided "at fixed locations" only)
- national and single European emergency number access (which makes the definition of PATS circular).

A full list of obligations is given in Annex A.3. These additional obligations can be costly to provide. Consequently, to avoid these costs, some operators may seek to avoid these obligations, by not providing access to emergency services. Operators who do not provide PATS may provide some of these extra facilities (e.g. itemised billing) if they so wish, but they are not obliged to do so, and will make a judgement as to which additional facilities give a marketing advantage that is worth the cost. **We note that all operators providing public ECS (i.e. not just providers of PATS) can be subject to mechanisms to share the net cost of USO, so there is no advantage here in avoiding designation as a provider of PATS.**

Another impact is that providers of public telephone networks are subject to similar, additional obligations, for example, as regards "all necessary steps to maintain proper and effective functioning of network". The Universal Service Directive defines a public telephone network as "an electronic communications network which is used to provide

[47] An interviewed large vendor is in effect discussing this issue when he says, "The EU can regulate what standards must be met to describe the service as a PSTN service, to remove confusion".

publicly available telephone services". Thus, it matters to the underlying network providers whether the service provider is considered to be offering PATS. While this definition is useful in the PSTN, because the PSTN network and service are very closely related, the definition does not work very well in a VoIP network because it could cause obligations to fall on a third party that offers IP connectivity but was not associated with the decision to provide PATS (e.g. an IP transit provider, a bitstream access provider, an ISP, etc). This seems unfair.

Whether a service is PATS is a serious issue for regulators. The Finnish regulator, Ficora, recently determined that the VoIP offer of TeliaSonera (Sonera Talkband, 'Puhekaista') was PATS, and was therefore obliged to provide all the facilities required of PATS (including: ability to make international calls, to have a phone bill, to be able to prevent publication of the number in directories, to be able to block certain numbers from calling the number, and to be able to withhold the caller number when making calls). Ficora used a narrow reading of the USO Directive to determine that the service was PATS: the client uses a phone number which follows national standards and which allows the client to make and receive calls in their own country, and have access to emergency services.[48]

Inbound only

Given that there are traditional telecoms operators which offer inbound-only services (e.g. for dial IP termination), it would be useful for it to be formally clarified whether this definition of PATS includes services that are inbound or outbound only.

This is easy enough to resolve (simply by reading the definition to be "and/or").

Another option for regulatory 'gaming' would be to **unbundle the calls from access to emergency services** (there is, in effect, no direct efficiency penalty to doing this in a VoIP environment, whereas in a traditional PSTN it would double the costs). A user could then buy calls from company A, and access to emergency services from company B Arguably, neither of these would be PATS. This may be appear to be a trivial legalistic point, but it is perfectly feasible using VoIP, as a result of the unbundling of access from calls within

[48] http://www.ficora.fi/suomi/

VoIP. In practice, however, this is unlikely to occur because this option is not very user-friendly – consumers do not like having multiple bills for telephony services.

Access to emergency services

If 'inbound only' service providers are included, then these typically do not provide access to emergency services.

More widely, is a service that provided calls to and from national numbers, but which did not provide access to emergency services, is (or could be) still a publicly-available telephone service?

It is arguably illogical for the NRF to encourage VoIP service providers to exclude access to emergency services by offering advantages in regulatory terms (specifically, lower obligations in other areas) as a result. This is directly contrary to Recital 36 of the Universal Services Directive says *"It is important that users should be able to call the single European emergency number '112', and any other national emergency telephone numbers, free of charge, from any telephone, including public pay telephones, without the use of any means of payment."*

VoIP service providers in the USA (such as Vonage) do offer access to emergency services and may well offer these in the EU purely in order to meet customer demand, although they will weigh this against the cost that in so doing they would become providers of PATS and would be obliged to support the additional obligations.

Removing the requirement within the definition of PATS for "access to emergency services" would be undesirable, because it would mean that all calls through a number or numbers in a national or international numbering plan were potentially PATS. This would widen the category to include a variety of operators using VoIP, who were not intending to provide a voice telephony service equivalent to the PSTN, and were not intending to market their service as anything other than an adjunct to it (e.g. for cheap, lower quality, international calls only), but who did interface to the PSTN via a gateway.

Annex A.2 contains a discussion of other views on this issue.

Network integrity requirements

In a similar way to providing access to emergency services, providers of PATS at fixed locations are required to take measures to ensure the availability of services (including access to emergency services) in the case of force majeure and catastrophic network breakdown (Universal Service Directive, Article 23). The actual wording of the requirement depends on national law.

While a VoIP service using a high bit-rate codec can meet or even exceed the speech quality of a fixed PSTN (and even more so a mobile) call, it can only do so if the packet loss, latency and jitter are all low. It is difficult to guarantee that this will be the case for the required duration of the call in an IP network. Providing guarantees when interconnecting via the public Internet is particularly hard as the public Internet is prone to unexpected increases in packet loss and jitter. This is true at any time; but if the public Internet is under attack (e.g. by a worm or virus) it may be impossible.

An extreme interpretation of the network integrity requirement of the Universal Service Directive might, therefore, create an impasse similar to that of access to emergency services discussed above: some PATS service providers using VoIP might be unable to meet their obligations. For example, a provider (e.g. using a business model like 'Vonage') that relies on the Internet might find it impossible to offer service to some users if certain major Internet routers were under a major electronic or physical attack. Nevertheless, it is possible to argue that certain types of disaster are dealt with better by IP technology than the existing PSTN network, so this issue is not entirely straightforward.

In Analysys's opinion, it is probably not necessary to fully replicate the exact qualities of a fixed network, circuit-switched call for all user groups. It is evident that users will tolerate significantly lower quality in the mobile network. Mobile calls are more often blocked by the network, have a lower speech quality, and are quite likely to 'drop' during the call than fixed network calls (e.g. as a result of handover and excessive congestion, or because the handset runs out of power).

In addition, mobile networks have been, in general, less reliable than fixed ones (individual base stations offline, which puts a hole in coverage, or in more serious cases, incidents losing central infrastructure such as a home location register (HLR), which means that

huge numbers of customers are unable to make calls for up to a few hours). Some users find this an acceptable balance and choose to not have a fixed phone and instead, rely on their mobile telephone service.

Interestingly, the NRF does not impose conditions relating to the proper and effective functioning of the network on mobile PATS operators, only on fixed ones. This is, to some extent, a pragmatic recognition of the different nature of the mobile network, mobile handsets being battery-powered devices, mobile user's tolerance of lower quality, and the unpredictable nature of the radio environment. We note that radio-based consumer handsets for fixed telephony (DECT, etc.) carry warnings about use in emergency situations, encouraging the user to keep an alternative line powered fixed telephone in case the radio based system is unavailable.

It might, therefore, be argued that relevant VoIP operators should be treated in a similar way to mobile operators as regards conditions relating to the proper and effective functioning of the network (in particular, if the service is well understood by end-users to be less reliable). For example, VoIP over WiFi might look more like a mobile operator. Providers of a PATS VoIP service that use WiFi or even wireline access could therefore argue that these obligations do not apply to them, because they are not "provided at a fixed location" because VoIP services can be highly location-independent.

There is a significant issue at stake here: a relaxation of the requirement for VoIP providers of PATS would represent a potential problem, because:

- firstly, it would not be technologically neutral
- secondly, in the long run, it is possible that all the fixed networks (including the current incumbents) will use VoIP, and, therefore, it could cause a significant change in the quality of services offered to the public (in this case, in the availability of the telephony network in disaster situations).

This is very different to the case of location independence, where it is arguable that some access to emergency services (even with no ability to fix the user's location if the user is away from home) is better than none, and the occasions where location independence will be a major issue are rare (e.g. because the young, the elderly, and the sick are more likely to call from home than from another location).

In this case, however, a simple resolution is not available, because in the long term, this could change the quality of services offered to the public (in this case, the availability of the telephony network in disaster situations).

An additional, more minor, issue is that if a service provider's network assets are based in a different country from the user (and/or controlled by a different legal entity), this may make it more difficult to ensure continued network and service availability. It is, therefore, an open question whether the need for resilience will (as a result) affect the technologies and system architectures adopted by PATS providers.

Whether VoIP services on fixed networks are provided "at a fixed location"

As we have seen above, some of the more onerous obligations of providers of PATS apply only to providers of PATS "at a fixed location". This wording was apparently intended to distinguish between mobile network use and fixed network use. The obligations of PATS "at a fixed location" include network integrity, as discussed above.

All providers of VoIP service (which use WiFi or even wireline access) could argue that they are not "provided at a fixed location" because VoIP services can be highly location-independent.

Alternatively, regulators might seek to distinguish between considering certain VoIP network architectures as "provided at a fixed location". In this way, the future replacement to the PSTN might still be considered to be "PATS at a fixed location" and the potential problem of a loss in service availability could be evaded. Nevertheless, such an approach is dangerous as it will be very difficult to draw this distinction without causing distortions in the market (e.g. incentives for service providers and network operators to use particular architectures).

Consequently, to avoid distortions, VoIP provided over fixed networks should probably be considered to be provided "at a fixed location". A harmonised position on this issue might be worthwhile.

If users choose to use links at the edge of the network that use short range radio (WiFi/DECT/Bluetooth), then those users should be informed that the service may be less reliable as a result (just as some DECT handsets currently carry warnings about use in cases where there is a power cut).

Proposed approaches to definition of PATS and impact on provision of emergency services and network integrity

There are two choices, in principle, regarding the definition of PATS:

- Read the definition narrowly and state that any VoIP provider which does not offer access to the emergency services is not PATS, and any that does is PATS (which is clear and simple, but will lead to a disincentive to provide access to the emergency services)
- Read the definition in a very broad way and state that any VoIP provider that provides a service in direct competition with (and as a substitute for) the PSTN is PATS.

In the first of these cases, there are potentially profound implications for public safety if there are many devices that look like telephones but which cannot obtain emergency service. A small number of people every year will have their access to emergency services hampered by this, and the consequences could be fatal for some. While the choice to not provide access to emergency services might be up to the operator, it is also possible that the regulator could be blamed for setting unrealistically stringent quality standards on access to emergency services. In the second case, there can be an impasse arising from a disconnect between markets and technologies.

- If end users perceived a service to be PATS, or it was marketed as a substitute for PATS, then it would be obliged to provide access to emergency services and the required level of network integrity.
- If access to emergency services and network integrity has to be provided at a very high standard of quality,[49] probably only carrier internal use providers and 'Yahoo! BB'

[49] An interviewed regulatory organisation refers to this point.

providers will be able to meet this standard. B2 and FastWeb[50] acknowledge that their networks would fail in a power cut.[51]:

Therefore, a 'Vonage'-type service provider might be obliged to provide something it is incapable of providing.

Relaxing the requirements, for example, arguing that VoIP operators should be treated in a similar way to mobile operators as regards conditions relating to the quality of access to emergency services (e.g. as long as the reduced quality was made very clear to end users), may not be acceptable as a solution. This is because, in the long run, all networks might use VoIP and this relaxed requirement would change the quality of services offered to the public (specifically, access to emergency services and the availability of the telephony network in disaster situations).

It is not obvious what approach should be taken to the definition of PATS.

2.8.4 Extraterritorial service providers

It is possible that service providers (or providers of associated facilities) will be outside the EU. This is less of an issue for voice services than for data services because:

- service providers will usually have assets (e.g. voice gateways) in the country of interest, so will be reached by national law
- minimising latency is important to some voice services, so a local database may be a better solution for technical reasons (though this does not apply to call set-up, so services needed during call set-up, for example ENUM, need not be local).

Certain associated facilities could be in a different country, e.g. databases such as domain name system (DNS) or presence management databases, and these could be legally separate from the service provider. In such a case, regulators would not be able to apply

[50] An interviewed broadband network operator and an alternative broadband network operator refer to this point.

[51] We note that Yahoo! BB itself does not provide access to emergency service (it uses DSL line sharing, which allows the user to plug the telephone into the NTT line for this purpose).

their national law to the providers of the associated facility. As in the hypothetical case discussed in the presence management case (see Annex A.4.3), in such a case, it is difficult to see how such an associated facility could be regulated under the NRF, unless the EC was to mandate a particular standard in the Official Journal. (See Annex A.5.3.)

2.8.5 Impact on the relevant markets recommended by the EC

The EC has recommended a list of relevant markets to the NRAs on both retail and wholesale levels:

Retail level

1. Access to the public telephone network at a fixed location for residential customers.
2. Access to the public telephone network at a fixed location for non-residential customers.
3. Publicly available local and/or national telephone services provided at a fixed location for residential customers.
4. Publicly available international telephone services provided at a fixed location for residential customers.
5. Publicly available local and/or national telephone services provided at a fixed location for non-residential customers.
6. Publicly available international telephone services provided at a fixed location for non-residential customers.
7. The minimum set of leased lines.

Wholesale level

8. Call origination on the public telephone network provided at a fixed location
9. Call termination on individual public telephone networks provided at a fixed location
10. Transit services in the fixed public telephone network
11. Wholesale unbundled access (including shared access) to metallic loops and sub-loops for the purpose of providing broadband and voice services

12. Wholesale broadband access. This market covers 'bit-stream' access that permit the transmission of broadband data in both directions and other wholesale access provided over other infrastructures, if and when they offer facilities equivalent to bit-stream access
13. Wholesale terminating segments of leased lines
14. Wholesale trunk segments of leased lines
15. Access and call origination on public mobile telephone networks
16. Voice call termination on individual mobile networks
17. The wholesale national market for international roaming on public mobile networks
18. Broadcasting transmission services, to deliver broadcast content to end users
(Optional): 19. Conditional access systems to digital television and radio services broadcast.

VoIP services are potential substitute services within some of these markets and will need to be considered in reviews of these markets. Even though the VoIP market is small at the moment, it can be argued that VoIP needs to be considered as a prospective form of competition even in the first set of market reviews, currently under way.

As defined by the EC, Retail Call Markets 3–6 and Wholesale Markets 8–10 are PATS. As the process of economic market definition, by its very nature, seeks to include substitute products, certain VoIP services will be considered potential substitute services within many of these relevant markets.

In the market reviews, therefore, a 'broad' definition of PATS is used. However, there is not necessarily a strong argument for using a broad definition of PATS when deciding which services should have to meet the obligations of PATS.

Markets 1 and 2 could look radically different for a VoIP user; in such a case, Wholesale Relevant Markets 11 and 12 are key to ensuring access, and (for example) an operator such as Vonage can provide "access to the fixed telephone network" via a gateway. As the amount of VoIP-based access increases (specifically, using the 'Vonage' or 'Yahoo! BB' models) this will gradually mean that the regulation (e.g. the appropriate remedies to adopt, if there is SMP) of Relevant Retail Markets 1 and 2 will be linked to the state of Relevant Wholesale Markets 11 and 12 (as well as the take-up of VoIP services and broadband Internet access). This is an example of a gradual linkage between apparently unrelated relevant markets, which arises from the introduction of VoIP.

We note that it is possible for the national regulators to adopt different market definitions. If national regulators change these definitions, added complexity might result in this area.

Another impact of VoIP and associated convergent services on the relevant markets is that presence management in combination with voice services could, in certain circumstances, link together the wholesale markets for voice termination (Markets 9 and 16 of the EC Recommendation). It could do so because it would enable the fixed and mobile telephones to be alternative equivalent means of reaching a given end user. If the calling party knows that the called party is at his desk, the caller may choose whether to call a fixed desk phone or mobile phone. The termination markets would still be distinct in some circumstances (for example, when the called party was away from his desk), but this linkage will complicate the regulation of these relevant markets because it means that the monopoly of termination to customers on the operator's own network might no longer exist (in particular, for the fixed operator).

Regulators will need to monitor the development of presence management in conducting reviews of the relevant markets for voice termination.

2.9 The impact of growth in the VoIP market

In this section we discuss a number of topics that may be affected by the growth in usage of VoIP, specifically:

- USO funding
- broadband access
- regulatory costing
- use of VoIP by regulated operators.

2.9.1 USO funding

Changes to the telecoms market arising from the adoption of VoIP will change the net cost of providing Universal Service.

Three effects contribute to this:

- **Long-distance and international voice call profits will be reduced** (either by loss of market share of the incumbent, or by lower prices resulting from competition, or both). This effect will probably be slow (because customer migration is a relatively slow process: churn in fixed voice services is quite low) and a relatively small addition to current trends (because it depends on large scale uptake of VoIP over broadband connections, and there is already substantial competition from indirect access providers).

- **The access network costs will be spread over fewer lines**. Changes to the total number of access lines rented will be small, because most broadband end users will use products based on line sharing (except in countries with very widespread cable networks). Nevertheless, even a few percent fewer end-user lines (resulting from the use of "second line replacement" services and multiple line services for SMEs based on IADs) can have significant effects on the cost of access. This is because the cost base of the access network is (in essence) almost all fixed cost, thus 1% fewer lines implies nearly 1% increased cost per line. As a result, line rentals may have to rise slowly to match increased per-line access costs resulting from a lower total number of lines. If the rise in line rental charges (to maintain balanced tariffs) did not happen e.g. due to inappropriate price caps, the net cost of USO will increase here too.

- **Loss of revenue to 'free' services.** A third effect is that the small amount of voice telephony traffic revenue is genuinely lost to self-provided consumers. VoIP use cannot be effectively 'taxed' (for example by a USO levy on ECS revenues) because:
  - firstly, there is no revenue to tax (a 'free' service)
  - secondly, there is no service provider to tax
  - thirdly, there is no call data on which to base any levy.

All three of these effects are, in our view, relatively small in Europe, at least in the medium term, but they are cumulative, will all cause gradually increasing pressure on the funding of USO. In the short term, these arguments will be most noticeable in countries where the net cost of USO is already explicitly funded (e.g. France).

As noted elsewhere, under the NRF, all operators providing public ECS (i.e. not just providers of PATS) can be subject to mechanisms to share the net cost of USO.[52]

2.9.2 Broadband access

Although we see having broadband access as key to the adoption of VoIP for the DIY, 'Vonage', and 'Yahoo! BB' models[53] the reverse is not the case – VoIP is not itself likely to greatly increase the demand for broadband. The availability of cheaper voice calls using VoIP is likely to be a small incremental driver for buying broadband.

VoIP is not yet used by a very large fraction of broadband customers in Europe, therefore, it is not the primary reason to purchase broadband.

VoIP does not offer dramatically lower call costs compared to indirect access operators, until a substantial number of the calls made are on-net. Even if broadband penetration were to reach 25% of all lines, and all of these took VoIP, that would still make only roughly 6% (25% of 25%) of a random selection of fixed-to-fixed calls VoIP to VoIP. (This assumes that broadband customers are as likely to want to call other broadband customers as anyone else). Not all of these potential end-destinations will be on-net (many will have a different service provider, and not all of these will interconnect with 'VoIP peering' enabling free retail calls). Therefore, VoIP is not a compelling reason to buy broadband: although VoIP may be 'nice-to-have'.

What may have more of an effect on broadband take-up is if a "second line replacement product" (like 'Vonage') was used to replace the 4% of residential lines that are second lines (e.g. used for dial up Internet access).[54] However, even in this case, broadband is still more expensive than the second line.

---

[52] An interviewed specialist software vendor raises the issue, but is assumed to be referring to the USA or non-EU countries.

[53] An interviewed VoIP provider and a large vendor also make this point.

[54] An interviewed VoIP provider refers to this point.

2.9.3 Regulatory costing of voice telephony interconnection

IP-based voice technologies may change the underlying costs of providing certain regulated telecoms services (e.g. voice termination). In Analysys's view, this is not a new issue, although it may create considerable work for the regulators' economists, and 'only' requires that regulators are both aware of the new cost structures (which may, in itself, be difficult, given that equipment and software prices may be rapidly changing) and able to incorporate these into their regulatory cost models in appropriate ways.

There are two quite distinct mechanisms by which VoIP might have a material impact on voice telephony markets:

- VoIP may lower barriers to entry and expansion in voice telephony markets, thereby increasing competition, even if it were not actually a significantly lower cost technology
- VoIP may be a significantly lower cost technology for supplying voice telephony.

Impact of increased competition

Increased competition in the supply of voice telephony services is widely considered to be of benefit to consumers and the economy, even if such increased competition is not immediately accompanied by dramatic reductions in voice telephony prices. The dynamic benefits of competition in the supply of telecoms services: the increased incentive on operators to become and remain efficient, and to innovate in order to gain competitive advantage, are generally considered to out-weigh any reduction in static efficiency (an increase in total costs) that might arise from having demand spread across multiple suppliers in an industry that is widely acknowledged to experience economies of scale.

As VoIP may increase competition in the supply of voice telephony services, and a commensurate reduction in the market share enjoyed by incumbent operators, it may, therefore, lead to a reduction in the economies of scale enjoyed by the incumbent operator. However, it is important to realise that the impact of this reduction in incumbents' market share will tend to be narrowly focussed on the PSTN-specific parts of their networks; even if the incumbent operator no longer carries voice telephony traffic on its PSTN, it is still

likely to continue to carry a very high proportion of this traffic as asynchronous transfer mode (ATM) or IP traffic, certainly over those parts of its network closest to the end user.

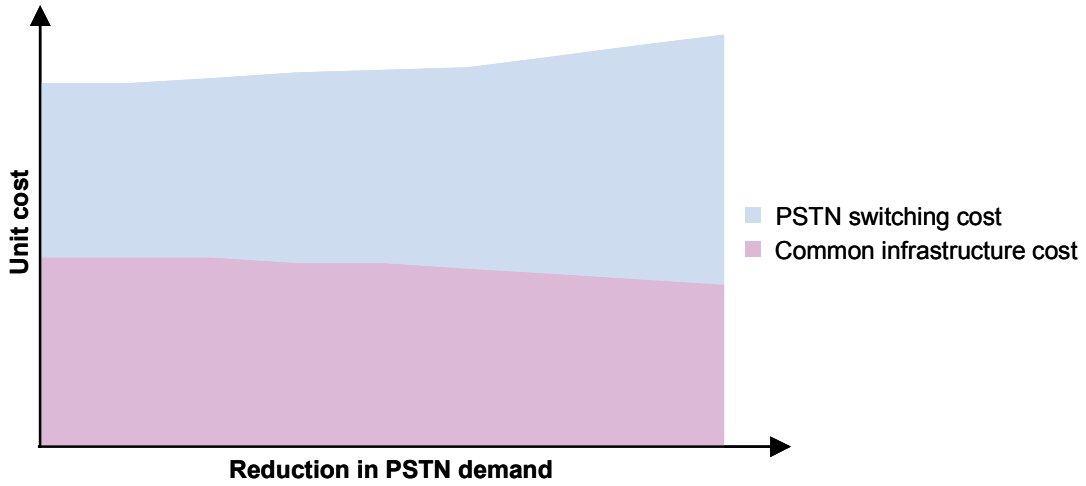

Exhibit 2.12: *An illustration of the impact of VoIP on the cost of PSTN [Source: Analysys]*

Any reduction in the economies of scale enjoyed by incumbent operators as a result of increased competition for voice telephony services is therefore likely to be focussed solely on PSTN-specific assets and activities e.g. switches. At the same time, the incumbent operator is likely to enjoy a significant increase in the volume of ATM and IP traffic that it is asked to carry, and hence, see increased economies of scale in the carriage of these types of traffic.

As competition increases, and economies of scale reduce for incumbents, we would consider it reasonable for cost-based interconnection charges to increase (or at least not to decline as rapidly as they might do otherwise). However, it is vital that any cost models used to set such interconnection charges reflect the totality of demand for the services supplied by regulated operators, and hence, the true economies of scale that they enjoy, and not focus narrowly on the demand for traditional PSTN services (in other words a total network model rather than a stand-alone PSTN network model).

When regulating interconnection (and retail) prices, NRAs should properly understand the impact of reduced PSTN, but increased ATM and IP traffic volumes, on the efficient costs of supply for incumbent operators.

Impact of lower cost technology

Irrespective of its impact on competition, VoIP may have the potential to reduce the costs of supplying voice telephony services (or increase the value derived by consumers at the same total cost). If this were to be the case, in a competitive market this would lead to a reduction in (retail) prices. As a result, operators of old technologies (PSTN) might be obliged to undertake (unanticipated) write-downs of the value of their existing assets, since they would no longer be able to earn the returns from those assets that they had previously anticipated.

The cost of such unanticipated write-downs should be borne by investors. In a competitive market, it would not be possible for the operators of old technology to pass on those write-downs to customers through higher prices, because those customers would have the choice of buying their service from the operators of the new technology.

However, it would be wrong to think that this represents a transfer of value from investors to customers. The risk that new technology will reduce the value of existing assets faster than anticipated is clearly one component of the overall risk faced by telecoms operators and, no doubt, will have been factored into the returns demanded by investors for the use of their capital. In other words, investors have already been recompensed for the risk that new technology will reduce the value of their investment more quickly than anticipated, through a weighted average cost of capital (WACC) that includes an (implicit) allowance for such risk.

Similarly, to the extent that the introduction of VoIP technology necessitates the bringing forward of investment by an incumbent (for example the early replacement of PSTN assets by VoIP assets), the risk of such early investment should have been foreseen by investors, and reflected in the return on capital employed that they require.

Thus, to the extent that NRAs have historically regulated (and continue to regulate) prices on the basis of the costs of supply that include a cost of capital commensurate with that reasonably required by investors (reflecting the risks that they face), and permits depreciation of the value of assets in line with reasonable expectations of future cost trends, there should be no need for any increase in prices, or windfall loss imposed, as a result of

the adoption of a lower-cost (new) technology as the standard for the valuation of assets (i.e. the modern equivalent asset)[55].

NRAs should continue to use forward-looking economic cost models as the basis for price regulation. The cost of unanticipated write-downs of the value of pre-existing assets should not be included in the cost-base used to regulate prices (or to assess the economic return generated by services).

If VoIP is not a lower cost technology, but a higher value one, then any increase in total cost should be 'allocated' to new 'added value' services, and not basic voice telephony.

2.9.4 Use of VoIP by regulated operators

Incumbent operators may choose to deploy VoIP technology, which raises the question of whether a single 'voice termination' rate should be charged for termination across both the PSTN and VoIP networks, or whether separate termination rates should be allowed (and if so, whether both should be regulated)[56].

As previously discussed, VoIP combined with presence management has the potential to remove the barriers to competition between networks for termination, and thereby convert the currently separate individual network termination markets into a smaller number of multi-network termination markets (at least for voice traffic). However, in the interim, we can expect terminating operators to continue to dominate their respective individual network termination markets. In this situation, it is important to understand how termination should be viewed when terminating operators employ multiple networks.

---

[55] True forward-looking cost models, whether they use economic depreciation or (tilted) annuities, will naturally tend to produce results that correctly ignore any such exceptional write-down of pre-existing asset values. Alternatively, cost models based on financial information are more likely to (incorrectly) include such write-downs in the calculated costs of service, although they may also have incorrectly depreciated the value of assets in the past.

[56] This refers to the termination of traffic that is explicitly identified as voice traffic, not the interconnection of basic IP traffic, which may, in fact be carrying voice data).

In this instance, the technology used to transport the voice telephony traffic to its destination should not be confused with the technology of the interconnection interface between the two networks. The issue of who should pay for gateways between VoIP and PSTN has already been discussed in Section 2.7.5.

Where the terminating operator employs both old and new (PSTN and VoIP) technologies to terminate calls, a number of different cases need to be distinguished:

- Case 1: The originating operator and terminating end-user have no choice as to the technology used by the terminating operator to transport the call
- Case 2: The terminating end-user has chosen a particular technology for the termination of calls to them (presumably linked to a decision about the technology used to transport outgoing calls) and the originating operator has no choice
- Case 3: The terminating end-user has not chosen a particular technology for the termination of calls to them, but the originating operator is able to do so on a call-by-call basis.

In the first case, it is clear that the terminating operator should charge the same price for termination, irrespective of the technology that it uses to terminate the call (since neither the originating operator, nor terminating end-user is able to act on any differential price signal that might be given). Furthermore, to the extent that it is appropriate to regulate the price of such termination, the relevant cost benchmark would clearly be the efficient cost of supply using the most efficient technology, irrespective of the mix of technologies actually used by the terminating operator (especially as the terminating operator's decision to use both technologies in parallel would provide *prima facie* evidence of them being equivalent).

In the second case, it is no longer necessary for the terminating operator to charge the same price for termination of calls using the two different technologies (since at least one party to the call is able to respond to a differential price signal). However, if there is a case for regulating the termination charges levied by the terminating operator, then it will almost certainly be necessary to (separately) regulate the prices charged for termination using each technology. End-user choice does not prevent terminating operators from dominating the termination market.

Only in the third case might it be possible to regulate the termination charges levied by the terminating operator for only one of the two technologies. In this example, it is the originating operator (and perhaps their customers) that is able to choose which technology to use on a call-by-call basis, and hence which termination charge to incur. For this to be acceptable, however, the quality of service offered using the two technologies must be

comparable, and the regulated product should be the one based on the lower cost technology.

In summary:

Where terminating operators control the choice of technology used to transport terminating calls, they should not be allowed to charge different prices for the use of different technologies. In these circumstances, and if termination prices are to be regulated, the relevant cost benchmark is the efficient cost of supply using the most efficient technology, irrespective of the mix of technologies actually used by the terminating operator.

Where terminating operators permit terminating customers to select which technology is used to terminate calls (but not the originating operator), it would be acceptable for terminating operators to charge different termination prices for the different technologies, but in those circumstances where it is appropriate to regulate such prices, the prices for termination of calls using both technologies will need to be regulated (separately).

Where terminating operators permit originating operators to select which technology is used to terminate calls, it would be acceptable for terminating operators to charge different termination prices for the different technologies. Furthermore, if it is appropriate to regulate the prices of termination, it may only be necessary to regulate the price charged for use of the lower cost technology.

2.10 Conclusion

The different forms of VoIP service considered in this section can create a number of effects:

- additional competition (where it is economically viable)
- reduced prices
- reduced costs of providing telephony services
- allow users to make a trade-off and choose lower quality, lower price solutions
- enable new services.

Different types of service have different effects:

Service type	*Impact for user*	*Impact for service provider*
Self-provided consumer (DIY)	Option of lower quality, lower price	N/A
	New services	
	Reduced costs	
Independent of Internet access ('Vonage')	Additional competition	Reduced costs
	Reduced prices	New services
	Option of lower quality, lower price	
	New services	
Provided by broadband access service provider ('Yahoo! BB')	Additional competition	Reduced costs
	Reduced prices	New services
	New services	
Corporate internal use on business LAN/WAN ('IP PBX')	Reduced costs	(If provided as a managed service:
	New services	Reduced costs
		New services)
Carrier internal use	International routes: Reduce prices	International routes: Reduced costs
	National operators: New services	National operators: Reduced costs
	Match competitors prices	

All of these are good for the EU telecoms market as a whole, as they will generate both consumer surplus (from reduced prices) and producer surplus (from new services, and new equipment).

It is very unlikely in the short to medium term that any VoIP service provider will obtain SMP in any of the (existing) relevant markets. However, as already noted, it is clear that VoIP services used on fixed networks, despite their location independence, are potential substitute services within many of the defined relevant markets "at a fixed location" and will need to be considered in future market reviews of these markets.

It is, however, possible that regulatory intervention will be needed if another player seeks to use control of some choke point to discriminate against VoIP providers. It is also important to ensure that the way in which the NRF is implemented by governments and regulators does not create unnecessary difficulties for VoIP service providers (such as availability of numbers within the national E.164 range).

3 Associated convergent services: instant messaging and presence management

3.1 Introduction

In this chapter we look at instant messaging and presence management (IM and PM) as an example of an integrated data service, which is interesting in its own right (it is large and competitive), but also because it is converging with voice services in several ways: via its underlying protocols and through voice chat services being added to the basic IM service, which may also be extended into a 'telephony' service by the use of gateways into the PSTN.

Our discussion of IM and PM is also of a wider relevance. There may be many other future services similar to IM and PM, which will raise corresponding regulatory issues.

The structure of this chapter is as follows:

- description of the service and how it works (Section 3.2)
- discussion of how this service is likely to be used (Section 3.3) and how it works as a business (Section 3.4)
- examination of the potential impact of this service and where the benefits are likely to arise (Section 3.5)
- consideration of the barriers to commercial deployment of this service (Section 3.6) and issues relevant to regulators (and, in particular, the NRF) (Section 3.7)
- discussion of potential remedies within the NRF (Section 3.8)

- conclusions regarding the regulation of IM and PM and more generally for similar services (Section 3.9).

Ex-ante regulation is not our aim. In particular, it should not be assumed that because we examine in great detail the kinds of regulatory remedies available, we are in favour of their use. We are simply trying to draw out the relevant issues associated with each potential remedy.

3.2 Instant messaging and presence management

There are a variety of 'chat' or instant messaging services available over the Internet. These are systems such as AOL Instant Messenger, ICQ (also owned by AOL), MSN Messenger, Yahoo! Chat, etc., that can be used to exchange small, text-based messages. It is a service not unlike email, but in near-real-time, allowing users to chat informally. Both fixed and mobile versions of this service are available.

In order to use these services, it is useful to know when friends are available to chat and how to contact them. Presence management is a service for finding, retrieving, and subscribing to changes in the current status of other users (e.g. 'online' or 'offline').

In future, user presence information may be more 'fine grained' (e.g. the user is listening in on a desk-based conference call, but is prepared to be interrupted by an urgent request) by being linked to, e.g., a diary, mobile phone setting, current location, what applications the user has open, etc.

Another example is a conference call where the user can see the identity of callers on screen as well as other status information, such as who is on hold and who is speaking.

3.3 Technical basis for IM and PM

End users have a piece of compatible client software, often downloaded from the Internet. The client software connects over the Internet to a central server, which monitors the presence of the user (i.e. that the user is online, which Web pages s/he is browsing, etc.). It

can also monitor the presence of a user's 'buddies' via this central server. Exhibit 3.1, below, illustrates the user's view of the client application.

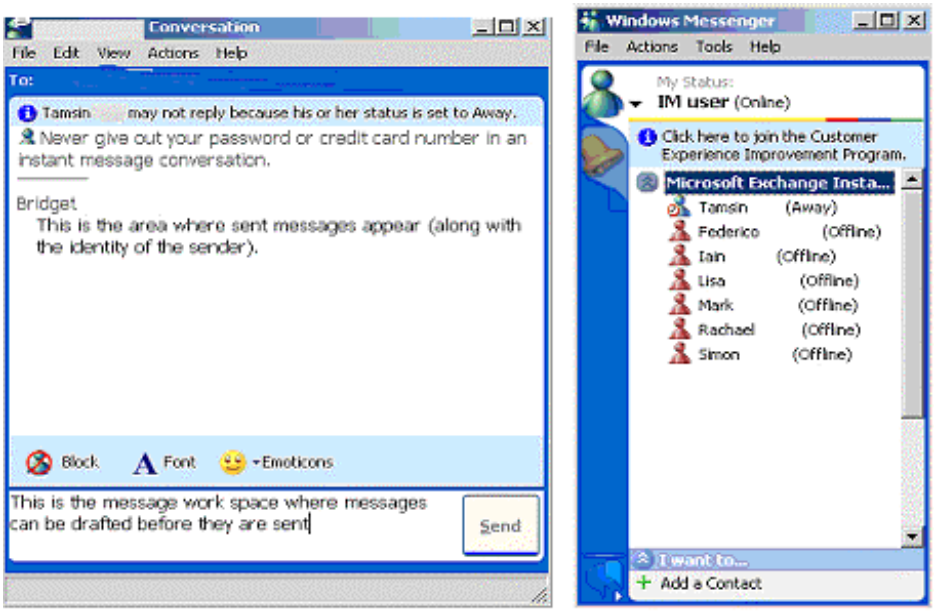

Exhibit 3.1: *Example message screen and buddy list [Source: MSN]*

The client can be used to exchange small, text-based messages with buddies and other users – like email – in near-real time. Unlike email, these messages are sent directly to their destination (not routed via the server).

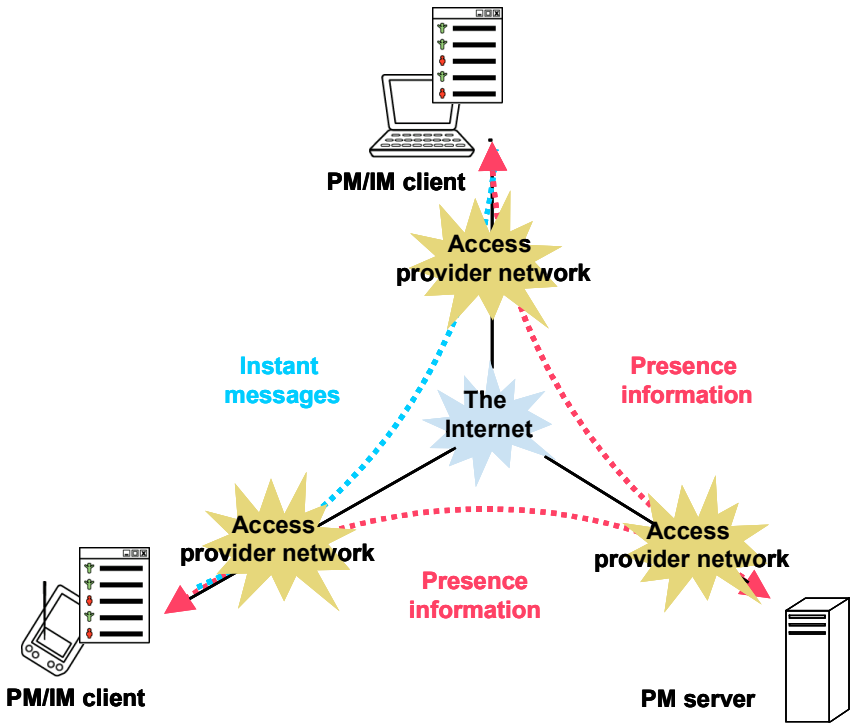

Exhibit 3.2: *Information flows in the IM and PM service [Source: Analysys]*

Multiple-user forums ('chat rooms') are also provided that use a similar functionality.

Various enhancements to the basic service allow a user to:

- send images and files
- customise the client software's appearance (through 'skins')
- encrypt or log files
- initiate phone and videoconference calls.

3.3.1 Standards used

The protocols used by the majority of IM service users are closed (proprietary). For example, AOL's two services, AIM and ICQ, both use a closed AOL protocol called OSCAR. (Despite this, they are only just starting to become interoperable.)

One of the possible standards that can be used for VoIP, SIP (RFC3261) is highly relevant to IM. It already provides session-oriented application initiation and certain presence management facilities (RFC3265). Internet RFC 3428 proposes an extension to SIP to provide basic IM facilities within SIP itself (actually carrying the message using SIP, rather than just using SIP for session initiation). There are open standards available to IM providers, but providers have chosen not to use them for commercial reasons.

It is far from clear that SIP (as extended by RFC 3428) or other open standards, such as Jabber, will ever be widely used, despite their attractiveness (in terms of being open standards), and given the strength of AOL, MSN, and Yahoo!'s market position and reliance on closed standards.[57] Microsoft has shown some enthusiasm for SIP (it is built into Windows XP) but it remains to be seen whether Microsoft will try to adopt an open standard on this occasion.

The lack of open standards means that end users need to use the client software appropriate to the buddy they wish to send a message. For this reason, users have multiple accounts on different systems (e.g. MSN, AOL). This is also supported by a recent Forrester report stating that 20% of AIM users have an account on another system.

Interestingly, large, corporate end-user organisations, frustrated by the lack of interoperability for business use of IM and the consequent "multiple IM products taking up valuable real estate on the desktop" have created a user group (the Financial Services Instant Messaging Association – www.financialim.org): interoperability is key amongst their needs.

3.4 How IM and PM works as a business

The basic service offered by AOL, MSN and Yahoo! is free to end users, even those on a different ISP. The messages themselves are exchanged directly between the end users using the Internet – if on a flat-rate ISP, this is at no incremental cost to the end users. The IM

[57] Interviews with a standards organisation and a specialist software vendor disagree and think that the open standards will prevail; Analysys thinks this will not occur.

and PM service providers incur the costs of running the servers and creating the server and client software.

So who pays?

- End users:
  - AOL charges for the 'Expressions' skins on its AIM client software.
  - Microsoft has added improved parental controls in MSN Messenger, but these facilities are only available for MSN's paying customers
  - Business use of IM can require extra functionality: for example, logging of messages for compliance purposes in the financial industry, or making the system work in a secure manner for intra-company use, or working through a secured firewall. The software to do this exists (often created by third parties, though requiring knowledge of the protocols) and is charged for.
- Third parties:
  - In some cases, advertisers now pay the service providers for their adverts to be displayed in the client software. This development means that control of the client software is becoming more important to the operators of the servers, and they will seek to put an end to multiple-system clients (such as Trillian). A multiple system client is one piece of software on a PC that allows a user to send messages to friends on all three major IM systems. These clients are not under an operator's control, and endanger the advertiser-funded business model, as there cannot be three or four sets of adverts simultaneously on an end-user screen.
  - Paid-for multicast IM (bulk mailings of instant messages) are also sold to companies wishing to use IM to reach their existing customers.
- The IM company absorbs the cost:
  - In other cases, the IM providers are hoping to be able to generate additional (and paid-for) value added services at some point in the future. It is yet to be seen whether this is a viable hope; this dotcom business model (make losses now, hope for returns in the future) creates a financial barrier to entry to this market.

Exhibit 3.3, below, illustrates the revenue flows and commercial relationships within the IM market itself. The end user's Internet access and the presence management service provider's Internet access have been omitted for the sake of clarity (even though they may well be the dominant costs, given that most of the large IM services are free).

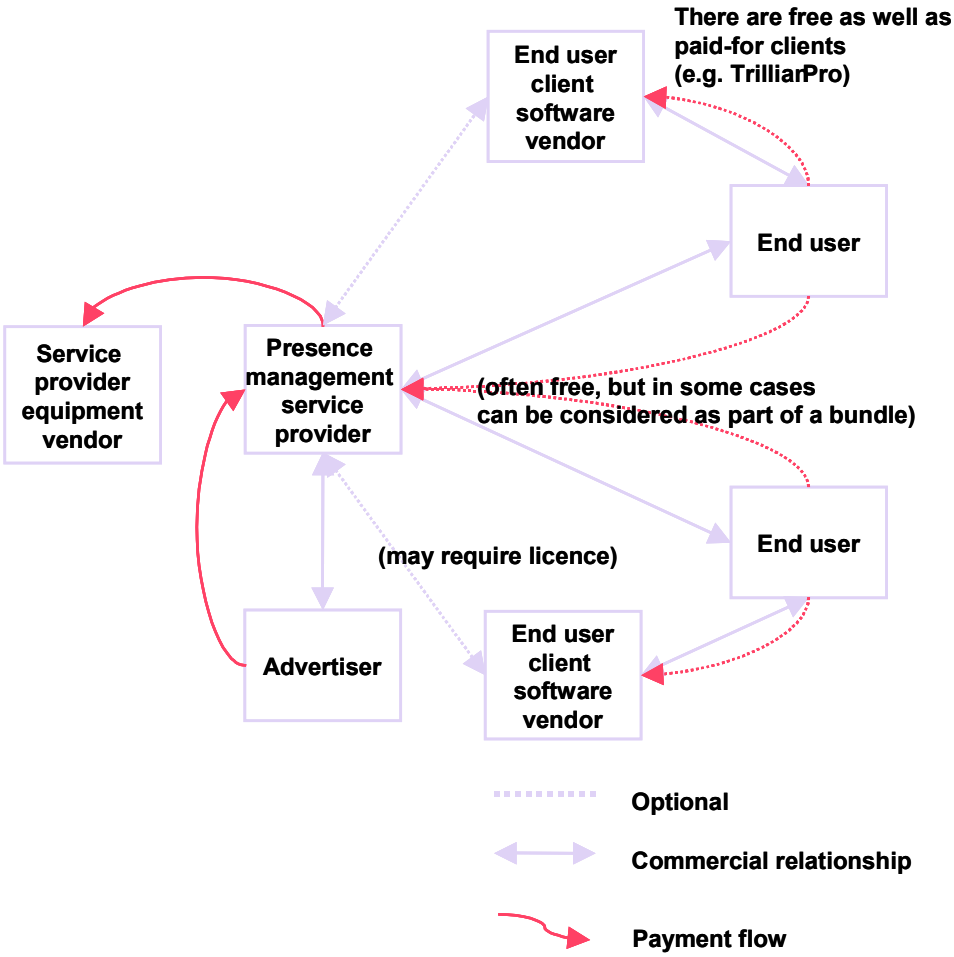

Exhibit 3.3: *IM and PM business model [Source: Analysys]*

3.5 The potential impact of IM and PM on the telecoms market

End users appear to be very attracted to this service, which offers an immediacy and informality similar to SMS at a very low cost. IM is thus an extremely popular service and already has of order 400 million users worldwide. AOL has approximately 160 million active users worldwide. Microsoft has over 100 million active users worldwide (Source: ComScore Media Metrix, November 2003).[58] According to IDC and Meta, more than 1

[58] If we wish to be quantitative, the ability to (and the need to) have an account on multiple systems simultaneously, for free, means that it is difficult to accurately estimate the current number of IM users.

billion messages per day are sent using instant messaging applications. Yankee Group reports that the number is well above 3 billion IM transmissions per day.

With regard to forecasts, the Radicati Group forecasts threefold growth in subscribers and slightly lower growth in messages per day by 2007.

3.5.1 Where are the benefits going to arise?

As previously noted, the immediacy and informality of this service gives end users a valuable alternative to email, voice telephony, and SMS. Many of these benefits have already been obtained, though there remains a substantial opportunity for growth in the use of IM, both in the residential market (which will come both from increased use of PCs and wider uptake of IM by current PC users who have not yet started to use it) and, in particular, as an informal communication tool within and between businesses.

More widely, integration of presence management with telephony is particularly attractive[59] in that it can provide more sophisticated features, which are not possible with traditional telephony, giving the end user more control, especially if the user presence information is more fine-grained.

This presence information could also be used to support certain new features in (unified) messaging systems: messages could be rerouted to email, SMS, or IM, depending on what devices are on, what applications the users have open and user location.

This is not to say that such sophisticated presence management facilities will be easy to offer to end users. The user interface challenges alone are considerable, especially if the user's preferred device has a small screen (such as a mobile phone) or limited means of data entry (e.g. numeric keypad).

Features such as integration of presence with telephony were once thought by the telephony standards community to be achievable using IN. As with many such efforts, this

[59] Interviews with a VoIP service provider and a specialist software vendor agree; an interviewed mobile operator agrees, but says that location is more valuable than presence.

was a failure.[60] Instead, IN has been much more widely used for much less ambitious services created by telecoms network operators and service providers that have very little end-user interaction, and are well matched to the numeric keypad interface: non-geographic numbers, number portability, and prepay systems.

3.6 Barriers to commercial deployment

This is a relatively new and growing market, but it has an interesting history, and two potential choke points:

- presence management data
- access networks, in particular, mobile access networks

The most significant of these is protocol for access to the presence management data.

3.6.1 Presence management data

The major player, AOL, as the owner of two of the largest systems (AIM and ICQ) has not made its protocol open, and has (in effect), tried to maintain its share of this market by not interconnecting (specifically, not allowing competing clients to interact with its server). AOL is using access to presence management data as a choke point because as the largest player, it will gain the largest 'network benefits'.

Network benefits arise when consumers' benefits (from using a product or service) depend on the number of other users of a compatible product or service. Therefore, the biggest supplier of a closed system can provide the greatest benefits to users, and has the least incentive to open the system. At the extreme, this is why interconnection regulations are needed to introduce competition into the telephony market. Nevertheless, providing interoperability is not a trivial undertaking: it is only very recently that AOL has announced that it will provide interoperability between its own two services, AIM and ICQ.

[60] An interviewed specialist software vendor agrees with this point.

MSN and Yahoo! have responded by building parallel systems and matching the business model. This has been reasonably successful (mainly due to their large existing base of ISP customers in the USA) and they now have appreciable market share (around 20% each). Microsoft has also bundled MSN IM into Windows XP.

Certain third-party software houses have tried to reverse-engineer the protocols in order to allow a single application (end user client software) to interact with multiple central servers. In this way, the end users need not know which 'presence server' is being used, as long as they have accounts on each of the major ones (which are, after all, free). Odigo and Trillian are examples, however it should be noted:

- AOL periodically breaks this compatibility by changing the protocols.
- MSN is in the process of requiring client software to be licensed – the implications are not yet clear, but could require third-party clients to pay a fee, which could severely impact them (Odigo and Trillian are free for basic services, Trillian has a paid for version with additional features). In the worst case, this could effectively close the MSN Messenger application to third-party clients, given that the MS client is free.

The technical barrier being erected is access to the presence management information, specifically via the protocol (or, arguably, application program interface (API) used. This barrier could be considered either a technical one (lack of documented protocol) and/or a commercial one (not prepared to give free access to the server).

During the AOL Time Warner merger proceeding, a number of IM providers petitioned the Federal Communications Commission (FCC) to require AOL to open its IM standard. The FCC decided against this, but did see a danger in allowing AOL to leverage its position in IM with Time Warner's offering of broadband Internet services for the offering of future IM services that required broadband (e.g. IM with video), and as a result, imposed a condition relating to IM on the AOL/Time Warner merger. This condition prevented AOL from launching enhanced video messaging via IM for five years, or until such a time as either AOL IM was interoperable with other services by adopting an open standard (or by making multiple commercial agreements) or by showing that the imposition of the condition no longer served the public interest because there had been a material change in circumstance. This imposition of a condition was very unusual because the FCC has been highly deregulatory for Internet services in general.

AOL has not provided interoperability, and has recently petitioned that these conditions be withdrawn on the grounds that the public interest was not served, given that Yahoo! and MSN have both launched services similar to those which AOL is not allowed (under the conditions). The FCC agreed and the condition has been withdrawn.[61]

3.6.2 Access networks

Fixed access networks

As is noted elsewhere in this document, operators of the access networks are in a position to block access to specific services. However:

- a non-dominant provider is unlikely to block access to specified addresses or ports because customers will go elsewhere if this occurs
- as previously discussed, an operator with SMP cannot do this.

This issue is very unlikely to occur within fixed networks because operators have no incentive to block access to IM.

Mobile access networks

IM is, in effect, a substitute for SMS; both are near-real-time short messages, used in an informal way, by a youthful user group.

IM can be transformed into SMS and vice versa, and because SMS is a premium product, IM as SMS is not a threat to mobile operator's revenues. In the long run, however, IM on mobile networks can be a serious threat[62] to the revenues that operators earn from SMS, because IM can run as a GPRS application on the handset/PDA or laptop. This GPRS traffic is likely to be considerably cheaper than SMS (SMS is priced on a 'per message'

[61] FCC-03-193A1 decision on IM.

[62] An interviewed specialist software vendor agrees with this point.

basis, which works out in the order of EUR1000/Mbyte, compared with approximately EUR1.75 per Mbyte for GPRS).

Some GPRS operators are already offering IM services on a limited set of handsets. O2 in Germany and the UK is one example. Interestingly, however, O2 is charging an additional per-day subscription for this service (approximately EUR1 per day in the UK – equivalent to 20 SMS per day), which lessens the revenue threat somewhat.

If the mobile operators offered a completely open access to the Internet, then they would not be able to charge this extra fee for access to IM, and their SMS revenues would be threatened. This issue is also discussed in Section 2.4.

3.7 Issues relevant to regulators

Within this section we look at the application of the NRF to IM and PM, in particular, with a view to discovering issues that may be relevant to other, similar services. Areas of interest include:

- In what way does the NRF apply to the instant messaging or more particularly the presence management market?
- Is IM and PM part of an existing relevant market?
- What would be the impact on hypothetical regulation of this or similar associated convergent service markets if the associated facilities provider was located outside the EU?

3.7.1 Application of the NRF to IM and PM

In summary, the NRF probably applies to instant messaging (as an ECS) but it could be argued not to apply to presence management (on the grounds that PM is not an ECS). PM could, however, be argued to be an associated facility of IM.

We examine each of these three major points below:

- IM as an ECS
- information society service arguments
- PM as an associated facility.

IM as an ECS

As stated in the Framework Directive Article 2 (c), an electronic communications service means:

A service normally provided for remuneration which consists wholly or mainly in the conveyance of signals on electronic communications networks, including telecommunications services and transmission services in networks used for broadcasting, but exclude services providing, or exercising editorial control over, content transmitted using electronic communications networks and services; it does not include information society services, as defined in Article 1 of Directive 98/34/EC, which do not consist wholly or mainly in the conveyance of signals on electronic communications networks.

There is existing European case law,[63] which states:

…sporting activities and, in particular, a high-ranking athlete's participation in an international competition are capable of involving the provision of a number of separate, but closely related, services which may fall within the scope of Article 59 of the Treaty even if some of those services are not paid for by those for whom they are performed.

This shows that:

- a bundle of services can be considered as provided for remuneration even if some of the services are 'free'
- the remuneration does not have to be paid by the end user of the service (so an advertising-funded service is considered as provided for remuneration).

[63] DG Market Guide to the case law of the European Court of Justice on Articles 49 et seq. EC Treaty.

Many of the large IM providers have retail ISPs, and gain revenue from their ISP customers for the entire bundle of services, so it would be difficult for them to argue that they gain no revenue from this service. The IM service providers may also gain revenue from advertisers if they use a business model funded by advertising. As a result, these services are almost certainly "services normally provided for remuneration".

It is also arguable that IM is exempt because it is a "service providing content" transmitted over ECN and ECS (in this case, the Internet access service). IM, however, is "a service… which consists mainly in the conveyance of signals on ECN…", and so we are of the opinion that it is an ECS.

These are not points that only apply to IM. Very similar arguments could be applied to VoIP services, one could argue that a voice transmission is actually content. In exactly the same way, however, voice is "a service… which consists mainly in the conveyance of signals on ECN…" and so it appears to be an ECS.

Information society service arguments

Presence management is arguably not an ECS, but "an information society service which does not consist mainly in the conveyance of signals on electronic communications networks". We expand on this argument in Annex A.4.1.

If presence management is an information society service (ISS), then the NRF does not apply. However, the ISS Directive might be considered to allow more intrusive regulation in some areas than those under the NRF, so it is possible that PM providers may wish to argue that PM is indeed an ECS.

PM as an associated facility

Presence management could be argued to be an 'associated facility' of instant messaging.

Associated facilities means those facilities associated with an electronic communications network and/or an electronic communications service which enable and/or support the provision of services via that network and/or service. It includes conditional access systems and electronic programme guides[64].

We suggest that the concept of associated facilities may be appropriate to apply to automatic and essential access to address translation / presence / location information databases (depending on the service considered).

The views of some regulators on this issue are discussed in Annex A.2 .

Exhibits 3.4 and 3.5 below show how the roles of the DNS server and presence management server are similar. In both cases, the server translates a name into an address; in both cases it is in some way essential to the use of the communications service.

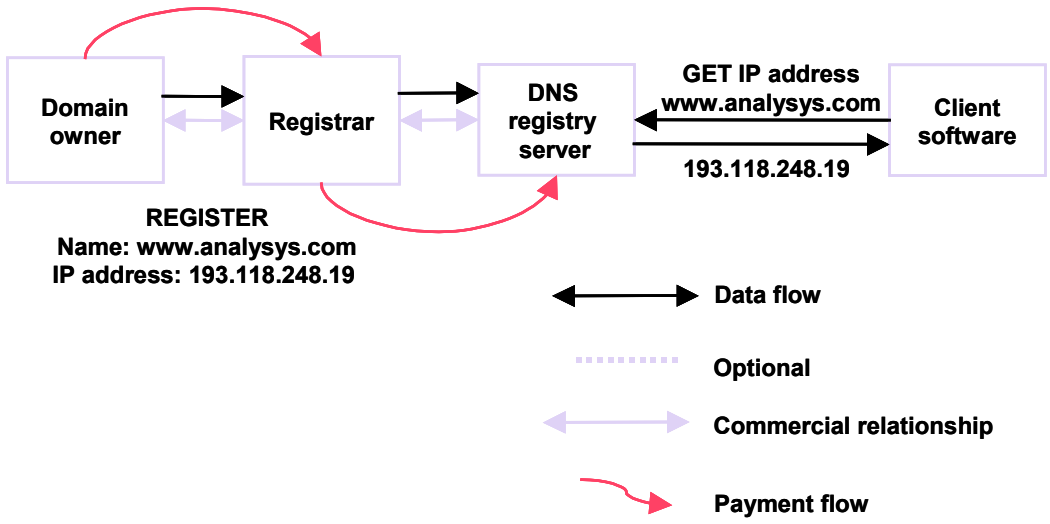

Exhibit 3.4: *Schematic of information flows within a DNS service [Source: Analysys]*

[64] Source: Framework Directive Article 2.

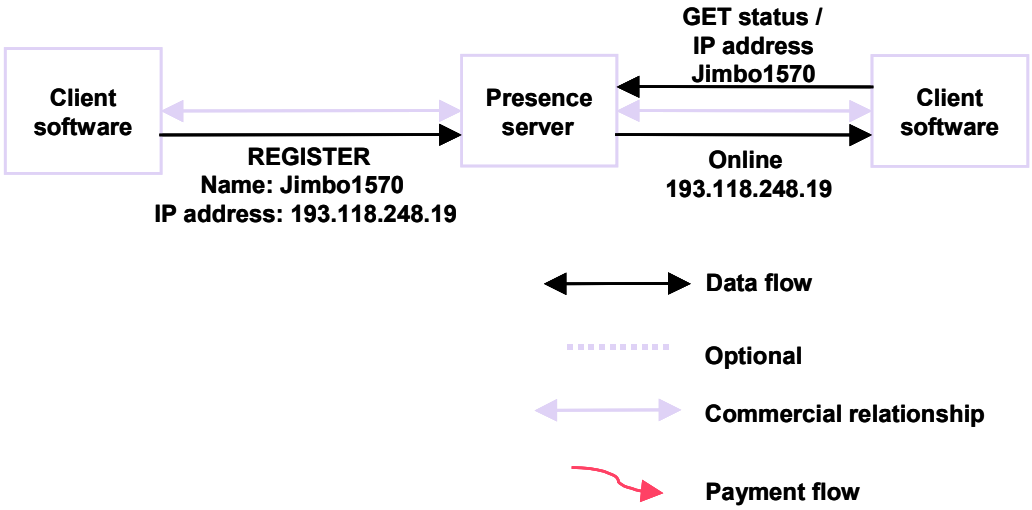

Exhibit 3.5: *Schematic of information flows within a presence management service [Source: Analysys]*

It can be argued that DNS is not essential for Web browsing, as it is possible (if inconvenient) to reach many Web pages via direct IP addresses. Nevertheless, if, for example, the future ENUM[65] system uses DNS (as is proposed), then it will be an essential means of converting telephone numbers into IP addresses.

The procedures for determining whether a particular network or service element is to be considered an associated facility are rather unclear. Some kind of harmonised position on this issue may be worthwhile.

3.7.2 Treatment of voice chat services

We have already argued that IM is an ECS. If an enhanced IM service were to be a PATS, it would be subject to many more costly and intrusive general conditions of authorisation.

[65] ENUM is a proposed DNS-based standard (RFC 2916) from the Internet Engineering Task Force that maps phone numbers to URIs, and ultimately, IP addresses.

For the time being at least, a voice chat service using IM infrastructure (like Apple's iChat AV) is not a PATS because it does not "originate and receive national and international calls and access to emergency services through a number or numbers in a national or international telephone numbering plan". It uses its own addressing system (IM user identities), and does not provide access to the emergency services.

A voice chat service that had a gateway to the PSTN might, however, start to meet these criteria. Nevertheless, it might be argued not to be a PATS, even if it did provide national and international calls and access to emergency services because it was not the same quality and was, as a result, not a substitute for the PSTN. A much more extensive discussion of this issue and how it may be addressed is given in Section 2.8 of the previous chapter.

3.7.3 Existing relevant markets

IM and PM are not part of an existing relevant market, unless voice services start to be based on presence management, in which case it might be argued to be an associated facility within existing retail and wholesale markets for fixed voice calls.

A new "instant messaging service" relevant market could be created by NRAs if required, under the procedures of Article 7 of the Framework Directive. Alternatively, the EC could include such a market in a future revision of its Recommendation.

A similar discussion has been raised elsewhere in Electronic Communications: the New EU Framework,[66] while discussing the steps that would be needed to use Article 12(5) of the Access Directive in this hypothetical market.

[66] Winston Maxwell General Editor, Oceana Publications Inc., December 2002.

3.7.4 Extraterritorial associated facilities provider

As is discussed further in Annex A.4.3, it is quite possible that associated facilities will be located either partly or wholly outside the country in which the service is offered and indeed outside the EU ('partly' because the databases may have a distributed structure). This is potentially important because in such a case, regulators may not be able to apply their national law to the providers of the associated facility unless they have some local presence (e.g. as a local service provider).

3.8 Potential remedies to anti-competitive behaviour

In this section we examine the potential remedies available to regulators. We do this not because we have concluded that regulation is necessary, but because the same types of issues are likely to occur relating to many new or emerging services, and we can understand regulatory issues for all sorts of convergent services which might arise in future by looking at IM as a hypothetical case.

There are a number of regulatory regimes which apply, in order of increasing intrusiveness:

- general conditions on providers of ECNs, associated facilities, public ECS, or PATS
- using Article 5 of the Access Directive
- ex-ante regulation of players with SMP in a relevant market (e.g. via Article 12 of the Access Directive)
- other measures, including standardisation and ex-post competition law.

3.8.1 General conditions

If both IM and PM were considered to be ECS (or associated facilities), then they would be subject to general conditions of authorisation. Most of these are (in effect) concerned with consumer protection, and are not onerous. The conditions are discussed in slightly more detail in Annex 5.1.

3.8.2 Article 5 of the Access Directive

Article 5.1 of the Access Directive could be used to impose obligations on certain players even if they are not dominant (i.e. potentially all players), if they control access to end users. The question is whether associated convergent service providers are undertakings that control access to end-users.

Within the Access Directive, (Recital 19)*:*

Control of means of access to end users may entail ownership or control of the physical link to the end-user (either fixed or mobile) and/or the ability to change or withdraw the national number or numbers needed to access an end-users network termination point.

It is unclear whether this might, for example, include ownership or control of an IP address, a URI (which identifies a resource on the Internet e.g. www.analysys.com or james@analysys.com) or an IM user ID, as once an IP address exists there is no obligation to use another means, such as a SIP address, to find it. Accordingly, providers of associated convergent services, such as IM and presence management services, may not be "undertakings that control access to end users".

It is therefore worthwhile to clarify whether in the definition of control of access to end users the phrase "the national number or numbers needed to access an end-users network termination point" goes beyond an E.164 number and whether it includes, for example, IP addresses, SIP URI, email addresses, IM user IDs, etc.

Although this seems a narrow point, it is extremely important, because regulation under Article 5 of the Access Directive could extend to include undertakings without SMP offering a wide variety of services (i.e. the impact of this point is much wider than just IM and PM).

3.8.3 Remedies that apply to players with SMP in a relevant market

If associated convergent services (such as IM and PM) were considered to be ECS (or associated facilities), and there were a relevant market which applied, where one player

were dominant (or several were jointly dominant), then there are potential ex-ante remedies available within the NRF, specifically via Article 12 of the Access Directive.

Under Article 12, operators may be required inter alia:

"…to grant open access to technical interfaces, protocols or other key technologies that are indispensable for the interoperability of services or virtual network services" *and "to provide specified services needed to ensure interoperability of end to end services to users, including facilities for intelligent network services or roaming on mobile networks."*

This is discussed in more detail in Annex A.5.

3.8.4 Other measures including standardisation and ex-post competition law

There are alternative ways of intervening in such a market as this.

- If PM or a similar associated facility was considered to be an information society service, then national law, as long as it abides by the Information Society Services Directive, is a possible means of regulation.
- the Commission could (in some circumstances) mandate a particular standard in order to improve interoperability.
- Article 6 of the Software Directive (Directive 91/250/EC of 14 May 1991) might, in effect, solve the problem of a closed protocol for associated convergent services, similar to presence management, because it would be legal to reverse engineer the protocol.
- Recently, (24/9/03) the European Parliament voted for amendments to the proposed EU Directive on the Patentability of Computer-Implemented Inventions. These amendments would stop the use of patents to prevent competitors from becoming interoperable.
- As always, ex-post competition law remedies could be used.

Annex A.5 discusses some of these potential remedies in slightly more detail.

3.9 Conclusions

In this section we draw conclusions regarding IM and PM, and more general points arising from this discussion.

3.9.1 Conclusions regarding IM and PM

IM and PM is a relatively new market and is still undergoing rapid growth. However, it could be argued that there are already a large number of users and that, therefore, this service is not so new or so rapidly growing that regulatory forbearance is necessarily required.

The alleged harm to consumers arising from the behaviour of dominant players is, as yet, a relatively minor inconvenience – consumers need multiple instances of client software (in cases where the third party clients are unable to interoperate). This is an example of "multiple IM products taking up valuable real estate on the desktop", as previously mentioned.

Nevertheless, if we draw an analogy into the traditional voice telecoms market, users would need multiple telephones (clients) on their desk (PC desktop), one per competing telephone service provider (IM service). Regulators would probably consider such a situation unacceptable. So we should not simply assume that needing multiple clients, or having closed protocols (which creates this need) is not an issue of concern.

We emphasise that the above statements form a discussion aimed at finding the potential areas of this service and similar services within the NRF, and the remedies which might be used in these cases, and that this discussion contains many hypothetical statements. We are not recommending ex-ante regulation of IM and PM services at this time.

3.9.2 More general conclusions

In this section we have looked at IM and PM as an example of an associated convergent data service. In doing so, we have raised the following wider issues.

- Free services: There is existing European case law that suggests that IM services (and similar services) are "services normally provided for remuneration".

- Associated facilities: If regulators wished to intervene either in similar markets or indeed in this specific case, then it would be essential to clarify whether PM (or a similar service) is an 'associated facility'. The procedures for determining whether a particular network or service element is to be considered an associated facility are rather unclear. Some kind of harmonised position on this issue may be worthwhile.

- Control of access to end users: It is important to clarify whether in the definition of control of access to end users "the national number or numbers needed to access an end-users network termination point" goes beyond an E.164 number and whether it includes, for example, an IP address, SIP addresses, email addresses, IM user identities, etc. If so, then Article 5 of the Access Directive could be used.

- Relevant markets: If PM (or a similar service) is an associated facility, and there is a relevant market defined, and any of the existing players were found to be dominant or jointly dominant, Article 12 of the Access Directive could be used.

- Extraterritoriality: Certain network facilities, for example, presence management databases, can be provided from a different country. This country may even be outside the EU. Regulators do have tools with which to regulate the provision of associated facilities within the NRF. Nevertheless, it may be difficult to apply these remedies to companies that are in another jurisdiction.

4 Roadmap for the application of the New Regulatory Framework to IP voice and convergent services

4.1 Introduction

The use of IP to carry voice and associated convergent services is of great importance for all who use voice and data communications. It has already had some substantial effects, notably in the area of international voice connectivity. Other effects are potentially much larger, but they are correspondingly slower, as they depend upon: equipment replacement cycles (within corporates and telecoms network operators), competitive broadband access network operator deployments, the take-up by end-users of broadband Internet access, and the attractiveness of the new VoIP service offers (which is strongly affected by existing competition within the voice calls market).

European countries with competitive voice calls markets and few, new entrant broadband access networks may see substantially different outcomes to outcomes in markets with radically different broadband network deployments (such as Japan) and markets with radically different PSTN interconnect arrangements (such as the USA). Many such differences are already appearing. These differences do not necessarily mean that VoIP is failing in Europe or that major changes in regulatory policy are required.

There are a number of potential issues that arise for regulators from the move towards VoIP, which we have discussed in the sections above. In most cases, the issue will not necessarily cause serious or immediate harm to the deployment of IP voice and associated

convergent services, and regulators have appropriate powers to deal with them in a timely way.

In most cases, the attention needed fits within the normal activities of regulators:

- monitor market developments
- review policy and its impacts
- clarify existing policies to aid market players
- devise new policies or adapt old ones where necessary
- build knowledge and internal capabilities in addressing the issues raised by technological changes (e.g. new network architectures and new forms of interconnection), in particular in:
  - economic costing
  - technical standards
  - likely commercial structures.

Summary actions are gathered together under the headings below.

In Analysys's view, the most important issues are:

- definition of PATS (Section 4.1.1)
- impact of location independence on emergency access
- network availability in cases of disaster
- possible pressure on national numbering plans (Section 4.1.2)
- possible issues arising from extraterritorial service providers. (Section 4.1.3)

Other issues include:

- impact on the relevant markets defined by the EC (Section 4.1.4)
- whether VoIP services on fixed networks are provided "at a fixed location" (Section 4.1.5)
- treatment of free services (Section 4.1.6)
- treatment of self-provided services (Section 4.1.7)
- designation of associated facilities (Section 4.1.8)
- clarifying control of access to end users (Section 4.1.9)

- impact on lawful intercept (Section 4.1.10)
- interconnect to the PSTN (Section 4.1.11)
- interconnect to other VoIP service providers' networks (Section 4.1.12)
- the possibility of commercial barriers erected by access operators (Section 4.1.13)
- security issues (Section 4.1.14)
- effects on USO funding (Section 4.1.15)
- changes to regulatory costing. (Section 4.1.16)

4.1.1 Definition of PATS

Electronic communications services are divided into a number of different categories under the NRF:

- private ECS
- public ECS
- PATS (a subset of public ECS)
- defined relevant markets.

Each of these is regulated, to a lesser or greater degree.

Almost all VoIP services will be public ECS. Very few providers of VoIP services, possibly none in the short to medium term, will be players with significant market power. The key question is, therefore:

How do we decide which VoIP services are PATS, and hence subject to similar regulation to existing, non-dominant, PSTN service providers?

The NRF (Universal Service Directive) defines PATS as:

A "publicly available telephone service" means a service available to the public for originating and receiving national and international calls and access to emergency services through a number or numbers in a national or international telephone numbering plan, and in addition may, where relevant, include one or more of the following services: the provision of operator assistance, directory enquiry services, directories, provision of

public pay phones, provision of service under special terms, provision of special facilities for customers with disabilities or with special social needs and/or the provision of non-geographic services.

This definition is highly important for two reasons:

- Providers of PATS are subject to additional regulation over and above providers of public ECS under the Universal Service Directive – these additional obligations can be costly to provide.

- Providers of public telephone networks are subject to similar, additional obligations over and above the obligations of providers of public electronic communications networks. The Universal Service Directive defines a public telephone network as "an electronic communications network which is used to provide publicly available telephone services". Thus, it matters to the underlying network providers whether the service provider is considered to be offering PATS. While this definition is useful in the PSTN, because the PSTN network and service are very closely related, the definition does not work very well in a VoIP network because it could cause obligations to fall on a third party that offers IP connectivity, but was not associated with the decision to provide PATS (e.g. an IP transit provider, a bitstream access provider, an ISP, etc). This seems unfair.

In principle, there are two choices regarding the interpretation of the definition of PATS:

- Narrow definition: Any VoIP provider that does not offer access to the emergency services is not PATS (and, therefore, not subject to the specific conditions imposed upon the providers of PATS). Any VoIP provider that does offer access to the emergency services (and calls to telephone numbers) is PATS, and therefore subject to all of the conditions imposed. Although clear and simple, this is likely to be a disincentive to provide access to the emergency services and this may have significant implications for public safety as VoIP becomes more widely adopted.

- Broad definition: Any VoIP provider that provides a service in direct competition with (and as a substitute for) the PSTN is PATS (and therefore subject to the full range of obligations imposed on PATS providers). However this could lead to the imposition of

the full obligations of being a provider of PATS on many VoIP services that are not equivalent to the PSTN. Furthermore rigorous application of the broad definition could lead to some types of service provider might be obliged to provide something they are incapable of providing.

It is not obvious what approach should be taken.

There is no easy answer on this point, and we suggest that NRAs and the EC may wish to form some working group to consider how to resolve it.

Location independence and emergency access

If VoIP service providers do provide emergency services access, it may be of a reduced quality, as a result of the location independence of VoIP technologies. In contrast to the existing PSTN, a VoIP service provider cannot necessarily supply the emergency services with the address users are calling from (a user may, for example, be calling from a public WiFi hotspot rather than at home).

End users will need to be made aware that the quality of emergency services provided on a VoIP connection will be lower if they choose to use their VoIP connection at more than one location, or do not accurately inform their VoIP provider of their address. However, it seems feasible for VoIP service providers to provide a reasonable form of access to the emergency services, which is at least as good at that provided by existing mobile networks (i.e. those facing a similar issue mapping caller location for the emergency services).

We therefore recommend that the NRAs consider how the limitations on emergency services could and should be made clear to end users.

Network availability in cases of disaster

Providers of PATS at fixed locations are required to ensure the availability of services (including access to emergency services) in the case of force majeure and catastrophic network breakdown (Universal Service Directive, Article 23).

Some PATS providers using VoIP might be unable to meet the obligations for network availability in cases of force majeure (for example, if certain major Internet routers were under a major electronic or physical attack). Again, as in the case of emergency service access, under a broad definition of PATS, some types of service provider might be obliged to provide something they are incapable of providing.

Restating the requirements for resilience and availability may be useful, but we recommend against any relaxation of the requirement for VoIP providers of PATS, because is possible that all the fixed networks (including the current incumbents) will eventually use VoIP. Relaxing the requirement might have a small implication now, but over time would cause a significant change in the availability of the telephony network in disaster situations.

We suggest that this issue is considered further by the EC and by Member States.

4.1.2 Possible pressure on national numbering plans

As yet, there is no consensus on what numbers within national numbering plans ought to be used for VoIP. In principle, it is desirable for VoIP subscribers (and therefore VoIP service providers) to have access to all number types including geographic numbers. Various services that would not be reasonable to consider as PATS (e.g. second lines provided over IP) will probably need access to geographic numbers to be successful.

There will be an increased demand for numbers of all types coming from the deployment of VoIP. It is also possible that, once ENUM is deployed, telephone numbers will be used for additional purposes (e.g. as a form of digital identity). Such uses will create additional pressure on numbering ranges.

However, there may not be enough numbers within the numbering plans of Member States to allow access to certain types of numbers, (such as geographic numbers) for a large number of new service providers, and for new services (such as virtual numbers). As national numbering plans all differ, and face different issues, a harmonised approach is not required. Some countries may have few problems with their numbering plan as a result; others may face considerable difficulties in certain geographic areas or with certain non-geographic code types.

We recommend that NRAs consider whether new numbering ranges should be developed for use by new services enabled by VoIP in order to avoid strong pressure on existing numbering ranges.

4.1.3 Possible issues arising from extraterritorial service providers

One outcome of moving to an IP-based network is that certain network facilities, such as the resolution of names (e.g. URI into IP addresses), can be provided from a different country. This country may even be outside the EU and therefore not subject to the NRF. Not all facilities will be extraterritorial: some, such as PSTN gateways, are still likely to be within the country for both technical and economic reasons.

If there were ever to be a problem requiring regulatory intervention (and we emphasise that so far, this has not been the case), regulators do have tools with which to regulate the provision of such services, which can be considered associated facilities within the NRF. Nevertheless, it may be difficult to apply these remedies to companies that are in another jurisdiction.

Furthermore, if a service provider's network assets are based in a different country from the user (and/or controlled by a different legal entity) this may make it more difficult to ensure continued network and service availability. It is, therefore, an open question whether the need for resilience will (as a result) affect the technologies and system architectures adopted by PATS providers.

These issues are familiar in e-commerce and in Internet communications services, but will now appear for the first time in the voice services market.

We recommend that NRAs and Member States explicitly consider whether extraterritorial provision of domestic or EU voice services (or components within these services) merits any modification or extension to current policy.

4.1.4 Impact on the relevant markets defined by the Commission

One impact of VoIP and associated convergent services on the relevant markets is that presence management in combination with voice services could, in certain circumstances, link together the wholesale markets for voice termination (Markets 9 and 16 of the EC Recommendation). The termination markets would still be distinct in some circumstances (for example, when away from the desk), but this linkage will complicate the regulation of these relevant markets, because it means that the monopoly of termination to customers on the user's own network may no longer exist (in particular, for the fixed operator).

Regulators will need to monitor the development of presence management in conducting reviews of the relevant markets for voice termination.

4.1.5 Whether VoIP services on fixed networks are provided "at a fixed location"

Providers of PATS at a fixed location are subject to additional obligations over those who provide mobile network services.

All providers of VoIP service (which use WiFi, or even wireline access) could argue that they are not "provided at a fixed location" because VoIP services can be highly location-independent.

Alternatively, regulators might seek to distinguish between considering certain VoIP network architectures as "provided at a fixed location". Such an approach is dangerous, as

it will be very difficult to draw this distinction without causing distortions in the market (e.g. incentives for service providers and network operators to use particular architectures).

Consequently, to avoid these distortions in the market, VoIP provided over fixed networks should probably be considered as provided "at a fixed location". A harmonised position on this issue might be worthwhile.

4.1.6 Treatment of free services

It is unclear whether a 'free' service such as AIM or Skype is indeed included in the definition of an ECS. This is important because if it is not an ECS then it cannot be regulated under the NRF.

There is existing European case law which shows that:

- a bundle of services can be considered as provided for remuneration even if some of the services are 'free'
- the remuneration does not have to be paid by the end user of the service (so an advertising-funded service is considered as provided for remuneration).

As a result, AIM would probably be considered a service provided for remuneration, whereas it remains unclear whether a peer-to-peer application, such as Skype, which is truly 'free' is currently a 'service' at all.

Regulators need to be aware of this issue but, as it is a legal point, the courts will ultimately decide.

4.1.7 Treatment of self-provided services

It is unclear, though it seems very likely, that a self-provided service is not a "service provided for remuneration" at all. If it is not a "service provided for remuneration" then it

is not subject to the NRF. For example, it would not be subject to general conditions of authorisation.

The fact that paid-for equipment and software are used may be irrelevant as these are goods, and there is a distinction within the EC Treaty between goods and services.

It is possible that within a major corporate, there might be a telecoms division which is 'paid' by internal transfers of money from other divisions. This might possibly be considered a private ECS.

Even if in some cases these services are considered as private ECS, then this is unlikely to be a significant issue because the general conditions of authorisation for private ECS are not very restrictive.

Regulators need to be aware of this issue but, as it is a legal point, the courts will ultimately decide.

4.1.8 Designation of associated facilities

The procedures for determining whether a particular network or service element is to be considered an associated facility are rather unclear.

Associated facilities are important as they can represent choke points within the network, both for voice and for associated convergent services, and it may be necessary to regulate them if anti-competitive behaviour is observed. If regulation of providers of associated facilities were to be required, remedies under Article 5 of the Access Directive would appear to be available without a relevant market definition. We accept that Article 5 is unlikely to be used except in extreme cases.

We recommend that regulators consider the processes for determining whether a particular network or service element is to be considered an associated facility.

4.1.9 Clarifying control of access to end users

It is worthwhile to clarify whether in the definition of control of access to end users the phrase "the national number or numbers needed to access an end-users network termination point" goes beyond an E.164 number and whether it includes, for example, IP addresses, SIP URI, email addresses, IM user IDs, etc.

If this is the case, then Article 5 of the Access Directive could be used to solve a wider range of issues, covering a broad range of market players.

Regulators need to be aware of this issue but, as it is a legal issue, it will be determined by the courts

4.1.10 Impact on lawful intercept

Lawful intercept of voice telephony using IP could take place at a variety of locations within the network, at the facilities of different network operators and service providers. It is probably necessary for the legal intercept agencies themselves to make the decision as to where in the network they wish to intercept the traffic.

We recommend that some form of harmonised approach between legal interception agencies (e.g. location of intercept, format of intercept) would help minimise the cost to service providers (in particular, pan-national service providers). This would help reduce barriers to entry in providing voice services.

We note that the usefulness of lawful intercept may be decreased once VoIP calls are strongly encrypted end to end.

4.1.11 Interconnect to the PSTN

While we expect difficult arguments about interconnect SLAs and pricing (and costing for operators who are dominant and are undertaking major network transformations), we think that these are just part of the normal operation of telecoms regulation.

The only ways in which VoIP affects these arguments is that it is the cause of the major network transformations, and it can cause increased competition and loss of market share by the incumbent operator.

Regulators will need to consider the pricing of PSTN interconnection in the future as part of the proportionate remedies which may be imposed as a result of market reviews.

4.1.12 Interconnect to other VoIP service providers networks

Analysys expects three models for interconnect:

- via the PSTN
- VoIP peering (free of payment, with conditions)
- VoIP termination (paid-for).

At this stage, we recommend that regulators need only monitor the emergence of the new forms of interconnect, bearing in mind that interconnect disputes are almost certain to arise.

The fact that the technical standards for new forms of interconnect are not yet fully worked out is not necessarily a problem, given the timescales on which carrier-scale implementations will be required (estimated 2006–10). Nevertheless, regulators and the EC should encourage and observe this work through ETSI TISPAN and elsewhere.

4.1.13 Possible commercial barriers by access operators

There is nothing (other than competition) to stop operators who have a vested commercial interest from making VoIP commercially unattractive. This could be a major issue if it were used in an anti-competitive way to block the emergence of competitive VoIP services.

This commercial barrier is, in effect, impossible to achieve for fixed for broadband access providers, given the very low incremental price per bit on almost all wholesale DSL tariffs, and given the nature of the relevant market which means it is very likely to be ex-ante regulated.

On the other hand, this issue will be particularly relevant for mobile operators, who do not have an infinite network capacity and are as a result much more concerned about, and wary of, flat-rate pricing for data services. Competition between operators should ensure a wide range of competitive tariffs, though in the case of mobile networks we do not expect these to lead to widespread take-up of VoIP except for carrier internal use.

Regulators will need to understand these issues, and should expect to have to resolve a number of disputes in this area.

4.1.14 Security issues

End users who are buying telephony services will, however, still expect their calls to be secure and their bills accurate. This is not just a matter for those operators providing PATS; providers of ECS are also obliged to have accurate bills (though they may not be obliged to have these billing systems audited, etc.), and end user data privacy is protected by national data protection laws, and, in particular, the Directive on privacy and electronic communications (2002/58/EC).

A considerable amount of effort is, therefore, being expended developing standards to build a service that meets users' needs and expectations for privacy (and lawful intercept), user authentication, and guarantees about quality of service, accurate billing, etc. on IP networks in general and the Internet in particular. Regulators will need to support these efforts, and educate the public about the security of the system.

4.1.15 Effects on USO funding

Changes to the telecoms market arising from the adoption of VoIP will change the net cost of providing universal service. Three effects contribute to this:

- long-distance and international voice call profits will be reduced
- access network costs will be spread over fewer lines
- there will be a loss of revenue to 'free' services.

Regulators will need to monitor these effects, all three of which are relatively small in Europe, at least in the medium term, but they are cumulative, and will gradually increase pressure on the funding of USO. In the short term, these arguments will be most noticeable in countries where the net cost of USO is already explicitly funded (e.g. France).

4.1.16 Changes to regulatory costing

IP-based voice technologies may change the underlying costs of providing certain regulated telecoms services (e.g. voice termination). This implies that in cases where the costs are used to set regulated prices (e.g. as a result of long-run incremental cost (LRIC) models), a forward-looking costing based on modern equivalent assets could, in some cases, use IP technologies. In Analysys's view this is not a new issue, although it may create considerable work for the regulators' economists.

The issue requires regulators to be aware of the new cost structures (which may in itself be difficult, given rapid change in equipment and software prices), as well as to appropriately incorporate these structures into their regulatory cost models. NRAs should continue to use

forward-looking economic cost models as the basis for price regulation remedies. The cost of unanticipated write-downs of the value of pre-existing assets should not be included in the cost base used to regulate prices (or to assess the economic return generated by services).

Where terminating operators control the choice of technology used to transport terminating calls, they should not be allowed to charge different prices for the use of different technologies. In these circumstances, and if termination prices are to be regulated, the relevant cost benchmark is the efficient cost of supply using the most efficient technology, irrespective of the mix of technologies actually used by the terminating operator.

Where terminating operators permit terminating customers to select which technology is used to terminate calls (but not the originating operator), it would be acceptable for terminating operators to charge different termination prices for the different technologies. In those circumstances where it is appropriate to regulate such prices, however, the prices for termination of calls using both technologies will need to be regulated (separately).

Annex A: Supporting detail necessary to understand the main report

This annex contains a series of discussions of issues that provide additional information for the reader. The inclusion of such text in the main body of the report would have detracted from the flow of the argument.

A.1 Session border controllers

Session border controllers, or session controllers, have recently emerged as the VoIP call control products for situations where gateways are not required because calls are carried entirely on VoIP. These products often operate using all three VoIP protocols combining H.323 gatekeepers, SIP proxies and media gateway control protocol (MGCP) control. Session border controllers promise to play a critical role in offering VoIP services in the immediate future, because they allow services to be offered, sometimes with quality guarantees, across multiple IP networks, even when there are firewalls to be traversed.

The session (border) controller:

- acts as a network access termination (NAT) for the service provider's network and hides the real IP addresses of their customers from interconnecting networks
- hides the details of the service provider's network architecture, such as the number and location of their servers, from the interconnecting networks
- acts like a firewall preventing hacker attacks, denial of service attacks, etc., being launched from interconnected networks
- transfers QoS information and can translate between different mechanisms being used by different service providers
- polices the connection, monitoring the number of packets sent and media type against details provided at the call set-up. As a result, it can, for example, prevent users trying to make video calls while only paying for voice calls
- provides detailed call information for billing and settlement purposes
- handles NAT traversal, which allows the operator to provide service to customers behind firewalls without requiring them to upgrade the firewall.

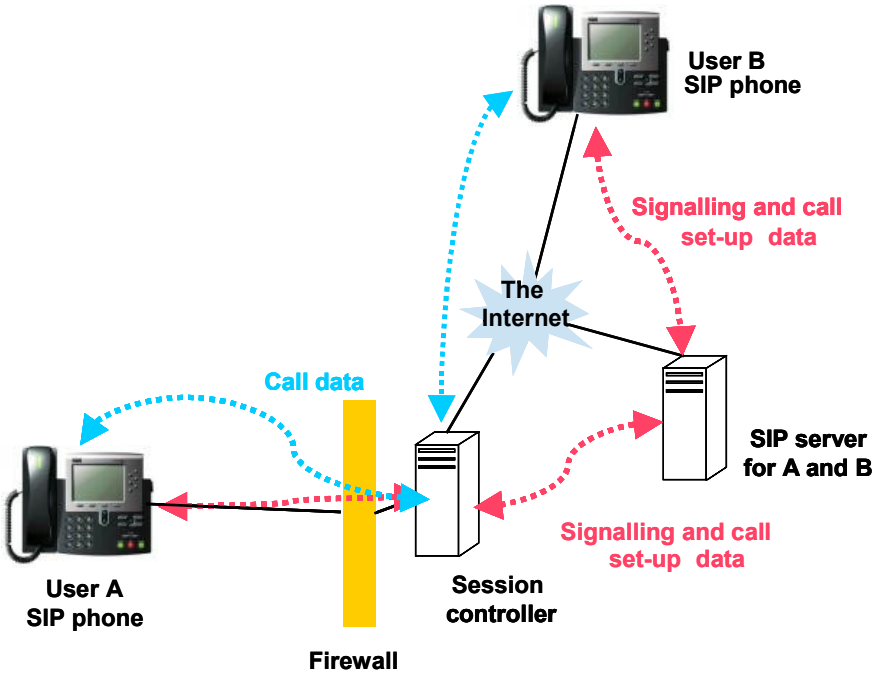

Exhibit A.1: *Session controller providing NAT traversal Note: both media and signalling go through session border controller [Source: Analysys]*

A session controller acts as a proxy for all users in a network. The home network's DNS routes all off-network calls to the session controller by giving its address as the address of any remote call agent. The session controller creates new signalling and media addresses that are sent to the remote network. The called party in the remote network sees the session controller as the source of the call. All signalling and media will be returned via the session controller. In this way, the called party's network does not know the user's real address. Incoming calls are redirected in a similar fashion.

A.1.1 Relevance of session border controllers to VoIP to VoIP interconnection

Where two VoIP networks interconnect, they hide the details of their internal networks by using session border controllers. In the case shown in Exhibit A.2, a SIP-based access provider network like that of Yahoo! BB is connected to an incumbent network with carrier

internal use of VoIP. All signalling is passed between the session border controllers, but the call data still goes directly between the end points.

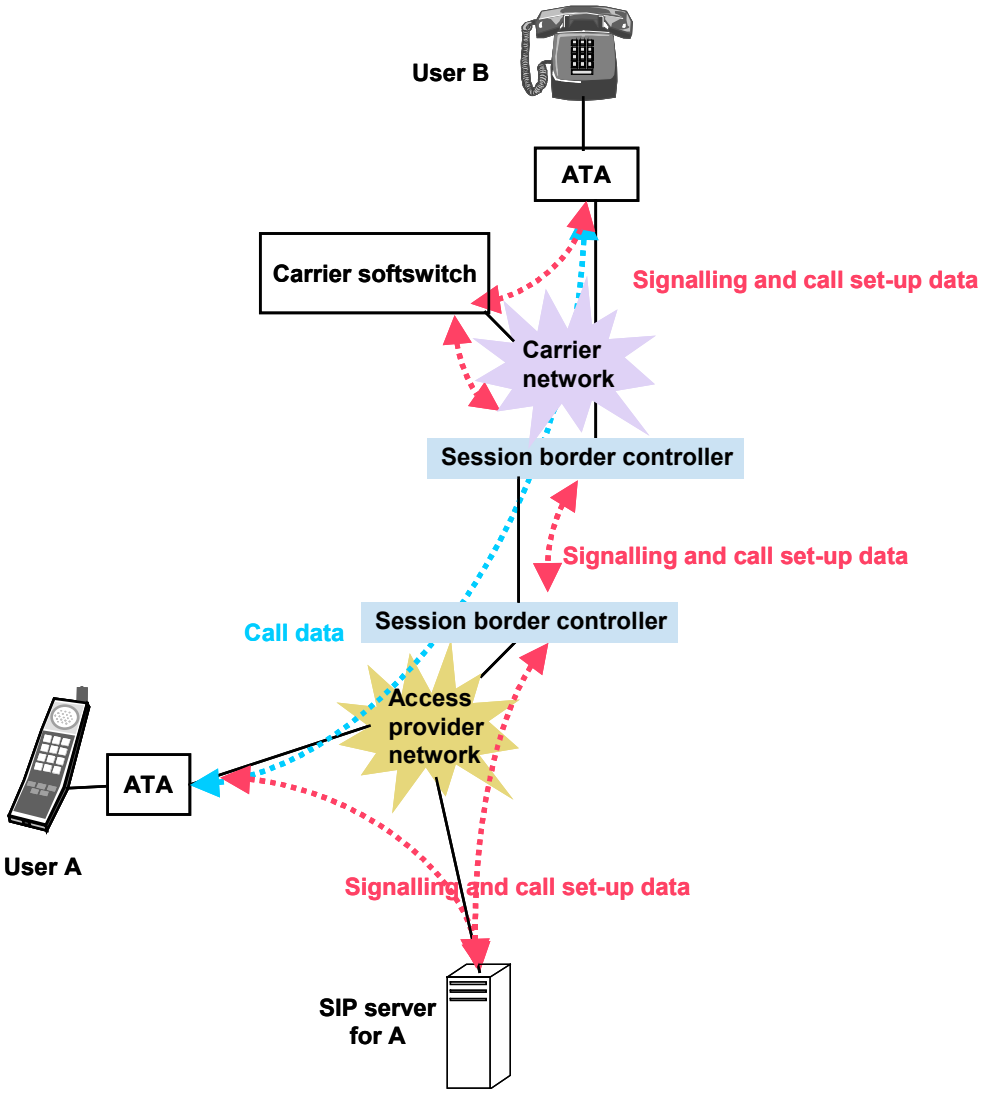

Exhibit A.2: *VoIP (Yahoo! BB) to VoIP (carrier internal use) interconnect using session border controllers [Source: Analysys]*

A.2 Other views of the definition of PATS

In this section, we look at the views of a number of organisations that have considered the question "When should VoIP be regulated like PSTN?"

A.2.1 European Commission

Historically the EC's position, upheld by the 2000 consultation, is as follows:

…at that time Internet voice services could in principle not be considered as voice telephony, because they failed to meet simultaneously each of the four elements of the definition of voice telephony pursuant to the Services Directive, namely:

- *voice telephony is offered commercially as such*
- *it is provided for the public*
- *it is provided to and from public switched network termination points*
- *it involves direct speech transport and switching of speech in real time, in particular the same level of reliability and speech quality as produced by the public switched telecommunications networks (PSTNs).*

(Note: at the time, public voice telephony as a concept was roughly equivalent to the current PATS.)

The differences between the NRF definition of PATS and the historic definition of Public voice telephony (PVT) are:

- The definition of PVT repeated above explicitly mentions "*direct speech transport and switching of speech in real time, in particular the same level of reliability and speech quality as produced by the public switched telecommunications networks (PSTNs)",* whereas the definition of PATS does not. This means that a wider variety of voice services could, in principle, qualify as PATS under the new definition.

- The definition of PATS includes "access to emergency services" whereas the old definition of PVT does not. This definition does perhaps show that the reliability and

speech quality aspects of social provision of telephony are still important to the definition of PATS (at least for reliable and high-quality access to the emergency services).

A.2.2 European National Regulatory Authorities

The NRAs have historical positions, some of which are similar to the EC (for example, RegTP in Germany still sees the real-time aspect as a distinguishing factor between VoIP and voice telephony).

Others take positions different from that of the EC. For example, the UK regulator, Ofcom's historic position repeated in its recent publication[67] is that:

a VoIP service should be regulated as public voice telephony if any of the following apply:

- *the service is marketed as a substitute for traditional Public Switched Telecommunication Network (PSTN) voice services; or*
- *the service appears to the customer to be a substitute for public voice telephony; or*
- *the service provides the customer's sole means of access to the traditional circuit switched PSTN.*

However, where a VoIP service is clearly being offered as an adjunct to a traditional circuit switched PSTN voice telephony service or as a secondary service, it is likely not to be considered as public voice telephony

This definition avoids the issue of commercial offers, origination/termination points or numbering, or explicit concerns with reliability and quality, instead relying on whether the service is marketed as a substitute (quality claims may be a factor here), is seen by customers as a substitute (implicitly, perceived quality is a factor here), or forms the only

[67] "Voice over IP - updated questions and answers" Oftel, 3 November 2003.

means of reaching the PSTN (which we understand to have related to ensuring access to emergency service within workplaces, amongst other issues).[68]

Interestingly, ETNO takes a position which also regards substitution as the key factor in its "ETNO Expert Contribution to the ITU Secretary General's Report to WTPF on IP Telephony": *"As long as IP Telephony is not a substitute to Public Voice Telephony, the ITU should help to promote the development of IP Telephony by encouraging national regulators to refrain from applying PSTN specific regulations to IP Telephony."*

The substantive issue with this approach if it is adopted within the NRF is that although, in principle, it is clear in certain cases where either the service is PATS under both narrow and broad definitions (offers access to emergency services and is a substitute) or where it is not PATS under both definitions (where it does not offer emergency service, or does not market their service as a substitute), there remains a case where the position remains unclear (if it meets the broad but not the narrow definition). Such a case occurs if an operator wishes to market its service as a substitute to the PSTN (which would make this PATS in Ofcom's view) but not offer access to the emergency services (which is not PATS under a narrow reading of the US Directive).

Vonage now provides access to emergency services in the USA (although its service is in some ways inferior to that offered by the incumbent local exchange carriers (ILECs). This is offered despite its lack of control of the access network. In Japan, however, Yahoo!BB (which does control its own access network) does not offer access to emergency services (end users can dial directly on their telephone line as line sharing is used). This situation seems contradictory, but probably reflects differences in both regulatory environment and in access technology (Vonage wants to be able to offer full voice services over cable modem access).

[68] An interviewed incumbent operator and a large vendor and 18 take a similar position.

A.2.3 Position of US FCC

The FCC has long exempted computer services from common carrier regulation, on the basis that as long as the underlying transmission services were regulated and thus available at reasonable prices, the provision of computer services utilising these transmission services could be competitive, and thus did not require regulation. This distinction was most recently made in the Telecommunications Act of 1996 (the 1996 Act), defining telecommunications as "*[T]he transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received,*" while information services was defined as "*[T]he offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications.*" The former are regulated, while the latter are not regulated.

While it is clear that telephony services offered over the PSTN are considered telecommunications services under the 1996 Act, the FCC has not yet classified VoIP services as a telecommunications services, and thus, by default, they are considered to be information services not subject to regulation, along with all other Internet services. In 1998, the FCC released a report commonly referred to as the 'Stevens Report' that suggested that phone-to-phone services offered in a fashion similar to circuit-switched voice services (i.e. using the same equipment and numbers), may be a telecommunications service, but did not make a definitive determination in this regard.

Recently, there have been a number of actions at the FCC and state level regarding the regulatory treatment of VoIP services. At the FCC, several VoIP providers, including AT&T and Vonage, have filed petitions seeking definitive rulings from the FCC that VoIP services should not be regulated as telecommunications services. At the same time, at the state level, public utility commissions and courts have either begun or concluded proceedings on the status of VoIP services.

In response, the FCC held an open forum on 1 December 2003, which represented the beginning of a proceeding to determine the regulatory classification of VoIP services. At this forum, representatives of VoIP providers, financial analysts, and state regulators made presentations to the FCC Chairman and Commissioners about VoIP services, and presented their views on the regulation of these services.

A common theme raised during this forum was that the FCC would consider the applicability of economic and social regulations on VoIP services as separate issues.

- Broadly speaking, economic regulations are controls on rates and services that apply to providers with market power. At present, this basically only applies to ILECs for local services. Given the ease of entry for VoIP services, it is not likely that such economic regulations would apply to VoIP providers.
- Social regulations are non-economic regulations such as emergency (911) services and universal service obligations (including access deficits). These regulations apply to all providers of telecommunications services today, but not to VoIP providers. The VoIP proceeding will decide whether, and to what extent, such social regulations should apply to VoIP providers.

A.3 Obligations of providers of PATS

Providers of PATS are subject to additional regulation over and above providers of public ECS under the Universal Service Directive. These conditions are quite significant and include:

- Article 5: The right (for end users) to an entry in a publicly available directory
- Article 7: Special measures for end users with disabilities
- Article 10: Limits to measures on non-payment of bills (Annex 1A part e)
- Article 21: Transparency and publication of prices
- Article 23: All necessary steps to maintain proper and effective functioning of network and access to services (provided "at fixed locations" only)
- Article 25: The obligation to provide operator assistance and directory enquiries
- Article 26+27: National and single European emergency number access (which makes the definition of PATS circular)
- Article 28: EU access to non-geographic numbers
- Article 29(a): Itemised bills
- Article 30: Obligation to provide number portability
- Article 34: Code of practice/dispute resolution
- General conditions can include additional requirements e.g. requirements to have metering and billing systems accredited.

Note that Articles 5, 7 and 10 are obligations that only apply to PATS providers who are also designated universal service providers.

A.4 Relevance of the NRF to associated convergent services

A.4.1 PM as an Information society service

However, presence management is arguably not an ECS but "an information society service which does not consist mainly in the conveyance of signals on electronic communications networks".

"An information society service, is any service normally provided for remuneration, at a distance, by electronic means and at the individual request of a recipient of services." For the purposes of this definition:

- "at a distance": means that the service is provided without the parties being simultaneously present,
- "by electronic means": means that the service is sent initially and received at its destination by means of electronic equipment for the processing (including digital compression) and storage of data, and entirely transmitted, conveyed and received by wire, by radio, by optical means or by other electromagnetic means
- "at the individual request of a recipient of services": means that the service is provided through the transmission of data on individual request.

That PM is an ISS is certainly arguable:

- We have already argued that IM is "normally provided for remuneration".
- The conveyance of signals itself is required (it is, after all, at a distance and by electronic means), but it is the provision of presence management information itself which is the heart of the service.
- Users certainly only receive presence management information having made a request (being on a 'buddy list') – but this information can be updated automatically and regularly without further requests. In this respect, presence management is little different from some kind of continuously updated Web page (such as the front page of a large news Web site which has a scrolling 'ticker').

If presence management is an information society service (ISS), then the NRF does not apply and instead, only the remedies allowed by the relevant ISS Directives (which restrict technical regulation and rules on services) can be used.

A.4.2 Views of regulators on PM as an associated facility

As shown in its recent document "The definition of 'relevant activity' for the purposes of administrative charging: guidelines issued by the Director General of Telecommunications 29 July 2003", it is clear that the UK regulator Ofcom views presence and name/address translation databases, such as DNS as associated facilities:

Where services are provided over an ECN but require the support of an associated facility they can be regarded as advanced services. Such services would include IP conveyance supported by the DNS, non-geographic number services supported by IN translation databases, instant messaging supported by a 'presence' database, mobile telephony supported by home location registers, television transmissions supported by conditional access systems and electronic programme guides.

The Irish regulator, ComReg, appears to agree as it lists "access to number translation or systems offering equivalent functionality" in the definition of access within its regulations.[69]

A similar discussion has been raised elsewhere,[70] which discusses the possibility of using Article 12(5) against Microsoft as a publisher of instant messaging software, which might be deemed an associated facility.

[69] S.I.No.305 of 2003 European Communities (Electronic Communications Networks and Services) (Access) Regulations 2003.

[70] *Electronic Communications: the new EU Framework*, Winston Maxwell General Editor, Oceana Publications Inc.

A.4.3 Extraterritorial associated facilities provider

We have seen that it is possible that regulators will consider databases, such as presence management, to be an associated facility.

A key difference between such databases and existing associated facilities is that in practice, existing associated facilities (such as intelligent network nodes, co-location, etc.) are (almost) always located in the country where the ECS is being offered. National law is thus currently a viable means of regulating the providers of associated facilities.

This is not the case for databases such as DNS or presence management databases, which can be located either partly or wholly outside the country in which the service is offered and indeed be located outside the EU (we say 'partly' because the databases may have a distributed structure). In such a case, regulators may not be able to apply their national law to the providers of the associated facility unless they have some local presence (e.g. as a local service provider).

If we imagine a hypothetical case, an IM service provider could sell its presence database and licence it on an exclusive basis from a legally separate company with no presence in the EU. As Recital 19 to the Access Directive makes clear, "An operator with mandated access obligations cannot be required to provide types of access that are not within its power to provide". In such a case it is difficult to see how the presence database could be regulated as an associated facility under the NRF, unless the Commission were to mandate a particular standard for presence management in the official journal. See below for a discussion of such remedies.

A.5 Remedies available to regulators in the associated convergent services markets

A.5.1 General conditions

If associated convergent services such as IM and PM were considered to be ECS (or associated facilities) then they would be subject to general conditions of authorisation.

Most of these are (in effect) concerned with consumer protection. Few of these would be of direct concern to IM and PM providers.

For example, only a few of the UK's general conditions apply:

- Condition 1: Obligation to Negotiate Interconnection (if providers of public ECNs or associated facilities)
- Condition 2: Standardisation and specified interfaces
- Condition 9: Requirement to Offer Contracts with Minimum Terms (which is unlikely to be an issue for a free service)
- Condition 11: Metering and billing (which is unlikely to be an issue for a free service)
- Condition 15: Codes of practice and dispute resolution.

Conditions 1 and 2 might offer means of resolving a protocol interoperability dispute if one were to arise. For example, the EC could (if it thought it necessary) mandate a standard interface for (for example) presence management databases and publish this decision in the OJ.

We note that such an action could impose significant financial penalties on the presence management companies (in that it could in the worst case destroy their advertising funded business model, because third-party clients without adverts could be created).

The general conditions, though aiming to produce the same effects (implementing the Directives), are quite different in different countries. As a result of these differences, we note that any required remedies that rely on the use of the general conditions may be jurisdiction-dependent. These differences are as a result of, for example, different legal systems, and different ways in which the NRF has been transposed into national law.

A.5.2 Article 12 of the Access Directive and its relevance to associated convergent services

If an associated convergent service was considered to be an ECS (or an associated facility) and there was a relevant market which applied, and one player was dominant (or several were jointly dominant) then the NRF offers possible ex-ante remedies using Article 12 of the Access Directive, specifically:

- Art 12(a): "operators may be required inter alia…to give third parties access to specified network elements and/or facilities, including unbundled access to the local loop.
- Art 12(e): "operators may be required inter alia…to grant open access to technical interfaces, protocols or other key technologies that are indispensable for the interoperability of services or virtual network services"
- Art 12(g): "operators may be required inter alia…to provide specified services needed to ensure interoperability of end to end services to users, including facilities for intelligent network services or roaming on mobile networks"
- Art 12(h): "operators may be required inter alia…to provide access to operational support systems or similar software systems necessary to ensure fair competition in the provision of services"

'Operator' means "an undertaking providing or authorised to provide a public communications network or associated facility".

A.5.3 Mandatory standardisation

Under the NRF (Framework Directive, Article 17) the Commission has the power to make a technical standard compulsory. This power is only available *"to the extent strictly necessary to ensure…interoperability and to improve freedom of choice for users"*.

As noted in the discussion of general conditions above, this power might offer means of resolving a protocol interoperability dispute if one were to arise.

A.5.4 Potential impact of other laws affecting the regulation of associated convergent services

The software directive and copyright protection laws

Decompilation (i.e. examination of computer executable code to determine its function) is allowed to reverse-engineer a protocol in order to provide interoperability, under Article 6

of the Software Directive. (Directive 91/250/EC of 14 May 1991). This might, in effect, solve the problem of a closed protocol for an associated facility such as a presence management server, because it would be legal to reverse engineer it. However, it does not ensure that the protocol is always available to third-party clients, because there will always be a delay in such reverse engineering.

Rights of end-users and software suppliers in this area may be subject to changes because they are (or can be) closely related to technical measures protecting intellectual property (typically digital rights management for video, audio, and image content, for example). In the USA, the wide-ranging Digital Millennium Copyright Act (DMCA) makes it (in effect) illegal to break such encryption systems even for uses that would have been considered fair use in traditional copyright law (such as enabling format conversion of electronic book material for the blind); therefore reverse engineering an encrypted presence management protocol could be (in effect) illegal if it was used to protect intellectual property. The relevant EU Directive, which is similar to the DMCA, is still in draft form.

The software patent directive

The European Parliament recently voted (24/9/03) for amendments to the proposed EU Directive on the Patentability of Computer-Implemented Inventions. The amendments included the following:

6a. Member States shall ensure that, wherever the use of a patented technique is needed for a significant purpose such as ensuring conversion of the conventions used in two different computer systems or networks so as to allow communication and exchange of data content between them, such use is not considered to be a patent infringement.

This could prevent the use of patents to protect a "closed" protocol within, for example, an associated facility. However, it should be remembered that it may well not become part of the final Directive.

Annex B: Glossary

2G	Second generation mobile technology
2.5G	Enhanced second generation mobile technology – generally refers to mobile communications based on GSM which can carry data at rates higher than standard GSM
3G	Third generation mobile technology – the next generation of mobile communications technology which supports other applications in addition to voice (e.g. full-motion video, video-conferencing and full Internet access)
3GPP	3rd Generation Partnership Project – a collaboration agreement which brings together a number of telecoms standards bodies (currently including ARIB, CCSA, ETSI, TI, TTA and TTC) and which aims to produce globally applicable technical specifications for a third generation mobile system based on GSM
ADSL	Asymmetric digital subscriber line – a communications technology that allows an ordinary telephone to be used for high-speed (broadband) communications. ADSL is therefore particularly well suited for Internet access since the transmission speed from the network to the user is much higher than the speed from the user to the network. (ADSL supports downstream data rates of 1.5Mbit/s–9Mbit/s and upstream data rates from 16kbit/s–640kbit/s.)

AES	Advanced encryption standard
AIM	The AOL Instant Messenger – AOL's proprietary instant messaging service
API	Application program interface – a set of routines, protocols and tools for building software applications
ARPU	Average revenue per user
ATA	Analogue terminal adapters – a handset-to-Ethernet adaptor that interfaces regular analogue phones with IP-based telephony networks
ATM	Asynchronous transfer mode – a high-speed switching technology which switches data in small cells (53 bytes) at very high speeds
Bill and keep	An approach to interconnect in which no interconnect payments are made between carriers; they 'bill' their end users and 'keep' the revenue.
Bitstream	Wholesale broadband access offers at the IP or ATM layers are often described as 'bitstream' access to distinguish them from 'unbundled local loops'.
Bluetooth	Bluetooth wireless technology – a standard developed by a group of manufacturers – allows wireless links between mobile computers, mobile phones, other portable handheld devices, and connectivity to the Internet
Broadband	A type of data high-speed data transmission, which allows the effective transmission of multiple simultaneous signals (e.g. voice, data and video) via a single (e.g. fibre, copper wire, satellite) channel. For the user, this effectively means a high-speed Internet connection which allows communications of greater than dial-up speeds
Cable modem	A device that allows a computer to connect to the Internet via a local cable network operator

CDRM	Control of digital rights management
CEN	Comité Européen de Normalisation
CENELEC	Comité Européen de Normalisation Électrotechnique
Centrex	*(Contraction of 'central exchange')* A business telephone service offered by a local telecoms operator from a local central office. This service provides an alternative to a private branch exchange (PBX)
Circuit switching	See 'switching'
CLEC	Competitive local exchange carrier – term used to describe an alternative (i.e. non-incumbent) operator
Click-to-dial	A feature of some Web portals that allows visitors to the site to talk to an agent in an associated contact centre
Codec	A device that encodes or decodes a signal – the translation of a binary value into a voltage that can be transmitted over a wire (e.g. telephone companies use codecs to convert binary signals transmitted on their digital networks to analogue signals converted on their analogue networks)
CPP	Calling party pays
DECT	Digital European cordless telecommunication – a system which handles all communication within a local area (e.g. within a company) and which then sends traffic on through the public network
DHCP	Dynamic host configuration protocol – a protocol that allows a network administrator to centrally manage and automate the assignment of IP addresses. It automatically sends a new IP address when a computer is plugged into a different place in the network – without DHCP, the IP address must be entered manually at each computer

DiffServ	*Contraction of "differentiated services"* – the result of an IETF working group that is defining a new bandwidth-management scheme (including QoS mechanisms) for IP networks. DiffServ is expected to be a key element of VoIP and has widespread support among equipment vendors and service providers. The DiffServ charter is defined at www.ietf.org/html.charters/diffserv-charter.html
DIY	An abbreviation of 'do-it-yourself', used in the context of this report to describe a self-provided consumer
DMCA	Digital Millennium Copyright Act – US law enacted in 1998, primarily to bring the USA into line with the WIPO treaties
DNS	Domain name system – a computer system to turn a domain name (e.g. www.analysys.com) into an IP address
DSL	Digital subscriber line – a family of similar technologies (e.g. ADSL) which allow ordinary telephone lines to be used for high speed broadband communications
E.164	An ITU-T standard network addressing format for international telecommunication numbering
E.164 number	A number from the international public telecommunication numbering plan which uniquely indicates a public network termination point and which typically consists of three fields: country code; national destination code; and subscriber number
ECN	Electronic communications network – networks set up for trading stocks and bonds using PCs and the Internet or a dial-in circuit into a private network
ECS	Electronic communication services – defined in the EC Framework Directive Article 2 (c) as: *A service normally provided for remuneration which consists wholly or mainly in the conveyance of signals on electronic*

	communications networks, including telecoms services and transmission services in networks used for broadcasting, but exclude services providing, or exercising editorial control over, content transmitted using electronic communications networks and services; it does not include information society services, as defined in Article 1 of Directive 98/34/EC, which do not consist wholly or mainly in the conveyance of signals on electronic communications networks.
ENUM	*(A contracted form of 'electronic number mapping')* – A project initiated by the IETF that seeks to standardise a protocol that takes a telephone number (as defined by the ITU) and resolves it to a series of URLs using DNS-based architecture
Ethernet	A local area network architecture (also known as IEEE 802.3) used for connecting computers, printers, workstations, terminals, servers, etc. within the same building
ETNO	European Public Telecommunications Network Operators' Association
ETSI	European Telecoms Standards Institute – main mission is to produce and maintain the technical standards necessary to achieve a unified European market for telecoms and related areas
FCC	Federal Communications Commission
Frame relay	A service designed for cost-efficient data transmission for intermittent traffic between local area networks (LANs) and between end-points in a wide area network (WAN). Frame relay is based on the older X.25 packet-switching technology. Unlike X.25 (which was designed for analogue signals), frame relay is a fast-packet technology, which means that the protocol does not attempt to correct errors
Gbit/s	Gigabit per second – a thousand million (billion) bits per second
GPRS	General packet radio system – one of the 2.5G standards which allows higher data speeds to be achieved using existing GSM technology

GSM	Global system for mobile communications: second generation digital pan-European mobile system – the most successful mobile standard globally
H.248	ITU standard for multi-media communications over packet networks
H.323	ITU standard for interactive real-time communications over packet networks
HLR	Home location register – a database that holds subscription information about every subscriber on a mobile network. Maintained by the subscriber's home carrier (or the network operator where the user initiated the call), the HLR contains pertinent user information, including address, account status, and preferences.
HTTP	Hyper text transfer protocol
IAD	Integrated access device – a customer premises device which combines media such as voice, data, and Internet access in a single unit
ICQ	Derivative of 'I seek you' – a downloadable instant messaging program developed by Mirabilis. It is used as a conferencing tool by individuals to chat online, email, perform file transfers, play computer games etc.
IDE	Integrated drive electronics –Interface for connecting additional hard drives to a computer
IEC	International Electrotechnical Commission – prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardisation and as references when drafting international tenders and contracts
IEEE	Institute of Electrical and Electronics Engineers – technical professional association

IETF	Internet Engineering Task Force – open international community of network designers, operators, vendors, and researchers concerned with the evolution of Internet architecture and its operation
ILEC	Incumbent local exchange carrier – the dominant phone carrier within a geographic area (in the USA, this would be as officially defined by the Federal Communications Commission)
IM	Instant messaging – A text-based service (cf voice-based service) which alerts users to when friends or colleagues are online and which allows them to communicate with each other in real time through private online chat areas. Users create a list of other users with whom they wish to communicate; when a user from this list is online, the service alerts the user and enables immediate contact with the correspondent. Instant messaging was originally a proprietary service offered by Internet service providers such as AOL and MSN
IMS	IP multimedia system
IN	Intelligent network – Computer-controlled network that allows more than just setting up calls – for instance routeing calls to different destinations at different times of day
Incumbent	The monopoly telecoms operator that existed in most countries prior to telecoms liberalisation. The incumbent is usually policed by a telecoms regulator to ensure that competing operators get fair access to its network
Interconnection	The point at which one network hands over traffic to another network. The price and terms and conditions that apply to the handover are also referred to as interconnection
Intranet	Private network that uses the same technology as the Internet

IP	Internet protocol – the communications standards used by the Internet (strictly, only the Internet networking protocol, but commonly used to include a whole related set of protocols)
IP address	Every computer connected to the Internet is assigned a unique IP address – a 32-bit numeric identifier written as four numbers separated by periods
IP phone	Devices that can send and receive voice calls over an IP network - the same kind of network that carries Web pages and application traffic
ISDN	Integrated services digital network – the technical standard used in the public switched telephone network (PSTN). Also used to refer to a medium-bandwidth access technology
ISO	International Standards Organization
ISP	Internet service provider – an organisation which allows companies and individuals to connect to the Internet
ISS	Information society services – term used (by the EU) to indicate certain Internet-based services
ITU	International Telecommunication Union – the body established by the United Nations to oversee the delivery of international telephone calls. It now has an important role in devising standards and regulates the international allocation of radio frequencies
kbit/s	Kilobits per second – a thousand bits per second
LAN	Local area network – a network in a building or on a site usually used to connect computers together
Latency	A measure of the delay caused in communicating between two points
LRIC	Long run incremental cost

Mbit/s	Megabits per second – a million bits per second
MDF	Main distribution frame – a cable rack that interconnects the private or public telephone lines coming into a building with the internal network
MGCP	Media gateway control protocol – a protocol to control multimedia communications over packet networks
Mobility market	The full range of services used when end users are away from home or their place of work, including 2G and 3G networks as well as access to the Internet on WiFi hotspots
Modem	Equipment that converts digital signals to analogue signals and vice versa allowing digital devices such as computers to communicate using analogue links such as telephone lines
MPLS	Multi protocol label switching – an IETF standard intended for Internet application and widely supported method of speeding up IP-based data communication over ATM networks. It gives network operators a great deal of flexibility to divert and route traffic around link failures, congestion, and bottlenecks
MSN	Microsoft Network: A Microsoft product family which includes services such as its ISP, MSN Hotmail, MSN Messenger, MSN Search, Communities, Chat, Shopping and Personal Finance
MVNO	Mobile virtual network operator – a company that buys network capacity from a network operator to offer its own branded mobile subscriptions and value-added services

NAT	Network address translation – an Internet standard that enables a local area network (LAN) to use one set of IP addresses for internal traffic and a second set of addresses for external traffic. It: • provides a type of firewall by hiding internal IP addresses • enables a company to use more internal IP addresses • allows a company to combine multiple ISDN connections into a single Internet connection.
NDA	Non-disclosure agreement
NGN	Next generation networks – a catch-all phrase for the infrastructure that will enable the advanced new services that are expected to be offered by mobile and fixed network operators in the future, while continuing to support all of today's existing services
NRA	National regulatory authority
NRF	New Regulatory Framework – European framework for electronic communications networks and services applied throughout the Member States from 25 July 2003. All Member States must adapt national legislation implementing the Directives by 24 July 2003 with the exception of the Data Protection Directive, for which the date is 31 October 2003. The NRF is intended to provide a coherent, reliable and flexible approach to the regulation of electronic communication networks and services in fast-moving markets. The Directives provide a lighter regulatory touch where markets have become more competitive yet ensure that a minimum of services are available to all users at an affordable price and that the basic rights of consumers continue to be protected
OEM	Original equipment manufacturer
OJ	Official Journal (of the European Union)
ONP	Open network provision – Council Directive 90/387/EEC of 28 June 1990 on the establishment of the internal market for telecoms services through

	the implementation of open network provision (ONP). EU objective to establish harmonised conditions for the provision of an open telecoms network, the basic objective for the completion of a single market in value-added services
OS	Operating system
OSS	Open source software
Packet switching	See 'switching'
PATS	Publicly available telephony service. The Universal Service Directive defines PATS as providing access to emergency services
PBX	Private branch exchange – an in-house telephone switching system that interconnects telephone extensions with the outside telephone network. It may include functions such as least cost routing for outside calls, call forwarding, conference calling and call accounting. Modern PBXs use all-digital methods for switching and may support both digital terminals and telephones along with analogue telephones
PDA	Personal digital assistant –a handheld device that combines computing, telephone/fax, and networking features. A typical PDA can function as a cellular phone, fax sender, and personal organiser. Many PDAs incorporate handwriting and/or voice recognition features
PLMN	Public land mobile networks
PM	Presence management – the ability to tell a phone system via a Web interface, application running on PC or phone interface, where you are so that it can locate you and connect your calls. It combines one-number dialling and multiple outbound calls to help the caller connect

POTS	Plain old telephone service
PR-ISDN	Primary rate integrated services digital network
Presence management	Capability within a network to identify and locate a specific user that is currently using the network
PSTN	Public switched telephone network – the telephone network
PTO	Public telecommunications operator
PVT	Public voice telephony
QoS	Quality of service – how good the service provided by an operator actually is. It covers technical issues such as failing to connect calls and dropping calls, as well as how quickly an operator responds to requests from the customer
R&TTE	Radio and Telecommunications Terminal Equipment
RAS	Remote access server
Router	A specialised computer dedicated to the reception and queuing of TCP/IP packets and responsible for sending them on towards their final destination. Essentially it is an Internet switch
Self-provided consumer	Where users provide their own telecoms systems/circuits in order to meet their own external communications needs
Server	A shared computer on the local area network that stores and distributes data
SIM	Security identity module

SIMPLE	SIP for instant messaging and presence leveraging – the part of the SIP standards concerned with presence notification and instant messaging
SIP	Session Initiation Protocol – high-level protocol that establishes a connection between specific sites on the Internet , used predominantly for voice communications between end-user sites
SIP-T	Session Initiation Protocol for telephones –an extension to SIP that allows the transmission of encapsulated SS7 signalling information between SIP gateways
SLA	Service level agreement – a contract between the provider and the user that specifies the level of service that can be expected during its term. It might govern, for example, application availability and performance and response time for problem resolution (such as network down, server failure, etc)
SME	Small or medium-sized enterprise – a standard term referring to businesses of up to 500 employees
SMP	Significant market power – spelt out in full in main body and sometimes abbreviated
SMS	Short message service – a service for sending short text messages (generally no more than 140–160 characters) to mobile phones
SPAN	Services and protocols for advanced networks – a technical committee set up by ETSI
SS7	Signalling system number 7 – a set of internationally implemented signalling standards
STQ	ETSI's technical committee for Speech, Transmission Planning, and Quality of Service. Formed in 1997 and initially intended as a centre of expertise on speech quality issues, STQ has broadened its scope to handle more general quality issues

Switching	The process whereby traffic is routed over the network to its intended destination: **circuit switching** – a form of switching where data is sent through a network on a path which is reserved for the entire duration of a session **cell switching** – a form of switching where data is assembled into groups of equal size, addressed and sent through a network to its destination **packet switching** – the same as cell switching but with data assembled into groups of variable size.
TI	Standard US 1.536Mbit/s transmission rate
TCP/IP	Transmission control protocol/Internet protocol – the Internet protocols for file transfer
TIPHON	Telecommunications and Internet Protocol Harmonisation Over Networks – an ETSI project to define the interactions between circuit-switched voice networks and VoIP packet technologies
TISPAN	TISPAN (the merger of TIPHON and SPAN) is the ETSI core competence centre for fixed networks and for migration from switched circuit networks to packet-based networks with an architecture that can serve in both. It is responsible for all aspects of standardisation for present and future converged networks including: service aspects; architectural aspects; protocol aspects; QoS studies; security-related studies; and mobility aspects within fixed networks, using existing and emerging technologies
ToS	Type of service –provides an indication of the abstract parameters of the quality of service desired. These parameters are to be used to guide the selection of the actual service parameters when transmitting a datagram through a particular network
UDP-IP	User datagram protocol using Internet protocol – Internet protocols for real-time traffic

UMTS	Universal mobile telecommunications systems – a name for 3G mobile telecoms
URI	Uniform resource identifier (includes URLs, URNs, etc.)
URL	Uniform resource locator – unique address of a document or a resource on the Internet consisting of the form of protocol, server domain name and pathname
URN	Universal resource name – location-independent names for Internet resources
USO	Universal service obligation – the obligation to make a service available in a geographical area or to a specific group of users, even if the company on which the obligation is imposed is not able to obtain a commercial profit on the service
VAS	Value-added services – Services that offer more than basic telecoms services such as routeing calls to different destinations at the request of the customer
Virtual number	A secondary number that allows a call to be redirected from a home mobile number (i.e. so that the caller and calling party pay a local rate)
VoIP	Voice over IP – voice services carried over IP networks
VPN	Virtual private network – a service that looks like a private network to the customer but which is delivered over a shared network
WACC	weighted average cost of capital
Walled garden	A commercial and technical model in which the service provider limits the access to the Internet as a whole, and provides instead a small selection of services within the 'walled garden' instead.

WAN	Wide area network – a network which covers a large area – usually a public network covering a country or region
WiFi	Wireless LAN standard published by the 802 Committee of the IEEE
WIPO treaties	International treaties signed in Geneva in 1996, designed to bring uniformity to international copyright law
WTPF	World Telecommunication Policy Forum
X25	A commonly-used network protocol that protocol allows computers on different public networks to communicate through an intermediary computer at the network layer level. Adopted as a standard by the Consultative Committee for International Telegraph and Telephone (CCITT) in 1976