

Telecoms Infotech Forum

Briefing paper

IP Telephony and Voice over Broadband

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Telecoms InfoTechnology Forum

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The objective of TIF is to stimulate informed interest in the policy and regulatory aspects of information and communications technologies (ICTs), to foster greater transparency and a better understanding of the economic and technological dynamics of the sector, its impact on social welfare and its policy implications.

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IP Telephony and Voice over Broadband

‘Today, in 2004, VoIP is a fashion statement. If you're a fashion statement, you run the risk of being unfashionable.’ Jeff Pulver

‘The telecom world will be forever altered. The old one was about connecting places. The new one is about connecting people.’¹

Introduction

VoIP comes in two different guises. One is as Internet Telephony with voice traffic routed on a ‘best effort’ basis over PC-Internet-PC, PC-Internet-PSTN and PSTN-Internet-PSTN networks. The other is as VoBB with voice traffic transmitted over managed & proprietary ‘QoS’ (Quality of Service) networks that use IP technology to render end-to-end IP telephony over an NGN (Next Generation Network) rather than over the Public Internet.

One way to view VoIP is as the quintessential example of a disruptive technology. It has the potential to upset traditional business models, it accelerates technology obsolescence and it plays havoc with established regulations. Another approach is to see VoIP, and especially VoBB, as a stepping stone towards the delivery of next generation multimedia and value-added services (VAS) over next generation networks.² Which particular mix of these comes about rather depends upon who dominates the process over the coming years. Will the young upstarts set the pace or will the incumbents control it?

VoIP and VoBB implementation raises several challenges: commercial ones (who will invest in the networks if the use of facilities is unpaid for), technological ones (quality assurance and load control), marketing ones (how low can prices go), and regulatory ones (including numbering and avoidance of the universal service charge, interconnection charges and state taxes), all invariably intermingled. Also, it is not yet a perfected technology and it has some constraints like nomadic numbers and their impact on emergency services which are cause for major consumer protection concerns. As a stepping stone, VoBB promises an interesting array of new and bundled services.³ As always from a commercial viewpoint, outcomes hinge around who ‘owns’ the customers, and how far can peer-to-peer fully meshed networking (including 4G fixed-mobile convergence in which handsets become IP transceivers automatically adding new nodes to the network as users join it) evolve beyond the control of the traditional network operators.

¹ From ‘The ABCs of VoIP’ in *BusinessWeek Online*, 21 September 2004.

² Multimedia services involve voice combined with image, video and data, sometimes referred to as ‘rich voice’. Value-added features include portable phone numbers (or the ability to pick up a call anywhere by simply establishing an IP address), customized voice mail including the ability to listen to voice mail as an email attachment (‘voice mail on steroids’) and managing calls through a Web based account.

³ Services like Vonage in the USA and HKBN in Hong Kong effectively bundle the retailing of the broadband line with voice services, whereas incumbent operators retail voice but only wholesale broadband to ISPs who then resale to the end user. One result could be to push incumbents into retailing broadband directly while ISPs become virtual voice service providers (VSPs).

Technological Challenge

VoBB technology benefits from the confluence of several technology trends, among them are greater storage capabilities, an increase in silicon processing power, stronger compression engines or codecs (even though 64k is required at the moment to insure a high level of sound quality), powerful encryption software, improved network monitoring tools and the emergence of Session Initiation Protocol (SIP) as the VoIP signaling standard of choice partly due to its adoption by Cisco.⁴ The introduction of IPv6 will improve VoIP applications by increasing the supply of unique IP addresses that SIP requires to communicate over the Internet and improve VoIP security.⁵ MPLS (Multi Protocol Label Switching) is another key technology that allows the Internet to give higher priority to VoIP communications so that conversations will not cut in and out.

From an existing telephone operator's perspective, as they embark on the migration to an end-to-end IP-based infrastructure, VoBB becomes a more efficient way of routing and delivering voice traffic as Internet calls share bandwidth space on the network with everyone else and unlike traditional calls do not require a separate circuit for each user. An Internet voice call is treated like any other piece of Internet data or application such as a Web page or audio file or email distributed over the Net and carriers are turned into 'bit haulers'.

The more dexterous incumbents are responding to the challenge with the triple play option. Because of a technology like VoBB, telephone and cable TV operators can transmit voice, video and audio down the same pipe and bundle packaged TV, VoIP, videoconferencing and high speed Internet services.⁶

But for many large established telephone monopolies, those operators encumbered with legacy networks and not terribly innovative or swift to change, emerging VoIP pioneers are threatening because they not only offer one flat rate for a call that lasts one minute across the city or three hours to a destination on the other side of the world but do so to a large extent by bypassing the conventional switched telephone network (PSTN), cutting out the 'middle men of public switches'.⁷ Calls are switched from analog to digital bits, packets of data, transmitted by the most efficient route (sometimes called best effort), either on the public Internet or privately owned data networks, then reassembled at the other end and converted where necessary back into a traditional phone signal just before the call reaches its destination.⁸ VoIP providers

⁴ The ITU's H.323 is another contender for IP-based telephony signaling scheme and is used in older VoIP devices and software. SIP still must address issues of scalability as VoIP subscribers grow from a few hundred thousand to several million and its need for border and session controllers which can be costly.

⁵ Curiously enough IPv6 might create incredibly long phone numbers to key in addresses and this development could affect the design of handsets.

⁶ In what has been dubbed 'project light-speed,' SBC has committed US\$400 million over the next 10 years to Microsoft's IPTV platform for the delivery of television programming to homes over high-speed lines. (*Chicago Tribune*, 18 November 2004) SBC CEO Edward Whitacre was quoted as saying 'We believe we can be the 2nd largest video provider in our footprint within 5 years'. (*Cablefax*, 17 November 2004)

⁷ Especially in places where a monopoly on the fixed line side remains in place, where interconnection charges are outrageously high, and where there is an immigrant community that would be an immediate market for VoIP service (see Mexico).

⁸ Many carriers have been using VoIP technology for a long time to carry international voice traffic and do the reassembly of packets in exchanges rather than at the receiver end.

as such can speak to anyone with a regular phone and do not need to be large companies. Small ones can jump into the business because they can make use of an established network (i.e. the Internet) and by using computers and SIP proxy servers that are independent of the expensive telco infrastructure can avoid the huge capital investments needed to build and maintain a traditional phone network.

As competition intensifies, quality becomes an issue.⁹ The quality of Net telephony has been boosted by the growing penetration of broadband connections and people operating home computers more powerful than those on the spacecrafts that landed on the moon. But there are still some doubts. Data networks over which Internet phone calls ride, often over multiple networks,¹⁰ are diverse environments with all sorts of different hardware and software elements that get upgraded on a regular basis. Network congestion and outages do occur and affect VoIP quality and reliability. When downloading a large file and making a simultaneous VoIP phone call, static may be heard on the line or the call is dropped altogether.

Other technical drawbacks for VoBB are the lack of a dial-tone-like service in case of a power outage and the lack of emergency services, issues to be discussed in greater detail in the regulatory section.¹¹ In the future, VoIP traffic, including that generated by peer-to-peer VoIP, might crunch and congest networks between the last mile and the backbone, especially in a market like the US where broadband has been defined downward as 128k ISDN, and forcing operators to throttle certain applications. This might not be such a big problem in Hong Kong where broadband networks are of a far superior quality.

Marketing Challenge

There are several interesting types of marketing challenges and advertising approaches based on the background of the companies involved, whether they are established or start-ups, firstcomer or latecomer, and the technological choices and business model they have adopted, whether they own the network or use another company's network, whether they are peer-to-peer, use an adapter/router, offer free unlimited calls, etc. The first type is exemplified by Vonage and its faceoff with AT&T, and the competition between those two and Baby Bells like SBC and Verizon. The second type is represented by a company called Skype. And a third type by the cable TV companies or Multiple Service Operators (MSOs). Vonage and Skype represent the two most exciting developments in the market so far, with Skype perhaps the more radical of the two approaches. Table 1 offers a summary of VoIP service providers and their different packages.

The Vonage Approach: VoIP trailblazer

Well-funded New Jersey startup Vonage is an independent VoBB provider in the US with no control over either the IP backbone or the last-mile delivery but it has done the best job of creating (jump-starting) and educating the market, of equating the

⁹ The first such phone call services over the Net emerged a decade ago amidst much hoopla but they foundered because the technology was immature. For example, users could not receive calls, or they had to use a special kind of phone, or they could call only people who were online at the same time.

¹⁰ Even a company with as large a network as AT&T cannot control data traffic along the lines owned by Comcast or other local providers of cable or DSL service.

¹¹ In case of electricity failure, some VoBB providers route their customers' calls to another phone like a cell phone.

Vonage brandname with VoIP.¹² It provides subscribers with a multimedia terminal adapter (MTA) which they can take on the road and plug into any broadband connection to send and receive unlimited calls over the public Internet that are often terminated on a PSTN network using the same phone number, and charges US users between US\$15-30 a month for the service, well below the US\$60-70 per month charged for comparable plans for PSTN service by dominant US telephone carriers.¹³ This is a feature called portability.¹⁴ Its service in essence allows users to take their phone number with them wherever they are in the world.¹⁵ Vonage subscribers can now select a London-based virtual number for \$7.99 per month to serve as an inexpensive second number for UK-based friends, family and business associates to communicate with the Vonage subscriber wherever that person is in the world and only pay a local calling rate. Vonage's clout, and volume purchases, enables it to sell its routers (MTAs) at affordable prices from vendors like Linksys, a division of Cisco Systems.

In July 2003 the Minnesota Public Utilities Commission (MPUC) sought to regulate Vonage as a traditional common carrier (including rate structure approval and certification) and filed a complaint against it for failing to apply for a certificate for public convenience and necessity (CPCN). Vonage counterclaimed its service's technology and character were a reality of the Internet which knows 'no state boundaries or borders', a 'geographically agnostic Internet', and which made it exempt from being managed on a state-by-state basis. In October 2003 a federal judge in Minneapolis found that Vonage's VoIP service was an 'information service' and therefore it did not have to register with the MPUC nor did the MPUC have the authority under the 1996 Telecommunications Act to regulate the company. The state regulators appealed that decision which was decided in November 2004 by an FCC recognition, a preemptive move on its part, that Vonage's service was 'inherently' an interstate service and thus not subject to state regulations.

¹² Vonage has more than 200,000 subscribers after raising \$103 million in venture capital for its initial launch and another \$105 million for overseas expansion.

¹³ VoIP providers complete PSTN-bound calls by teaming with CLECs [competitive local exchange carriers or those telephone companies that compete with an incumbent local exchange carrier (ILEC)] that pay reciprocal compensation and in a few instances providers make direct connections and pay access charges. ILECs are upset that carriers like Vonage which terminate in excess of 90 per cent (according to the PSTN operators) of their traffic to the legacy network do not have to pay into the existing intercarrier and universal service regimes at the same levels as their competitors. On the intercarrier issue, Vonage is said to be seeking arrangements with other Internet-based VoIP providers such as a peering agreement with pulver.com and is exploring agreements with cellular providers for the direct exchange of communications traffic. In such cases, according to Vonage, 'the call termination location is not only unknown but irrelevant to Vonage'. The difference in pricing packages also reflects the access fees, number-portability, 911, subscriber line charges and state and universal service taxes imposed on traditional telephony that are not imposed on Internet telephony services. This can cut a typical monthly phone bill by US\$15-17. The *Wall Street Journal* (17 November 2004) reported that SBC plans to file a new tariff with the FCC that increases the fees paid by Internet telephony service providers for calls completed on SBC's local phone network so that VoIP providers pay the higher fees associated with long-distance calls and not the substantially lower ones associated with local calls. SBC's 'interstate connectivity service' is called TIPToP which stands for True IP to PSTN.

¹⁴ The majority of Vonage customers in the US can import their existing numbers to the new service but some telephone companies refuse to allow customers to take their numbers with them. Most Vonage customers do not want their number listed in a phonebook because they are trying to avoid telemarketers, something which many Hong Kong residents might want to do as well.

¹⁵ That means the same phone always has the same number, but its IP address can change.

On the marketing front, Vonage has put together a retailing deal with Amazon and engaged in a price war with AT&T by matching its discounted plan of \$29.99 with a \$25 unlimited local and long-distance calling plan.¹⁶ One potential vulnerability for a company like Vonage is that because it does not control the wires running to the homes and offices (which allows it to be more cost effective than its competitors) network owners could easily manipulate bit streams to give network-owned VoIP services priority over Vonage services.¹⁷ And Vonage customers did experience service outages twice in August of 2004. Future plans include the prospect of undercutting mobile operators' high roaming charges through WiMax technology (WiFi 'softphones').

The AT&T Approach: No longer your granddaddy's phone company

AT&T unveiled its own Internet phone service plan CallVantage to leverage least cost routing. VoIP became the centrepiece of AT&T's consumer strategy when AT&T announced in July 2004 that it would stop marketing traditional phone services and drop out of the competitive local service market altogether on the grounds that it had become untenable. This followed a decision by the FCC to let incumbent local exchange carriers charge market rates for leasing their lines and switches nullifying the previous steep discounts which some states had been very aggressive in enforcing. AT&T's new strategy seems to rest upon offering IP services over a secure & managed network to the business community, whereas the mass consumer market is less concerned about issues of security and quality and more responsive to promotional marketing campaigns and price competition.

Incumbents: Some smart, many not

All incumbents (those 'marketing powerhouses with huge customer base') are involved in an exploratory stage trying to figure out how to integrate Web based technology with legacy networks and they are conducting VoBB trials to determine the set of features that will appeal to the largest market. Driven by a desire to protect local phone business which in the US has lost 4 million lines in the past two years mostly to wireless telephony and by a fear of cannibalizing their existing voice services, incumbents are putting together bundles that include local, long distance and cellular telephony.¹⁸ In some cases, the monthly difference between VoIP packages and traditional telephone plans is not sufficiently compelling to entice people to replace their phone line with VoIP, particularly if it is the primary line. Many will happily retain their landline because it is 'bulletproof' and 'powerproof'.

Some like Verizon have been more attuned to the changes and have begun offering their own VoIP services. The introduction of 'naked DSL' access to incumbents' broadband pipes without the requirement that customers also subscribe to their voice offering will have a salutary effect on VoIP takeup.¹⁹ There is a fear, as alluded to

¹⁶ The rate cuts raise the question of whether anyone will ever make any money selling Internet phone service. However, IP cuts network costs and is therefore a relatively high margin service. Although voice becomes a commodity business, sheer volume can make the business profitable.

¹⁷ At least one Internet service provider in the state of Washington canceled a customer's Web-access service because Vonage did not have a contract with the ISP.

¹⁸ Forrester Research estimates currently there are no more than 500,000 VoIP 'lines' (active accounts) in total in the entire USA. By comparison SBC alone has more than 54 million circuit switched lines.

¹⁹ Even customers who buy Verizon's VoIP service are required to pay for traditional Verizon voice service.

earlier, that network providers of broadband connections ('gatekeepers of high speed on-ramps'), once they roll out their own VoIP service, might try to degrade 3rd party 'access independent' offerings like a Vonage to gain a competitive advantage by limiting the amount of bandwidth dedicated to competing VoIP providers.²⁰ Broadband access providers, the owners of last-mile transmission facilities, could conceivably unfurl marketing gambits that place the accent on 'preferred' access and service.

The Skype Way: Peer-to-peer revolution

Founded in August 2003 by the iconoclasts who created the popular KaZaA music downloading service, Skype, based in Luxembourg, brings peer-to-peer software that can be downloaded to a computer and once installed provides free fully-encrypted voice calls over the Internet to other Skype users around the world.²¹ Uniquely Skype has no phone lines or pricey switching equipment or expensive centralized computers of its own and uses instead the millions of connected PCs and the public Internet to weave together a distributed network. It is a network that can theoretically expand indefinitely at almost no cost to Skype.²² Unlike Vonage which uses a centrally managed system to handle call transfers to the traditional phone network, daily Skype users, many of them 'geeks' but also many who are this generation's youth accustomed to using IM (instant messaging) as their principle mode of communication, create an ad-hoc network on the fly sharing computer resources and bandwidth to manage the traffic flow and ensure call quality.

Rather than spending millions on advertising like Vonage or AT&T, Skype relies on viral marketing or 'word of mouth'. It is trying to amass as many subscribers as possible and then start selling services such as voice mail, call waiting and follow-me calls, similar in some ways to the market grabbing strategies taken by Yahoo! and Google and free software download ICQ instant messaging. In September 2004 Skype launched its first revenue-generating service called SkypeOut which lets subscribers place calls from their PCs to regular offline phones for 2 cents a minute. This contrasts to Vonage which charges a flat monthly fee. Skype also plans to deploy small business services next year such as larger conference calls, group billing and software tools to tie Skype user lists into company phone directories. It has even made a version of its software that runs on handheld devices powered by Microsoft's Pocket PC program enabling a WiFi'd PDA to run Skype for the users on the go. Siemens has recently introduced a device that beams Skype calls to a cordless household telephone, a possible precursor for a Skype-enabled mobile phone, and has developed a handset with Skype software embedded that uses a USB to connect directly to the PC.

As Skype tries to garner the largest number of subscribers (like MS Messenger or AOL IM have done in the messaging community) there is a fear that 'islands of communities' might develop that are essentially closed and cannot 'interoperate' with

²⁰ This could loom as a big challenge if the number of broadband providers in each market dwindles down to one or two players. Alternative access technologies like WiMax or broadband over power lines might break the bottleneck but they are far from being 'mature market forces'.

²¹ Since the software was first made available in August 2003 there have been more than 22 million downloads and the service is currently registering 60,000 new users every day.

²² 'It costs Skype less than 1 cent to add a new user versus hundreds of dollars for a traditional VoIP provider.' (*BusinessWeek*, November 1 2004)

one another. Skype is trialing a service called SkypeIn which gives Skype customers a phone number and area code to allow calls from the public network.

The Cable Guys

Cable companies are eager to enter into VoIP because they have no local service to cannibalize so any VoIP revenue represents a gain. Many Multiple Service Operators (MSOs) can run VoIP traffic through soft switches over their high capacity managed networks thereby ensuring quality and reliability and are teaming up in alliances with companies like Level 3, MCI, Sprint, Vonage and others to build quickly and deploy VoIP services.²³ Specialized companies offer solutions for billing and order taking, value-added services like voice recognition, while voice service providers (VSPs) offer provisioning and switching capabilities. Comcast, the largest MSO in the US, is planning to partner with Sprint and AT&T to lease physical connectivity to the public network to avoid infrastructure duplication. Sprint provides Time Warner's New York City franchise with long distance and PSTN interconnection facilities and support for emergency services, directory assistance, operator services and voice mail.

But many, especially Wall Street pundits, view VoIP as a low margin business, as a free add-on, and argue that companies can only survive if they make VoIP a part of a facilities-based triple play including broadband and broadcast, an area in which cable TV companies are well positioned. VoIP becomes a marketing advantage because cable companies can bundle phone (even though for the moment they lack the key cellular element) and broadband and video. Nevertheless, managing in-house capabilities alongside partnerships promises to be a difficult task.

Demand: Residential and Corporate

Will VoIP become the driver for broadband, rather like the demand for fast Internet access and for fast response time for gamers? Possibly, but only where domestic long distance and international calling charges remain non-reflective of underlying costs, for example in Japan, but maybe not in Hong Kong and the US. In Japan, Softbank's Yahoo! Broadband has 3.5 million customers for its voice service which it bundles with its broadband service.

For corporates, IP telephony is the way to connect far-flung offices and campuses and cut down on PBX costs and unwieldy infrastructure. The Heinz corporation is deploying VoIP with the goal of eliminating all charges, worldwide, from public telephone networks for internal calls. Boeing, Ford and the Bank of America are other recent examples of companies that have done large scale VoIP installations, buying Cisco IP handsets in bulk quantity, even when they cost as much as \$350 per IP-ready handset. Once Chinese manufacturers enter the market, the cost of USB IP phones should fall dramatically. Langham Place, a hotel in Hong Kong, announced a VoIP deployment, working in conjunction with CrystalVoice Communications. Guests can email a contact who can then click on an icon in the message and dial into the guest's room for free from anywhere in the world using the VoIP phone in each room.

²³ This may sometimes run counter to cable companies' corporate strategies of customer control and cost efficiencies.

Table 1: Who Else is Providing VoIP or VoBB Services?

US	
SunRocket, backed by Nokia	\$24.99 a month, no other fees, enhanced 911, unlimited domestic long distance + 100 minutes of calls to anywhere in the world
VoiceGlo	Office Depot's 900 outlets sell phones that plug into laptops with VoiceGlo calling plans; simple self installation, can also run on dial up connection due to codec that compresses voice for transmission over narrow connection
Free World Dial Up	Run by Jeff Pulver, the grassroots evangelist for VoIP
Friendster Phone	Partnered with VoiceGlo; option for college students who belong to Friendster's social network ('web of trust'), can purchase several alternate phone numbers with different area codes so friends and family don't incur long-distance charges
Net2Phone	Provides cable companies with turnkey VoIP services to resell to their subscribers, their 'captured audience'
Covad	Innovative sales pitch drawing visitors to VoIPthemovie.com Web site
EarthLink	#3 ISP in the US, offers its 1.2 million high-speed customers free PC-to-PC Internet phone calling, dial an Internet address instead of normal phone number, appeal limited to avid tech users
Primus	\$19.95 monthly VoIP service called Lingo; leveraging its global IP backbone and termination agreements to offer different international calling packages
Zoom Technologies	Modem manufacturer, not a carrier, but offering free 2 nd line peer-to-peer voice service called Global Village with purchase of its asymmetrical DSL modems
8X8, Packet8	Competing on the features and capabilities it can add on to voice platform; just launched the industry's first consumer videophone service
USA Datanet	\$24.95 a month unlimited local and long distance
Nuvio	Wholesale VoIP provider
Europe	
Free (France)	Unlimited free phone calls throughout France, marketed as 2 nd line, raised VoIP's visibility by making it a no-extra-charge option included with broadband service
Neuf Telecom and Tiscali France	Bundled voice into broadband offerings
Gossiptel (UK) and Siptgate (UK and Germany)	Vonage copycats; Siptgate customers are billed 1.19 pence per minute for calls to fixed line numbers in Britain, call to mobile priced at 14.9 pence a minute
Freenet.de and United Internet (Germany)	Introduced Germany's first low-rate VoIP calls in February 2004
FastWeb (Italy)	Circumventing traditional phone network and delivering voice through own high-bandwidth fiber optic connections in limited metropolitan areas
Incumbents and former monopolists	
AT&T	Cut the price for its CallVantage service by \$5 a month to \$29.99; calls initiated on a cell phone can be transferred without interruption; the do-not-disturb function can be set to receive certain calls or set to a timer; 'Locate Me' feature rings up to five separate numbers simultaneously
BT	Added VoIP services but priced at standard fixed line rates
Verizon	VoIP calling plan VoiceWing starts at \$34.95
SBC	Unified Communications: bundling fixed and wireless; testing VoIP service and will make it available to five million residential subscribers of its high-speed Internet connections by early next year
Softbank's Yahoo! BB (Japan)	Bundles a VoIP connection with cable or DSL broadband service; charges 7.5 yen per three-minute calls to the US while NTT charges 80 yen; calls between BB Phone users in Japan are free
Cable	
Time Warner (New York City)	\$39.95 a month for unlimited local and long distance; watershed deal with MCI and Sprint to strike up strategic partnership in December 2003; does not allow its VoIP phones to be mobile and has disallowed out-of-region area codes
EWT (Germany)	Plans to launch VoP over its fiber optic network
Wildcards	
Microsoft	Has intention to play in VoIP: Live Communications Server (LCS) allows IM clients to interoperate, prelude to VoIP functionality (multicast, multimedia IP conferencing, automatic call center application, PBX, interactive voice response, other real time collaboration apps); possibility of MS branded phone that could plug into USB port
Wireless VoIP	Vonage might comarket its service with WiFi providers; version of Skype software for cellphones; handset makers starting to build in systems that let people use VoIP to talk for free over public WiFi and cellular networks; November 2004 the first combination WiFi/cellphone NEC model N900iL went on sale in Japan by NTT DoCoMo. The phone makes SIP-based VoIP calls over a standard 802.11b WiFi network and is being marketed to corporate customers
Open Source VoIP	Some claim it will be bigger than the Linux market; Asterisk, a freely downloadable program which allows anyone to have their own home-grown PBX and become a 'service provider'

Regulatory Challenge

For many the attraction of VoBB is that it is an unregulated service and governments are in danger of acting in an obstructionist manner impeding new competition and innovative services. But realistically there are several specific regulatory issues to be dealt with, the following ones are seen mostly in the context of the European and American markets but are applicable to all countries and markets and Table 2 at the end of the section offers a more global perspective.

Emergency Calls

VoIP providers unlike traditional land-line carriers are not mandated to provide emergency 911 services (as they are known in the US) and this could become a political issue as regulators are concerned with upholding public safety standards and enforcing social obligations. The question then becomes whether to mandate 911 via regulatory fiat or whether market pressure will drive VoIP providers to seek a solution themselves as a fully functional 911 service becomes a strong selling point for the service. VoIP does not automatically provide emergency operators with a caller's phone number and location information which is data stored in E-911 systems, therefore requiring that the 911 operator ask the identity and location of the caller.²⁴ In the case of a heart attack, this could become a life-or-death issue. This can be addressed by offering a 'best effort' emergency service at no extra charge as Vonage has done (others might charge their subscribers) through the use of intermediaries like Intrado which help VoIP providers connect to the traditional 911 calling network.

Vonage subscribers must provide their location information to a database (a Vonage Web site) maintained on an Intrado server which is passed along to the correct 911 call center. Whenever Vonage users are on the move with their adapters they must 'manually' update the location of their phones.²⁵ Sometimes there are routing problems as some 911 Internet phone calls have gone to the wrong answering location or to administrative lines at the nearest public safety agency which do not get answered immediately. Further complicating matters is that 911 has to be negotiated and implemented on a state by state, or even town by town, basis.²⁶ There has been talk of using location detection technologies like VoIP 911 enabled by GPS chips installed in the end user devices but these remain expensive, are not yet accurate to the meter, and will take another couple years before they are fully effective. Lastly there is the issue of who foots the bill for 911 services. With traditional telephony most carriers add a 911 charge to the phone bill. In the final analysis, rather than making proscriptive regulations, many favor educating the consumer so that they can make an informed decision being well aware that VoIP has certain limitations when it comes to

²⁴ Enhanced 911 allows police and fire dispatchers to automatically see on computer monitors the address of a 911 call and a call-back number. It allows help to be sent quickly even if a person gets disconnected or cannot tell the operator what is wrong or where to go.

²⁵ Vonage recently rolled out 911 calling in Rhode Island. It expects to offer the service nationwide by the end of 2005.

²⁶ The US has employed the federalist concept of the states as 50 laboratories helping to discover the best policy approaches through experimentation. The diversity of state rules means multistate telcos generally must comply with the toughest regulation, resulting in higher costs in less-regulated states and compliance with rules those states don't feel are necessary.

911.²⁷ Knowing the risks involved they then can take the necessary steps to protect themselves.²⁸

USA

Many state regulators in the US (the public utilities boards) are against the FCC's light touch, hands-off approach and have sought sterner regulations for VoIP not only because of a concern with protecting public safety but also because VoIP threatens to undermine the current universal service funding system where users in wealthier regions subsidize telephony for the poor through an elaborate taxation regime.²⁹

VoIP providers won a major jurisdictional fight when the FCC came out in November 2004 with a ruling that VoIP is an 'interstate' service, not 'intrastate', and thus exempt and shielded from state regulation and fees. The FCC's chairman Michael Powell has been influenced by a belief that current regulations of permits and prices and costs have done a poor job of anticipating the changes brought in by the new IP universe. He has sought to free emerging Internet technologies from regulations created for 'the old Bell phone monopolies that no longer exist'.³⁰ On the broader and thornier issues of whether VoIP is a telecom or information service, whether Internet telephony providers must provide access to the disabled, pay intercarrier compensation and contribute to universal service, the FCC will tackle them in its IP-Enabled Services Proceeding set to begin in February 2005. In light of VoIP's march, to come up with a new system of funding for universal service will be tricky and politically challenging.

Europe

In Europe regulators use a designation of Publicly Available Telephony Services (PATS) to classify operators and assign them certain rights and obligations they must fulfill, like the provision emergency services, be able to work after a disaster, number portability, access to directory services, data protection, and certain consumer protection measures related to contracts and tariffs. The question then is whether VoIP providers will be defined as PATS carriers (where compliance is expensive) or left unregulated.³¹ In Holland the regulator OPTA has classified two VoIP categories, IP telephony (fixed and nomadic) with the possibility of calling the PSTN and VoIP

²⁷ Others contend that mandating 911 might actually be positive in that regulation will force providers to improve their 911 capabilities, and the technology that results from those efforts will be useful elsewhere.

²⁸ Some depict the incumbents as vultures waiting for the first fatality that can be linked to a malfunctioning VoIP 911 service and use this as fodder in their battle against VoIP providers.

²⁹ 24 states collect \$1.9 billion a year for universal service obligations such as subsidizing rural phone service and Internet to schools. That pool of money could shrink considerably as more customers switch from traditional phone service to Internet calling plans. States might be forced to raise other taxes such as income or property to make up the deficit. Or users of traditional phone services might be forced to pay higher rates.

³⁰ 'To hold that packets flying across national and indeed international digital networks should be subject to state commission economic regulatory authority is to dumb down the Internet to match the limited vision of government officials. That would be a tragedy.' (Powell speech) Earlier in 2004 in what has become known as the Pulver decision the FCC decreed that Internet phone services from computer to computer are information providers and not telephone companies.

³¹ Compliance would require that the VoIP provider in part pay for a gateway to the PSTN, more costly than just routing calls over the Internet. The UK's Internet Service Providers' Association (ISPA) has claimed that PATS compliance would 'effectively deliver a death sentence to the UK's emerging VoIP industry'.

linked with a broadband service, as constituting Electronic Communications Services (ECS). ECS providers must meet PATS demands. The UK regulator OFCOM has been determined to keep out of the way and limit its interference in an embryonic market, thinking that a laissez-faire attitude that nurtures a nascent technology is the surest route to a thriving VoIP market and competition. OFCOM has said that it considers it not desirable (nor necessary or appropriate) that all new voice services offer the same features as PATS nor is it desirable to rely on the criteria such as the appearance of a service, the 'duck test', to determine the level of regulation.³² The European Commission will be coming out with VoIP guidelines but it already has intimated that emergency service access might denote a PATS-compliant VoIP offering which could act as a disincentive for VoIP providers to implement such access.

Numbering

Numbering is also proving to be a challenge for regulators not only because service can rarely commence without access to numbering resources but also because numbering plans have been inefficiently allocated and with VoIP comes the advent of 'nomadic' numbers. Unlike cable VoIP, VoIP providers like Vonage can offer a nomadic service which allows a consumer to plug into any broadband connection to activate the service using the same number, making it impossible to determine what boundaries the traffic traverses. With VoIP plans offering subscribers up to 10 different virtual numbers access to numbering resources is critical. In the US, the Iowa Utilities Board denied numbering resources to VoIP providers, the only state regulator to have done so.³³ In the UK there has been a debate between issuing geographic and non-geographic numbers for VoIP. OFCOM unveiled new telephone numbers for broadband telephony voice services permitting providers to offer consumers the choice of geographic numbers beginning with '01' and '02' which makes the migratory shift to VoIP easier because they can choose numbers that indicate where they are located and also retain their existing fixed line number which they are most familiar with and nongeographic numbers beginning with the new code '065' that can be used anywhere in the UK and are suitable for people who want to use their Net phone service from many locations. The use of nongeographic numbers also has the advantage of enabling any business to appear as a local entity. The German regulator RegTP granted geographic number ranges to Indigo Networks (SiPGate) and Econo Deutschland (Nokotel) for VoIP services on the condition that the numbers could only be used within the areas they belong to, thinking that nomadic numbers would confuse consumers. It has decided to allocate the first numbers for VoIP using the dialing code '032' starting in January 2005.³⁴ Ireland's Commission for Communications Regulation (ComReg) has designated numbers in the '076' code

³² To some a simple-minded test: Since companies like Vonage and other VoIP providers advertise themselves as 'phone companies' ('looks like a duck') delivering 'phone services' ('quacks like a duck'), some regulators have tried to subject these companies to exactly the same rules as traditional phone companies ('must be a duck'), despite the technical differences.

³³ Iowans could order phone service from Vonage, but without a physical network presence in the state, Vonage could not offer phone numbers with Iowa area codes. Only after the very recent FCC decision has Vonage begun to offer VoIP phone numbers with 515 and 641 area codes for central Iowa. (*The Des Moines Register*, 19 November 2004)

³⁴ The German Competitive Carriers Association (VATN) criticized RegTP's decision and said both geographic and nongeographic numbers should be available for VoIP.

for VoIP.³⁵ In some respect, VoIP service providers might be better off if they can get numbers from a regulator instead of having to secure them from a ‘horizontal competitor’ because many VoIP providers are not facilities-based or operators of fixed networks.

Law Enforcement and Monitoring

The FBI has been pushing the regulator to enforce VoIP provider compliance with the Communications Assistance for Law Enforcement Act (CALEA) that permits national security and law enforcement agencies to wiretap conversations and expecting VoIP providers to place call intercept equipment on every broadband access circuit. But this presents a formidable challenge not only because VoIP providers do not own the transport network and VoIP uses powerful encryption technology but also from a SIP technical viewpoint.³⁶ So long as a call involves someone on a PSTN at one end monitoring is possible and Vonage claims its calls are routed through a central call control to deal with Network Address Translation (NAT) allowing it to do monitoring.

Security

One big potential problem and regulatory challenge is security, hackers and VoIP spam.³⁷ VoIP phones are vulnerable to all the ills of any computer-run service, including hacking and spam. And since VoIP services are not regulated, customers are not entitled to the same rights and protections as standard phone users. Hackers can easily eavesdrop on unsecured Net conversations or fake a Caller ID, which many financial institutions use to confirm customers’ identities, or take over a computer.³⁸ Spammers could ultimately fill electronic voicemail boxes with ‘SPIT’, which stands for Spam over Internet telephony. Like e-mail, the same message could be broadcast to thousands of VoIP users at virtually no cost, filling up voice mailboxes with hundreds of unsolicited messages. Or the phone could be ringing every few minutes with recorded voice pitches for software, drugs, etc. Spammers could also locate the specialized computers VoIP providers use to route calls – known as SIP proxies – and hack into them to deliver SPIT.

³⁵ Some argue the use of a separate code for a particular technology does not make sense and could lead to potential discrimination by providers with market power and control over facilities as VoIP providers are confined in ‘reserved ghettos of special number blocks’. The Irish regulator thought otherwise that ‘in practice the opposite is more likely to happen as users associate VoIP services, and the code, with added features and capabilities.’ (ComReg quote)

³⁶ SIP based telephony generates a stream of Real Time Protocol (RTP) packets that can flow directly between endpoints bypassing even the IP telephony provider’s soft switch. So a softswitch can only monitor or record SIP call signaling not actual conversation.

³⁷ One report conjured up this doomsday scenario, ‘VoIP voicemail could become clogged with heavy breathing and salacious voice messages while denial-of-service attacks, launched by armies of spambots dumped by viruses on innocent computers, could block phone lines’.

³⁸ In November 2004 Skype updated its Internet telephony software, patching a critical flaw in its client for Microsoft Windows-based systems. Security information provider Secunia had said the vulnerability could allow attackers to take control of a Skype user’s PC after the victim clicks on a specially created URL. By including a long string of characters in the link, the attacker could trigger a memory error known as a buffer overflow that could then be exploited to run a program. (*ZDNet UK*, 16 November 2004)

Table 2: Who Outside the US and Europe is providing VoIP or VoBB?

Canada and South America	
Brazil	BrTurbo, the bandwidth provider of Brazilian telecom operator Brazil Telecom, is offering a free VoIP application which permits online audio and video chat rooms
Canada	CRTC's preliminary view would be to let Internet telephony service providers freely set prices while incumbent players' VoIP offerings would be regulated
Mexico	Secretariat of Communications and Transport proposed that cable firms offer telephony in conjunction with a local telecoms entity and not independently
Panama and Grenada	VoIP services suspended by deliberately blocking 'ports' or Internet entry point for VoIP services
Asia	
Australia	Telstra will enable residential customers to make telephone calls over broadband in 2005
China	MII said initial regulations on VoIP could be released soon, and that the new technology could be classified as a value-added service rather than a basic service; China Telecom, China Mobile and China Unicom already offer domestic and international long-distance VoIP; Tom Online launched PC-to-PC VoIP service in partnership with Skype
Hong Kong	November 2003 Hutchison Global Communications (HGC) launched Vfone which combines voice and video telephony; New World Telecommunications (NWT) is rolling out new PC-to-phone 'soft-phone' service NetTalk; China Motion Telecom plans to offer PC-to-phone service at HK\$59 a month, with phone-to-phone VoIP coming later; Hong Kong Broadband, a unit of City Telecom, launched PC-to-phone service in August at HK\$38 per month and the service is available over other operators' broadband networks, including PCCW's Netvigator; SmarTone Telecommunications unveiled a VoIP product where subscribers pay HK\$98 per month and HK\$600 for the adapter, which is given to the intended overseas call recipient. However, the box is assigned an eight-digit access code instead of a Hong Kong phone number, limiting calls to between the SmarTone subscriber and the call recipient; iCable will launch VoIP services in partnership with Wharf T&T known as Digital Homeline and priced at HK\$66 per month
India	Anyuser Telecom has brought down its VoIP IDD call rates to the US, the UK, Canada, Singapore and Belgium to Rs1.75 per minute, inclusive of 10 percent service tax
Indonesia	PT Telkom launched its international call VoIP service with code 017 in 2001; other VoIP licenses have been granted to Indosat, Gaharu Sejahtera, Atlasat Solusindo and Excelcomindo Pratama
Japan	18 cable operators in Kansai area offering secondary IP phone service as part of broadband offering; KDDI launched cut-price 'Metal Plus' service; Yahoo! BB has been an incredible success story with a marketing campaign that included giving out free modems on the street; half of all broadband-connected households are using Internet phones; the International Packet Communications Consortium (IPCC) launched VoIP Forum of Japan (VFJ) in November 2004
Philippines	National Telecommunications Commission (NTC) still studying how to open VoIP to value-added service providers and for public use without hurting telcos; PLDT is currently charging 18 US cents a minute for IP phone card calling to the US, Netopia Internet Café has a 10 US cents offer via Net2Phone, telcos sell inbound VoIP at 11.4 US cents
Singapore	IDA proposes to allow both facilities-based operators (FBOs) and smaller and more asset-light service-based operators (SBOs) to provide VoIP services, using infrastructure leased from other operators; IDA plans to issue a new series of 8-digit numbers, with potentially 10 million numbers to be allocated, dedicated to serve VoIP users starting with code '3'; SingTel has a strategic agreement with SIPphone to deliver VoIP services; AT&T plans to offer VoIP to corporate customers
South Korea	Government plans to promote Internet-based telephony services by creating a dedicated dialing code for VoIP, an IP-only prefix '070' to be used anywhere in the country; fixed-line operators KT and Hanaro to be allowed to use the '070' prefix starting next year; Ministry of Information and Communication (MIC) plans to set VoIP interconnection rates and is considering a revenue sharing model; Serome C&T launched PC-based telephone service in 2000; Samsung Networks and SK Telink already deploy VoIP services to corporate clients
Thailand	TOT plans to extend its IDD VoIP services to cover 154 destinations worldwide with rates ranging from seven to 32 baht per minute; CAT Telecom will introduce free, unlimited IP domestic long-distance telephone calling to all household and corporate customers of its Internet access services as part of a new marketing offensive; NTC does not allow others to provide VoIP
Vietnam	Hanoi Telecoms Company offers domestic long distance and international VoIP; Viettel, a telecoms service arm of the military, carries a total of two million domestic VoIP minutes per month and 300,000 international VoIP minutes; the fees for VNPT's VoIP service are from 7:00 a.m. to 23:00 p.m. US\$0.52 for the first minute, US\$0.052 for every subsequent block of six seconds. On holidays and at weekends, the fee falls to US\$0.42 for the first minute and US\$0.042 for every subsequent block of six seconds.

Conclusion

VoIP in its various forms raises several complex questions that go beyond the immediacy of whether or not consumers get cheaper telephone calls, but at the same time IP technology is ushering in a world of peer-to-peer communications that provides opportunities (and dangers) for multiple business models and players. Which ones survive and which ones thrive should be market-determined, but markets can also fail unless supported by sensible regulation facilitating competition. Emergency services may be an example of where regulation can mix market solutions with incentives to adopt technologies and service models that safeguard the public interest.

Challenges such as who will invest in networks and how to pay for universal service are genuinely serious issues in many jurisdictions, but as the industry makes the transition to NGNs future business models may yet provide the answers. Consumers and regulators will soon learn about them.