**digital**

# Internet Telephony

*White paper:* An overview of the Internet telephony market

Once the domain of hobbyists, voice communications over the Internet has the potential to restructure the whole telecommunications industry. Internet telephony could cost traditional phone companies $8 billion in lost revenues over the next four years and could eliminate the profits of U.S. long-distance carriers by stealing just 6 percent of U.S. telephone traffic[1]. One reason is that Internet-based phone service can be provided not only by traditional phone companies, but also by new carriers such as Internet Service Providers (ISPs) who have their own IP networks.

By Tom Mercer
Director of Business Development
Communications Industry Solutions
DIGITAL Worldwide Services

According to some experts, ISPs are the next generation of telephone companies who will provide voice-over-packet-network service. They even predict that in the future, the present public switched telephone network will migrate to voice-over-IP networks. This is supported by the fact that the volume of data traffic has already surpassed that of voice traffic.

This means that telecom operators, who are now concerned about transporting data over voice networks, will increasingly have to deal with transporting voice over data networks. Technology is improving so fast that it will not be long until phone-to-phone service on the Internet offers the same call quality as conventional phone service. And it doesn't stop with just voice over the Internet. Other applications include fax over the Internet, call center integration, conference bridging and telecommuter access. These applications are all made possible over a single access line using a packetized architecture and the Internet.

The industry started in 1995 when VocalTec introduced software known as Internet Phone. Since then, at least 25 new software companies like MG2 and NetSpeak have been formed, many equipment manufacturers like Lucent, Nortel, and Cisco have entered the industry, and a new telecommunications operator market segment known as Internet telephony service providers like ITXC and Delta Three has emerged.

The market is expected to explode in 1998 as most telecommunications companies begin lab and service trials to understand the implications of Internet telephony either on their core business or as a means of entering new markets. Internet telephony has broad market appeal for consumers, business and service providers.

The focus of this paper is on Internet telephony for the telecommunications industry, including ISPs and the new Internet telephony service providers. This paper will describe what Internet telephony is, size the market, position the players and describe the challenges and opportunities that lie ahead for the telecommunications industry.

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[1] Action Information Services, October, 1997

Have you ever dreamed of . . .

Calling from your PC throughout the world without paying long distance?  Seeing the face of a far away loved one as often as you like?  Making a face to face business meeting no matter where you are?  Having instant access to people around the globe who share the same interests as you?

A new industry is being born —  Internet telephony.

Internet telephony is growing up.  No longer can it be viewed simply as a hobbyist market for saving long distance calling charges by using the Internet.  Rapidly changing technology is making Internet telephony a legitimate alternative for voice services over the Internet.  Telecommunications companies must make some hard choices to determine whether this is a threat to their business or an opportunity to embrace.

**What is it?**

Internet telephony, also known as voice-over-Internet Protocol (VoIP), has evolved from calling PC to PC for saving on long distance calling charges . . .to connecting users over the Internet for multiparty voice and data conferencing for improving productivity while reducing long distance charges . . . to browsing a web site and connecting directly to an agent while using the active Internet connection.

A typical IP network carries multiple voice conversations in the space of a single telephone call.  Voice over IP is a digitized voice signal sliced into packets and sent with other packets (data, e-mail, video images) across a packet-switched network.  At the receiving end, the re-assembled packets arrive as a normal sounding voice call.  IP packet switching is more efficient than circuit-switching, only occupying the network as traffic requires bandwidth and not tying up an entire circuit.  The result is that Internet calls are cheaper than regular calls.

Because voice over the Internet is packetized, it can be particularly challenging.  Individual packets can take different routes across the Internet and arrive at different times.  In a text message this can be reconstructed once all the packetized pieces have arrived.  But in "real-time" voice communication, timely delivery to avoid significant pauses are required.

Other technical issues include:

- Latency and half second delays
- Dropouts (lost packets)
- Poor digitization by obsolete codecs resulting in poor fidelity
- Quality of service (QoS) on public data networks
- Security
- Numbering.

More advanced router and switching technology, expected later this year, should resolve many of
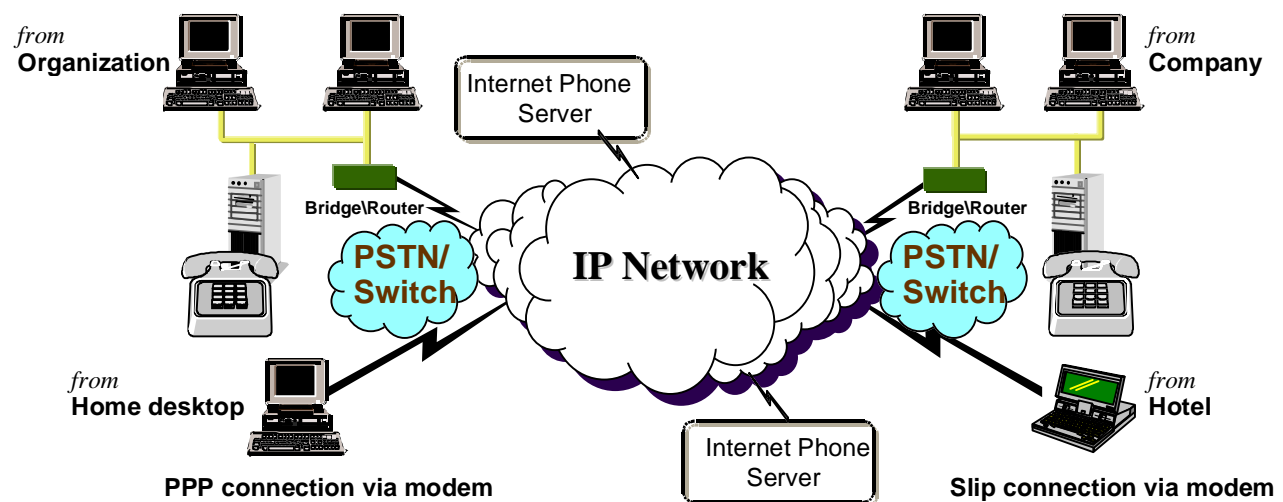


*Internet Telephony architecture takes voice, data, fax or video communication, compresses it, packetizes it, and routes it over the IP network to a destination address where it is then decompressed and passed to the user.*

these issues and allow carriers to send delay-sensitive voice and video traffic ahead of data traffic. With the implementation of Resource Reservation Protocol (RSVP) the bandwidth can actually be reserved for time-sensitive traffic on the Internet. It can also assign priorities to various traffic types. Routers signal each other to request a clear path through a network and set it up. This will address the variations in transmission delays inherent in IP networks.

Internet telephony gateway products bridge the gap between the Public Switched Telephone Network (PSTN) and the Internet to enable unlimited long distance calling from telephone to telephone, fax to fax, PC to telephone, telephone to PC and web browser to telephone.

## Weighing the connection options

Several Internet telephony options are now available:

**PC to PC.** This is possible when both PCs are equipped with a microphone and speaker. The user "dials" the phone number of the person they want to reach, and the person on the other end can respond. This is a half-duplex or full-duplex set up and requires that parties be equipped to talk at the time of the call.

The addition of a video camera will provide video conferencing capability as well as connect to Microsoft's NetMeeting application. There is a feature for white boarding that allows conference participants to review and edit documents in real time.

**PC to telephone or telephone to PC.** Users can place and receive calls to any ordinary telephone. This is the likely set up for a web surfer connecting to a call center. But it may also be the set up for someone at a PC on an office LAN.

A PC equipped with Internet telephony software places a call. The digitized voice packets are sent over IP. At the end, the call hops off the network at a gateway. The voice data is reassembled, decompressed and converted to the Public Switched Telephone Network (PSTN) format. It is then sent over PSTN to its destination.

In the other direction, a remote worker communicating with the home office may place a telephone call that reaches a gateway. The data is digitized and compressed. The call "hops on" the Internet and finds the PC on the other end by using the unique IP address.

It's also an efficient connection for a person retrieving voice mail and returning voice messages via laptops in remote locations such as hotel rooms around the world — a single connection for the cost of a local call. This combines the low cost of Internet connections with the ubiquity of telephones on the PSTN.

**Telephone to telephone.** Intra-company and international calls will generally be phone to phone. A telephone dials into a gateway. The voice data is converted and packetized. It "hops on" the Internet. At the end point the data hits another gateway and "hops off" the Internet. The voice data is converted back to PSTN format and sent over the PSTN to its destination. Any corporation with an internal IP data network can save money by putting voice onto the network.

## The emergence of international standards

One of the most important factors driving the huge growth in Internet telephony is the emergence of international standards. The Voice-over-IP Forum was founded to ensure and promote industry-wide interoperability of Internet voice communications products. VocalTec, Cisco Systems and Dialogic are the founding members.

The Forum members are evaluating technology and standards for call management agents, compression algorithms and other features including integrating with web-based voicemail, multiparty collaboration, and multimedia supplementary services like call waiting and call transfer. The Internet telephony industry has adopted H.323 as the software standard for interoperability. The H.323 standard allows for interoperability between Internet telephony products by establishing standards for audio and video compression and decompression.

Compression algorithm standards are being driven by Microsoft's G.723 and Micom's G.729.

European Telecommunications Standards Institute (ETSI) launched TIPHON Net in 1997 to develop

standards to facilitate interoperability between IP telephony equipment and carriers. (TIPHON stands for Telecommunications and Internet Protocol Harmonization Over Networks.)

The future enabler of Internet telephony technology will require scalable, open platforms to enable the hundreds of millions of installed telephones and fast-growing number of computer clients using Microsoft's NetMeeting and Netscape's Communicator to communicate over the Internet.

## Market outlook

It is estimated that the difference between an Internet phone call and a regular circuit switched call is 19 cents versus 95 cents per minute. In some cases, international calls over the Internet cost just 20 percent of normal phone service. One of the first and biggest target markets will be the $18 billion market for calls from the U.S. to foreign destinations.

A substantial proportion of international PSTN call revenue — nearly $15 billion per year within Europe alone — is at risk as telephone services, fax services and voice mail all move towards the Internet.

At the end of 1995, the estimated number of active Internet telephony users was 500,000, which represented $20 million in revenue and 600 million call minutes.

International Data Corporation (IDC) estimates that the Internet telephony market will grow to 16 million users by the end of 1999, translating to a $560 million business.[2]

Probe Research predicts that Internet-based networks will carry more than 7% to 11% of the world's international phone traffic by 2002, 34% of the U.S. domestic long distance traffic, and 10% of the world's fax communication.

According to a Frost & Sullivan study released in 1997, the total equipment market for VoIP is estimated to be over $2 billion by 2001 and $16 billion by 2004. These will be primarily telephony gateway platforms that bridge the Internet and public switched telephone network.

An IDC study estimated that the size of the software portion of the Internet telephony market will grow from $3.5 million in 1995 to $560 million by 1999.

One of the fastest-growing segments is *web-enabled call centers*. Call centers are encouraging web surfing customers to push a "click and talk" button on their web sites rather than log off and wait for a call back, which is impractical and slows down the purchase process. Instead, the buyer simply clicks a button and connects to an agent instantly using Internet telephony.

Today, most commercial Internet telephony implementations are for customer support call centers. MCI's Vault architecture lets customers on a web site simultaneously talk to a customer representative. Sprint also has a service "give me a call" that lets a Web surfer place a voice call from a browser.

Another hot application is *fax over the Internet*. Fax currently accounts for 40% of all traffic on traditional voice networks translating to over $30 billion per year for just sending and receiving a fax. Users get the same cost saving benefits on fax transmissions as on voice calls.

When MCI's Internet telephony traffic grew 15% a month during 1997, the company responded by investing in network infrastructure to improve performance.

Emerging and new entrant service providers see Internet telephony as *a market penetration strategy*. Take for example Bertelsmann in Germany who revealed its plans to undercut Deutsche Telekom's long distance telephone charges by between 30 and 60 percent by providing telephone services over the Internet. Deutsche Telekom has used the Internet to introduce new telephone services in the UK as part of its global strategy. Deutsche Telekom selected VocalTec as its technology partner to penetrate this market.

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[2] Winther, Mark, "The World Wide Web Phones Home: Internet Telephony Market Assessment, 1996-1999", IDC white paper.

The Internet telephony market has enormous opportunity for software vendors, component suppliers, telecommunications equipment manufacturers, computer suppliers and Internet Telephony Service Providers (ITSPs). The table above lists the key suppliers in this emerging industry.

The other major industry segment that will benefit is systems integrators who will provide these solutions to telecommunications service providers by integrating Internet telephony solutions with network management, billing and support systems.

According to Computer Telephony Magazine, **VocalTec** has helped drive every advance in Internet telephony. Since its introduction in 1995 of the Internet Phone to the telephony gateway, VocalTec has been the first to deliver the crucial improvements. VocalTec develops and markets software that combines the power of telephones and networked computers to deliver multimedia communications worldwide over IP networks.

The company pioneered open systems to bridge the Internet and intranets to the Public Switched Telephone Network.

The following carriers have Internet telephony trials underway; USA Global Link, IDT, Delta3, WorldCom, AT&T, MCI, U.S. West, Bell Atlantic, Sprint, AT&T in Japan, KDD in Japan, Dacom in Korea, Deutsche Telekom in Germany, France Telecom, Telecom Finland and New Zealand Telecom.

**IDT Corporation** is an example of the new Internet Telephony Service Provider. It introduced a service called Net2Phone Direct which provides PC to phone service throughout the world, and phone to phone Internet telephony services in the U.S. Users of both services can call any telephone around the world using the Internet at rates 95% less than local phone companies. Calls from local numbers to anywhere in the U.S. cost 8 cents per minute any time, UK at 18 cents per minute, Australia at 20 cents per minute while MCI charges $1.42 a minute, and Japan at 29 cents per minute. Note the average U.S. long distance rate is $1 per minute during off peak hours.

**ITXC** is an example of a new entrant Internet carrier. Its WWexchange service is designed to connect member Internet telephony service providers. ITXC is a start up company backed by AT&T and VocalTec and will offer it's services beginning April 1998. ITXC provides network infrastructure and management for Internet telephony service providers so they don't have to create their own infrastructure, billing and administration.

**Bell Canada** is the first national carrier to reorganize itself in the expectation that the traditional phone network will be subsumed by the Internet. It formed a separate division called Emergis designed to cannibalize the parent business by creating an advanced network based on the Internet to carry an increasing proportion of the parent company's voice traffic.

## Key industry players

| Software | Component | TEMs | Computer | ITSPs |
|---|---|---|---|---|
| VocalTec | Dialogic | Lucent | DIGITAL | ITXC |
| MG2 | Natural Micro | Nortel | Compaq | IDT |
| NetSpeak | Micom | Ericsson | IBM | Level 3 |
| Winteractive | ViaDSP | Siemens | SUN | Delta Three |
| Vienna Systems | Bell Labs | Motorola | H-P | Qwest |
| Voxware | | Cisco Systems | | |
| NetPhone | | Bay Networks | | |
| Inter-tel | | Arbinet | | |

A start-up called **Level 3** is spending billions of dollars to build a new IP network that could change the way business is done. It will create the first business-focused, pure Internet based local and long distance carrier with a new economic and technology model. The goal is to deliver services at $1/27^{th}$ the cost of today's traditional circuit-switched networks. It will integrate voice, data and video over high bandwidth transmission facilities connecting an IP network architecture. Level 3 plans to take advantage of a ground-up IP network design to deliver services instead of converging circuit-switched and IP-based networks like most incumbent carriers. Level 3's approach running all traffic over a single network is easier, cheaper and quicker to manage and upgrade.

**WorldCom** announced in July 1997 that it will introduce a worldwide Internet telephony service.

**America Online**, the largest online service provider has introduced a voice over the Internet service for 9 cents a minute. And, connecting to www.internetcollect.com will allow users to make 8 cents per minute collect calls anywhere over the Internet.

In September 1997, **Deutsche Telekom** and **VocalTec** made a joint announcement in which Deutsche Telekom will purchase more than $30 million of VocalTec products, services and support for a planned rollout of Internet telephony services and acquire a twenty one percent stake in VocalTec. Deutsche Telekom will become the first major carrier to develop a portfolio of Internet telephony services to supplement its existing telephony services worldwide. The two companies are already working on the "T-NetCall" pilot in which Deutsche Telekom is giving 1,000 selected customers the ability to communicate via the Internet using a conventional or mobile telephone.

**Bellcore** has formed a new business unit to bring its expertise in telephony to the Internet. The new unit, called Soliant Internet Systems, is intended to make Internet telephony as easy as using the public switched network. Bellcore will develop software solutions for Internet telephony and integrate them into carrier networks.

**Bell Labs** has formed a new division called elemedia to bring Internet components to the marketplace. One of its first developments, voice compression software, is used by Lucent Technologies in the Internet Telephony Server. This server-based solution running on Compaq Proliant computers places voice and fax calls over the Internet. Elemedia has also licensed its voice coder software to firms who are implementing products that transmit voice over IP networks.

## Telecommunications industry challenges

Telephone companies have some hard choices to make about voice and fax traffic on the Internet. What could be a more fundamental challenge to the carrier business model than free usage that bypasses the billing system? What could be more crippling to overall network performance than Internet users "dialing up" and holding switched voice circuits for hours, corrupting traffic models and creating poor customer satisfaction? A radical challenge like this calls for radical measures. Changes don't have to be made overnight — they can be phased in over time, matching the development of Internet telephony stride for stride. But, carriers can't ignore this technology shift.

Fax currently accounts for 40% of all traffic on traditional voice networks translating to over $30–$40 billion per year for just sending and receiving a fax. Some of this traffic will migrate to the Internet to avoid long distance phone charges and impact the revenue of traditional phone companies. The capability exists today to send and receive faxes over the Internet including direct fax to fax, computer modem to fax, and fax to PC and e-mail connections.

Carriers need to stop fighting the Internet. Instead, they need to make Internet access a basic part of their service. Wherever possible, carriers have to start doing away with artificial distinctions between voice and data. If they don't, someone else will. Local or global, voice or data, wireless or wireline, switched network or the Internet — technology doesn't care about such distinctions. Over time, neither will customers.

Carriers need to embrace Internet telephony and not view it as a threat to its bread and butter long distance business, primarily because the voice quality just isn't there yet. But that doesn't mean carriers aren't investigating Internet telephony and advanced applications. Some carriers are looking at Internet telephony as an alternative service by calling it a second brand of service. Some are looking at it as a way to move some of the traffic from their core long distance network.

Today Internet telephony is expected to have explosive growth in the market for this new technology. Tomorrow a variety of value added services will be offered: PC to PC conferencing, PC to phone and vice versa, audio, data and video conferencing, call centers and training centers.

Some of the key challenges for suppliers to the telephone companies include continued improvement in voice quality, adoption of interoperability standards and a reduction in the cost per port. Telephone companies target a $500 per-port cost before significant deployment can be feasible. Current Internet telephony solutions average from $1,000 to $1,500 per port.

The other impediments to full scale deployment include scalable gateway platforms, billing, and network management systems that support Internet telephony services, and the integration services that help implement solutions.

Public switched telephone networks currently have global reach and guaranteed uptime — the $800 billion worldwide telecommunications industry is, after all, the legacy of over 100 years of continuous investments. But packet switched IP networks promise ubiquitous communications at a fraction of the costs and the potential for substantially broader bandwidth of information exchange.

**Tactics to consider**

Telephone companies must understand the implications of Internet telephony on its core business and determine how it will embrace the technology. Should the networks converge? Should new services be introduced to expand existing markets? Should services be introduced in new markets? Should an IP infrastructure be built to reduce cost or cannibalize the existing network? How many support systems can be reused?

A few companies have been hard at work solving these and other issues for this emerging market. Lab trials and small pilots will answer many of the questions surrounding voice quality and interoperability. But the larger issues of deployment need careful planning as price, performance and network integration with existing legacy systems make or break success.

Telephone company executives should

1. Develop an Internet telephony strategy

2. Hire a systems integration firm to plan, design and implement a pilot network

3. Write a test plan, perform testing and make recommendations for service deployment… and take a leadership role in shaping the future of Internet telephony.