VoIP Primer
Voice over Internet Protocol

Why the Net May Replace Ma Bell: A Guide for State Aging Service Systems

National Aging Information and Referral Support Center

National Association of State Units on Aging ▲ Washington, DC

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Introduction

> *"WHO COULD have foreseen what the telephone bells have done to ring out the old ways and to ring in the new; to ring out delay and isolation and to ring in the efficiency and friendliness of a truly united people?"*
>
> —Herbert N. Casson, *The History of the Telephone Fully Illustrated,* 1910

Internet Voice, also known as Voice over Internet Protocol (VoIP) or IP telephony, allows people to make telephone calls anywhere in the world using a high speed Internet connected computer as a phone. To receive or make a call, VoIP callers simply need to load special software on their computers or use a special computer adapter.

While the wireless technology is not new, what is new is that there is a growing customer interest in its applications. A couple of factors are fueling the interest, including lower phone bills and maintenance costs, converging of voice and data networks onto a single infrastructure (e.g., client tracking), more VoIP providers (AT&T plans to have a million VoIP subscribers by 2005), and wider access to fast Internet service.

Replacing traditional phone systems with VoIP offers all kinds of new possibilities unheard of before now. Federal Communications Commission Chairman Michael Powell has been a true champion of VoIP, calling it "the most significant paradigm shift in the entire history of modern communications since the invention of the telephone." Echoing the same view, FCC Commissioner Jonathan Adelstein has stated, "Internet-based communications like VoIP may open up new emergency response and medical monitoring services that do not exist today. "

The market for VoIP is growing rapidly. According to a recent poll by Meta Group, Inc., 68 percent of large organizations have either switched to VoIP or plan to do so in the next two years. Between 2004 and 2008, the percentage of corporate telephone lines using VoIP is projected to increase from 4 percent to 44 percent.

Moreover, polls show that state governments are exploring VoIP systems, as well. The National Association of State Telecommunications and Technology Professionals reports that over half of the states already are implementing the technology, mostly as a pilot or "proof of concept." The survey also found that 20 percent of the states have no activity yet, but have plans to do something within two years.

Major telecom enterprises, most notably AT&T, Verizon, Sprint, and Time Warner are leaping in, too. Sprint recently announced that it will provide the new option in 2005. Some industry analysts predict that by 2008, 16 percent of U.S. homes will have VoIP phone service. The *Wall Street Journal* reports, "In just over a year, one out of every eight households in the Portland, Maine region has signed up for Internet phone service supplied by Time Warner Inc.'s cable-television unit."

. . . . .

Given this climate, it is hardly surprising that some state and local governments should already be on the cutting edge. To cite one example, as reported in the April 2004 *Austin Business Journal*, the Texas Health and Human Services Commission is implementing a statewide 2-1-1 information and referral service based on VoIP technology. It will reportedly save 80 percent from what the same 211 system would cost using 800 numbers. And more recently, California's Performance Review team announced that it has recommended statewide adoption of VoIP by July 1, 2005.

In little more than a decade, the Internet has revolutionized the way people communicate. Within the next two to three years, if not before, there is a good chance your agency will be using VoIP. If not, it is going to be there for you. This is a basic primer on VoIP. It is a starting point to understanding the new technology.

VoIP: A Primer

or: What is Voice over Internet Protocol, anyway?

> *"WE LIVE in a world that is tied together by technology. We can travel to any part of the globe in a matter of hours and communicate by television, telephone, radio, or over computer networks nearly instantaneously…"*
>
> —Technology: A Science Odyssey, PBS

Voice over Internet Protocol (VoIP) is not difficult to understand, but unless you are very technically inclined, you do have to take time to learn some of the jargon.

First of all there's the term ***VoIP*** itself. Very simply, VoIP is an emerging technology that turns voice into a stream of computer bits, and then routes those over the **Internet**, just like e-mail.

The concept is similar to the way a CD works. The music itself exists in an **analog** form, as waves in the air, created by vibrations of the music and voice. These sounds are then translated into a digital format that is encoded onto the CD. The CD player finds and scans the track for digital bits, translates them back into their original analog form, routes them to your amp and eventually through your speakers. Voila! Now you can listen to your music.

VoIP treats the digitized voice packets the same way. Voice packets travel over the Internet. When the call is picked up the "sounds" are translated back into analog audio.

Another way to think of it is as a VCR. Much like when VCRs appeared on the market in the 1980s and evolved to DVDs, VoIP setups are likewise rapidly becoming more accessible and easier to use. Today, many VoIP features can be customized and include interactive voice recognition, call center administration, voice mail, mobile calling, video conferencing, database queries, customer relationship management, instant messaging and Web browsing, according to the technology experts.

Judging from news accounts, VoIP is becoming ever more popular – particularly in the large business sector. For instance, the aerospace firm Boeing announced in July 2004 that it plans to roll out VoIP service to more than 150,000 employees worldwide. Today, about 12 percent of all long-

distance calls in the world are now sent over the Internet according a poll by market research firm TeleGeography, Inc., of Washington, DC, and many businesses that have outsourced customer call centers abroad reportedly are using VoIP connections to bring down costs.

In the simplest terms, VoIP technology consolidates voice onto a single network infrastructure capable of carrying both data and voice traffic. A VoIP phone system may include voice-only service, or combine voice with other information services, such as the ability to send an e-mail message. Voice transmittal is indistinguishable from Web, e-mail, and instant messaging traffic.

How Does VoIP Work?

> *"THIRTY-FIVE short years, and presto! The newborn art of telephony is full grown. Three million telephones are now scattered abroad in foreign countries, and seven millions are massed here, in the land of its birth."*
> – Herbert N. Casson, *The History of the Telephone Fully Illustrated,* 1910

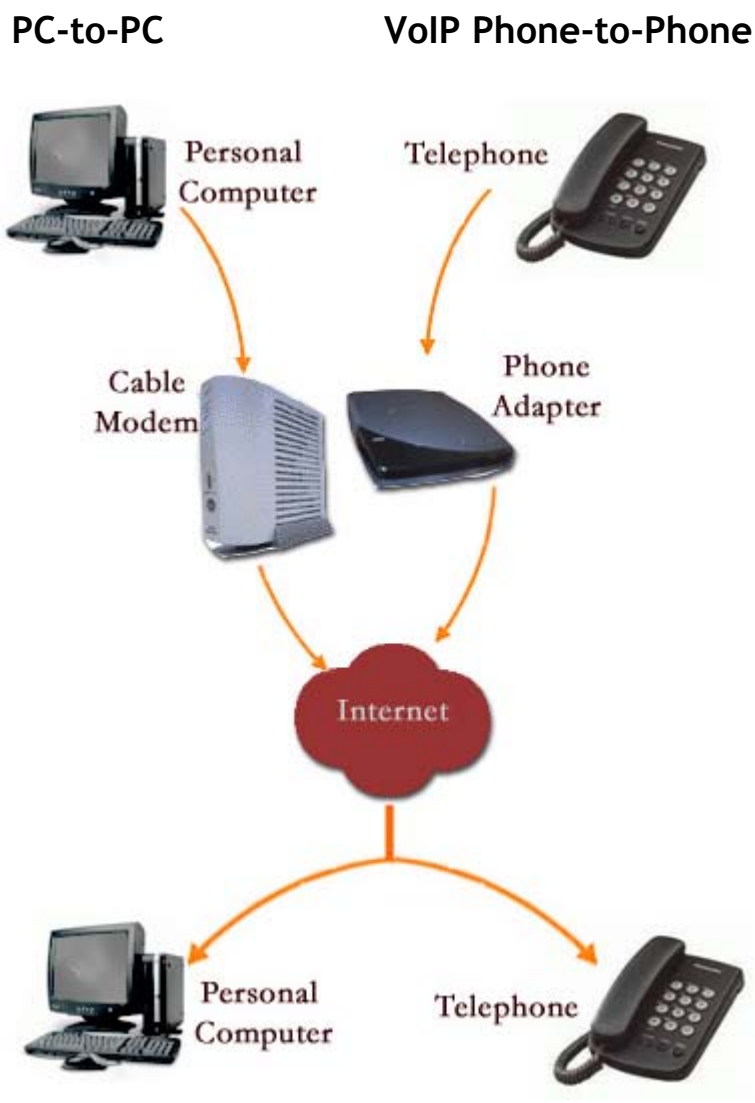
As with most other new technologies, VoIP's earliest users were ingenious computer buffs who in this case figured out how to talk for free over the Internet. Now, as a result of mass-market VoIP phone service, anyone can make a VoIP call with a special **VoIP telephone** or a regular phone with an **adapter.** It is quite an achievement.

Simply put, VoIP is a voice-enabling overlay network that essentially replicates the traditional phone system on the Internet. Just as computers talk to each other by breaking information (e-mails, text messaging, and instant messaging) into small chunks, VoIP converts a caller's voice into digitized audio **packets** and transmits those over the Internet. When the call is picked up, the packets are changed back into a voice signal.

Traditional phone calls travel through dedicated lines using copper wires, fiber optic cables, and elaborate **circuit switching** equipment. Industry observers say that while extremely reliable, these networks can be very expensive for phone companies to set up and maintain. In contrast, VoIP systems route calls through a single network infrastructure capable of carrying both data and voice traffic.

VoIP/Internet Voice calls can begin or end on either a phone or a computer. To take advantage of the technology, you need a high speed Internet (**broadband**) connection, such as a **cable modem** or **Digital Subscriber Line** (DSL), so that information can be transferred between computers, and a VoIP **gateway,** a device which takes a phone signal, digitizes and packets it, and routes it over the Internet. On one side, the gateway connects voice to the Internet world. On the other side, it connects data to the telephone world.

Exhibit 1
Voice over Internet Protocol



Source: U.S. Federal Communications Commission
http://www.fcc.gov/voip/

VoIP: Four Types of Service
PC-to-PC
Requirements: ▪ Software ▪ Microphone ▪ Speakers ▪ Sound card ▪ Always-on broadband net connection
What Does It Cost? Usually no charge.
PC-to-Phone
Requirements: ▪ Anyone with a computer can be called by someone with a computer. ▪ The computer will need special software. ▪ Always-on broadband net connection
What Does It Cost? There may be a per-minute fee.
Phone-to-PC
Requirements: ▪ Some vendors provide special calling numbers or cards that allow a caller (voice) to reach an Internet phone user. ▪ The person being called must have VoIP software installed in their computer.
What Does It Cost? ▪ The cost of the call is usually cheaper than a traditional long distance call.
Phone-to-Phone
Requirements: ▪ Via VoIP gateways a call can be made by any standard telephone to another standard telephone across the world. ▪ The caller must call into a gateway and enter the number to be called. The vendor makes the connection through its IP network.
What Does It Cost? ▪ $30 to $40 a month.
Source: "How VoIP Works," HowStuffWorks.

Four Different Types of VoIP Calls . . .

"THE PAST decade has seen some of the most amazing advances in technologies that offer a breathtaking array of new options and choices."

— FCC Chairman Michael K. Powell, 2003

VoIP voice calls can be made entirely over the Internet or through existing phone networks.

1. PC-to-PC: The first way to place a VoIP call is on a computer outfitted with special software (that you can easily download), a headset, and a microphone. By using the computer, the call bypasses the telephone company and goes directly through your cable/DSL modem.

2. PC-to-Phone: Calls can also be made directly from a computer to a network of common VoIP phone subscribers or to any telephone number. Like PC to PC calling, VoIP requires the computer to have a broadband connection, such as cable modem or DSL, as well as special software. You will also need a VoIP service to place the call.

3. Phone-to-PC: For calls on the phone, you need to sign up with a VoIP service provider. Depending on the company, calls can be placed either through a special phone set or a regular phone connected to an Internet adapter.

4. Phone-to-Phone: The latest advance in VoIP technology is Internet phones, devices that can plug into a phone jack. You can either call another IP phone directly or a normal phone through a special gateway (the vendor makes the connection through its IP network).

. . . Three Types of Virtual Phone Service

1. **Mass-market plans (traditional phone networks) –** Traditional telephone and cable companies already have built their own data networks and thus have the capacity to deploy voice inexpensively. Examples of companies moving quickly to offer Internet phone service include big names like AT&T, Time Warner Cable, Comcast, Qwest, Sprint, and Verizon.
2. **VoIP subscription services —** VoIP vendors piggyback on the existing DSL and cable modem infrastructure. Some examples of VoIP providers are Vonage, Net2Phone, VoicePulse, Packet8, and Virgin Mobile USA. Free World Dialup is a noncommercial VoIP network that allows users to make free telephone calls over the Internet to other Free World Dialup members throughout the world.
3. **Data and voice convergence (customized) –** Government organizations and large enterprises contract with a VoIP company like Avaya, Angel.com, or Cisco to create a single, converged network, moving their phone systems over to their existing data networks so they can communicate with each other.

Is It Worthwhile? Why Switch?

> *"LIKE CALIFORNIA, some other states report savings, but the major force behind VoIP adoption is support for particular applications that IP handles better than traditional systems, particularly call centers."*
>
> — California Performance Review News, August 2004

Technology experts say the crux of VoIP's attraction right now is that it enables the integration of voice, data, and video communications on a single network. Saving money on long distance bills is also a plus.

According to industry and news reports, VoIP dialing plans currently cost about 30 percent less than traditional long-distance phone service. One reason is that the FCC considers VoIP an information service and not a phone service. For now, VoIP gateways don't have to pay local or regional access fees, nor are Internet-based phone services required to contribute to the **Universal Service Fund,** which subsidizes local phone service for low-income callers and expensive rural areas. And that translates to lower prices.

VoIP/Internet Phone Service
Pros
▪ Cheaper calls and cost savings on telephone service fees
▪ Multipurpose usage: Integration of voice/data/video traffic
▪ Efficiency and standardization
▪ Return on investment
Cons
▪ Cost for new hardware
▪ Network reliability (Low quality transfer, power failure, delays in transmission) – As one reporter writes, *"When was the last time you had to reboot your phone?"*
▪ Security and the potential for hackers and spam.

Why Would an Organization Switch to VoIP?

▪ **Convergence of voice, video, and data communications**. Although still in its infancy, the technology allows for the integration of voice, video, and data networks.

▪ **Cost advantages**. Combining voice/data networks offers potential cost savings on long-distance bills and can help cut costly infrastructure expenses.

▪ **Return on investment**. While there is an initial cost to building the infrastructure and implementing VoIP systems, many large organizations believe the transition is prudent as a long term investment. A driving force in the change to VoIP, the savings come from

simplification of communication systems and increased network efficiency.

A case in point with regard to cost: Traditional PBXs (**private branch exchange**), private telephone networks that businesses, university campuses, nonprofits, and government agencies use for making calls, are expensive to maintain. There are a wide variety of vendors that provide PBX services. For this reason, one government department might have one type of system and another department a different system. It is entirely likely that none of them work with the other. One agency might have hundreds of PBX units, and when a phone set needs to be replaced, a compatible set may be no longer available.

In contrast, VoIP systems are robust and can be expanded to include sub-state and local agencies. With a VoIP virtual PBX system, phones can be standardized across all agencies. IT staff have only one telecommunications system to manage. The phones are "plug and play," which reduces costs when agencies move or staff change offices. This is especially important to large organizations since moving a telephone often costs $75 or more for reprogramming and other infrastructure modifications.

A Real World Example of VoIP

The City of Rockville, Maryland converted its telephone system to VoIP two years ago in 2002. The system consists of 400 IP telephones at 13 different sites in the city. The system is saving the city $100,000 per year in telecommunications costs. The number of trunk and leased telephone lines needed by the city has been reduced. Calls made over the private network do not incur message fees from the telephone company. Also, the cost of cabling a building is reduced as each office needs only one rather than two cables.

Not only has the system saved money, but citizen services are also reported to have improved. Since all city employees are on the same telephone system, a call can be transferred immediately to the appropriate employee rather than giving the citizen another number to call. All of the city's telephone numbers are on the same block of numbers making it easier for citizens to contact city government. Early last fall in 2003, the ferocity of Hurricane Isabel caused structural damage to one city building that made it

uninhabitable as an office. The employees in that facility unplugged their telephones and went to another city facility where the telephones were plugged back in. They were up and going immediately. In fact, the city information technology department didn't know these employees had relocated.

Before You Jump on the Bandwagon

> *"TRADITIONAL PHONE networks operate at 99.999% reliability, so your [callers and staff] will expect no less."*
>
> —"Prepare for VoIP," Processor.com

Whether you decide to go with VoIP or not depends on your particular situation. There are many organizations, including state and local government agencies, that already are using VoIP or are anticipating doing so in the near future.

Experts say, however, that fully converged networks are probably a long way off for most local service provider agencies and small nonprofits. Since most telephone calls are likely to come from local callers, industry experts advise smaller organizations and businesses to keep their regular telephone systems – at least for the time being.

If You Are Thinking About Voice over IP

Before you undertake a complete overhaul of your existing communications infrastructure:

- **Assess your agency's readiness.** Create a strategic communications plan. Analyze the strengths and weaknesses of your existing system.
- **Move to VoIP at your own pace.** Talk to experienced IT professionals. Talk to other human service organizations/agencies that have considered converting to, or have already signed up for, VoIP.
- **Do a cost analysis** of the options and companies available to provide coverage to your full service area.
- **Have your data network assessed for compatibility** with VoIP. Make sure your system is fully upgraded and tuned.
- **Test the water**. Get vendors to provide demonstrations. Have selected staff try out the systems.

Online Resources

There's a plethora of stories in newspapers and trade magazines about VoIP now. If you're considering VoIP, separating the hype from the useful information isn't always easy. Here are a few online resources that can help:

- The Postively Broadband Campaign, *Has Broadband Found Its True Calling? A Vision for Voice Over Internet Protocol.* An Industry White Paper, 2004 www.positivelybroadband.org/library/downloads/VOIP_White_Paper.pdf

- Tyson, Jeff, "How VoIP Works," HowStuffWorks.com. http://computer.howstuffworks.com/ip-telephony.htm/ (excellent, broad introduction to VoIP with photos)

- U.S. Federal Communications Commission, *FCC Consumer Facts VoIP/Internet Voice,* www.fcc.gov/voip (the FCC Web site provides a plain talk tutorial for beginners)

- Walker, John Q. and Jeffrey T. Hicks, "Planning for VoIP: White Paper," NetIQ Corporation, December 2002 www.netsense.info/downloads/Planning_VoIP_WP.pdf

- Wolter, Charlotte, "VoIP: The Right Call," *PC Magazine*, 22 June 2004 www.pcmag.com/print_article/0,1761,a=128117,00.asp (reviews the costs, benefits of VoIP, as well as the pros and cons)

Telephones Then and Now

Telephones, Then and Now

Telephones
- Hand-crank
- Rotary technology (dial telephones, *pulse dialing*)
- Touch tone (faster and less prone to error than pulse dialing)
- Car phones
- Portable, battery operated cordless phones
- Cell phones
- Internet telephony (s*mart phones*, *soft phones)*

Gatekeepers and Gateways
- Telephone operators
- Electronic switchboards
- Automatic dial system
- Automatic "switching" using "phantom circuits"
- Internet Service Provider (ISP)
- IP PBX *(computerized switchboard)*
- Packet switching (VoIP)

Circuits
- Wire
- Radio wave
- Fiber optic cable (fiber optics)
- Microwave radio transmission
- Transistor
- Satellite
- Transatlantic telephone cable
- Cellular
- Digital
- Wireless Internet *(broadband)*

Phone Enhancements
- Long distance service
- Remote access voice mail
- Call-waiting/call-forwarding
- Three-way calling
- Abbreviated dialing for frequently dialed numbers
- Built-in answering machines
- Speaker phones
- Fax lines
- Video phones
- Pagers
- Wireless network links

How Telephones Work

For over 100 years, telephone networks have been based on circuit switching. When a call is made between two persons, the connection is maintained for the entire duration of the call. Because the system is connecting two points in both directions, the connection is called a circuit. If the call lasts ten minutes, the circuit is open continuously between the two parties for the entire ten minutes.

The major components of a telephone system are gateways, gatekeepers and telephone sets.

Central Switching – Number Please?
A hundred years ago, in the early days of phones, there was a "live operator" on the line every time you lifted the receiver. What happened when a call was made?

1. The caller picked up the ear piece and turned the crank on the telephone, which rang a bell on the *switchboard* to get the attention of the operator (the *gateway*).
2. The local operator plugged a headset into the incoming line and asked for a "number please."
3. The local operator checked the status of the party's line. Is it available, or busy?

4. The local operator (the gatekeeper) either manually made a connection between the lines with jacks, creating a circuit, or told the caller the line is busy.
5. The lines remained connected for the duration of the call.
6. When the call was over, the local operator manually unpluged each line.

If you wished to make a "long distance" call, say to a neighboring city, your operator would call that area's operator to connect you. If you wanted to call much further away, then the call would be set up with a whole chain of operators, each one calling the next.

As the number of subscribers grew, each subscriber was given an identification number (*telephone number*). However, the system worked much the same with a live operator connecting these circuits.

> **Did You Know?**
> It was thought that people would have problems remembering 7 digit telephone numbers (2 *exchange* xx plus *subscriber xxxxx*) so a letter to number scheme was developed to make for easier mnemonics. (You may recall your own number. One of the most well known exchange names was made famous by the Glenn Miller song called PEnnsylvania 6-5000.) "Zero, "O," was always reserved for operator calls. The letters Q and Z were not used to avoid confusion with "O" and "2."

Automatic Telephone Switching. The incorporation of rotary technology into the telephone set altered the working of the system. First invented in 1879, the rotary is a mechanical device inserted in the telephone set. When rotated and released, it generated direct current pulses that were transmitted to switching equipment activated by the direct current pulses to establish a connection without any assistance from an operator.

1. The caller picks up the receiver and listens for a dial tone. The tone indicates the person has a connection to the local office (*gateway*) of the telephone carrier.
2. The caller dials the number of the person to whom they wish to speak.

3. The call is routed through the *switch* at the local telephone carrier exchange to the local exchange (*gatekeeper)* of the party being called.
4. A connection is made between the caller's telephone and the recipient's telephone, opening the circuit.
5. The parties talk for a period of time and then hang up.
6. When the telephones are hung up, the circuit is closed, freeing the telephone lines.

Touch Tone Replaces Rotary. The next major technological innovation was the touch tone system, which greatly increased the speed of dialing. Touch-tone uses tones in the voice band frequency, one high and one low, rather than pulses generated by rotary dials to make a connection. First introduced by Bell Labs in 1963, touch-tone replaced rotary dials and ushered in a new generation of telephone services and capabilities including *voice mail.* While expanding the functionality of the telephone, the basic operation of the telephone system remained the same.

> **Did You Know?**
> The first touch-tone system was installed in Baltimore, Maryland in 1941. The first commercial touch-tones were previewed at the 1962 Seattle World's Fair.

Digital Transmission and Switching. In 1962 Bell Labs developed the first digital, multi-function system for transmitting voice signals. This innovation laid the groundwork for today's advanced network of 911, 800-numbers, call waiting, and caller ID. In addition, it provided the foundation for the convergence of wireless high speed data connections and voice communications.

Virtual Calling. Over the last 20 years, the ways we communicate have changed greatly.

1. The caller picks up the phone and dials a number. The call is routed through a VoIP gateway phone or VoIP service provider, which sends the call over the Internet to the called party's local telephone company.
2. Another way to call is to type the number using a computer keyboard. The call is routed through the computer modem.

3. At this stage, the caller's voice is converted into digital information, translated into Internet Protocol, and then transmitted over an IP network.
4. The PC on the receiving end receives the information and converts it back to regular sound. If the call is made inside a virtual private network (VPN), a contained system for an organization, the call does not reach the public Internet.
5. The VoIP phone or conventional phone on the receiving end will ring when a call is sent to it. For computer-to-computer placed calls, a call signaler on the screen will alert you that there is an incoming call.

Did You Know?

Astronauts use VoIP to keep in touch with friends and family. They speak through a headset with a microphone, and the signal is sent up to 90,000 miles via a communications satellite. According to the NASA.gov site, that long distance can mean a time lag of up to 1 second in conversations. Standard IP phone systems would disconnect with such a delay, so the *Softphone* astronauts use has been adapted. A new digital tool allows high-speed data transfers, calls, e-mails, and video signals.

Glossary – "VoIP Speak"

Common VoIP Acronyms and Terms Defined

ANALOG PHONE: Transmits calls by means of electrical signals. The standard analog telephone may be used by VoIP systems; however, it must be connected to a special adapter.

BROADBAND. Commonly known as high-speed Internet, the most common types of broadband choices for Internet access are cable modems (which use the same connection as cable TV), and DSL-Digital Subscriber Line modems (which use your existing phone line). TimeWarner Cable, Cablevision, Vonage and other cable providers each will be striving in 2005 to capture their share of the broadband line telephone market, according to news accounts.

CABLE MODEM. A device that enables a broadband connection to the Internet using cable television infrastructure.

DIGITAL SUBSCRIBER LINE (DSL). A high speed Internet connection for moving data over regular phone lines; unlike traditional dial-up connections, DSL service is "always on access." In recent months, companies like Vonage, Verizon (VoiceWing™), and AT&T have begun introducing mass-market VoIP services requiring a DSL; *also referred* to as a BROADBAND connection.

FREE WORLD DIALUP (FWD). Free World Dialup lets members of its service talk to each other over Internet broadband connections using VoIP phones or "softphone" software on their computers. The service is only available between members and does not interact with regular phone service, however, using a simple prefix access code, FWD customers can call the subscribers of most non-FWD broadband Internet phone services (e.g., Vonage).

GATEWAY. A network device that connects a telephone set or line to a computer network. The primary functions of an IP gateway include voice and fax compression/decompression, packetization, call routing, and control signaling. Additional features may include interfaces to external controllers, such as Gatekeepers or Softswitches, billing systems, and network management systems; s*ee also* SMART PHONE.

INTERNET. A global "network of networks" linking many thousands of computer networks all over the world. Each network, called a host, is independent. Its operators can choose which Internet services to use and which local services to make available to the global Internet community.

INTERNET PROTOCOLS. A set of instructions used to transfer files or data from one machine to the other. All computers on the Internet communicate with each other using the Transmission Control Protocol / Internet Protocol (TCP/IP).

IP NUMBER (INTERNET PROTOCOL NUMBER). Every resource that is on the Internet has a unique IP address. Most Web sites and servers also have one or more domain names that are easier for people to remember

INTRANET. Web site (or group of Web sites) belonging to an organization and accessible only to the organization's employees or those authorized.

IP ADAPTER. Device that transforms voice into data packets to travel through an IP network; it is usually connected to an ANALOG phone.

INTERNET SERVICE PROVIDER (ISP). A company that provides a gateway connection to the Internet.

INTERNET TELEPHONY. Telephone calls carried over the Internet without long distance charges; also called *IP telephony; see also* TELEPHONY.

IP PBX (PRIVATE BRANCH EXCHANGE). A computerized version of a telephone switchboard used in companies and organizations to handle internal and external calls. The IP PBX provides the same functions and features as the traditional PBX.

LAND LINE. A regular telephone line using wire circuits (as opposed to satellite, cellular, or mobile telephone links using radio or digital signals).

LOCAL AREA NETWORK (LAN). A network of connected computers, which that are all in the same location (such as a single building). LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line. However, the distances are limited, and there is a limit to the number of computers that can be connected to a single LAN.

PACKET: A piece of a phone call (data) transmitted over a network, containing the destination address in addition to the message.

PACKET SWITCHING. The method used to move phone calls and data around on the Internet.

PRIVATE BRANCH EXCHANGE (PBX). A departmental telephone network where users share a certain number of outside lines for making telephone calls.

PUBLIC SWITCHED TELEPHONE NETWORK (PSTN). This is the standard telephone service that most homes use.

QUALITY OF SERVICE (QOS). In VoIP packet-switched networks, QoS is defined as network reliability, call quality (no static, delays), cost, etc.

ROUTER. A device or sometimes software in the computer that looks at the destination addresses of the packets passing through it and decides where to send it.

SMART PHONE. A phone that can access e-mail, faxes, voice mail, Web pages, and other files. It also has the potential to connect to a speech-recognition server by phone, which would allow a user to dictate notes or responses, and then see the recognized text as it is returned from the server. IP telephones plug into the LAN just like a computer terminal.

SOFT PHONE (also spelled as *softphone).* Equipped with a headset or a hand-held device, and using the numbers on the keyboard to dial, a soft phone can usually perform traditional telephone functions, such as teleconferencing and call forwarding. Soft phones typically make use of the computer's sound card for audio input and output.

SWITCH. A device that filters and forwards packets between networks.

TELEPHONE CIRCUIT. A telephone connection.

TELEPHONY. Taken from the Greek words "far sounds," telephony is the science behind telephones; also refers to computer hardware or software that functions like telephone equipment.

TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP). In computer terminology, a protocol and a roadmap that tells how to send messages back and forth over the Internet.

VOICE OVER INTERNET PROTOCOL (VOIP). Technology that uses hardware or software to make telephone calls via the Internet.

WATS LINE. An acronym for Wide Area Telephone Service; fixed rate.

WIDE-ARE NETWORK (WAN): A communications network connecting geographically separated computers, printers, and other devices. A WAN allows any connected device to interact with any other on the network.

WORLD WIDE WEB (WWW). A revolutionary Internet browsing system allowing point and click navigation using hyperlinks. The world's greatest reference library, the Web is the most familiar part of the Internet to most people; *see also* INTERNET.

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Exhibit 2
Different Types of Voice over IP Applications

VoIP Service	Description	Target Market
Pre-Paid Cards	Uses IP gateways to enable you to place phone to phone calls over the Internet and/or private IP networks around the world at a lower per minute rate.	Consumers, business travelers, small business
Softphone Services	Software on your computer that converts voice to packets and allows you to place calls over the Internet	Consumers, small business
Voice over Broadband	With an adapter, gives you advanced calling features and allows you to place phone-to-phone calls over your broadband connection typically for a flat rate domestically and reduced rate internationally.	Consumers, small business
PBX Internet	Supplementing existing PBX with IP gateways to enable voice packets.	Mid to large businesses with legacy PBXs
Pure VoIP	An IP server packet-switched solution that completely replaces any legacy circuit-switched equipment and starts and ends with the voice call as IP.	Mid to large businesses

Source: "Has Broadband Found Its True Calling? A Vision for Voice Over Internet Protocol," An Industry White Paper prepared by the Positively Broadband Campaign, January 2004