

A Quick Introduction to Voice over Internet Protocol (VoIP)

by Charles Jackson^{1 2}

Introduction

This short note offers a quick overview of voice communications using internet technology to carry the voice signal. The purpose is to assist a public policy decision maker who wishes to understand some of the current debate regarding VoIP. The main point is: the phrase *voice over internet protocol (VoIP)* is deceptively simple. VoIP refers to dozens of activities that differ greatly in their quality, cost, and relationship to traditional regulatory boundaries.

VoIP Technology in a Nutshell

Data communications over the Internet relies on dozens of protocols—rules defining the required steps for a communications task. For example, part of the protocol for telephone calls includes (1) waiting for dial tone before dialing and (2) the different sounds that indicate that the called telephone is either ringing or busy. The internet protocol (IP) is the basic protocol at the heart of the Internet. An IP message is the data communications equivalent of a postcard—it carries the recipient's and sender's addresses, a block of data, and little else. Other protocols, such as TCP and HTTP, build on IP to create additional capabilities.

IP is a flexible building block—it has become the data communications equivalent of 2by4s and plywood—one can build anything using IP. IP is often used for communications that never touch the Internet—such as communications between a computer and a nearby printer or communications within an organization's private network.

Naturally enough, one kind of data that can be carried by IP is digitally encoded voice. Thus, voice over IP or VoIP. But, VoIP is not just one thing—it is many different things. The differences arise from many sources, including the nature of the network used to carry VoIP, the terminal equipment used to generate the VoIP signals, and the software used to provide the VoIP connection.

Network Differences

Using VoIP over an unreliable network or a network with excessive delay results in poor voice quality. In contrast, VoIP over an uncongested, minimal-delay network can provide voice quality as good as (or even better than) that provided by traditional telephone networks.

¹ Prepared for the University of Florida's Public Utility Research Center (PURC) 2004 Annual Conference. This represents my views and does not necessarily represent the views of PURC.

² This is meant to provide a quick overview of the various technical and business arrangements that fall under the name VoIP. I welcome suggested improvements. Please send them to clj@jacksons.net.

VoIP connections over the public Internet encounter a wide range of network conditions. Sometimes such connections work well; other times they perform poorly.

VoIP over a network designed and operated to provide high-quality connections, such as a corporate data network or a lightly used local area network, provides connections that sound just as good as traditional telephone service. Similarly, if a telecommunications carrier chooses to use VoIP in providing telephone service, the carrier can manage its network so that voice quality matches that of traditional telephone service.

Terminal Equipment Differences

The terminal equipment used with VoIP connections affects the speech quality and calling experience. At one extreme is the home computer with a microphone and speakers. Generally speaking, these systems provide poor speech quality because of problems with echoes and volume adjustment. Replacing the speaker and microphone with a headset alleviates many of these problems.

The other extreme is a telephone designed to plug into an Ethernet local area network. Cisco sells the Cisco IP Phone 7970G, shown in the figure below.



Figure 1 Cisco 7970G IP Phone

This unit is hearing aid compatible, and the dial pad meets ADA requirements.³ It can be used as a PBX extension with no VoIP connection to the outside world, or it can connect over a data network to other VoIP phones.

Between these two extremes is the integrated access device—an adapter that allows a traditional phone to appear to a data network as a VoIP device.

Software Differences

VoIP software can be specialized for telephone-like conversations, or it may have a voice capability that is only incidental to its primary purpose. AOL's Instant Messenger software has a *talk button*. Selecting the talk button with the mouse and clicking on it begins the process of establishing a voice connection in parallel with an existing text chat session. As far as I can tell, hardly anybody uses this capability of AOL Instant Messenger but it may be a valuable option for individuals that have difficulty reading. Microsoft sells a combined hardware/software product called *Microsoft Sidewinder Game Voice* that provides both the ability to use voice commands to control computer games and a voice communications capability among the players of a multiplayer game. That voice capability permits groups of players to coordinate attacks on other players and allows players to taunt their opponents.

The Cisco phone described above contains software that permits it to function like a traditional telephone with voice mail, selectable ring tones, etc.

Gateways and Telephone Numbers

For many VoIP applications such as voice communications among the players of a computer game, there is no need for connections to the traditional telephone network. But VoIP applications that provide telephone service need the ability to connect to the existing public switched telephone network (PSTN). The connecting points, which allow traffic to flow between the VoIP network and the PSTN, are called *gateways*. Gateways allow VoIP telephones to receive calls dialed to telephone numbers and permit VoIP telephones to place calls to traditional telephones. That is, a gateway permits a telephone number to be associated with a specific VoIP user. Gateway service is not a built-in element of Internet service. Rather, gateway service is usually purchased separately from suppliers such as Vonage or BellSouth.⁴

Examples of Uses of VoIP

The discussion above provides some examples of VoIP use—such as that by computer gamers to enhance their game playing or as part of AOL Instant Messenger.

Microsoft's Windows Messenger software provides voice, video, whiteboard, program sharing, file sharing, and text chat capabilities to users with compatible software and connected by an appropriate network such as the public Internet or a private corporate

³ See

http://www.cisco.com/en/US/products/hw/phones/ps379/products_data_sheet09186a00801c9638.html.

⁴ See <http://www.interconnection.bellsouth.com/products/html/iptelgate.html>.

network. Windows Messenger is provided with the Windows XP operating system and is also available for the Apple Macintosh. Thus, the vast majority of desktop computers have installed on them software that provides voice communications over the Internet. Hardly anybody uses those capabilities today.

Vonage provides a VoIP service that resembles traditional telephone service. However, users must “bring their own access.” That is, Vonage provides gateway service, but Vonage’s customers must arrange for their own access to the public Internet.⁵ Calls are carried over the public Internet from the user’s premises to the Vonage Gateway. Vonage customers have phone numbers and can make calls to and receive calls from traditional telephones.

In December 2003, Cox Cable began providing voice telephone service in Roanoke, Virginia, using VoIP technology. In the Roanoke system Cox Cable provides the access connection, using cable modems, as well as providing the gateway.⁶ The service connects to the existing inside wiring in the home and is intended to appear to the consumer as a direct substitute for the telephone service provided by the local telephone company. The Cox Cable service uses the customer’s own telephones and provides common telephone services such as call waiting, caller ID, and 911 service.

Summing Up

Let me just reiterate my central point—VoIP refers to many different types of communications capabilities and services. Policy makers should be informed of the vast differences between the basic VoIP capabilities built into almost every computer, the narrow voice capabilities provided by some gaming software, and the more complex arrangements, such as that of Cox Cable, that use VoIP as part of a larger system that reproduces every part of traditional telephone service.

Other Resources

For a discussion of some of the policy issues associated with VoIP, the FCC’s web page on VoIP is a good place to start <http://www.fcc.gov/voip/welcome.html> and the various documents available at that Web page. Many policy positions on VoIP are set forth in the documents at <http://www.fcc.gov/voip/materials-view.html>.

For anyone who wants to read further regarding VoIP technology, the best place to start is probably Professor Henning Schulzrinne’s web page: <http://www.cs.columbia.edu/~hgs/internet/internet-telephony.html>. That page has pointers to many other sources of technical information.

⁵ See www.vonage.com.

⁶ See http://zdnet.com.com/2100-1105_2-5124440.html and <http://www.cox.com/Roanoke/telephone/>.