

VoIP for the Future Is In-Process NOW

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Introduction

Global technology standards, such as Internet Protocol (IP), Ethernet, and Linux have allowed U.S. businesses as well as educators to build international connections. One development evolving since the late 1990's due to this standardization is Voice over Internet Protocol (VoIP) also called Internet telephony, which is spreading around the country, and around the world. It is improving the way higher education, research organizations, and business use networking resources to communicate, conduct research, teach students, and provide mobile collaborative technology. The huge advantage for VoIP is that it utilizes the wired and wireless Internet network to transport voice traffic along side the instant messaging (IM) and email data traffic. This convergence of voice and data into a single, powerful network provides cost savings as it improves service. It is not the duplication of telephone services that is the true advantage of VoIP, rather it is its opening of new communication options. Private usage, public usage, and business usage are all growing rapidly. The two markets for VoIP are the home market, served by companies such as Skype and Vonage, and the enterprise market which includes corporations and educational organizations and is dominated by Cisco, Avaya, and Nortel. Education is making use of the benefits with districts saving money on phone charges, administrative and maintenance costs, as well as alleviating barriers to effective communication. Phone, voice mail, audio-conferencing, email all on one seamless network, utilized by computer or hand-held softphone from virtually anywhere, benefits telecommuters, businesses, and the educational community, as well as showing great promise for those with impaired speech, hearing, or mobility.

Literature

The attraction of VoIP

Education has really taken to VoIP. As cell phones reduced school telephone costs and usage previously, now VoIP is being adopted across the nation which will reduce the costs for telephony further. "Unified messaging, uncompromised voice quality, choice of features and functions, multiple migration paths, and coexistence with legacy systems," (Young, 2005) are responsible for full-scale implementation. While IT organization adoption has been rapid, jumping from 44% in 2005 to 62% in 2006, educational adoption is equally pervasive. As of June 2006, 77% of the responding colleges and universities using VoIP will be expanding – with the only ones not expanding being those who have just done so. The most frequently mentioned benefit was improved end-user services, with cost savings being in second place, and third place was overall network efficiency. Security, quality-of-service and emergency 911 issues were the top concerns. To improve telephone service with technology prior to a large-

scale deployment, Verizon is also partnering with Department of Computer Science at Columbia University to explore security technologies for VoIP, as well as a second project to research Presence, a messaging technology that lets users quickly find each other no matter where they are located. Both projects will bring additional support for the educational community.

Texas and Japanese schools are going far beyond the “pen-pal” interactions of former generations. (Panettieri, 2006) They are studying the shared issues of environmental issues regarding the rivers both communities border. Benefits realized have been enhanced global exploration and communication, increased interaction and understanding of the natural environment in both countries, increased comfort and use of new technologies with VoIP as the primary method of interaction, and an increase in understanding and appreciation of different educational methods as teachers from both countries work together in each other’s schools.

School districts in Oregon, Nevada, and Southern California (Milner, 2005) only wanted to replace their aging phone systems. The Oregon district used ShoreTel (www.shoretel.com) to install a call server and about 60 phones at one school. They found that with minimal improvements to infrastructure it could be rolled-out using a combination of IP telephony and traditional telephone lines (POTS – plain old telephone lines). Within 12 months, they added 13 other schools plus the district transportation and maintenance locations, and trained district technologists in system support and maintenance. Not only did they spend less than ½ the previous amount for maintenance, the most important change was the improvement in communication between parents and teachers. Within 2 years there was a phone in every classroom with additional features like email-based voicemail and daily audio bulletins. The Nevada school district implementation was one of the largest on record with more than 300 locations and 22,000 phones installed and connected to a wide area network (WAN) and a VoIP network. They discovered that with maintenance costing so much less using VoIP, they could replace the bulk of the district’s phone system and still save money. The biggest cost savings has been in the areas of maintenance and support, freeing 100’s of thousands of dollars for other purchases. The Southern California district wanted to cut down on long-distance costs and found increased productivity and flexibility were gained as well. In 2003 for \$5 million, provided by a public bond, 14 schools plus maintenance facilities had instantaneous communication by dialing a 3-digit extension. Their unexpected gain was in ease of configuration, being tremendously easier than the previous PBX system that was replaced. It has been so successful and the savings have been so great that they have been investing in additional high-bandwidth access points for other sites and looking at moving into the wireless VoIP area next.

An extension of VoIP service being explored in a Maryland county is videoconferencing. (Millard, 2007) Using plug-in camera and classroom computers, they have found video-based meetings were “just as effective as in-person conferences without the hassle and expense of calling teachers and administrators to the central office.” (Millard, 2007, p.31) This seems noteworthy to consider within Hawaii’s island school complexes as well as the state-wide school district. An additional finding after using the videoconferencing for a year was that the meetings tending to be shorter and were better attended, so were becoming the preferred meeting method. These same collaborative technologies allow businesses to replace much of their travel needed to meet with clients and colleagues. They are not designed to replace face-to-face meetings as the social aspect especially in business can be critical, but it can enable staff to work more efficiently and productively between physical meetings.

A popular free VoIP telephony product rapidly growing for individual use is Skype, started in 2003 and purchased by E-Bay in 2006. Unlike other Internet phone services, it uses peer-to-peer networking, relaying traffic through its users rather than using its own servers to carry the online signals. Some schools are also taking advantage of this free service to connect to native language speakers in other countries, as well as host audio and video conferences of up to 10 participants. It is a multi-platform software (PC, Mac and Linux) that downloads and installs in minutes. Calls vary in quality depending on personal connections and number of online users. SkypeCasts (similar to a call in radio program) are a new feature to communicate with up to 100 users simultaneously. Global and domestic connectivity are critical features for university faculty collaboration as well as personal and educational use by students. With little time expenditure and very little cost (headsets and multi-user connection hardware only) this technology is readily accessible to classrooms and faculty with broadband connectivity. Its simple operation and high connective reliability without concern for operating system of each user increases its transparency for less technically comfortable users.

The latest leap is into the realm of wireless VoIP and data transfer. Wireless IP telephony and softphone capabilities have given mobility to users and provide continuity for businesses as well as during emergencies. After the loss of traditional wired networks during Hurricane Katrina, rethinking infrastructure put wireless technologies in the forefront. Prices have plummeted as the technology has matured allowing discounts to cover extra features and enhancements. Wireless networks can now offer mesh systems without traveling through a central switch setting the stage for self-healing networks. Infonetics Research (www.infonetics.com) predicts roughly 31% of ALL North American organizations (including schools) will deploy VoIP wireless LANs by 2007. Although upfront costs for wireless are higher, organizations that have a high degree of

employee mobility may save the costs back through skipping expensive phone-line changes and ongoing voicemail charges. Employees are productive faster and more consistently with wireless availability, another form of cost and aggravation savings.

VoIP isn't perfect

VoIP has also generated a fair amount of frustration. Users' increasing mobility has made users difficult to reach on the first try. The average organization with IP communications utilizes more than six separate communications devices and more than five communications applications. In response to this issue in the education realm, many school districts are expanding IP communication beyond voice and including a variety of IP applications, referred to as unified communications. (Villano, 2006) In addition to voice, it additionally includes additional features such as calendaring functions, secure chat, videoconferencing, collaboration, instant messaging, district alert, discreet alarm messaging, and softphones. Vendors supplying unified communications include FirstClass (www.firstclass.com), Siemens (www.siemens.com) in collaboration with Microsoft Exchange (www.microsoft.com), Cisco Systems (www.cisco.com) in collaboration with LiteScape (www.lifescape.com), Alcatel (www.alcatel.com) in collaboration with Verizon (www.verizon.com), as well as others. The benefits of unified communications include the visible ease of making and receiving phone calls and voice messages. Perhaps more importantly, it also includes the less visible benefit of running all the communication traffic over the data network. The organization no longer needs a parallel voice network, allowing the cancellation of most or all of the traditional phone lines and costly PBX centers. A Northern California school district estimates their implementation will pay for itself in for or five years, meanwhile providing improved communication tools. (Villano, 2006.) The savings in time and money increase as the scope expands by increasing users and features. Users (teachers and administrators) have taken to the new technology rapidly and enthusiastically, seeking additional features as current features are mastered.

One of the biggest pitfalls for schools wanting to move to a VoIP network is having a weak network that isn't strong enough to support more than Web surfing. Some schools find they need to improve their routing and switching equipment as well as increase their bandwidth before they can move to add VoIP capabilities. Call quality varies widely depending on number of users on a network. No matter how great using VoIP can be, the truth is, there's no point in investing in VoIP unless you can meet the minimum bandwidth requirements for high-quality calls. (Milner, 2005) Dealing with the heat generated by all the newly acquired equipment is a less anticipated issue. Investing in and budgeting for heavy-duty air conditioning units however, solves the problem preventing equipment melt-downs.

“Comparing communication by telephone to that provided over the Internet is the equivalent of comparing the railroad industry to the airlines.” (Santovec, 2005) While they both move people and goods, it appears obvious that railroad regulations wouldn’t apply to the airline industry. However, what is happening with the emerging VoIP industry as it gradually replaces POTS is analogous. Government has historically developed rules and regulations for each new technology. Critical to the future of the Internet is how much and what those regulations will be. E911 access is one stumbling block as some VoIP providers such as Vonage and Skype do not provide emergency phone access and tragedies have occurred. Another area where regulation may occur is in the area of law enforcement’s need for wire taps. Wire taps are much more difficult to apply with VoIP. Taxation is always a concern of government regulators. 15% of some states’ revenue comes from phone taxes. Although no one wants to tax the Internet, as phone usage disappears, government will be looking for ways to replace these revenues. Currently there are no Internet rules regulating disabled access, and in compliance with the Americans with Disabilities Act (ADA), accommodations will need to be made. Copyright issues with music transfer have brought copyright and peer-to-peer sharing rights into collision and will need to be sorted out. It is speculated that as taxes and regulations appear, outsourcing of jobs may increase to combat them. How lawmakers proceed will be critical in determining the future of the Internet, as well as potential for slowing down or even crippling innovation.

Even without new taxes and regulations, another version of U.S. outsourcing for cost savings is now occurring in education as a growing number of companies in India are supplying American customers with online tutoring through VoIP, complete with accompanying whiteboards and chat screens. With a large, tech-savvy, highly educated, but usually low-wage workforce, Indian companies can offer rates at ¼ to ½ off of comparable U.S. companies’ rates. One such large Indian company is EduMatics (www.edumatics.com) with 39 locations in India, Singapore, and the U.S. that has been in operation since 1994.

Innovation is occurring that may help resolve accessibility issues in distance education. Three programs are now available which offer advanced accessibility features utilizing VoIP as it provides an effective medium for incorporating audio, text and video. In these new integrated communication tools, speech, text, language translation, captioning, speech recognition, and speech synthesis from text are now available. They are additionally compatible with screen reader and Braille display technology. Deaf persons can place or receive TTY-compatible calls from their computer without the need for a TTY device. They can also read their voicemail from their email program much faster as TTY operates at a much slower speed. The FCC will have to be convinced that VoIP providers can successfully transmit TTY code over an IP network,

without loss of data or call quality to comply with the ADA law. Currently, VoIP is designed to transmit only human speech, so TTY data is more likely to get distorted.

Best of all, VoIP is also one of the cheapest technologies available to help the disabled perform their jobs better. Allan eC (All Languages Electronic Conversation), iCommunicator that works with Dragon Naturally Speaking, and Open Campus 4.0 each offer different tool combinations to help persons with hearing or vision difficulties. While distance education is not the primary function of any of these accessibility products, they are progressing toward truly inclusive communication interfaces. Costs are very high, and more development is needed the area of VoIP regarding speech recognition, speech synthesis, and sign language avatar programs. Setting up VoIP to use assistive-technology software isn't easy and frequently takes a specially trained telecom manager to assemble and fit to the individualized needs, although VoIP providers are working to remedy this issue. Assistive Internet-based telephony overall, shows great promise to help the deaf and blind become more productive and communicate better.

The education field perceives some of the assets of VoIP communication to be liabilities. Some schools are blocking IM programs popularly used by students, so offering another IM tool with open international communications is not uniformly welcomed. The concern is the introduction of security and privacy risks for school networks and students alike. IM systems are increasingly used by hackers to spread worms and viruses. Due to the blocking of IM sites, some instructors have moved their conferencing off-site to homes or public Wi-Fi Internet hot-spot locations such as Starbucks and Borders. The up-side of this off-site movement is facilitation of time-difference accommodations such as U.S. students convening in the early evening and the Japanese students in the early morning hours. These accommodations are more difficult in the K-12 environment, leaving international collaboration mostly to the higher education age group.

The free VoIP service, Skype, is being limited or banned from some college campus networks due to concerns with security and bandwidth usage. The very nature of Skype's peer-to-peer operation causes the controversy, and opens a user's computer to unauthorized access. While each call takes little bandwidth, multiple calls add up quickly, especially with file-transfer utilization. File transfer can also move malicious content, but the call and chats are well encrypted and are little threat. The larger financially based issue is, since Skype is a private company, free and open utilization of the university's network is transferring cost of doing business to the university. Rodney Petersen, a senior policy analyst at Educause, a higher-education technology group says he feels it to be a promising, advantageous educational tool, and universities should not ban it without careful consideration and good cause. (Woo, 2006)

Skype is actively working with concerned universities to provide a new service addressing these concerns.

While each of these individual issues with VoIP may be solvable, there exists an overarching issue that is going to take strong personalized management design and interpersonal training: getting voice and data networking engineers to work together. Some potential ways to surmount this may be having both groups report to a common manager and cross-training both. However since data engineers have typically earned a higher salary, resolution must come in job descriptions and pay parity. Technological issues may be more easily resolved than these human roadblocks.

Efficacy

Using IP for a communication system has many benefits. VoIP has proven to save a lot of money on long distance, make voice mail more accessible, and enable users to answer their phones from anywhere. Additionally, adding and transferring extensions is done easily within a VoIP system. Many businesses and now schools are discovering that VoIP can lighten costs in several ways beyond reducing long distance phoning budgets. Gradually replacing old telephony infrastructure is the most common transitional strategy for both business and education. Replacing aging PBX systems has quickly and easily offered phones in every classroom complete with voicemail on every phone complete with light up message button and screen message, access to school directories directly from the classroom, and the ability to issue notifications and receive Amber alerts. The emergency broadcast function allows direct communication with fire or police, improving their response time. Some schools are using VoIP for broadcasting in areas without phones via outside speakers. As cable, Internet, and telephone converge to run over one system it is likely lower maintenance and personnel costs will result.

For individuals, VoIP is the latest big advance in connecting with each other worldwide, following cell phones, blogs, wikis, podcasts, and email, and in many ways combining these other advances into one seamless package. The Robertson Education Empowerment Foundation is utilizing this powerful connectivity package to implement a nation-wide initiative (Global University Phone System: GUPS) linking all U.S. college and university telephone systems via the Internet for free, enabling free calling between universities and any Internet-connected personal computer. (Roach, 2005)

Voice communications are crucial for proper functioning in all levels of education and among all stakeholders creating a complex web of necessary interactions. Wireless VoIP is emerging as the preferred solution for it offers better geographic coverage, increased mobility, improved network performance, and significant cost savings.

Product Review

While there are many pieces of equipment specific to VoIP technology, the most obvious to the end-user is the softphone. Several companies make a variety of models that offer a diversity of features. The critical key to merchandizing VoIP for the consumer, commercial, and educational markets is educational demonstrations. It seems to clearly be a product where to use it is to love it. Some companies are treating it as phone service, others as Internet service, while offering a mix of free and pay services. Clearly the service and its products are actively evolving.

Cisco (www.cisco.com) unified communications phones have LCD displays including dynamic soft keys for call features and functions, and can be expanded to include XML (Extensible Markup Language) capabilities. The information display is pixel-based, symbols are global and intuitive to understand, a user guide is built in, the soft keys are screen-based, and the phone has a color touch-screen. Message indicator is built in, the speakerphone can attach external speakers for increased audio output, it is hearing-aid compatible, and there are audible and visual alerts advising users of phone status. Wireless IP Phones are available, as are video telephony functions, adding video conferencing to the communication mixture. Additionally Cisco offers IP Communicator software to provide calling from a computer and analog telephone adaptors and gateways to turn these devices into IP devices.

Vonage (www.vonage.com) offers a cordless handset with optional additional handsets that require no home wiring. Also available is a Wi-Fi pocket-sized, wireless Internet phone which works with a wireless router and also can be used at Wi-Fi hotspots worldwide. While it is not a telephone, Vonage also offers a 256MB USB flash drive that fits on a keychain, which can turn any PC into a fully functional Vonage telephone.

Nortel (www.nortel.com) offers IP phones with headsets, support for high-resolution graphical displays, USB, and Bluetooth. Both Nortel and Cisco offer Gigabit Ethernet-enabled models and touchscreen display phones.

Skype (www.skype.com) sells a variety of phones made by Philips, USRobotics, Linksys, Polycom, VoSKY, SMC, Netgear, Belkin, and Panasonic, offering cordless handsets, plug-ins to computers, speaker phones, and cordless or Wi-Fi phones which don't require a computer.

When a classroom is not part of a VoIP network, Califone International (www.califone.com) has created a USB Jackbox to help connectivity. It plugs into a computer and allows up to 6 students to use headphones and microphones to listen to recorded audio or streaming audio, to speak then listen to their own voices, to connect with other students through

any VoIP application, and also to create recordings to share. At less than \$100, the price is low enough to fit into most classroom budgets.

Future features being examined are voice recognition and interactive voice response features, card readers to authenticate a user or programmed to swipe credit cards, and 3-D displays. Considering the rapid development within this technology, these may already be in testing and the literature has just not been able to keep up. The future may actually be happening now.

Conclusions

VoIP offers a cost effective, innovative future for communication and collaboration. It is still rapidly evolving and experiencing to-be-expected growing pains. As with any revolutionary new technology, rules will need to be made, systems tweaked, and software adapted. While these are yet to be completed, the current level of usability warrants close examination as well as in many cases, immediate adoption without waiting for all the resolutions. The benefits in most situations far outweigh the liabilities. VoIP will be in our future, and for many visionary individuals and institutions, the future is now.

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