

Voice Over IP: Challenge and Promise

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If you have dismissed voice over IP as an X or Y generation's pipedream, you're the one with your head in the clouds. The message streaming from next generation network (NGN) suppliers and competitive local exchange carriers (CLECs) at telecom conferences this year has been that voiceover the Internet protocol (VoIP), has taken firm hold domestically and internationally and will grow at an increasing rate over the next several years. That message has been muted in recent months with the bludgeoning of dot-com startups and IT companies in the market and the international telecom industry slowdown.

But the shift to VoIP and next-generation networks is under way. It is happening for three big reasons: First, telecom and information services providers and their customers have struggled for decades with separate systems for voice and data, which do not work together and often conflict. Second, these separate systems deny customers more advanced, efficient and productive services, which a single system can provide. Third, current technology is generally for more costly than VoIP

In Western Europe, Latin America, the United States and nations around the world, many thousands of voice conversations already have shifted from the old Public Switched Telephone Network (PSTN), which we have known and mostly loved for generations, to a new "network of networks," with the Internet at its core. Before the end of the decade, a voice telephone call will no longer enjoy the secure but expensive luxury of a dedicated circuit path on the PSTN. Instead, it will be chopped into tiny bits and sprinkled almost

unnoticed among billions of data bits that travel in tiny 'packets' over myriad Internet routes, to rejoin (harmoniously, we hope) at the listener's ear. Don't fret. IP telephony, which includes voice over packet in any form including voice over the Internet, will offer far more useful services than anything PSTN has to offer.

Assessing the Market

Skeptics may say that there is no demand for VoIP or other next-generation services from the cities or the heartland — no real evidence that customers are ready to trade the familiar, tried and true system for one that is still not proven and may be unreliable. And there are technical problems that must still be addressed in the provisioning of high-quality VoIP services so that they will operate fully and transparently with existing networks and systems at high speeds and under peak traffic loads. The impact of the economic slowdown in the U.S. and elsewhere is a widespread concern. Many telecom and IT providers and suppliers overbuilt or overstocked to prepare for customer demands which have slackened and which may not pick up again for a year or more. With revenues off, venture capital firms want no part of funding further new offerings such as VoIP from CLECs or resellers who do not have their own networks. The cash shortage has hit not just startups and smaller companies, but leading suppliers and service providers. We are witnessing significant, wrenching consolidation in telecoms and IT.

Still, larger CLECs, incumbent local exchange carriers (ILECs), equipment and systems suppliers and industry experts have little doubt that the telecommunica-



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tions industry will come out of the current slump. In their view, VoIP and related broadband Internet services are the technologies of the future. In the opinion of experts, this technology will prove to be every bit as disruptive as digital technology and fiber optics, and will open the door to a broad array of interactive services, far-reaching competition and the wholesale restructuring of the industry worldwide. Numerous experts we consulted believe that remaining technical difficulties are now being resolved. They say that after the economic slowdown, a more sober and consolidated industry will see the efficiency and relatively low costs of VoIP services as increasingly advantageous.

Interactive Multimedia Broadband

This is not just about voice. It is about high-speed, broadband interactive multimedia IP services, which enable customers with offices and employees dispersed at locations throughout the world to work collaboratively and just as effectively as if they were all physically together in one room. VoIP means that voice conversation and interactive multimedia will be integral parts of our ordinary communication in a few years, enabling us to draw upon the knowledge and expertise of colleagues wherever they are, and to act quickly and decisively with up-to-the-minute information. To some extent this takes place on the PSTN now, but it is expensive. In next-generation networks, it will be more functional, easier to use and less expensive. That is what customers will need and want.

VoIP Advantages

VoIP services have two powerful cost advantages over traditional services. First, instead of constructing their own complete networks or leasing high-priced capacity from incumbent carriers, VoIP providers utilize advanced, extensive and low-priced Internet facilities, which are constantly being improved and expanded. Second, the packet-switching technology at the core of VoIP services derives many times more capacity from capital-intensive network resources than is possible in a traditional circuit-switched network.

Resulting cost reductions will open the enormous potential for telecom and IT for business, government, universities, research laboratories and individuals.

Today, the PSTN is overburdened by sharply rising demands for local access. Explosive growth of the Internet has clogged telephone circuits and switching facilities with repeated bursts of data that designers of the PSTN never imagined. Increasingly, local telephone facilities are tied up in e-mail and data transmissions that average 40 minutes and often continue for hours at a time. These facilities, designed to handle many calls of short duration, are ill equipped for spasmodic traffic jams, which require all the capacity they have and more, so that they are unavailable for the voice calls they were intended to carry. Assigning new area codes and installing more local exchanges and access lines is perhaps as effective as building new streets and installing more traffic lights in an area where the population is growing rapidly and the number of heavy trucks coming into the area continues to increase.

Suppliers see clearly emerging trends that together will revolutionize the telecom industry from the infrastructure to the customer. Digital loop carriers will continue their growth," says David Broecker, vice president of systems development at NEC America, "because application developers are now designing applications specific to the service. New video streaming programs will have a major impact on the traffic within the network, causing needs for continued growth in the backbone." To some extent, xDSL alleviates stress on local facilities by digitizing the signal within the home or office, allowing a single access line to handle more than one message, voice or data, at a given time. Customers with multiple lines typically terminate the service on one or more of their lines when they subscribe to DSL. VoIP technology, however, not only digitizes but also packetizes the voice signals and can do so both in long-distance and local networks. Packetizing voice vastly expands the capacity of transmission and switching facilities and is far more economical than circuit switching. Dedicating a circuit to a single telephone call, as is done in

today's PSTN, is an expensive squandering of scarce network resources.

Established service providers with high-capacity networks in place know that traditional network and switching systems are highly reliable and they want to optimize and maintain their networks to the extent that it is practical to do so.

At the same time, providers know that traditional networks cost far more to build and maintain than IP facilities and they face increasing competition from CLECs who are putting IP networks in place, hoping to attract customers with more advanced services at lower prices.

Quality of Service

In the PSTN environment, service providers and customers take high-quality service for granted. With some serious exceptions in wireless, we are used to telecommunications networks that are so consistently reliable that we feel perplexed and rather helpless when they are down. We use telephones of all kinds and our calls go through more than 90 percent of the time. Our conversations are so clear that we often say, "It sounds like you're just a few feet away." Corporations and other group customers know precisely which telephone station has been used to make or receive calls and which station is not functioning normally. This information facilitates detailed call records and billing; service-order changes; maintenance and repair; and overall management. We also take for granted a wide range of features that allow us to use secure codes to obtain personal records, transfer funds in our bank accounts, make payments, etc.

The VoIP Difference

In the Internet environment, however, we must pay attention to the type of equipment, the modem and the software we are using. URLs and e-mail addresses are irrational, complicated and difficult to remember. If we add a new software program to our computer, our system chokes up. We are accustomed to dial-up failures, transmission delays and interruptions.

For long-distance transmission, and particularly on international routes between countries served by advanced Internet facilities, more and more traditional PSTN service

providers shift their voice calls and other traffic to an IP carrier, because it is far less costly and the quality is not discernibly different.

Taking IP voice through high-capacity and high-speed routers and switching systems presents further challenge. PSTN advanced switching systems — PBXs, Centrex, #5ESS and #4 tandem ESS — handle heavy traffic with high reliability. Lucent's #5ESS, for example, can serve a quarter-million subscriber lines and a hundred thousand trunk lines, linking them with more than 130 million lines and 100 million trunks that are laced through 5,000 switching systems in countries around the world. Yet the Lucent #5ESS has average downtime of less than 10 seconds per year. At a PSTN primary switching center, typically a #5ESS, a unique circuit is set up for each telephone call by an out-of-band signaling system known generally as SS7, which sets up a dedicated circuit for each telephone call and maintains the circuit for the duration of the call.

VoIP systems, however, establish no such dedicated path. Instead, as with e-mail and other data transmitted over the Internet, in VoIP the voice signal from each person communicating is broken up into innumerable tiny packets, each containing a minuscule segment of the spoken message plus an address code for its final destination. These packets travel separately within a huge stream of other voice and data packets, each finding its own best way back and forth across the vast network of networks between the people on the call. This capability to use switching, routing and transmission networks so efficiently presents the major challenge to VoIP today, but it is also its incomparable strength. We may be just months away from communications applications more advanced and sophisticated than most of us have thought possible. Our goal must be not to design and build IP routers and switches that will mimic the capabilities of today's BXs, Centrex, or even the #5ESS; the goal must be to design and build systems that will be as versatile as the Internet itself, as adaptable as customers need them to be.

Not all types of service require the same level of quality, reliability or

adaptability. In many data transmissions, some packets may be delayed or lost without much harm, because a brief delay in their arrival or the loss of a few packets usually has little impact. In speech transmission, the packets must arrive at their destination intact and in immediate and proper succession. Corruption, delay or loss of packets often results in gaps or loss of the voice signal, breaking up, cracking, static, jitter, etc.

Voice over ATM and other hybrid approaches, including voice over frame relay, are sometimes used to distinguish service types, typically relying on the differentiated services (DiffServ) protocol or the multiprotocol label switching (MPLS) approach to do so. Ultimately, in a network that handles various classes of service, from voice to high speed, interactive multimedia broadband, the software programs must be sophisticated enough to give top priority to the voice services inherent in these communications while preserving the quality of the accompanying services.

Standards

Incomplete and conflicting standards now prevent software programs and systems from working well together. There are several sets of standards currently in use, none of which meets the needs of either VoIP or next-generation networks or has broad acceptance throughout the industry. The widely used H.323, developed by the International Telecommunications Union's telecommunications group, is not generally regarded as satisfactory and is further encumbered by various inconsistent versions. Other standards include H.248, the Media Gateway Control Protocol (MGCP) and the Session Initiation Protocol (SIP). Although opinions are mixed, many observers think that the great majority of systems could be interoperable in a year or so.

Perhaps the greatest challenge before VoIP and broadband Internet hardware and software technicians is to develop technologies that will assure a full range of advanced services and features now available on the PSTN, with the same quality that is common and expected in the high-volume, high-speed circuit-switched environment. More than

that, the technology must integrate PSTN, VoIP and other next-generation network services seamlessly and transparently.

Considerable effort is being made to reconfigure PBX, Centrex, and Class 4 and Class 5 PSTN switches but, in the opinion of several leading service providers, progress on the #4ESS and Centrex systems is often overstated and no VoIP system currently provides features comparable to the #5ESS. One difficulty is converting the digital signal into analog form and carrying it through to the receiving party. "The #5ESS is highly sophisticated and tough to duplicate," says one industry expert. "Today's IP technologies cannot yet perform at a level comparable to the #5, but it will happen."

Vendors suggest that the market for VoIP products and systems will pick up as the industry and the economy come out of the present trough. The current market for VoIP products and systems is approaching \$200 million, in their view, but should exceed a billion dollars in another three years.

The Case for VoIP, Part II

We're Pleased to Present Part Two of our series taking an in-depth look at the market for Voice Over IP (VoIP). This original market analysis comes to us from Dr. Richard Thayer, founder and president of Telecommunications & Technologies International, Inc. (TTI).

Part I of the series ended with a discussion on standards. Incomplete and conflicting standards now prevent software programs and systems from working well together. There are several sets of standards currently in use, none of which meets the needs of either VoIP or next-generation networks or has broad acceptance throughout the industry. Though a significant issue, it's not exactly the only hindrance to VoIP.

Regulatory Forbearance

VoIP providers and proponents have had reason to be pleased by the rather hands-off view toward vir-

tually all Internet services that has been taken by regulators, the FCC in particular. The courts have not intervened to require Internet-based services to be regulated, although at least one court has ruled that VoIP providers must pay access fees to local carriers. A lenient regulatory approach to Internet-based services and even non-regulation in many cases appear to be common both in the U.S. and in other countries.

Aileen Pisciotta, a partner at Kelley, Drye & Warren in Washington, DC, describes the FCC's approach to the regulatory treatment of Internet services as "shoebox unregulation." For some years now, she points out, the commission has avoided imposing on the Internet or Internet-based services any of the same rules and regulations that apply to traditional telecommunications services, although the commission's own rulings have suggested that the rules apply in some instances.

The FCC has chosen to treat all Internet or IP-related services with this undifferentiated unregulation approach, sort of like putting any service carrying the Internet "label" in a metaphorical "shoebox" in the back of the closet, where these services are out of sight and out of mind.

More broadly, however, the FCC's present laissez faire approach to telecommunications has strengthened the position of the Bell companies and other ILECs and made it even more difficult than it has been for CLECs of virtually all stripes to carve out viable markets in the ILEC territories, which, of course, is the entire United States.

Powerful members of the Energy and Commerce Committee in the U.S. House of Representatives have weighed in for relaxing regulation as well, but a current bill designed to advance Internet and broadband services could have less positive effects. Legislation sponsored by Rep. W.J. "Billy" Tauzin, the Republican chairman of the committee, and co-sponsored by John D. Dingell, the committee's ranking Democrat and co-sponsored by many other committee members, would go even further than the FCC in deregulating the Bell companies. Legislation the committee is now considering would allow the Bell companies to immediately offer long-distance services, bypassing the

current requirement that they first open their markets to competition. Together, the FCC and congressional actions could make life considerably more difficult and uncertain for new, would-be entrants to the telecommunications industry and could further discourage investment in the new services these entrants propose, including, prominently, VoIP.

VoIP CLECs

RCN Corp., a CLEC with sound financial backing, is not waiting for an economic turnaround to begin its next venture in VoIP. Since 1999, RCN has bundled together local and long distance telephone, cable TV and high-speed Internet services for homes in many of the top residential markets in the United States. With a goal of being the dominant provider of residential communications services over its own network in the nation's major market areas, RCN has delivered broadband Internet services for service providers, resellers and enterprise companies, and serves more than 200,000 homes in these key markets.

RCN is perhaps the only CLEC whose market plan is to give consumers an alternative to the incumbent local telephone and cable TV providers, by offering them a package of local phone, cable TV and broadband Internet services. RCN has recently announced that in addition to carrying VoIP for other service providers, it will soon offer its own VoIP services, entering the market as a wholesaler in the near future.

ITXC, an international Internet-based carrier with corporate headquarters in Princeton, NJ, directly counters the view that the quality of VoIP service is inferior to voice on the PSTN. The company describes its voice service as consistently high quality and states that "...by 2010 all interactive voice communication will be transported on the public Internet," including both what we know as "phone calls" and "e-calls," which it says are better than traditional phone communications.

ITXC says that it is the world's largest global network for voice on the Internet, with 466 or more IP points of presence in 96 countries. Since it began operations in 1998, ITXC has carried more than a billion minutes of wholesale traffic, including millions of

minutes of billable traffic everyday now, making ITXC one of the country's largest providers of international switched resale services. Keep those facts in mind when you hear someone say that if you make calls internationally you are likely using VoIP whether you know it or not, because your carrier is using VoIP.

ISI in Fort Lauderdale, FL, appears to be doing well as a wholesale carrier providing VoIP services to several U.S. metropolitan areas and several countries in Latin America. Its revenues are up more than 10% so far this year to more than a million dollars per month currently. Other CLECs, do well by combining wholesale and retail RCN, such as FOCAL Communications, headquartered in Chicago, offers broadband services to large corporations, ISPs, ASPs, VARs and content providers in major metropolitan areas across the United States and offers VoIP services directly to customers in the New York metropolitan area.

Next Issue: Established Service Providers. Perhaps one of the clearest indications that VoIP is the technology of the future is that the Bell companies and other established service providers are responding to the CLECs' VoIP competitive challenge by operating as CLECs themselves outside their traditional serving areas and, more than that, by transitioning to the Internet protocol for voice and broadband services provisioning in their own serving areas.

The Case for VoIP, Part III

We're pleased to present the third of our multi-part series taking an in-depth look at the market for Voice Over IP (VoIP). This original market analysis comes to us from Dr. Richard Thayer, founder and president of Telecommunications & Technologies International, Inc. (TTI). Part II of the series ended with a discussion on VoIP CLECs.

This week: Established Service Providers. By Dr. Richard Thayer, Telecommunications & Technologies International, Inc.

Perhaps one of the clearest indications that VoIP is the technology of the future is that the Bell companies and other established service providers are responding to the CLECs' VoIP competitive challenge by operating as CLECs themselves outside their traditional serving areas and, more than that, by transitioning to the Internet protocol for voice and broadband services provisioning in their own serving areas.

Qwest Communications International, Inc. was among the first international service providers to move aggressively into broadband Internet-based communications, addressing customers' requests for integrated voice, data and multimedia services. Qwest's strategy is simply to expand upon its extensive network resources with high-speed Internet access and Web hosting, private networks and wireless communications, to provide managed solutions and advanced applications to business customers and an increasing range of new services to residential customers as well.

Qwest maintains an aggressive schedule for deploying VoIP and broadband, competing with CLECs who are offering these services in Qwest's territory. It is determined to provide customers the services they want at fully competitive prices.

In January 1998, Qwest introduced its Phone-to-Phone IP Voice long-distance services for consumers and small businesses in nine US cities, and expanded the services to customers in 25 cities later that same year. In March, 2001, Qwest announced its CyberVoice Interconnect offering, a wholesale VoIP terminating service which, it says, enables carriers, IP telephony service providers, ISPs and Web portals to deliver clear, reliable voice calls over Qwest's nationwide broadband Internet network. ITXC was announced as the first customer.

BellSouth currently provides VoIP

services to several hundred thousand residential and business customers in its region and expects to have close to a million VoIP customers within a year. In this instance also, competition is an important factor as demand for sophisticated new services at lower cost drives customers away from circuit switching to VoIP and Internet broadband. Like other service providers, Bell South is responding to customers, large and small businesses alike, who believe that by integrating voice with other services on the Internet, they can open up tremendous resources within their companies and vastly expand their market potential.

In October 2000, SBC announced plans to introduce a range of business service offerings based on IP, including: distributed IP PBX and Centrex services, with links between existing switched voice networks and IP-based data networks. IP telephony is intended to promote integrated voice, video and data services, broadband service, and unified messaging. SBC's further goals for VoIP are to improve network manageability and reduce support costs.

BT Spain, a subsidiary established by BT more than seven years ago to address the market in Spain, now has a national multi-service IP network in place in Spain, with the capacity to transmit five million calls and 32,000 TV channels simultaneously. BT received its first license to operate in Spain in April 1994, and was allowed to provide telecommunications service over its own facilities beginning in December 1998, which effectively authorized BT Spain to provide services throughout the country.

BT Spain has built a carrier-class network that some consider not only advanced but even unique and has been providing VoIP and some multimedia IP services to customers since the end of 1999. BT Spain offers an increasing range of IP-based services, from simple voice, data and virtual

private networks to value-added multimedia. The company's complete line of services will include IP video-conferencing, virtual private networks, freephone (800 service), unified messaging and more. BT operates in all major cities in Spain, including Madrid, Barcelona, Valencia, Seville and Málaga, and serves more than 350,000 customers throughout the nation.

BT's network in Spain is linked with its pan-European network, Europe's largest multimedia communications network, which serves hundreds of cities on the Continent, and also interconnects with the BT-AT&T jointly owned Concert network. BT is investing hundreds of millions of dollars in Spain toward a goal of becoming the standard for next generation IP/multimedia networks.

We are in for an exhilarating ride as we move to a new mode of advanced and interactive voice and broadband multimedia communications. The International Telecommunications Union, not known for exaggeration, recently stated, "A fundamental paradigm shift has been underway in the telecommunications industry — a shift that has arguably brought about as dramatic a change in personal communications as the telephone did compared to the telegram. That change is a shift from traditional PSTN circuit-switched voice networks to packet-switched data networks, using Internet Protocol (IP) technology." When was the last time you sent a telegram?

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