EION WIRELESS

White Paper

Business Opportunities Created by Wireless VoIP

Introduction

This paper introduces Wireless Voice over Internet Protocol (WVoIP) to enterprises and service providers who want to identify and take advantage of the substantial business opportunities presented by this new technology.

We begin by describing the benefits of standard (wired) VoIP compared to traditional telephony, and the benefits of wireless networking. We point out that by combining VoIP and wireless technologies, companies and organizations can realize the benefits of both. We go on to introduce some of the important technical aspects of VoIP and WVoIP technology, and describe the main challenges involved in delivering VoIP services—challenges that have been addressed by EION's own wireless VoIP solutions. Next, we describe the opportunities created by the new technologies for both enterprises and service providers. Finally, we describe how EION, a leader in wireless IP-based networking, is spearheading the movement to wireless VoIP.

WVoIP—the Benefits of both VoIP and Wireless

VoIP's momentum is no doubt part of a larger movement to move all communications to IP-based networks. Driving this move is the fact that delivering everything over IP can be both more economical and allow the delivery of more advanced services.

By now, the benefits of VoIP are probably familiar:

- Earlier technical challenges regarding quality of service (QoS) and performance have been addressed, making VoIP a serious alternative to traditional PSTN-based communications systems, and placing VoIP on a level playing field with traditional technologies.
- VoIP systems are capable of delivering a substantially richer array of services than PSTN-based networks. In addition to those services with which consumers are currently familiar (such as call display, call waiting, and so on), VoIP supports advanced new services that integrate Internet and telephony applications—such as integrated email and voice mail.
- Implementing and maintaining VoIP networks costs much less than traditional PSTN, allowing enterprises with high call volumes to reduce their telecommunications costs, and service providers to add more subscribers and deliver more diverse services for a relatively low rate.

The benefits of wireless communications are also widely recognized:

- Wireless networking has allowed many companies, organizations, and even countries to make telephony widely available to both urban and remote rural areas without having to lay cable lines or copper wires.
- Wireless technology has advanced to the point where the quality of the services delivered over wireless networks is equivalent to or surpasses that of wired alternatives.

Nonetheless, it is less widely recognized how wireless technology can now be combined with IP-based networking to deliver telephony wirelessly—simultaneously achieving the benefits of both VoIP and wireless technology.

What is WVoIP?

Before going on to describe the components of WVoIP, it is important to understand the basic features of VoIP networks and how they differ from PSTN-based networks. With a PSTN (Public Switched Telephone Network), analog voice data is transmitted over copper wires on a network whose parts are owned and controlled by traditional telephone companies (called Incumbent Local Exchange Carriers or Telcos). With VoIP, voice calls are converted to a digital format that can be transmitted over an IP network (the Internet, a private intranet, or a Virtual Private Network [VPN]). Analog calls can be converted to IP format locally via VoIP gateway devices, transmitted to remote destinations over the Internet for little or no cost, and then enter the remote PSTN via a remote gateway. Wireless VoIP calls are also transmitted over the Internet, but they rely on wireless access to the Internet—through proprietary wireless protocols, or potentially, WiMAX-based technology.

VoIP Elements

VoIP systems generally include four elements:

- Call processing server or "gatekeeper"—an IP PBX or IP-enabled traditional PBX for routing and controlling call connections
- IP network—the Internet, intranet, or VPN
- Gateway device—converts voice content transmitted on traditional phones from analog to digital format (for transmission over the IP network)
- User devices—hardware or software devices that are used by callers in the way telephones are used in traditional systems, including traditional telephones, VoIP phones, and software running on a PC equipped with a microphone

The architecture for the VoIP network varies depending on the end user devices used to make calls. VoIP calls can be made using any combination of traditional phones, VoIP phones, and VoIP-equipped PCs.

Consider a simple scenario in which VoIP is used to make calls between two traditional telephones in a PSTN network. A user initiates a call using a traditional phone on a PSTN system. The call processing server or "gatekeeper" establishes the connection between the phones using a standardized signaling method (H.323 or SIP). The gateway device converts the analog content to voice IP packets that are then transmitted over the Internet via Real-time Transportation Protocol (RTP). At the receiving end, another gateway converts the packets back to analog content for delivery to the receiving circuit-based phone. (It is important to understand the difference between a gateway and gatekeeper: In VoIP terminology, gateways convert the messages to and from digital format; gatekeepers control signaling, that is, the establishment and termination of calls.)

Wireless VoIP (WVoIP)

Recent developments in emerging wireless technology make it possible to achieve a very high level of performance with WVoIP—allowing for the delivery of high-bandwidth applications and services over wireless networks.

VoIP over wireless introduces wireless access to the VoIP network. A number of architectures are possible. For example, in Figure 1 on page 5, conventional telephones are connected to gateway devices that are in turn connected to subscriber units with wireless connections to a tower-mounted base station. The gateways convert the signals to RTP for transmission over the Internet. The RTP messages are transmitted through the subscriber units to the base station, and then to a "gatekeeper" device that routes the calls, and establishes and terminates the connections as required. Calls could be made to other wireless networks with similar connections to the Internet, or to PSTN-based devices.

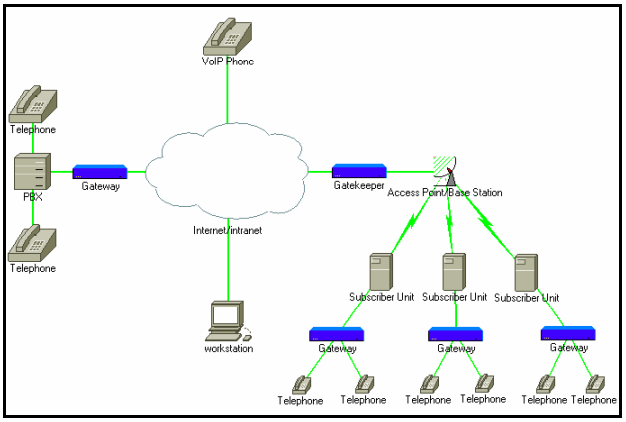

Figure 1: A VoIP/WVoIP Hybrid Network

In this type of implementation, the individual phones in an office building, apartment building, or condominium complex are connected to a gateway that is wirelessly linked to the Internet. Service providers can use this type of wireless access to the Internet to deliver inexpensive but advanced IP services (including voice) to places that currently do not have any connectivity at all (such as in developing countries or newly developed areas). They can also use it to deliver a relatively inexpensive and more sophisticated alternative to those who currently have traditional phone lines.

The Key Technical Challenge: Processing Power not Throughput

To be a viable alternative to PSTN-based telephony, a WVoIP system must be capable of carrying voice calls with the same (or very nearly the same) level of voice quality and reliability as the PSTN. And except for home networks, it must be capable of handling many simultaneous calls. The PSTN has proven to be reliable and capable of delivering excellent sound quality. Consumers are not likely to forgive even the slightest relative failures in voice quality or dependability from an IP-based service.

The main challenge facing WVoIP developers is that voice calls, in contrast to data transmissions, are extremely delay-sensitive. Delays (called latency) that are tolerable for data are not acceptable for voice calls as they can seriously degrade quality of communication. Although bandwidth availability plays an important role in the

delivery of data on IP-based networks, it is important to recognize that this is not true for VoIP. On the contrary, a VoIP call does not require much bandwidth at all. Instead, VoIP requires low latency, which in turn depends heavily on the processing speed of the devices involved in digitizing and managing the transmissions over the network.

Voice packets are typically quite small in size. However, each VoIP call will generate 100 packets per second. Moreover, unlike Ethernet data, voice packets must all arrive at the receiving gateway—and in a timely manner. Too many lost or late packets causes voice quality to suffer. Packets arriving too late or out of sequence are equivalent to lost packets: unlike data packets, voice packets cannot be retransmitted and used later. Most network devices (such as routers, switches, and servers) are limited in the number of PPS they can process, and each device introduces an additional constraint on network performance.

The topology of wireless systems can introduce additional demands for processing power. For example, in Figure 1 on page 5, an access point radio is connected to three subscriber units, each of which is in turn connected to a gateway device. The number of calls that can be handled simultaneously by such a network will depend less on the size of the pipe than on the processing speed of the network devices.

Since processing speed is so critical for the performance of WVoIP and VoIP networks, it should be regarded as a key benchmark in evaluating the capacity of potential vendor solutions.

Enterprise Solutions

VoIP technology can be used in a number of ways to help companies reduce their telecommunications costs—and doing it wirelessly can reduce costs even further. In this section, we describe wireless versions of three standard VoIP applications, and show how the wireless versions can be used by enterprises to achieve the same functionality as the wired versions while reducing the costs of implementation, operation, and expansion.

Wireless PSTN Bypass

In a wired PSTN bypass system, conventional phones are connected to gateway devices that are in turn connected by cable to the IP network. Calls are transmitted over the IP network instead of the PSTN. If desired, gateways capable of routing calls via either the PSTN or the IP network could route calls to either network depending on the time of day or destination of the call. As well, gateways could be connected to either single lines or a company PBX resulting in either a point-to-point or point-to-multipoint application.

In a wireless variation (Figure 2), the conventional telephones (or the company PBX) are connected to gateway devices that are in turn connected to radio access points. The access point devices transmit the calls wirelessly to subscriber units in remote offices. The company realizes all the benefits of VoIP, making internal, local, and long distance calls at little or no cost, plus the cost savings associated with not having to use cable or copper wire.

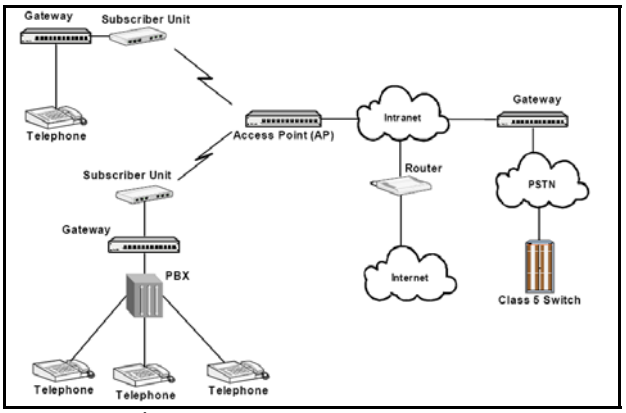

Figure 2. Wireless PSTN Bypass

Wireless PBX Extension

In a wired PBX extension, a company could allow remote phones to connect to the existing local IP connections on its PBX—connections that are typically already used by employees to access the internal corporate network and the Internet. VoIP could thus allow a company to leverage the use of its existing PBX by extending it to remote offices and teleworkers, without having to rely on the PSTN.

In a wireless version of a PBX extension, the company could realize additional savings by allowing remote phones to connect to the IP connections via a wireless network composed of subscriber units (SUs) and access points (APs)—reducing or eliminating the need for cable or copper wire. In the example shown in Figure 3, calls destined to remote offices or teleworkers are routed via gateway A to a wireless access point (AP) which relays the calls to one of the two subscriber units, depending on the destination of the call. The subscriber units are in turn connected to their own gateways, which are connected to one or more telephones or faxes. In this example, a gatekeeper function resident at gateway A controls call setup.

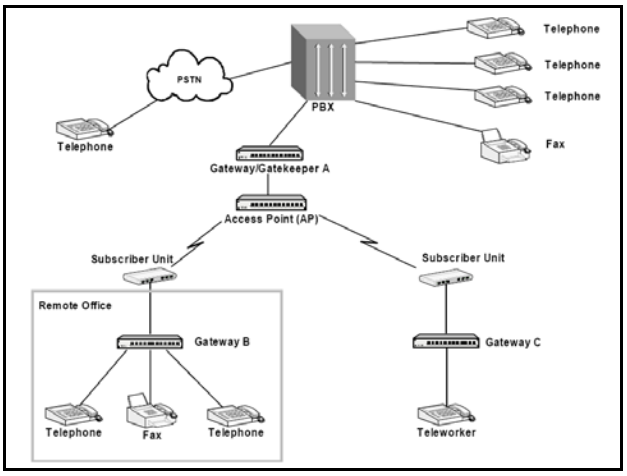

Figure 3. Wireless PBX Extension

Wireless Individual Line Aggregation

Individual line aggregation applications are typically used for multiple-unit dwellings. In a wired individual line aggregation, multiple individual lines are connected to a gateway located on the premises. The premises gateway connects to the network via cable to the IP network.

In the wireless version (Figure 4), the premises gateway connects to a subscriber unit located on the same premises. The gatekeeper at the combined gateway/gatekeeper controls call setup. This type of network topology is used to deliver voice services to remote users where copper wire, cable, or other means are not readily available.

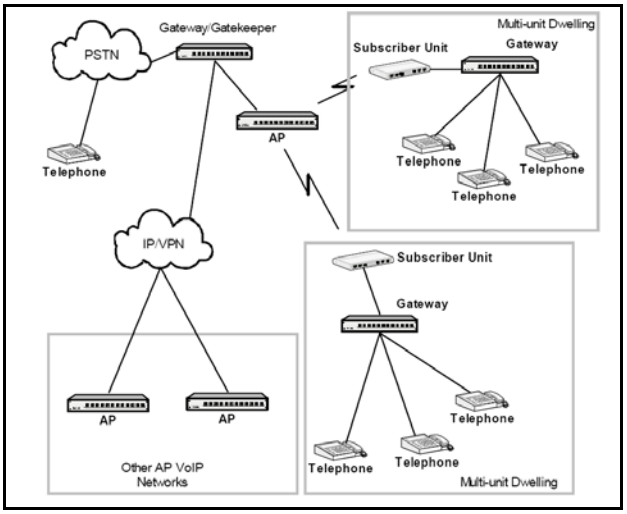

Figure 4. Wireless Individual Line Aggregation

Calls originating from a telephone at the multi-unit dwelling are processed by the local gateway. Signaling between the local gateway and the PSTN gateway/gatekeeper establishes and terminates the connections as required. The gateway/gatekeeper also routes the calls to either the PSTN or IP/VPN network. Calls destined for telephones on the PSTN are routed to the PSTN. Calls destined to telephones on other APs are routed via the IP/VPN network.

Opportunities for Service Providers

The emergence and maturation of IP telephony technology has created opportunities for enterprises to offer telephony bundled with advanced voice and data services at low cost to subscribers. And as with the enterprise solutions outlined above, solutions that enable service providers to deliver VoIP over wireless can be used to deliver even further savings for the service providers and their subscribers.

Inexpensive Telephony Network Expansion

The main advantage of WVoIP is that WVoIP networks can be created and operated much more affordably and quickly than traditional PSTN and wired IP. Wireless networks are easier and less expensive to implement and operate—particularly in remote, rugged or underdeveloped areas or countries. Wireless service providers thus have dramatically lower capital costs.

Cost Savings for Subscribers

Like standard wired VoIP, WVoIP allows users to bypass the PSTN for long distance calls. Since long distance calls are transmitted locally between the user devices and the IP network, no long distance charges are applied. This allows service providers to attract subscribers by offering long distance services for a much lower cost than incumbent providers. This cost saving has historically been the main driver for VoIP implementations. The degree of cost savings achievable using VoIP depends on calling patterns, but typically the payback period is less than one year. Competition has reduced long distance rates but local access charges have risen correspondingly. Wireless as a local access method is increasingly attractive as it can reduce local costs even further.

Bundling of Internet and Telephony Services

Using WVoIP, service providers can bundle email and voice mail messaging, IP data, video conferencing, streaming video over IP, and other integrated applications. Combining voice and data transmissions onto the same network reduces the total cost of ownership of the network by allowing the same network components to support voice- and data-related functions—for example, by storing both voice mail and email on the same server. And the

infrastructure savings associated with wireless allow providers to deliver bundled services more cost-effectively than they could with standard wired VoIP.

The following table lists the services that can be provided via WVoIP:

Service	Benefits
Traditional services	Familiar services that customers expect from telephony technology. (call display, call forwarding, call answer, and so on)
Access to voice mail and email from both telephone and PC	Convenient access. Voice messages can also be forwarded to any PC or VoIP phone connected to the Internet.
Video and voice conferencing	Useful services that business users have come to expect.
Data file transfer by phone	Receive, edit, and transmit data files using a phone.
Digital Fax	Faxes are routed to recipient's email account, allowing for easy copying, printing, and so on.
Follow-me services	Calls are routed to a number that can be accessed locally by the recipient regardless of the recipient's physical location. Can be used for toll-free contact numbers, or to create a "local" presence in a remote location u sing a number bearing the area code of the remote office.
Email alerts	Notification of incoming voice messages.

Single Bill for Telephony and Data Services

The convergence of telephone and data on one network overseen by a single provider allow for single billing arrangements, where both types of services appear on a single bill. This can be seen as a partial remedy for consumer frustration over multiple billings for services delivered over different types of networks.

Leverage Growth of WiMAX

A major driver for future WVoIP development is expected to be the spread of large city-sized "hot zones" supported by WiMAX technology. WiMAX will both dramatically extend the reach of wireless services and address quality of service (QoS) requirements of delay-sensitive applications such as voice and streaming video. It should also address the latency issues experienced by some early adopters of VoIP. The emergence and spread of wireless "big fat pipe" networks capable of delivering high-bandwidth applications using IP should lead to further adoption of WVoIP as an alternative to PSTN.

Companies can now create a wireless network with WiMAX levels of performance and range using a WiMAX technology such as EION's Libra MAX™.

Metered Billing

Significantly, consumers of telephony in many developing countries have become accustomed to expensive metered billing for both local and long distance calls. The high cost of PSTN combined with the prevailing use of metered billing for access to it, makes it possible for service providers to attract subscribers to metered, but relatively inexpensive local and long distance WVoIP.

WVoIP Markets

Hospitality

Hotels can implement WVoIP to recognize cost savings opportunities without compromising voice quality, disrupting existing infrastructure, or making the administration of communications infrastructure unacceptably complex. WVoIP can be used to provide hotel guests with continuous wireless connections to voice and data services via cell phones, PDAs, and laptops.

Multi-Office Enterprises

In today's information-driven economy, people spend a lot of time on interoffice, domestic, and international calls. The reduction/elimination of these costs can have a significant impact on corporate profitability and make it less expensive to pursue new geographic markets. Companies have also made significant investments in IP-based data network infrastructure to effectively deliver information and application services to users across the enterprise. WVoIP allows voice enabling of the IP network so companies can reduce or eliminate the cost of interoffice communications.

Banking

Financial institutions can potentially realize substantial cost savings by implementing WVoIP. However, the risk of reduced voice reliability and/or network disruption has prevented many organizations from taking full advantage of these savings opportunities. Selecting the right WVoIP solution can eliminate these risks—opening the door for banks to cut interoffice communication costs, consolidate

call centres, and avoid local access and long-distance phone charges.

Call Centres

To reduce costs and improve the quality of customer service, companies can rely on WVoIP to locate their call centre facilities where labour and facilities are less expensive—avoiding the telecom costs that would otherwise be associated with such initiatives.

Selecting Vendors

WVoIP solutions can be complex and vary widely. In most cases, no single vendor will have an "end-to-end" WVoIP solution for the establishment of WVoIP infrastructure. Thus implementing a WVoIP solution is likely to require the use of a number of vendors, each of which is responsible for part of the solution.

Selecting the right wireless technology vendor is critical. To reduce risk, service providers should select a vendor with as much expertise as possible with the technology—that is, with a long-term track record of grappling with and resolving technical issues concerning WVoIP, such as quality of service.

EION—the Leader for Wireless VoIP

At EION Wireless, we recognize the opportunities created by WVoIP for both service providers and enterprise customers. We have been thinking about and working on the challenges of wireless IP telephony for a long time. With over 10 years in wireless technology, EION has become a recognized leader for reliable cutting-edge solutions using emerging technologies like WiMAX and wireless VoIP. Now we're the first to develop "engineered solutions" for wireless VoIP that permit customers to deploy a system confident that all the technical integration details have been addressed.

Simple, Reliable, and Cost-effective Engineered WVoIP Solutions

EION's end-to-end wireless VoIP solutions can be used to create efficient and reliable wireless voice over IP networks without the complex multiple-box configurations required by competing systems. Our solutions can be used for a broad range of networking needs—from small point-to-point corporate networks to large point-to-multipoint systems operated by major carriers. And all of them are capable of delivering voice over IP with carrier-class Quality of Service (QoS).

EION's solutions are based on the Ultima 3 and the Libra family of products—products that were designed with demanding applications like IP telephony in mind.

The table below outlines the key features of EION's WVoIP solutions.

Feature	Benefits
High packet-per-second processing performance	More important than bandwidth for voice over IP, this is required to reduce latency and maximize the number of simultaneous calls an access point device or subscriber unit can handle on a voice IP network.
Includes built-in "packet prioritization"	Delay-sensitive voice packets are given priority over other data packets—critical for effective voice over IP applications.
Includes ultra-efficient polling algorithm	Further reduces latency and maximizes the number of simultaneous calls an access point device can handle on a voice IP network.
Low latency	Fewer dropped calls, delayed transmissions, and better voice quality.
Carrier-class QoS at all times	Voice quality and call reliability comparable to calls made over a PSTN.
Allows mix of voice and data traffic on IP network	Reduces overall cost of ownership—both voice and data can be transmitted using only one network.
Easily integrates with existing PBXs	Allows for easy PBX extensions, leveraging of existing investment.
Simpler than competing solutions	Reduces costs of implementation and maintenance.
Provides flexible, engineered solution	Reduces risk and effort for the customer.
Provides high capacity	Up to 4800 business subscribers or 7200 residential subscribers per access point.
Combines benefits of wireless networking and VoIP	Allows for both relatively easy and inexpensive network expansion and the cost savings associated with IP.
Products designed for large, mid-sized and small applications	Customers can select the right solution for their needs and budget.

A Record of Successful WVoIP Projects

With successful WVoIP networks deployed around the globe, including India, China, South Africa, and many other locations, our experienced engineering teams know what works—and what doesn't. When we encounter a problem, chances are good that we've seen it before and know what needs to be done to address it.

Providing Voice over IP to Areas Beyond the Reach of Cable—the Gujarat State Wide Area Network

EION Equipment is deployed by the Gujarat state government in western India to add wireless coverage to its new communications network. The Gujarat State Wide Area Network (GSWAN) is a new IP-based network designed to provide voice, video, and data communications to all administrative nodes in the state government, and to provide an efficient means for the citizens of Gujarat to access information about government services. The GSWAN was also integrated with another important state network: the Secretariat Integrated Communication Network (SICN). The converged system delivers data, video, and voice services on one IP network, making it more economical to maintain.

While there was a substantial reduction in operating costs associated with moving their telephony services to VoIP, the addition of wireless components based on EION's VIP 110-24 generated even more cost savings. Many important offices in the Gujurat government were located in remote areas that would have been expensive to reach by cable or copper wires. EION's wireless solution provided a cost-effective means of connecting these offices to the GSWAN, allowing them to use all of the advanced services that are provided on the regular wired parts of the network. EION's equipment was initially used to connect government offices within five kilometres of the State's district offices. A second order followed to add yet more government offices to the wireless network, as well as a hydroelectric project.

EION's Commitment to WVoIP

At EION, we've recognized the substantial opportunities WVoIP represents for both enterprises and service providers. We're committed to helping enterprises realize the cost savings achievable through wireless VoIP, and to helping service providers leverage this technology to expand their businesses quickly and inexpensively. We have the "end-to-end" engineered solutions for projects of every size—all of them based on our reliable, field-tested products. And we're committed to further development of excellent wireless voice over IP solutions. Enabling our customers to deliver voice, video and other advanced applications over wireless networks in cost effective ways is our core strength.

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