

APPLICATION NOTE

ST-0119 August 29, 2005

Product: ShoreTel system

System version: ShoreTel 6

Deploying Mobility using Wireless VoIP

Mobility brings organizations considerable improvements in employee productivity, customer satisfaction and cost savings. Wireless voice is emerging from a specialized, proprietary application used in vertical industries to become a productivity enabler in a wide variety of businesses and educational institutions. As voice becomes an application across your wireless LAN infrastructure, making the deployment successful means meeting the key challenges of wireless coverage, graceful scalability, quality of service, seamless roaming, and of course security.

Overview

More than two-thirds of IT telephony decision-makers cited mobility as the second most important new telephony application after conferencing, according to a ComputerWorld survey conducted in April 2005. It's no surprise, because mobility is a major driver for companies who are deploying wireless LANs (WLANs).

Once IT unleashes wireless LANs to enable mobile employees to stay constantly connected with laptops and PDAs, those same workers are quick to ask when they will be able to make and receive phone calls over the WLAN infrastructure. With wireless voice, employees can place and receive phone calls and hear pages no matter where they are—at their desks, in the hallways, in conference rooms or in the warehouse. Workers can use either a wireless IP phone or a soft phone on PDA or laptop for these calls. In addition, push-to-talk applications and paging can be run over the WLAN. This application note highlights some of the best practices in designing an IP telephony solution for mobility as well as unique considerations of running voice over a wireless LAN.

Business Benefits

Voice over IEEE 802.11 WLANs is becoming an increasingly mainstream application at enterprise companies and educational institutions. Proprietary wireless voice systems have long been used in warehouses, distribution facilities, retailers and healthcare organizations. Today, wireless voice is increasingly built using industry standards, namely using the Session Initiation Protocol (SIP) for call control over an 802.11 WLAN infrastructure.

Wireless voice can bring many benefits to an organization:

• Improve Employee Productivity. Wireless voice gives workers more flexibility. They don't miss calls when they are not at their desks because their phones are always with them. For instance, the adoption of a wireless voice system in a hospital can reduce the communications delay among clinicians, patients and support specialists. If a nurse needs to consult a physician, she typically has to go back to the nursing station to page the doctor, wait for a response and return to the patient with the answer.

- Improve Customer Satisfaction. Customers get answers faster when employees have wireless voice. For instance, in a customer service center, customers spend less time on hold because your employees stay connected even when they have to get up from their desks to find the answer to answer a customer's question.
- Achieve Cost Savings. When callers can reach their parties even when they're not at their desks also delivers cost savings. Your company doesn't foot the bill of returning missed calls. Wireless voice can also reduce operational costs associated with cell phones and private radio walkietalkie systems in the enterprise. And of course, wireless voice eliminates or reduces the need to wire buildings, which can be a significant cost savings in new deployments.
- Improve Safety. Wireless voice can be integral in improving the ability to

stay connected and in communication in remote locations. For example, with wireless voice, a school's faculty and staff are always in touch even when traveling across campus. And when location-based capabilities are available, their physical locations will always be known in emergencies.

Creating a Good Voice Environment

A WLAN infrastructure that is ready for the demands of voice must meet strict performance requirements. Voice was not usually the prime consideration when the WLAN was designed and deployed. In particular, network designers will want pay close attention to wireless coverage, network scalability, quality of service (QoS), and seamless roaming. Security is of course, a pre-requisite for any enterprise WLAN deployment. Requirements include:

 Sufficient RF Coverage. Deploying voice demands ubiquitous wireless coverage, so that roaming users don't hit "dead" spots without coverage as they turn corners or walk up and down the stairs while talking on their 802.11 phones. In contrast, many WLANs were designed to provide coverage where users sit and work – at their desks, in conference rooms and in common areas such as lobbies and lunchrooms.

Having a good understanding of the number of simultaneous users and the

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SH0RE Fax +1.408.331.3333 www.shoretel.com bandwidth requirements of their applications, including voice, is essential in the WLAN design phase. WLANs are a shared medium with bandwidth speeds ranging from 54Mbps with IEEE 802.11a or 802.11g to 11Mbps with IEEE 802.11b. Because of the shared medium, actual throughput is significantly slower than switched Ethernet at 10Mbps, 100Mbps or even 1Gbps.

Each WLAN must be designed to accommodate the unique characteristics of the environment. A WLAN is a radio frequency (RF) network, so a building's physical characteristics impact how the RF signals flow through the physical space. Building materials like sheetrock, steel and glass absorb the RF signals differently. Whether the facility has cubicles or offices impacts the WLAN design.

In a physical site survey, a network designer gathers the building's physical characteristics and assesses the RF coverage needs. Automated WLAN design tools are helpful to assess how many access points (APs) and wireless switches are needed to provide sufficient coverage and capacity.

• Scalability. The WLAN infrastructure must scale to handle the real-time demands of voice. 802.11 WLANs were originally designed to support data, not voice or video. 802.11 is modeled on 802.3 Ethernet, which allows stations to transmit on the network only when no other stations are transmitting. If two stations try to send data at the same time, the packets "collide" and one must wait a random amount of time before retransmitting. While this approach works well for data, it does not work well for latency-sensitive traffic like voice and video.

Increasing the WLAN capacity essentially deploying more APs and switches—is one approach to the problem. However, the more APs covering a particular area means the greater the possibility of co-channel interference, which can result in poor performance for both data and voice applications. In fact, early adopters of wireless voice often deployed separate infrastructures for voice and data traffic; however, doubling the acquisition cost and management overhead is simply impractical for enterprise deployment.

Scalability also means that the WLAN infrastructure should load balance traffic among APs to ensure that the user associates with the "best possible" AP. In 802.11, the client decides which AP to associate with based on the strongest signal; however, the client doesn't take into account the APs' existing traffic load. In reality, the AP with the strongest signal could be overloaded, and a poor voice quality could result. Plus,

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SHDRE Fax +1.408.331.3333 www.shoretel.com clients are "sticky," meaning that they tend to associate with the same AP they last associated with, so a bad connection once may mean a bad connection again.

The IEEE is working on a standard that allows the wireless IP phone to discover its neighboring APs and select the optimal AP for service. Prestandard solutions are available that provide this enterprise-grade scalability.

• Deliver Quality of Service. Quality of service (QoS) is required whether voice is running over a wired or wireless infrastructure. Guaranteeing voice the right of way over other applications can help minimize the packet loss, delay and jitter that cause poor voice quality, clicks and silent periods.

Because the 802.11 standard was developed without a way to distinguish voice and other delaysensitive traffic, the IEEE is developing the 802.11e standard to address QoS at Layer 2 for wireless networks. In the interim, the Wi-Fi Alliance released Wireless MultiMedia (WMM) as a subset of the capabilities in 802.11e. Vendors are bringing WMM implementations to market now.

WMM defines four priority levels to support different kinds of traffic, including voice, video, "best effort" for data, and background traffic. Enhancements to the 802.11 mediaaccess control (MAC) arbitrate access to the WLAN medium. These additions are backward compatible with existing 802.11 devices. Voice traffic destined for the network backbone can also be marked using DiffServ/Type-of-Service (ToS) or 802.11p bits so that voice priority is preserved across the network.

However, 802.11e or WMM may be just the first step for meeting enterprise requirements for voice. 802.11e or WMM doesn't provide QoS *per application*. If a user on a laptop is running a soft phone and checking email, the device receives the high priority assigned to it, not the voice application. As wireless usage grows, systems will be likely be enhanced for improved QoS solutions.

 Allow Seamless Roaming. In the enterprise, AP densities are high, which means that roaming can occur every few seconds at normal walking speeds. As users roam from AP to AP and across subnets, the underlying WLAN infrastructure must "hand off" these users quickly enough that their voice connections don't drop. The necessary re-association and reauthentication to the APs plus the necessary wireless encryption for airtight security also contribute delay.

Associating and de-associating with an AP may take from 150 ms to 500

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SHDRE Fax +1.408.331.3333 www.shoretel.com ms. VoIP performs optimally with less than 50 ms of delay, otherwise callers will hear noise and degraded voice quality. And VoIP calls drop when delays approach 150 ms.

Standards are under development to address the client-side issues. The IEEE 802.11i security standard will allow for users to be preauthenticated to neighboring APs before roaming, which will reduce overall roaming time. Some vendors include pre-standard version of this fast roaming capability in their WLAN solutions today.

• Ensure Airtight Security. Security continues to be a top concern of enterprises deploying WLANs, whether for data or voice.

Effective security is predicated on knowing who the users are. IEEE 802.1X authentication should be used whenever possible to verify a user's identity to the network. While 802.1X was originally developed for network access control for wired networks, many organizations are beginning to adopt it for their wired networks as well. Laptops and handhelds can support 802.1X authentication; however, less compute-powerful devices such as wireless IP phones may need less processor-intense authentication methods, such as by MAC address or username and password.

Insist on an Enterprise Solution

When deploying wireless voice to your organization, consider a total solution architected that will deliver the voice quality and reliability that your business needs.

ShoreTel has teamed with Meru Networks and Hitachi to create a complete solution for wireless voice.

ShoreTel 6 includes native support for SIP, including SIP trunking, SIP carriers and SIP devices. Native support for SIP is built around ShoreTel's voice switch services. With ShoreTel 6, you gain the benefits of SIP while retaining the considerable advantages of ShoreTel's distributed architecture, including 99.999 percent reliability and easy management. ShoreTel has made SIP easy to deploy and manage.

Selecting SIP Handsets

When selecting voice handsets, consider who will use the devices and how. A solution for a warehouse may require a more rugged IP voice handset with buttons easily manipulated by large fingers. A solution for a healthcare organization may require a sleeker, more compact solution because it will be viewed by customers.

With SIP support native in ShoreTel 6, your organization can use virtually any SIP handset. However, because the SIP standard is emerging, ShoreTel thoroughly tests SIP

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SH0RE Fax +1.408.331.3333 www.shoretel.com handsets to verify that they will work reliably and smoothly with the ShoreTel system before recommending these handsets to customers.

The Hitachi WirelessIP5000 is the first wireless IP phone certified to work with ShoreTel. The WirelessIP5000 is a lightweight, compact 801.11b phone that drops right into workers' pockets to go anywhere with them.

For more information on the Hitachi phone, see:

http://www.abptech.com/mainpages/produc ts/HCL-WirelessIP5000.html

Selecting the Wireless Infrastructure

All WLANs are not equal. A WLAN suitable for a home or small office is not up to the considerable demands of wireless voice in an organization. Be sure to select an enterprise-quality WLAN designed to meet the needs of voice.

ShoreTel recommends the Wireless LAN System from Meru Networks. The Meru WLAN System has an innovative architecture designed to seamlessly handle voice and data on the same wireless infrastructure. Meru's WLAN System provides the service quality, scalability and usability required for wireless VoIP implementations.

Meru optimizes the wireless infrastructure to provide a constant maximum throughput from each AP. Its Air Traffic Control (ATC) technology manages contention and exerts more control over client access than other WLAN products. With Meru, a single AP can effectively handle more than 100 active clients while maintaining maximum throughput.



Meru's ATC provides upstream and downstream over-the-air QoS, which makes reliable voice calls and real-time applications possible. ATC determines on a per flow basis whether a station is sending a voice or data packet, and then assigns the appropriate QoS on the fly. Meru's WLAN System can achieve 30 voice calls on a single AP with 802.11b—levels that are unheard of with most WLAN systems.

ATC uses a near-deterministic channel access methodology to solve the contention issues. When a voice call is being transmitted, no other stations can transmit. Voice signals can be compressed, transmitted or reconstructed, providing a low latency and jitter equivalent to toll-quality landlines. The solution is entirely standardsbased and works with any 802.11 client or

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SHORE Fax +1.408.331.3333 www.shoretel.com phone without requiring any client software. The ATC QoS method is also compatible with 802.11e.

Meru's Virtual Cell technology resolves fast roaming and handoff issues by enabling all APs to operate on a single channel. Because clients "see" individual Meru APs as a single AP, there's no delay in handoffs. At the same time, the traffic load is dynamically balanced across APs, so if a single AP is overloaded, traffic will be passed to a less loaded AP to ensure that voice communication continues uninterrupted.

Meru's Virtual Cell technology enables true pervasive coverage and lower deployment costs because there is no need to perform a full-blown RF site survey or reconfigure AP channels to eliminate co-channel interference in a pervasive network.

Preparing for the Future

As mobility becomes pervasive in the enterprise, employees will want to do far more than use their laptops in conference rooms. In the same way employees on the road were quick to take Wi-Fi hotspots in their hotel rooms and airports for granted, users will expect their key business tools to be available over the wireless, with voice being their most critical tool – hands down. With ShoreTel, Hitachi and Meru Networks, you'll be ready to meet those business needs.

Resources

Meru Networks www.merunetworks.com

Hitachi IP Phone

http://www.abptech.com/mainpages/produc ts/HCL-WirelessIP5000.html

ShoreTel 960 Stewart Drive Sunnyvale, CA 94085 USA Phone +1.408.331.3300 +1.877.80SHDRE Fax +1.408.331.3333 www.shoretel.com