The Evolution of Voice over IP over Wireless LAN in the Enterprise

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900 East Hamilton Avenue • Suite 230 • San Jose • California • 95008 • **t** 408.583.0011 • **f** 408.583.0031

www.infonetics.com • Silicon Valley, **CA** • Boston, **MA** • London, **UK**

Table of Contents

I. Introduction.....1

II. Evolution of the VoWLAN Market.....2

III. Enterprise Class VoWLAN Solutions.....5

IV. Summary and Conclusion.....14

List of Exhibits

Exhibit I	Deploying Voice over IP on Wireless LAN	3
Exhibit II	Important Factors in Evaluating Voice over Wireless LAN	6
Exhibit III	Barriers to Deploying VoIP on the Wireless LAN	8
Exhibit IV	Challenges of Calculating Capacity and Managing Wireless LAN Bandwidth	10
Exhibit V	Important Management Tool Features	12

I. Introduction

The wireless LAN (or WiFi) market is growing fast. According to Infonetics Research's *Wireless LAN Equipment* quarterly worldwide market share and forecast service, worldwide enterprise WLAN equipment revenue hit $1.3B in CY06 up 16% from CY05. We forecast revenue to rise 27% to $1.7B by CY07 and to hit $2.4B in CY09, as end-user organizations across all verticals adopt enterprise-class wireless LAN equipment and leverage the benefits of mobility for data networking.

At the same time, enterprises are adopting voice over IP (VoIP). In Infonetics' *Enterprise Telephony* quarterly worldwide market share and forecast service, the IP PBX market is forecast to grow from 10M lines in CY05 to almost 26 million lines by CY09.

The enterprise telephony market is undergoing a major technology transition, from circuit-based switching to packet switching, similar to what is happening in the service provider realm. It is occurring because organizations have built extensive data networks that have the potential to be used for telephony applications, thereby eliminating the need for running separate voice and data networks.

Voice over IP is a significant application driver for wireless LAN adoption, as voice capability cements the case for wireless networking. The reverse is also true, because voice becomes a more powerful tool when enabled across a wireless platform. There is no doubt that the two technologies are converging toward a powerful wireless voice solution for the enterprise, and user organizations are beginning to understand that they need a harmonious deployment of both to leverage the full benefits of each. There is a symbiosis between wireless LANs and VoIP, and together they form a cornerstone of the next generation of enterprise networking.

The ability to carry voice calls on corporate wireless LANs has appeal for employees that require a high degree of mobility, for example in a manufacturing or health services setting. Often, those mobility needs are currently met via cell phones. By offloading calls onto corporate wireless

networks using WiFi phones, organizations not only can save on the cost of cellular calls, but since they are being served by the corporate IP-PBX, they can take advantage of PBX features.

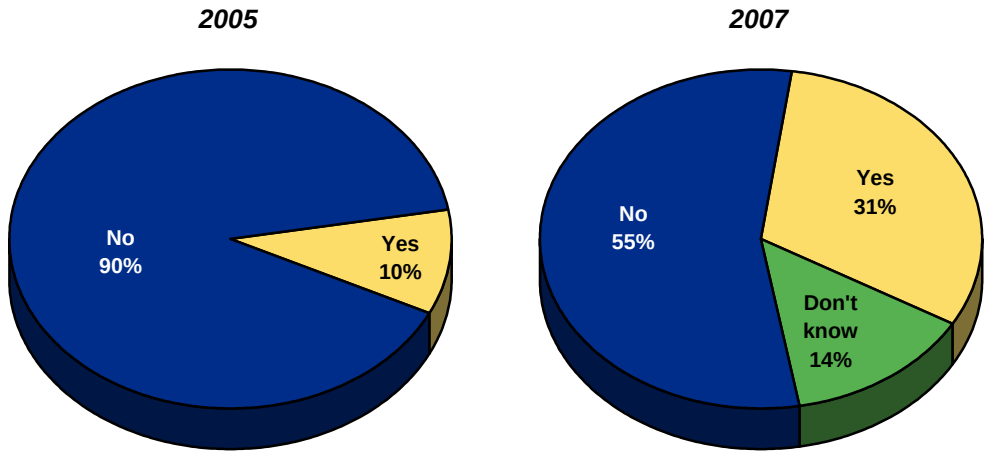
In the 2005 edition of *User Plans for Wireless LANs: North America*, Infonetics' annual survey of 240 small, medium, and large organizations that have deployed wireless LANs, we found that 31% of respondents expect to be using VoIP over their wireless network by the end of 2007, up from 10% in 2005. In addition, vendors such as Cisco, Vocera, NEC, Motorola, Spectralink, and others have already launched WiFi enabled IP voice handsets, which will also drive the adoption curve for wireless VoIP, and in *WiFi Phones* biannual worldwide market share and forecast service, Infonetics predicts that worldwide shipments of WiFi phones will grow 182% from about 388,000 in CY05 to over 1 million by the end of CY06, and almost 33 million by CY09, as enterprises and consumer steadily continue to deploy VoIP over WLAN.

II. Evolution of the VoWLAN Market

Voice calling over WiFi (or VoWLAN) has the potential to have a significant impact in the enterprise market. Rather than displace huge amounts of cellular-carrier revenue, it seems it will be an adjunct to cellular used mostly for employee-to-employee voice calls and intra-organization calls. The ability to use multiple IP applications over wireless LANs and WiFi hotspots with an IP phone handset is going to drive WiFi phone growth as much as will the lower cost of VoIP. For instance, a wireless VoIP phone could be used to make calls and to send e-mail, or to send e-mail with a voice message as an attachment, which could be appealing options for employee communications.

In *User Plans for Wireless LANs: North America 2005*, deploying VoIP over the wireless LAN triples from only 10% doing it now to 31% in 2007, and could be as high as 45%. (see Exhibit I). The growing availability of IP voice-capable handsets and PDAs, combined with the belief that the infrastructure is ready or very close to it, makes this market a promising one, gearing up for significant growth.

Exhibit I **Deploying Voice over IP on Wireless LAN**



Source: User Plans for Wireless LANs: North America 2005 *(Infonetics Research)*

There is growth across all vertical sectors in adoption of VoIP over the wireless LAN; at the time of the study, respondents from the education and finance sectors had not adopted VoWLAN, but were showing interest, while government and healthcare respondents were underway; however, the most interest came from the retail vertical.

Infonetics' recent survey of user organizations deploying VoIP *(User Plans for VoIP: North America 2006)* is based on 240 interviews with small, medium, and large organizations in North America. It indicates that only 5% of respondents have already deployed IP voice on a wireless LAN, rising to 20% overall by 2008, suggesting that the major ramp up in adoption will be a long-term trend. However, it may also indicate that the majority of respondents lack confidence in the currently available range of solutions that support voice over wireless LAN.

Adding to this adoption trend is the fact that cellular providers, particularly in Europe, are preparing to offer dual-mode WiFi/cellular services, meaning that

VoWLAN calling will be increasingly prevalent, as wireless voice calls will be possible in places where cellular signals cannot reach. Cellular carriers are in the process of spending billions of dollars upgrading their networks for high speed 3G services, but 3G bandwidth can't compare with wireless LAN speeds of up to 54M and higher. The ability to use both wireless technologies on a single device with a single number is likely to have widespread appeal, as it allows user organizations to take advantage of VoWLAN to offset wireless voice calls onto the IP network on-campus with the availability of 3G off-campus.

Although this potentially undermines call revenue for carriers, several, including TeliaSonera in Scandinavia, Telecom Italia in Italy, Orange in France, and T-Mobile in the U.S., have announced plans for dual-mode services. Infonetics forecasts shipments of 29.3 million dual-mode WiFi/cellular handsets worldwide by 2009, with 35% of those being in EMEA and 46% in Asia Pacific, indicating that dual-mode services will be a global trend.

The most difficult portion of such dual-mode networking is the handoff between the WiFi and cellular networks, and mobile carriers will need to deploy systems with traditional authentication features combined with advanced security features to protect the cellular network from the perceived security threats of the IP network. These challenges are being addressed by UMA and IMS technologies, so dual-mode is likely to achieve an increasingly stable technology footing.

Additionally, several cellular handset vendors such as Motorola and NEC have launched enterprise-class, dual-mode WiFi/cellular handsets, designed to appeal to corporate users, which will also drive enterprise adoption of dual-mode services and VoWLAN. Single-mode wireless VoIP/Skype phones from Linksys, D-Link, and NETGEAR will also have an impact—most likely in the SMB segment—despite being consumer-focused products.

VoWLAN is definitely arriving, with strong drivers for all regions, but it brings with it several challenges that must be met for it to be a truly enterprise-class application.

III. Enterprise Class VoWLAN Solutions

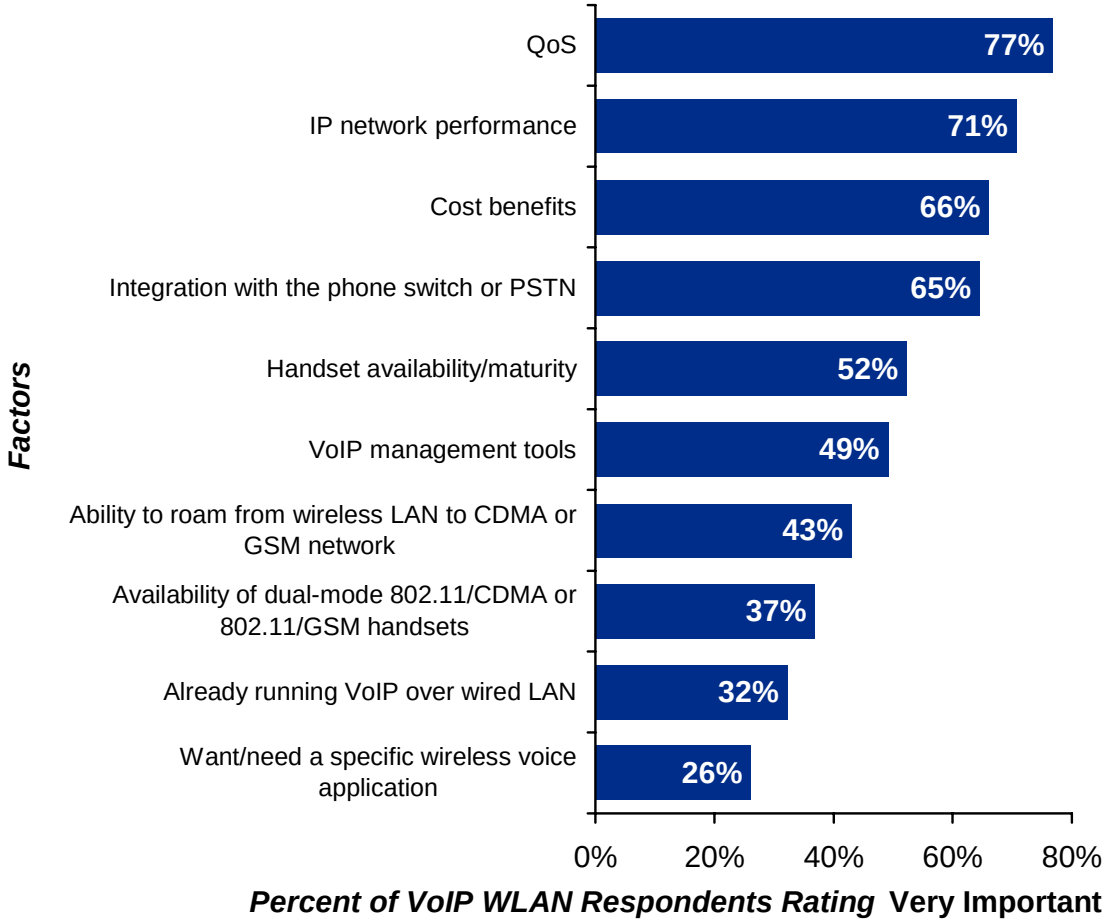
The requirements for IP voice traffic, such as roaming and low latency / jitter / delay, present a challenge to WiFi networks, and a number of infrastructure vendors are developing access points that can deliver QoS for VoWLAN. Voice applications demand highly predictable networks and any number of issues can lead to poor call quality for end-users.

Performance is a critical factor when respondents evaluate the deployment of voice over the wireless LAN. In *User Plans for Wireless LANs: North America 2004*, 77% of respondents rate QoS *very important* as a factor in evaluating whether to run VoWLAN, and 71% similarly rate IP network performance. (See Exhibit II below). This is a two-way concern: voice quality must be good, but voice traffic must not degrade the network's performance.

In addition, 49% rate VoIP management tools *very important*. That is, half of all enterprises considering deployment of VoWLAN are concerned that the management tools are not available. This indicates a real need for tools that give IT managers clear visibility into the minute-by-minute flow of traffic over their wireless networks, and to identify and troubleshoot faults.

However, performance analysis of the network must not come at the cost of the actual performance of the network. Those few tools that have been available for performance analysis of the wireless network, have required network encryption to be turned off while analysis is undertaken. So, while analysis of the network takes place—which may include troubleshooting a fault—the network is vulnerable to security threats and yet more performance issues. User organizations need tools that can do the performance analysis with traffic encryption still enabled, without compromising security, such as AirMagnet's VoFi Analyzer solution.

Exhibit II Important Factors in Evaluating Voice over Wireless LAN



Source: User Plans for Wireless LANs: North America 2004 *(Infonetics Research)*

Security aspects aside, it is arguable that any network performance measurements or fault diagnoses that are done while traffic encryption is off, will not give a true

depiction of how the network really performs, because is encryption itself can affect network performance.

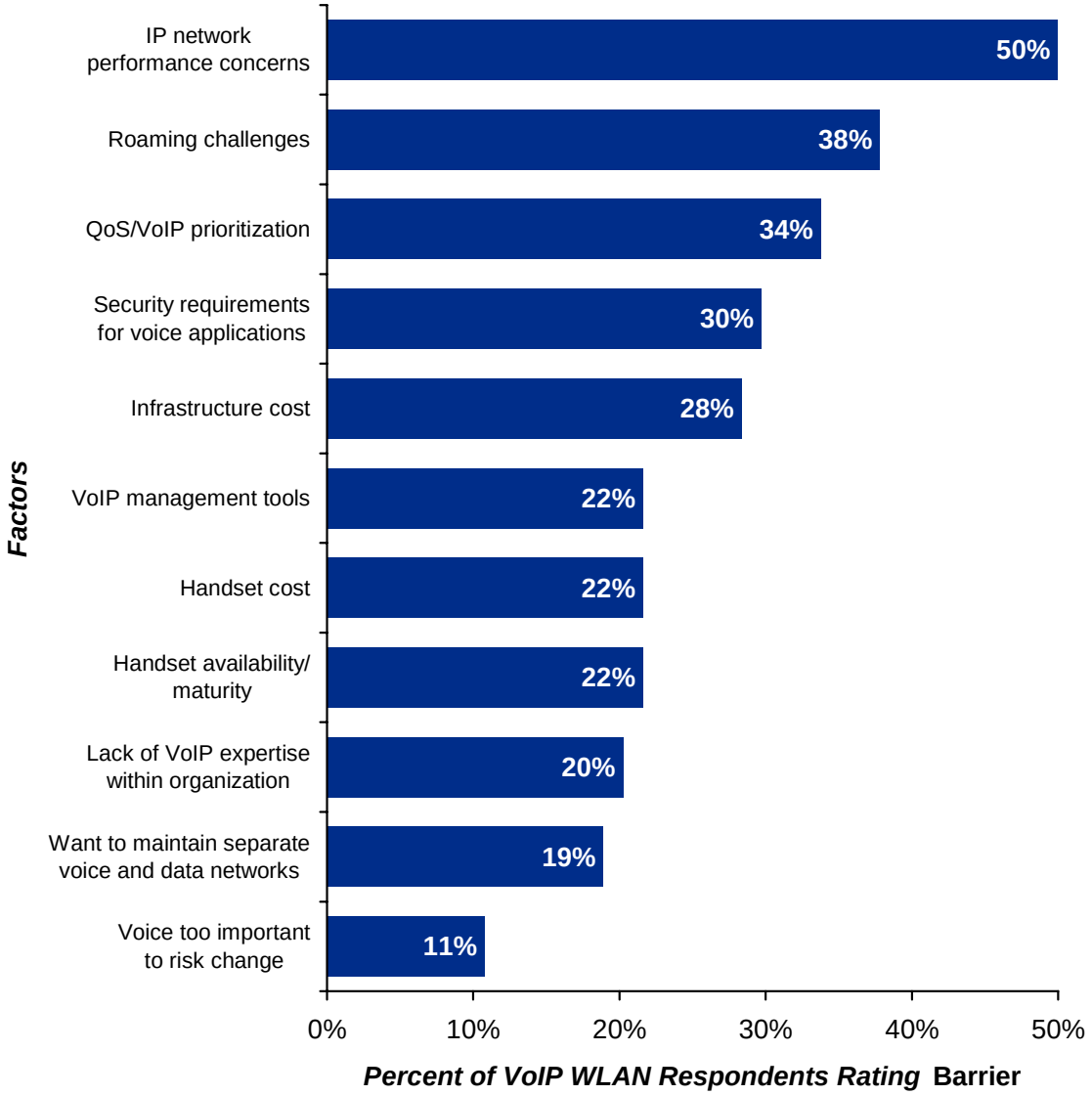
All verticals will find benefits of running wireless VoIP, but some will be more reluctant than others to trust a crucial and real-time application such as voice to the wireless network. Currently available WLAN hardware and software solutions do not necessarily offer sufficient support for QoS and roaming, both of which are fundamental to the acceptance of VoWLAN. There is clearly still a need for solutions that build confidence in the ability of wireless LANs to support voice, without undermining a carefully considered wireless network security perimeter, in order to convince hesitant organizations that VoWLAN can be a robust and reliable application ready for primetime, enterprise-wide deployment.

Though it may be a little premature to talk about widespread fixed-mobile convergence in the enterprise, there are certainly signs that many user organizations are keen to converge their networks, blurring the distinction between wired and wireless LANs, and between voice and data networks. This next generation of enterprise networking has potentially numerous benefits for the user organization, but also requires a shift in thinking for the IT manager.

Locating wireless users is a problematic and possibly disconcerting aspect of the next-generation enterprise network for IT managers, who may have learned their trade in a more traditional wired LAN environment. In the port-centric wired LAN world it is possible to look at the network and see who is where and what they are doing. The edge of a wireless LAN is far less distinct, and it changes dynamically. Adding wireless data to the network is one thing, but once an organization wants to deploy wireless VoIP, with all its performance requirements, the IT manager quite rightly should have concerns.

In *User Plans for Wireless LANs: North America 2005,* we asked respondents whether they consider various factors to be barriers to their deployment of VoIP over the wireless LAN. Exhibit III details the responses. Concerns about the performance of IP networks top the list.

Exhibit III **Barriers to Deploying VoIP on the Wireless LAN**



Source: User Plans for Wireless LANs: North America 2005 *(Infonetics Research)*

Roaming challenges are a barrier to 38% of respondents. Roaming is less than perfect in the cellular world, which is 15 years ahead of VoIP, so such concerns are understandable. QoS/VoIP prioritization is a potential barrier to a third of

respondents. Unlike data, voice calls can't be put together again without noticeable loss. If the network drops the call, the impact on the application—and therefore the business—is instantaneous.

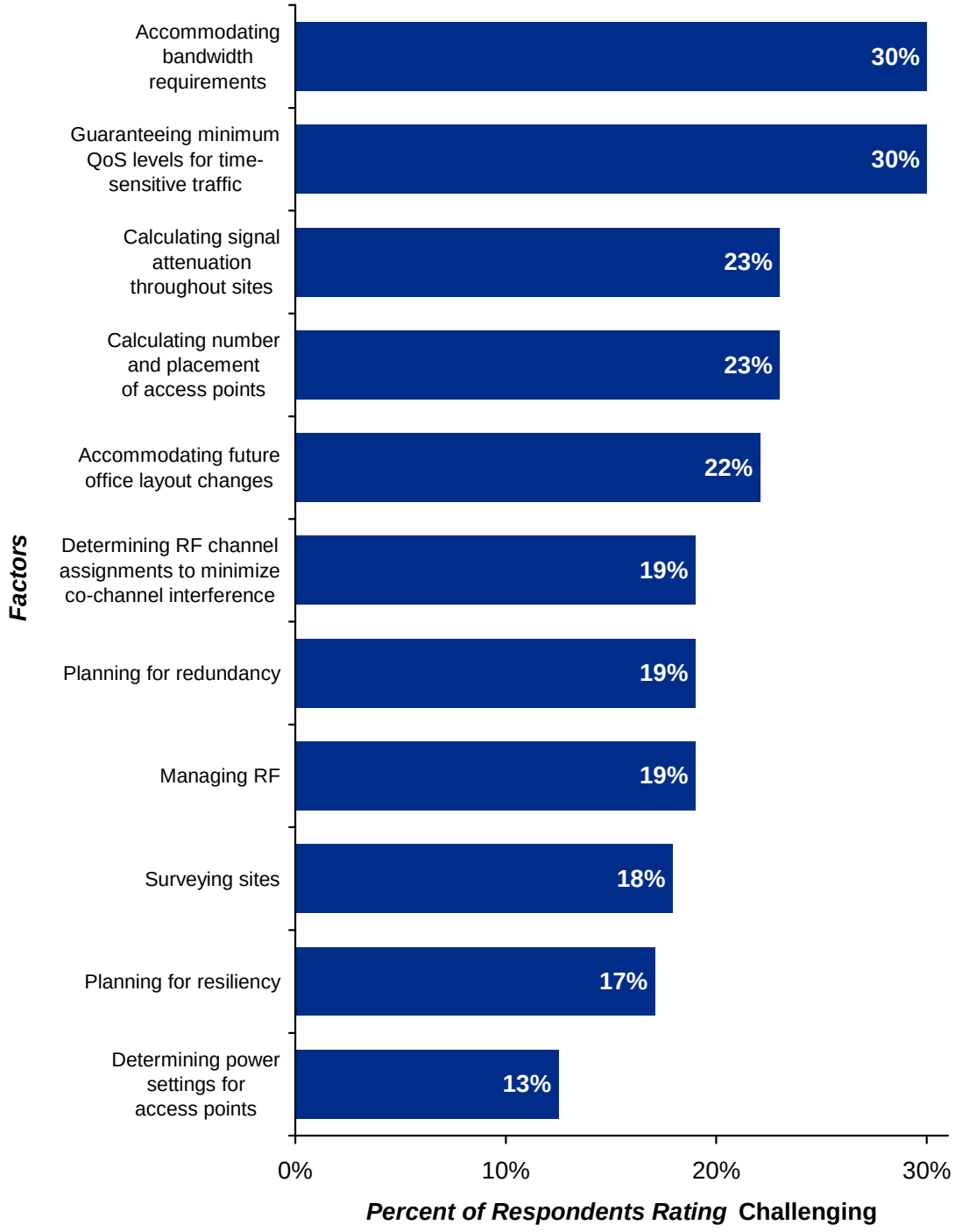
Twenty percent of respondents consider the lack of VoIP expertise within their organization to be a barrier, suggesting an anxiety regarding how to fix voice calls if they break. This lack of specific expertise in VoIP can be significantly reduced or overcome by network management tools that give a clear insight into the performance of voice applications over the wireless LAN.

Thirty percent of respondents consider security for voice applications to be a barrier. Organizations are hard pushed to keep unauthorized users from accessing their wireless networks, so the curse of the malicious or inadvertent network user abusing the wireless network needs to be removed before VoIP can be an efficient application for enterprises.

The survey also asked respondents to rate how challenging various factors are in planning capacity and managing bandwidth over the wireless LAN. Their responses are shown in Exhibit IV. IT managers likely have not yet really grappled with some of these problems, but as they scale up their wireless networks and numbers of users, and the range of applications flowing over the wireless LAN increases, they will undoubtedly uncover the need to monitor and analyze the performance of their VoWLAN applications in detail. Many users make do with standard management tools cobbled together with the tools that come with their wireless infrastructure products, but these will not provide sufficient insight into performance as their wireless networks grow in complexity.

Exhibit IV

Challenges of Calculating Capacity and Managing Wireless LAN Bandwidth

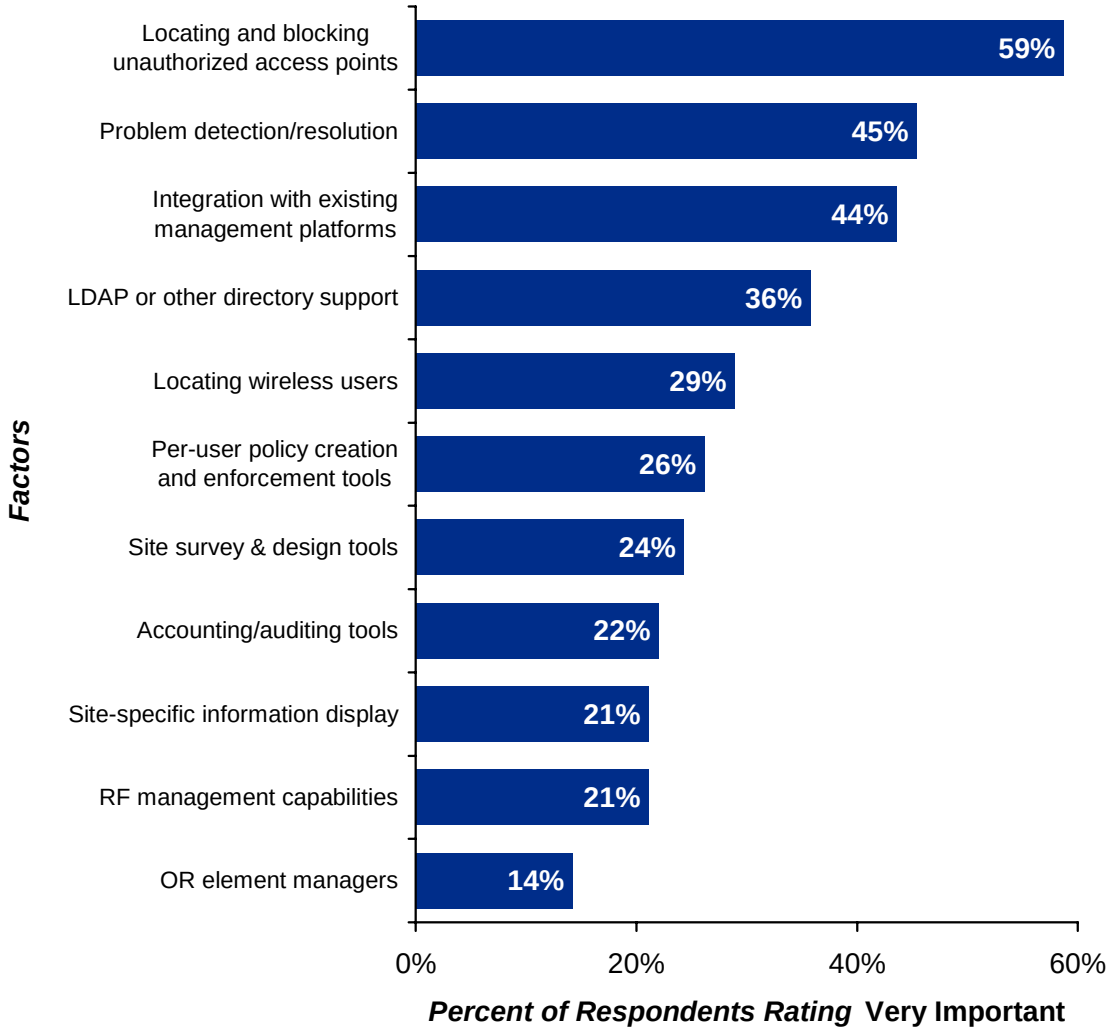


Source: User Plans for Wireless LANs: North America 2005 *(Infonetics Research)*

User organizations are gradually gaining experience in the challenges of planning capacity and managing bandwidth over the wireless LAN and how to get more wireless network efficiency. With access points being relatively cheap, they may regard most capacity problems as solvable by adding hardware. Since some respondents are still deploying their wireless LAN in an unplanned, organic methodology, and haven't begun to monitor and analyze the performance of their wireless network—and the applications flowing across it—in detail. When they do, they may uncover unforeseen problems. For example, 30% of respondents rate the need to guarantee minimum QoS levels for time-sensitive traffic *challenging* in planning capacity and managing bandwidth, but this percentage of respondents is likely to grow significantly once more of them begin deploying VoWLAN. This drives the need for solutions that not only can troubleshoot voice call problems, but deliver detailed reports so that the fault can be addressed in future planning and management of the network.

In the same study, we asked survey respondents to rate the importance of various product features in the decision to purchase management tools for the wireless LAN. The results are shown in Exhibit V below.

Exhibit V **Important Management Tool Features**



Source: User Plans for Wireless LANs: North America 2005 *(Infonetics Research)*

IT managers, as yet unfamiliar with the intricacies of wireless LANs and VoIP, need tools to monitor call quality in real-time and automatically diagnose the underlying issues leading to voice problems. As shown on the chart above, problem detection is a key requirement for IT managers, highlighting the need to be able to investigate a specific call. For VoWLAN, this means being able to

clearly see which wireless devices are competing for access point resources, and how voice vs. data traffic breaks down over the network.

IT managers would also benefit from access to dynamic visual information that correlates traffic flow with the performance of the network, and gives insight into any call by cross-referencing call metrics such as packet jitter, CRC errors, fragmentation, active call count, and data utilization. The ability to view call performance right down at the phone level and locate and diagnose problems such as interference from other sources will be vital to enable swift repair. Only with such tools will IT managers feel confident in being able to resolve call issues, and maintain quality voice applications.

With VoIP regulations changing, at least in the U.S., IT managers need a VoWLAN solution that includes a built-in reporting module, allowing them to document their troubleshooting sessions with trending reports, channel reports of voice vs. data, roaming reports, device and alarm reports and so on. This could serve as a valuable record of previous network issues and form the basis of future network planning for more efficient voice call support, and also an archive, enabling IT managers to verify the mandatory network compliance they are required by law to do.

As the next generation enterprise network, combining wired and wireless, voice and data, takes shape, IT managers need network management tools that can simultaneously monitor both the wireless and wired sides of a call and gather additional call-specific information. This would allow IT managers to view pertinent information about the call such as the phone number, end user details, call drop reasons, and correlated wired and wireless call quality scores. They would then have the option to view packet level details for their wireless traffic, including the ability to customize device and network-level packet filters, crucial for maintaining prioritization of, and QoS for, voice traffic, shown to be a key challenge for user organizations (see Exhibit IV above).

Infonetics' survey highlighted that, in addition to performance concerns, users have security concerns they want their wireless network management tool to address. Uppermost of these was locating and blocking unauthorized access points, which was rated highly by 59% of respondents. User organizations know they need to purge rogue access points, but they are less sure about how to go

about it. It is difficult even to distinguish malicious rogue access points from the accidental, perhaps merely the result of thin walls between one company and another, but the impact of unauthorized access points on voice traffic could be severely detrimental. Infonetics' survey data shows that IT managers are conscious of the need for real visibility into their wireless network; without it, they cannot make effective decisions regarding who, or what, is connected to their network and how best to support genuine users.

The challenges of VoIP and the limitations of wireless LANs require network management tools that enable more accurate monitoring of wireless network performance, giving phone-level visibility into call-related issues, while maintaining traffic encryption and fundamental security. If these user organizations' concerns can be addressed, and control of VoWLAN performance is put back in the hands of the IT manager, user organizations can transition to the next generation of converged enterprise network with confidence.

IV. Summary and Conclusion

- Adoption of both wireless LAN and voice over IP by user organizations is inevitably driving penetration of VoIP over WLAN (VoWLAN)
- VoWLAN brings challenges in terms of network performance monitoring and wireless network security; voice applications demand highly predictable networks and any number of issues can lead to poor call quality for end-users
- Concern about the performance of IP networks was the highest-rated barrier to adoption of VoIP, according to a report by Infonetics Research. Roaming support, QoS prioritization and security concerns are other high-rated barriers to deployment
- Though users understand the need to monitor and analyze the performance of their VoWLAN application in detail, many users make do with standard management tools cobbled together with the tools that come with their wireless infrastructure products

- Most management tools currently available are not sufficiently accurate in terms of performance monitoring and fault location; also, the ability to undertake these tasks without having to turn off traffic encryption is another important requirement of such tools, ensuring that network monitoring does not compromise network security

- IT managers want tools to monitor call quality in real-time and automatically diagnose the underlying issues leading to voice problems, and there is a need to be able to investigate call issues at the device level, on a call-by-call basis

- User organizations need tools that provide deep insight into any call by graphically correlating dozens of critical call metrics, giving user organizations an immediate visual representation of the network, and enabling swift fault diagnosis

- A built-in reporting module would prove to be a key tool, not only allowing IT managers to document their troubleshooting sessions with trending reports, but as a means of verifying mandatory VoIP network compliance, an obligation of all user organizations following recent regulatory legislation.

- To prevent further call issues, it is important that a VoWLAN analysis tool has the ability to monitor network performance while traffic remains encrypted, and also includes wireless attack identification, security vulnerabilities and events detection and built-in authentication support

About Infonetics

Infonetics Research (www.infonetics.com) is the premier international market research and consulting firm specializing in data networking and telecom. We provide a complete view of the market through constant interaction with equipment manufacturers, service providers, end-users, chip and component manufacturers, sales channels, and the financial community. We offer quarterly market share and forecasting, end-user survey research, service provider survey research, and service provider capex analysis. We are respected in the industry for our objectivity, accuracy, and ability to deliver on time all the time.

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Contact Information

US Headquarters
900 East Hamilton Ave #230
Campbell, CA 95008
United States
t +1 408.583.0011
f +1 408. 583.0031

Boston Metro Office
3 Baldwin Green Common #307
Woburn, MA 01801
United States
t +1 781.933.9649
f +1 781.933.9659

London Office
P.O. Box 629
Bromley, Kent BR1 4WB
United Kingdom
t +44 (0) 20.8290.1954
f +44 (0) 20.8290.1954

Sales

Larry Howard, Vice President
larry@infonetics.com
t +1 408.583.3335
f +1 408. 583.0031