

Does DECT have a future in the Wi-Fi world – and does it matter to the customer?

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By: Erik Stridbaek, Technical Director – KIRK Telecom A/S and Jonathan Ordman, Director – Wavelink Communications Pty Ltd

Introduction

The DECT versus VoWLAN debate currently raging within the telecommunications industry has generated a level of hype that is typical of the process many new technologies go through as they enter the market. The arguments centre around whether the dominant wireless telephony system – Digital Enhanced Cordless Telecommunications (DECT), will die an instant death once the Voice over Wireless LAN (VoWLAN), becomes widely available.

As a global supplier of wireless communication solutions, Danish company KIRK telecom, has followed the debate with interest, with a view that the latest technology does not always automatically, supersede the old. While KIRK telecom is currently one of the leading providers of DECT technology, the company also has a number of new VoWLAN products in its development pipeline. But before leaping onto the VoWLAN bandwagon, they are carefully evaluating the benefits and drawbacks of both systems – with the most important set of performance requirements in mind, those of the user.

Background

Along with workplaces such as factories, warehouses, schools and hospitals, there are a growing number of traditionally office-based working environments that require flexible, mobile IT and telecommunications networks. It is currently estimated that as many as 80% of workers across all industries are potentially mobile around their workplace and may require access to wireless voice communications. The implementation of wireless Local Area Networks (WLANs) to transfer data has lead some vendors to eagerly promote the idea of adding Internet Protocol (IP)-enabled wireless handsets to the data network. The persuasive argument that this is a simple, inexpensive and reliable method of delivering VoWLAN, has lead to declarations that DECT systems, traditionally used for wireless Private Automatic Branch Exchange (PABX), will not survive in the medium term. Despite these predictions, the consensus of panellists at the Wi-Fi VoIP Futures Summit at the VON trade show held in Boston in September 2003 was that *“there are a number of*

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challenges that must be met before voice over Wi-Fi goes mainstream... VoWLAN won't see widespread adoption until certain technical hurdles are addressed.”¹

What are the customer requirements?

Before getting into the more detailed requirements of a VoWLAN system, it is important to establish the reasons a business would need a converged network. The main attraction of a VoWLAN system is that it offers a single infrastructure for supporting wireless telephony and data, potentially providing a substantial return on investment by reducing hardware costs as well as longer-term operational, maintenance and support costs.

If the cost benefits of VoWLAN make it an attractive alternative to DECT, it is essential to summarise the minimum requirements that users generally demand for their wireless voice communications networks:

- **Quality** – wireless voice quality (QoS) needs to meet the same quality standards as traditional fixed line – echo-free, without speech flow interruption, distortion-free, without call drop-out and one-way speech.
- **Security** – a secure network that prevents eavesdropping, user impersonation and with encryption of calls considered essential.
- **Capacity** – how many phone users need access and do they need it simultaneously?
- **Interoperability** – the ability of software and hardware on multiple machines, from multiple vendors, to communicate with each other, ensuring users are not locked into costly propriety systems.
- **Coverage** – what range of distance needs to be covered? Is wireless telephone coverage needed indoors, outdoors or in areas not covered by the WLAN?
- **Handset performance** – Does the handset need to be physically robust? How do the handsets of both systems compare regarding battery life and voice quality?

While the order of priority for some of these requirements may change – capacity and coverage, for instance, quality is predominantly the overriding priority, particularly for external calls to customers and in critical applications such as healthcare.

Interoperability and the development of 802.11 standards

Unlike DECT, which is a mature technology that has gone through the complete standardization process addressing issues such as interoperability and

security, the 802.11 standard is still evolving. The 802.11 standard refers to a family of specifications developed by the Institute of Electrical and Electronics Engineers (IEEE) for wireless LAN technology. There are 13 different 802.11 standards currently in use, or in the process of being ratified. Despite the variety of standards, every 802.11 specification has been designed primarily for data, not voice.

Standard	Layer	Description
802.11a	PHY	54 Mb/s in 5 GHz band
802.11b	PHY	11Mb/s direct sequence in 2.4 GHz band
802.11c	MAC	Bridging operation
802.11d	PHY	International domains
802.11e	MAC	Quality of Service (QoS)
802.11f	MAC & PHY	Access point interoperability
802.11g	PHY	54 Mb/s at 2.4 GHz (802.11b compatible)
802.11h	MAC & PHY	Coordination with European HiperLAN2 standards
802.11i	MAC	Security
802.11j	MAC & PHY	Additional Japanese bands at 4.9 and 5 GHz
802.11k	MAC & PHY	Radio resource measurement enhancements
802.11m	MAC & PHY	Maintenance of earlier standards
802.11n	MAC & PHY	High throughput (>100 Mb/s)

Table1. 802.11 Standards Summary

Each of these standards (see Table 1) addresses different aspects of the WLAN operation, such as bridging, capacity and increased security. However, not all wireless products operate across every 802.11 standard – in fact, it is fairly common for different manufacturers to produce products that comply with only some of the standards within the 802.11 family, severely limiting product options for users. Standards 802.11b and 802.11g are considered “Wi-Fi certified”, but the term “Wi-Fi” is now generally used to refer to any 802.11 network. 802.11b and 802.11g do not support features such as security, QoS and call handover between access

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points, resulting in VoWLAN vendors either leaving out these features or developing their own proprietary solutions, which may not be interoperable with other vendors’ equipment. Neither 802.11b nor 802.11g are interoperable with 802.11a – again, severely limiting the choice of Wi-Fi products for users. The February 2004 issue of Computer World stated: *“Proprietary systems are plaguing the market on two levels: on vendor specific implementations of VoIP and the VoIP signalling protocols. These protocols would require end users to match their PBX with the Wi-Fi telephony system that they have selected”*² The Chief Operating Officer of Softjoy Labs agrees, noting that *“Current offerings are either proprietary or single vendor offerings. It’s exceedingly difficult to implement multi-vendor wireless voice. Any VoIP phone must work with any provider.”*⁴

DECT however, is an open standard, developed specifically for voice that is now being used in over 110 countries. The DECT Generic Access Profile (GAP) standard ensures operability between different vendors’ equipment. DECT is also the only member of the IMT-2000 standard for third generation (3G) wireless communications approved by the International Telecommunications Union (ITU) for uncoordinated use on an unlicensed spectrum.

Quality – the critical factor

Because the 802.11 networks were designed to carry data, not voice, 802.11b and 802.11g have no built-in mechanisms that tell the network to prioritise voice packets over data, a surge in network traffic may therefore disrupt voice calls, which in many cases, is not only an inconvenience, but a serious threat to customer service and business operations. In industries such as hospitality and retail, lost or interrupted calls can mean lost revenue. Typically, 99% availability is considered acceptable by LAN designers for data packets. Voice network engineers work on the basis of 99.999% availability. The difference may not seem significant, but while a half-second network dropout every minute will go largely un-noticed by PC users – such a delay will be obvious on the phone.³ The highly anticipated 802.11e standard, due to be ratified by mid 2005 aims to address the QoS issue by setting priority levels for data and voice users. With 802.11e, an access point will be able to give voice calls priority lessening the chances of dropouts, which has proved a major problem with VoWLAN systems. However, there are WLAN vendors that are not yet convinced that the improvements in 802.11e standard will make a substantial difference to large organisations. The CEO of WLAN producer, Meru Networks stated *“Meru notes that the IEEE is currently working on channel access mechanisms that can only prioritize traffic across four ‘access channels’, making the specification more suitable for*

small business and home applications than corporate networks".⁵

One of the major reasons the 802.11b and 802.11g standards are unable to offer consistent QoS is due to the band these standards operate on. The 2.4 GHz band is a completely open frequency shared with other wireless networks, Bluetooth devices, cordless phones, fixed-wireless broadband Internet access, amateur radio and even microwave ovens. It is for this reason that it has commonly been referred to as the "junk band" for several years. The wide range of devices sharing this narrow bandwidth leads to serious degradation of WLAN performance for both voice and data in terms of radio coverage, as well as QoS, as more devices come into operation.

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There are also unresolved issues surrounding the amount of data bandwidth available to wireless users from the access point.⁷ It has been demonstrated that even a single user with a slow connection to a wireless network can "significantly degrade the overall service to everyone using the Wi-Fi access station"⁸ leading to problems with the delivery of voice. Major LAN supplier, 3Com, agrees, stating that *"current WLANs are not well designed for voice traffic. The slowest device on a WLAN access point slows down the entire traffic. Voice traffic often breaks up, devices get disconnected and data connections are slowed down heavily"*.³

While these external interference and system load issues will continue to be addressed and improved in subsequent 802.11 standards, they are irrelevant for users of DECT technology. Because DECT operates within its own protected frequency band (1880-1900 MHz), it is completely unaffected by any competing technologies operating in the same band. Multiple DECT systems can operate in parallel and independently in the same area, free of interference or any degradation of service.

Quality – the seamless handover challenge

Another key quality challenge facing WLANs is the ability to roam between access points. While DECT telephony networks support seamless handover for voice calls being made on the move, the 802.11 standard currently only supports break-before-make handover.⁹ Again, when we consider that the 802.11 standard was originally designed for data, this does not prove a problem as data is transmitted in

discrete packets, but for voice, handover between the access points needs to be very fast in order to have a voice call free of interruptions.¹ Rather than addressing this critical issue, the 802.11i security standard, which is yet to be released, will actually make the situation worse by extending handover to over 70 milliseconds (ms), a break considered by many to be "impossible for voice calls".¹⁰ When a user moves from one access point to another while making a voice call, an encrypted tunnel must be broken down through one access point and re-formed through the new one. If this process takes more than 50 ms, the user will hear a break in the conversation.

An article published in Techworld last year, stated that: *"WLAN vendors have reported hand-over times of more than 70ms."*¹¹ In most cases, VoWLAN suppliers have typically addressed this issue via proprietary means. Acknowledging the problems caused by lack of

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standards in this area, a number of vendors have recently requested permission from the IEEE to set up a study group for a future voice over Wi-Fi standard under the banner of The Fast Roaming Study Group¹⁰. Should the IEEE grant permission for this special new standard (likely to be called 802.11r), it is not yet known how long it will take to develop and ratify.

Ensuring a secure network

The security schemes commonly used for Wi-Fi handsets, Wireless Equivalent Privacy (WEP) and Media Access Control (MAC) are widely regarded as insufficient.¹ WEP encrypts data, but does not prevent unauthorised computers from accessing a wireless network. MAC filtering is responsible for controlling access to the wireless network. Every piece of network hardware is assigned a unique and un-alterable MAC address by the manufacturer. MAC filtering works by granting access only to those computers using a network card with a "permitted" address. Aruba's vice-president of product marketing has stated: *"There's a huge security hole for voice. Static WEP is weak and can be broken. Using a MAC address means that once that address is admitted, it can go anywhere (on the network)."*¹³

The enhanced 802.11i security standard, yet to be ratified by the IEEE, aims to address these and other security issues, but in the interim, vendors have been left to come up with their own solutions. These include using virtual LANs to isolate voice onto a completely separate network or using a Virtual Private Network (VPN) which uses encryption to provide a secure connection through an otherwise

insecure network, typically the Internet. Not only are these options costly (eroding the savings made by adopting VoWLAN), but a VPN can introduce additional latency, which can negatively impact voice quality.¹

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Wi-Fi users to choose between enhanced security and better voice quality – two factors that most businesses regard as equally critical.

In comparison, the DECT standard incorporates built-in security protocols that eliminate eavesdropping, impersonation and other security breaches:

- 128-bit authentication and identification access security.
- Encryption system based on derived or static 64-bit cipher keys transmission security.

Meeting capacity requirements

Mobile voice users demand a free voice channel wherever and whenever they require one. While WLAN systems can be configured to provide up to seven active handsets operating per access point on a voice-only 802.11b WLAN, Technology and Business Magazine states: *“a more realistic limit is four or five connections before quality suffers.”*³ And, if voice is being added to a WLAN which is also carrying data, this drops to a maximum of three simultaneous voice conversations per access point. This makes VoWLAN a realistic option for smaller operations but considerably less attractive to larger organisations where the total number of employees and the density of mobile users are significantly higher.

Comparatively, the capacity of DECT, which was specifically designed to handle a high density of users, typically supports four to eight simultaneous conversations. In complete contrast to WLAN, DECT base stations can simply be co-located in traffic hot spots to provide the required number of additional voice channels (within certain limits), without the problem of co-channel interference.

Coverage – going the distance

WLAN data applications are typically confined to the areas of a workplace where workstations and PCs are located, as well as meeting rooms and individual offices. WLAN does generally not extend to corridors,

staircases or outdoor areas. This coverage does not change when wireless voice is added. Like cell phone users, VoWLAN users generally expect blanket wireless coverage throughout the workplace¹², which may include outdoor areas such as loading docks and driveways, store rooms and plant rooms.

With most access points, providing blanket coverage is complicated due to the co-channel interference inherent in the 802.11 standards. Access points too close together interfere with each other and if placed too far apart, holes are created in the coverage and the user can experience handover problems – hence, providing the necessary amount of simultaneous coverage while avoiding interference is much more difficult than it should be. TMCNET.com states: *“IT managers who have deployed basic islands of wireless coverage for data will face a complex challenge in scaling their WLAN to provide blanket coverage.”*¹²

Current estimates for the number of additional access points needed to upgrade a WLAN system to a full VoWLAN network are around 80%. From a user-perspective, this means significant additional cost, not only associated with the hardware itself, but with the high level of specialist expertise required for voice deployment, which demands careful channel allocation for each access point.

“From a user-perspective, this means significant additional cost”

Getting the best handset performance

Wi-Fi is notoriously power hungry and WLAN vendors acknowledge that Wi-Fi handsets need to produce a battery lifespan that is at least equivalent to cell phones for them to be successful.¹ New low-power Wi-Fi chipsets are claiming up to four hours of talk time and 60 hours of standby¹ but this is still well short of the 12 hours of talk and 100+ hours standby commonly found in DECT handsets today.

The variety of handset choice is another area where DECT has an advantage, due to the large number of manufacturers. The range of handsets meet a variety of needs including water, dust and shock resistance, duress alarm integration, location integration and intrinsic safety features for specific industry applications. A growing number of VoWLAN handsets are available, most of which are designed for office use, limiting the appeal of a VoWLAN system to primarily office-based businesses. While DECT phones generally deliver most PABX functionality (either as PABX-integrated or PABX-adjunct systems), *“that’s not always the case with wireless VoIP.”*¹³

DECT products have been sold for over 12 years and there are now more than 120 million systems

installed around the world¹⁴. Table 2 indicates that the number of DECT handsets for enterprise systems is forecast¹⁵ to be almost seven times the number of 802.11x handsets¹⁶ sold in 2004. Table 2 also shows that DECT is still forecast to outsell 802.11 by almost six times in 2006.

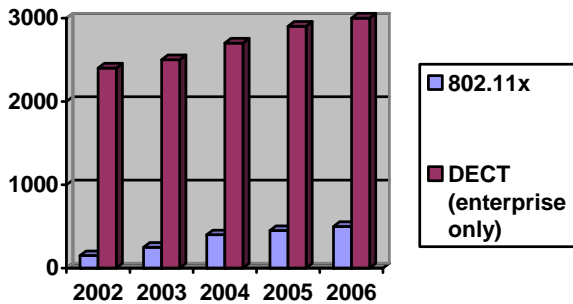


Table 2. DECT handset enterprise sales forecast vs. 802.11x wireless handset forecast

The advantages of this large on-going market for DECT include:

- Ongoing DECT product development and product enhancements.
- DECT vendors throughout Europe and Asia will continue to develop products that comply with the same standard, ensuring a wide variety of solutions that meet specific applications.
- Continuing competition and efficiency means prices for DECT will continue to fall.

Conclusion

For the customer, simply adding Wi-Fi capable handsets to an existing WLAN to provide a wireless voice system has a lot of financial and technical appeal on the surface. However, VoWLAN is not yet ready to completely replace DECT.

For smaller office-based businesses, VoWLAN could be a real option if specific quality and security requirements can be met, but if these factors are critical to the success of the business, VoWLAN has yet to meet the necessary standards. For organisations that require large areas of coverage, such as the retail sector, hospitals and factories, the costs of ensuring uninterrupted coverage, along with satisfactory quality and security, may negate the cost savings that make VoWLAN attractive in the first place.

There is no doubt that VoWLAN technology will improve and the 802.11 standard will continue to evolve – addressing many of the outstanding issues raised by this White Paper. However, the pace of progress is slower than anticipated and until these

challenges can be overcome, DECT is still the proven, cost-effective and flexible wireless answer for the majority of businesses.

By keeping pace with the latest VoWLAN developments, and continuing its role as a leading provider of unrivalled wireless DECT technology, KIRK telecom remains firmly committed to providing the best possible wireless solutions. An approach that allows customers to use the technology that best suits them, when it suits them.

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