WIN Communications Corporation

White Paper

6/2/2004

Comparing VoWLAN With the WIN Wireless Solution Using DEC/ISM?

Background

It is currently estimated that up to 80% of workers are potentially mobile around their workplace and may have a need to access wireless voice communications onsite. The implementation of wireless LANs (predominantly based on 802.11b and 802.11g standards) to carry data has lead some vendors to eagerly promote the idea that adding IP enabled wireless handsets to a data network as a relatively simple, inexpensive and reliable method of delivering voice over wireless LAN (VoWLAN). This has lead to declarations that wireless systems using the DECT/ISM standard, traditionally used for wireless PABX, will not be able to survive in the medium term. Despite this hype, 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 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] This paper seeks to dispel some of the hype and highlight some of the limitations potential users should be aware of that are inherent in the 802.11 solutions being offered today.

Wireless Voice – User Requirements

As a starting point, it is useful to summarize the minimum requirements that users in large enterprises demand for wireless voice applications. We will then examine whether these requirements are met by 802.11b/g WLAN standards.

- Equipment should be based on uniform industry standards, with interoperability between equipment from all vendors to ensure users are not locked into costly proprietary systems.
- A consistently high level of voice quality of service (QoS) is absolutely paramount, particularly with calls to external customers or in critical applications such as healthcare or manufacturing control.

- System performance cannot be compromised by interference from other technologies sharing the frequency band or by system load.

- Seamless handover of calls on the move between base stations / access points is an essential component of voice QoS.
- Radio coverage needs to extend to wherever mobile workers may be. This may include areas such as storage rooms, loading docks and outside smoking areas typically not covered by WLAN.
- Users expect their wireless system to be able to be configured to make or receive a mobile phone call on demand.
- The wireless network should be totally secure, with encryption of calls considered essential.
- Handset performance such as battery life, robustness and the delivery of PABX functionality must match commercial and industrial user expectations.

Ongoing Development of 802.11 Standards

The 802.11 IEEE standard was developed for data, not voice.[1] In fact, standards development is an ongoing process, with no less than 13 different 802.11 standards currently either in use or still to be ratified over the coming years, with possibly 14th standard to be introduced. Each standard addresses different aspects of WLAN operation and it is fairly common for different manufacturers to produce products that comply with only some of these standards.

Quality of Service

Since 802.11 networks were designed to carry data, not voice, 802.11 b/g standards have no QoS mechanisms built-in to tell the network to prioritise voice packets over data, so a surge in network traffic can disrupt voice calls.1 Voice is a real time application, and as such QoS control is essential. Without QoS there is a high probability of inducing end-to-end delays, jitter, out of sequence errors, packet losses, and contention resulting in people talking over each other or the sound breaking up.3

Further, while 99% availability is typically considered acceptable by LAN designers for data packets, voice network engineers work on the basis of 99.999% availability. PC users may not notice a half-second network dropout every minute, but someone speaking on a phone certainly would.[3]

The long-awaited 802.11e standard includes QoS and is expected to be ratified some time in 2004, but according to the CEO of WLAN producer, Meru Networks, "…802.11e will work just fine for small business and homes, but won't scale for the enterprise."[4] he 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]

External Interference and System Load

Adding voice to a data network has a number of ramifications. Wireless users share a fixed amount of data bandwidth available from the access point.[7] It has also 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, concurs, stating that "Current WLANs are not well designed for voice traffic. The slowest device on a WLAN access point slows down all traffic. Voice traffic often breaks up, devices get disconnected, and data connections are slowed down heavily."[3] In contrast to this, DECT/ISM operates in its own allocated protected frequency band and thus does not suffer from interference from competing technologies operating in the same band. This enables multiple DECT/ISM systems to operate in parallel and independently in the same area without interference or degradation of service. Further DEC/ISM systems can operate in the same coverage area as Wi-Fi networks without any interference.

Handover of calls between base stations / access points

Another key challenge facing WLANs is the ability to roam between access points. While DECT/ISM telephony networks support seamless handover for voice calls being made on the move, the same cannot be said for 802.11. 802.11 networks which only support break-before-make handover.[9] This not a problem for data which is transmitted in discrete packets, however, handover between access points needs to be very fast in order to have a clean voice call.[1] Ironically, the yet-to-be-released 802.11i security standard will actually make the situation worse still by extending handover to over 70 milliseconds, a break considered "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 50ms, the user will hear a break in the voice conversation.

WLAN vendors have reported hand-over times of more than 70ms.[11]

In most cases to date, VoWLAN suppliers have typically addressed this issue via proprietary means. Acknowledging the problems caused by lack of standards in this area, a number of these 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 Group.[10] Should the IEEE grant permission for this special new standard (likely to be called 802.11r), it is unknown how long it will take to develop and ratify.

Providing radio coverage for voice users

WLAN data applications are typically confined to selected areas in a workplace and would generally not extend to corridors, staircases, outdoor areas etc. The same cannot be said when wireless voice is added, where, like cellular users, VoWLAN users generally expect blanket wireless coverage throughout the workplace.[12] This includes outdoor areas, loading docks, driveways, storage rooms, etc.

With most access points, it is a complicated matter to provide blanket coverage due to the co-channel interference, between access points, inherent in 802.11. Access points too close together interfere with each other and if placed too far apart create holes in coverage and also create handover problems. This makes it difficult to simultaneously provide coverage while avoiding interference. 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 for voice support.[12] Estimates are that on average, the number of access points typically need to be increased by around 80% when upgrading from data to a full VoWLAN network. Prospective users need to be made aware of this significant additional cost. As well as this, any voice deployment requires a much higher level of specialist expertise with careful channel allocation for each access point.

Sufficient channel capacity

Mobile voice users demand their system to be configured to provide a free voice channel wherever and whenever they require it. While technically up to 7 active handsets may operate per access point on a voice-only 802.11b WLAN, "..a more realistic limit is four or five connections before quality suffers ."[3] More importantly, if voice is being added to a WLAN, which is also carrying data, this drops to a maximum of three (3) simultaneous voice conversations per access point.

Once again, this makes VoWLAN more suitable to smaller operations and less attractive in the larger enterprise where total numbers and density of mobile users is significantly higher.

DECT/ISM was specifically designed for a high density of users. DECT/ISM base stations typically support 4-8 simultaneous conversations and in traffic hot spots, additional DECT/ISM bases may simply be co-located to provide the required number of additional voice channels (within certain limits). This is not possible with WLAN access points due to co-channel interference problems.[12]

Security

It is generally accepted that the security schemes commonly used for Wi-Fi handsets, Wireless Encryption Protocol (WEP) and MAC address authentication are insufficient.[1] Aruba's VP of product marketing notes "There's a huge security hole for voice. Handsets and the technology today are a generation behind the state of the art….Static WEP is weak and can be broken and using a MAC address means that once that address is admitted, it can go wherever. Spoof that and it can send non-voice packets into the network to cause a disruption. "[13] The IEEE is yet to ratify the enhanced 802.11i security standard. In the interim some vendors are using virtual LANs to isolate voice onto a completely separate network or VPNs to enhance security. Not only are these options costly, but also a VPN can introduce additional latency, which can negatively impact voice quality.[1] As mentioned previously, the introduction of the 802.11i standard will also have a negative impact on call handover delays, so it may solve one problem while simply worsening another. In comparison, the DECT/ISM standard includes built-in 128-bit authentication and identification access security and built-in encryption based on derived or static 64 bits cipher keys transmission security[14], eliminating eavesdropping and other security breaches.

Handset Performance

Wi-Fi transceivers are notoriously power hungry and WLAN vendors acknowledge that Wi-Fi handsets need to produce battery life that are at least equivalent to cell phones for them to be successful.[1] New low-power Wi-Fi chipsets are claiming up to 4 hours of talk time and 60 hours of standby[1], but this is still well short of the 12 hours of talk and 100+ hours of standby commonly found in DECT/ISM handsets today.

While DECT/ISM phones generally deliver most PABX functionality (either as PABX-integrated or PABX-adjunct systems), "that's not always the case with wireless VoIP."[3] With DECT/ISM products having been sold for over 12 years, there is a large installed base of over 120 million systems[14]. In fact the number of DECT/ISM handsets for enterprise systems is forecast[15] to be almost 7 times the number of 802.11x handsets[16] sold in 2004. DECT/ISM is still forecast to outsell 802.11x by almost 6 times in 2006.

Conclusions

The concept of simply adding Wi-Fi capable handsets to an existing WLAN to provide a commercial-grade wireless voice system has a lot of financial and technical appeal on the surface. This paper has attempted to identify a number of important questions that prospective users should be asking vendors offering this solution, including:

- How many users can the system support in total?
- How many simultaneous voice calls can be held per access point?
- How many additional access points will be required to provide blanket voice coverage?
- Does the system comply with security standards?
- What is the measured delay in handover between access points? Is the handover protocol proprietary?

If the chosen wireless system does not comply with these points, the user must consider wireless alternatives to 802.11.

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