

Enterprise Use of Private Wireless Telephone Networks

The WiFi network

One approach to creating private wireless telephone systems for small-to-medium enterprise (SME) applications is to use WiFi networks. Mobile calls routed over these 802.11 WLANs (Wireless Local Area Networks) are connected to the existing telephone system in what is called Unlicensed Mobile Access (UMA). WiFi networks are generally low cost and easy to set up, and many businesses already have them in place to extend computer coverage throughout the premises. A number of handsets are available, including dual mode GSM/WiFi phones and WiFi-only models. To lower telephone service costs, the WiFi network can be connected to the outside world through the company's broadband connection.

There are, however, limitations to this approach from both the handset and the network sides, particularly as it applies to enterprise applications. In existing WLAN applications involving only computers, although multiple access points (APs) are routinely used, it is relatively rare for a user to be in motion while using the network, and even if the handoff from one access point to the next incurs some delay, it is unlikely to be noticed by the user. Not so with a user involved in a voice conversation, however, where delays or interruptions would create substantial communications problems. The variability of network usage also has a more noticeable impact on the handset user than the average computer user, since voice quality can be significantly degraded if available network bandwidth is suddenly reduced. This requires companies using WiFi voice to pay special care in making sure their WiFi networks have low contention ratios and proper packet prioritisation.

WiFi handsets contribute their own issues as well. Handsets designed for WiFi usage are notorious consumers of power, causing the battery life to be significantly shorter than other comparable handsets. Interference with other WiFi devices has also been a problem, and the security concerns that apply to computers on the network must be addressed for the handset as well. Finally, the cost of WiFi handsets is an inhibiting factor, since the volume of production is miniscule compared to conventional wireless telephone handsets and fully mobile types.

For the average consumer that has an existing home WiFi network or is considering one, the limitations described above are likely to be of less concern than for the enterprise application and offer the advantage of being useful at a growing number of WiFi hotspots. The issues noted, however, make this approach problematical in the business environment.

The GSM Picocell

The wide usage of GSM handsets (approximately 50 million in the UK alone) has resulted in the concept of the GSM picocell. A picocell is a wireless communication system typically covering a small area, such as a building or office campus, and a newly-licensed GSM band is now available for its use. In May of 2006, Ofcom (Office of Communications) issued 12 wireless licences for the frequencies 1781.7-1785 MHz paired with 1876-1880 MHz. These frequencies are known as the GSM Guard bands and the licences are for low power operation (below 200 mW compared to 10's of watts for conventional GSM systems).

The GSM picocell approach has a number of advantages in SME applications. First and foremost is the fact that existing GSM handsets can be used. In addition to providing the lowest cost handset, the

number of handset models to choose from is large and battery life is excellent. A corporate decision can be made as to whether the handsets will be set up to operate only in the picocell or also outside the premises using a macrocell network provider. Adding corporate telephone capacity is as simple as adding additional handsets. As with the WiFi network approach, costs can be lowered by using the company's broadband connection to carry calls outside the enterprise.

The basic design approach of GSM networks versus WiFi networks has a significant impact on the resultant voice quality of service (QoS) that each provides. The GSM protocol breaks each communication channel into eight time slots, each dedicated to a different user. This means that each user has, in effect, a private communications channel. The WiFi approach, in contrast, is a shared medium, where all users are competing for a fixed amount of bandwidth. The result is that the quality of the voice service (or whether usable service is available at all) is dependent on how many other users may be attempting to use the network at the time.

This issue highlights the fact that WiFi was not developed as a voice service, but was instead intended as a data medium. Thus it is not surprising that adding voice to a data network does not yield optimum performance of either. GSM, on the other hand, was developed with both voice and data in mind. Voice is treated differently than data by converting it to digital form using a special speech codec (coder-decoder) optimized to preserve speech quality. Also, in attempts to support higher traffic density that occurs when voice service is added to a WiFi network, more access points are often added. This strategy can often lead to co-channel interference, degrading voice service.

Security is another factor that is treated differently in the two approaches. Each GSM call is automatically encrypted, making it unintelligible even if the call were intercepted. Security in WiFi systems is entirely dependent on how carefully each individual network is set up, since WiFi access points typically default to an open, encryption free mode until configured otherwise.

The fact that GSM is a licenced service also is a significant factor in its favor. GSM picocells can be established only by licence holders who are required by their licence to conform to established standards in setting up each picocell. In contrast, the unlicensed nature of the WiFi service can lead to networks that yield substandard performance and can possibly interfere with other networks.

Finally, the GSM picocell infrastructure is well developed, small, easily installed and low in cost – ideal for application in a business environment. Finally, the text messaging capability provided by the short message service (SMS) built into GSM equipment and already being employed by many mobile users, is available in the picocell as well.

In summary, the GSM picocell offers lower overall costs, better communication quality and reliability, factors that make it a superior approach for business environments wanting to reap the advantages of the convergence of fixed and mobile communications. The significant factors to be considered in comparing these approaches are shown in the following matrix.

	GSM Picocell	WiFi Network
Handset Cost	Low	High
Handset Choices Available	High	Medium
Handset Battery Life	Good	Poor
Handset Usage Outside the Network	Wide	Limited/Variable
Licensed Service	Yes	No
Designed for Voice/data	Yes	No
Dedicated Voice Channel	Yes	No
Voice QoS	Good	Variable
Network Security	High	Variable
Reliability of Seamless Handoff Between APs	High	Variable
System Access Reliability	High	Variable
Overall Network Reliability	Excellent	Variable
Network Hardware Cost	Low	Lowest
Co-Channel Interference Potential	Low	Variable
Ease of adding handsets	Good	Good
Ease of infrastructure installation	Good	Good
Text Messaging Capability	Yes	No
Overall System Cost	Low	Medium
Potential to Reduce Total Communication Costs	High	Medium