Airborne™ 802.11b Wireless LAN Node Module
Approaches to Designing Embedded Wireless Networks

Introduction

There are a number of approaches to designing wireless networking into embedded systems. The most obvious is to use retail technologies such as PC Cards or USB adapters for low production costs. An alternate approach is to use integrated application-specific modules that provide all of the wireless network specific functionality for rapid development. Both of these approaches have their benefits, and a robust design requires balancing development and production needs.

Retail Technologies

The PC and notebook computer marketplaces have given rise to a variety of solutions for adding wireless networks. PCMCIA form-factor cards, USB adapters and mini-PCI modules are all readily available at commodity costs. Unfortunately, that also means at commodity quality and support levels.

PCMCIA form-factor cards (54 x 85.6+ x 5mm) are available in both PC Card (16-bit ISA-bus like interface) and Card Bus (32-bit PCI-bus like interface), depending on the throughput requirements.

These cards typically come in "extended" formats with an integrated antenna in the extension. They are designed to be easily added to systems in the field, and electrically will support hot swapping.

USB network adapters are either small "dongle" based modules with an integrated USB connector, or in wired modules, with an extension cable attached to the module.

They are typically much smaller than a PC mouse, and often have external antennas. USB adapters are easily field-installed.Mini-PCI modules are based on PCI standard for notebook computers. Unlike PCMCIA and USB adapters, mini-PCI modules have neither enclosures, nor attached or embedded antennas. They are installed inside the system with the antenna mounted remotely. Often these modules take advantage of the high-performance interface directly to the internal PCI bus, and offload much of the higher-level functionality to the host processor, making the hardware cheaper, but more software intensive.

Developer support for retail technology is nearly non-existent. They are great when used in PC or embedded PC environments under one of the Microsoft Windows operating systems. If you want to use one of the other embedded operating systems, or have existing devices without extensive networking capabilities, you will need more support than is provided by a retail product specialist.

Embed Quatech's Airborne™ 802.11b Wireless LAN Node Module into OEM applications in as little as 6 weeks.

- Highly integrated 802.11b wireless module with radio, base-band & application processor
- Built-in web server enables drop-in LAN and Internet connectivity
- Quick time-to-market & reduced development costs
- Reduces need for RF and communications expertise
- Integrated RTOS and TCP/IP Stack
- Configurable serial, digital & analog I/O ports

Although most embedded operating systems have TCP/IP stacks, very few have MAC drivers supporting Wireless LAN (WLAN) radios. WLAN MAC drivers are much more involved than Ethernet MAC drivers.

They have to deal with all of the issues of access points, ad-hoc connections, and other issues with the wireless infrastructure. These drivers can take on the order of man-months to develop, and even longer to fully test and certify compatibility.

QUATECH
A DPAC TECHNOLOGIES COMPANY
5675 Hudson Industrial Parkway Hudson, OH 44236
1.800.553.1170 www.quatech.com

Integrated Modules

Integrated modules – those with both network stack and wireless radios combined – are now becoming available for widespread use. They provide a standard communication interface to the host system, and provide all of the firmware and processing power to communicate across the network. This type of approach accelerates the development process.

Integrated modules are designed to encapsulate the complexities of the wireless system while providing a simple logical interface for developers. A product developer doesn't have to be an expert with networking protocols, software stacks, RF circuit design or wireless network configuration. The modules provide a fully self-contained wireless adapter that can connect to a network and move data without all of the low-level complexities.

Industry standard interfaces, such as RS-232, I2C and SPI, allow system developers to easily integrate and operate the modules. Simple serial connections allow even the smallest embedded processor access to powerful network capabilities. Both new designs and legacy designs can take advantage of the straightforward interface without massive system redesigns, prolonging design lifecycles and even providing for future product enhancement.

Integrated modules are driven by application more than by cost. Focusing on embedded industrial applications provides quality designs. These designs provide valuable capabilities as well as reliable operation. The savings of shorter development cycles as well as quality production are significant in all but the highest volume production. Integrated modules allow you to leverage the investments already made by others.

Firmware development using integrated modules is much simpler than for a WLAN MAC. All of the issues of WLAN connections and compatibility are taken care of in the integrated module.

Developers can focus on developing and testing application issues rather than WLAN communication and compatibility issues.

Retail vs. Industrial Solutions

In the industrial world, a product is not jus a collection of boards with software. There are other issues involved. Operating system issues and software support, product and manufacturing quality all enter into into the value of the solution. Buying solely on the cost of the card or module is not generally prudent in the industrial environment.

Lack of developer support for retail products can't be understated. Developers involved in critical projects can ill afford to struggle, experiment or simply wait for answers to questions. Application and operation questions need to be resolved in a timely manner by experienced support personnel. A partnership with the vendor is a must, and retail organizations are ill equipped for anything other than installation in a PC.

The manufacturing process for consumer retail products is significantly different than that for quality industrial products. Components are chosen for their price, not for their ability to support the design over all operating and temperature parameters. Component vendors change mid-production with little or no notice to the customer, and some retail vendors will actually change designs with no notice. Industrial users cannot afford the uncertainty involved with retail products.

The design process for industrial products is more rigorous than that for retail products. Each component, and their arrangement, is selected and optimized for performance, and not necessarily cost. More thorough analysis is done to provide adequate operating margin for the product, and the designs are intimately analyzed for stability. Many vendors of retail product merely ship a reference design, and do not understand the intricacies of the products. Developers need to understand the true cost that marginal or unreliable product will have on their product and on the company reputation.

Conclusion

While retail products have very tempting prices and features, they rarely belong in industrial applications. Requirements for industrial products are diametrically opposed to those of retail products. Often there is no practical industrial equivalent of a retail product, and developers going down the retail path during development may get trapped when it comes time to release the product. Starting development with quality, supported integrated modules not only reduce the front-end development costs of adding complex wireless technologies, but the enhanced product quality, stability and compatibility reduces the actual costs of the solution.