

Is the handset the center of your personal universe?

When integrated in the handset, ZigBee can play a crucial role in allowing users to seamlessly interact with their personal environment.

By Jon Adams

The cellular handset is the most carried piece of high technology in the world. Equipped with a display, well-understood user interface, wireless connectivity and long battery life, it is the ideal device for users wanting to transport their personal universe, including music, photos, movies, as well as voice and data connectivity to friends, family and the world. Now, it's time for that device to become the remote control and interface to the other devices in users' personal space—allowing them to interact with their environment by controlling temperature, adjusting light levels, monitoring security, changing channels on the TV or set-top box, locking or unlocking their car, and whatever else can be done wirelessly. ZigBee wireless technology, a real part of the home and office monitoring and control environment, has been demonstrated in handsets in preparation for that next level of interaction. Whether ZigBee is embedded in the cell phone, notebook computer, PDA or wristwatch, the challenges are plenty but the opportunity and functionality are compelling.

The handset as universal remote control

Turning the clock back 10 years, the cell phone was strictly a voice (and short message) communications device. More important, it had established a user interface that included a graphical display, a multifunction keyboard with some semblance of standardization and visual and aural feedback. Today, nearly an entire generation of consumers is trained in this interface, and that interface is continuing to improve, in terms of graphical power, as well as its ability to understand the user's intentions.

In many ways, the handset is the ideal device to assume the role of universal remote control. It is the single most high-tech piece of hardware most people carry and is on or near them most places they go. Increasingly, the handset is equipped with memory and processing power to spare. The more advanced handsets have room for third-party applications, games, music, ringtones, videos and images.

Cellular handset engineers have recognized that "one size does not fit all"—a fact that has never been more true than with the array of wireless protocols that are designed for dif-

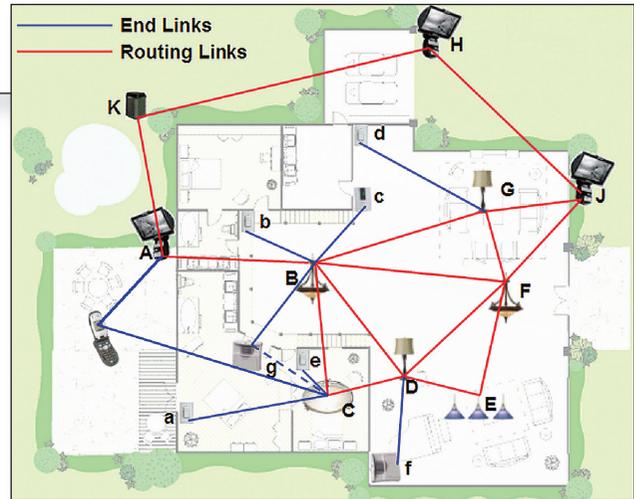


Figure 1. This graphic depicts a typical ZigBee-enabled home network.

ferent usage spaces. Many handsets have, in addition to the multiband/multimode cellular radio transceivers needed for basic telephony, a host of other radio transceivers that provide short-range wireless connectivity such as Bluetooth for headsets and syncing the calendar/address book, Wi-Fi for browsing the Internet and performing file transfer at higher speeds and much less cost than the cellular network, and near-field communications for short-range (e.g., a few inches or so) secure communications to enable the next generation of e-payment systems.

ZigBee's role

ZigBee wireless radio technology, an open international standard developed by the ZigBee Alliance, is on its way to becoming the wireless solution of choice for markets including commercial building automation, advanced meter reading for utilities, home control and monitoring, and asset management and tracking. At its heart is the ZigBee radio, a cost-effective, two-way digital packet radio, designed to operate for many years on a pair of AA alkaline batteries, as well as applications where battery power isn't necessary. These spread-spectrum transceivers operate at a data rate of 250 kbps. At first glance that may seem to be a far higher data rate than is needed for a light switch, that speed of communication means that messages are incredibly short. As a result, entire transactions take only a few milliseconds, which is a boost to battery life.

ZigBee radios are more than just point-to-point radios.

ZigBee-networked devices leverage a native mesh network topology that allows individual radios to alternate routes between source and destination. This feature increases the robustness and reliability of wireless communications.

Most ZigBee radios operate in the worldwide license-free 2.4 GHz spectrum and can be used legally anywhere in the world. ZigBee is also specified for use in the Americas in the 902 MHz to 928 MHz band, in Europe at 868 MHz, and in new sub 1 GHz license-free bands, which are in the process of opening in China, Japan and Korea. Due to the ability to ship anywhere in the world, the majority of the ZigBee radios built and sold use the 16 available channels in the 2.4 GHz spectrum.

An important feature of the ZigBee radio is that it is cost-effective. End modules including radio, application processor, plenty of non-volatile memory and antenna—everything but the battery and the engineer's design idea—are available for less than \$20. When developing a new product, the module approach offers a quick and effective way to go. It reduces development costs, shortens schedules and guarantees basic system communications and functionality. For high-volume applications there is another alternative. Here, radio transceiver chips are approaching \$1 in volume while fully integrated chips consisting of the radio, applications processor, memory, and, in some cases, most or all of the passive components, are priced at \$3 to \$4 in volume. Competition is a factor in driving the price; with all but three of the world's top 10 semiconductor manufacturers offering or planning to offer ZigBee radio technology.

With the advent of ZigBee 2006, the ZigBee standard has been refreshed to include added network functionality, robustness and new product profiles and use cases. ZigBee networks can consist of two to thousands of devices. In the home market, there's an average of 300 identified opportunities, ranging from lighting and heating, ventilation and air conditioning (HVAC), to security and safety and the yard/garden. In each of these areas ZigBee brings new levels of utility management and cost savings. The quick, brief communications between devices means that the radio band is almost always available for communications. Even if interference is detected, the radios autonomously wait a few milliseconds and try again. Through their persistence, they find a moment when the frequency is available for successful communications.

Mesh networking means that devices don't need to be in direct range of one another. The panic switch in the bedroom may turn on all the lights around the perimeter of the home, but that battery-operated light switch on the nightstand doesn't need to talk to each of the light fixtures. Instead, it may communicate with only one, which will relay the message to the other light fixtures requested. If there's interference or blockage on the path between the push-button switch and the light fixture, the light switch may try an alternate route through the light fixture in the hallway, or another device within radio range. This soft



Figure 2. ZigBee-enabled handsets and homes offer new functionality. Security devices attached to windows and doors, for example, can display their status on the handset's map, along with the home's meter reading or thermostat temperature. If the kids left the back door latched but unlocked, the handset can indicate that as well.

failover happens quickly and invisibly so that the time between the button push and the lights coming on is rarely more than few hundred milliseconds.

Back to the handset

With ZigBee radios attached to thermostats, lights, occupancy detectors, security monitors, HVAC air blowers, dampers and compressors, the ability to monitor and control the personal universe remotely becomes real and practical (Figure 1). Of course, this leads back to that cell phone and its intuitive user interface and display. Just two years ago, the first cell phone with ZigBee technology was demonstrated. Last year, the same technology was used in a remote-controlled toy racing car sold by a major cellular service provider. With a demonstration of the technology, the integration effort and software development required to make this product successful showed that the next steps to significant integration into the handset was doable.

ZigBee-enabled handsets can allow the user to interrogate local sensors and control elements that are part of the home's HVAC and lighting, change temperature, adjust lighting, and program scenes and moods, from the comfort of the sofa. In more sophisticated handsets, laptops or handheld computers with larger displays, the ZigBee-enabled home can be graphically represented. This adds an intuitive visualization to the state of the home (Figure 2).

The handset can be a powerful remote-control device, while remaining a champion at providing reliable wireless communication to family, friends and the world. ZigBee wireless technology, integrated into the handset, as well as handheld computers or PDAs, will play a crucial role in allowing users to seamlessly interact with their environment, and control over that personal universe. **EWT**

ABOUT THE AUTHOR

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