Technology design options for WiMedia devices

While UWB presents a golden opportunity for many, a company's approach to implementation can play a critical role in defining its success.

By Billy Brackenridge

Ultrawideband (UWB) is not a technology. It is a set of government-issued regulations that allow well-regulated access to a wide swath of RF spectrum. The WiMedia Alliance specifies an interoperable technology for exploiting this spectrum wit in the regulatory rules, but how WiMedia devices are built has been left to individual implementers. Decisions as to which technologies to deploy vary from company to company. Technical decisions on how to build a WiMedia-compliant device are dictated by the market, or more precisely, how different companies perceive the market.

The first proposed application for UWB was for moving video between a set-top box and a TV screen. UWB was proposed as a physical layer for IEEE 802.15.3 as this standard was well into development before regulators opened up the UWB spectrum. IEEE 802.15.3 was aimed at building wireless connections for the set-top box to TV screen. Manufacturers of battery-powered portable devices also became interested in UWB, and by the time the WiMedia Alliance was formed, the MAC layer evolved to support portable 'peer to peer' connections, as well as the set-top box application. While the WiMedia radio has its roots in IEEE 802.15.3, it evolved to take on a wider set of applications.

This split has led to a range of implementations of the WiMedia standard. One vendor might use multiple antennas and a SiGe front-end to give a settop box a longer range and higher bit rate. Another vendor might build a single-chip CMOS implementation in a small package that can fit in a mobile phone. The set-top box and mobile phone may have little in common in terms of how they are implemented, but they will be able to recognize each other and communicate by beaconing to share the frequency spectrum.

WiMedia is unique in that the market for silicon is larger than any single digital radio has been. It is capable of distributing digital video around a room and can be small and low powered enough to fit in portable media players and mobile phones. It is also simple enough to replace the USB cable used with a digital still camera. The market for replacing cables for PC desktop peripherals is a 'sure thing' as soon as costs are competitive with cables. The cost of entry into the mobile phone market is greater than USB cable replacement, but the volumes can be substantial. While all of these markets are large, the combination of them makes for an unprecedented opportunity.

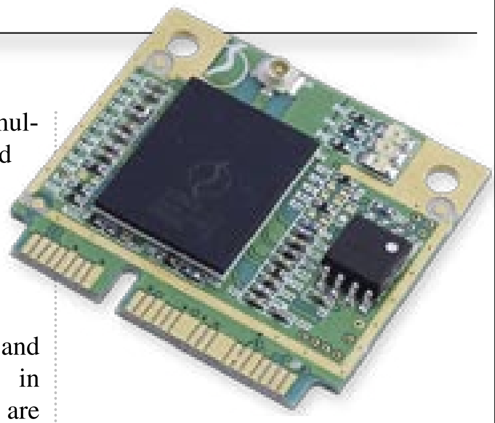

Figure 1. This half mini card, single-sided board shows the low bill of materials and small form factor of a single-chip SiP.

Staying single or not?

The major decision an implementer of WiMedia must make is whether to build a single-chip device or a multichip device. Traditionally, networking devices are divided into a MAC for media access and the physical (PHY) layer. The WiMedia Alliance has defined a MAC/PHY interface, which presupposes that there will be separate chips for this functionality. If a single-chip implementation is built, it must be able to act as a PHY since interoperability testing has been done at the PHY level. The split between MAC and PHY as separate devices is an artifact of WiMedia's history when UWB was seen as an alternative PHY to an existing IEEE 802.15.3 MAC.

WiMedia uses orthogonal division frequency multiplexing (OFDM) as its modulation technique. WiMedia also requires mandatory AES encryption that can be considered as part of the MAC or baseband, depending on implementation.

A WiMedia system is comprised

of a number of components, including the radio transceiver, baseband, media access controller, and non-volatile memory (NVM). Each of these components is necessary to build a WiMedia product, but whether each block constitutes a separate chip, several chips are combined in a module or everything is built into a single chip or package is an 'implementation detail.'

Figure 2. An example of a system-in-

Figure 3. This add-on card from Staccato Communications, the SDIO card (SC3226R SDIO for native Certified Wireless USB), uses a single-chip CMOS SiP packaged solution.

Today, the RF function is built in SiGe though some companies have sought out a CMOS implementation. A single-chip solution is where RF and digital components are in CMOS and reap the benefits of lowest-cost and smallest form factor (Figure 1).

Some RF implementations have chosen to exploit multiple antennas. The number of external RF components varies by implementation. Some vendors do the RF matching with passive components on a circuit board, others embed the passive elements in a low-temperature co-fired ceramic (LTCC) substrate. The resulting package is called a system in package (Figure 2).

There are many variations in host I/O interfaces. PCI, PCIe, SDIO, USB host, USB device and proprietary interfaces can be found in various implementations. Each of these physical I/O interface standards requires that the MAC speak protocols associated with these interfaces.

WiMedia radios are capable of simultaneously running several different over-the-air protocols. Certified Wireless USB, WiMedia's WiNet and Bluetooth 3.0 are examples of protocols that are defined or in the process of definition. Some applications will use proprietary protocols embedded in the WiMedia frame structure. Others implement the WiMedia MAC with a general-purpose processor and multiple I/O interfaces. Still others optimize the MAC for a faster time-to-market Certified Wireless USB implementation.

While WiMedia radios are capable of running multiple protocols, they don't have to.

Size matters

Experience with Bluetooth and WiFi suggest that the least-expensive solution that can meet the specification and satisfy user expectations will win the majority of the market. There may be a niche market for high performance, but price is the major factor.

Consider, for example, that mobile devices demand low power consumption and small packages. Here, price is important.

In the shorter term, the first devices to ship will be devices for desktop and notebook PCs and powered Certified Wireless USB hubs. The early devices can afford to burn more power and can be larger. There is room for passive components in a wireless USB hub.

The digital still camera lies somewhere in between. Size is important, but cameras only turn on the radio when sending pictures to another camera, a PC or a printer. Digital still cameras are expected to be early adopters of WiMedia-based solutions.

The driving force behind early adoption into mobile devices will be solutions implemented as add-on cards (Figure 3). Of course, the trend is toward smaller, cheaper packaging. Ultimately, low-cost and low-height packaging will use standard IC packaging technology. Examples include quad flatpack no-lead (QFN), or micro-lead frame (MLF); ball grid array (BGA); land grid array (LGA); and wafer chip-scale packaging (W-CSP).

Today, SiPs are based on LTCC and will move to stacked die in the near future. The details of how these packaging technologies work are not relevant. The important issue is that packaging technology is advancing just as Moore's Law is lowering the cost of CMOS chip production. The mobile phone industry is demanding smaller packages and better RF performance with miniscule power consumption.

Conclusion

For the foreseeable future, Moore's Law and evolving packaging technology are conspiring to make a rosy future for WiMedia. Moore's Law allows more complex digital devices, but as transistors get smaller it becomes possible to support higher frequencies with CMOS implementations. As more functionality is pressed into single-chip packages, automated testing becomes easier, as does automated assembly. Expect to see WiMedia evolve to better performance at lower prices and into more products.

While there may be some market acceptance for first-generation WiMedia products based on multichip solutions, the trend will be toward single-chip, low-power, low-cost solutions in small RF-efficient packages fabricated entirely in CMOS. **EWT**

ABOUT THE AUTHOR

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