Industry Focus- Wireless USB's Easy Data Transfer in Consumer Electronics

Wireless USB's Easy Data Transfer in Consumer Electronics

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The growing multimedia capabilities of consumer electronics are placing new demands on bulk data transfer between devices. Now WiMedia-standard Ultra Wideband (UWB) is entering the mainstream in laptops and computer peripherals, so consumers can easily transfer files without complex network configuration, and without cables.

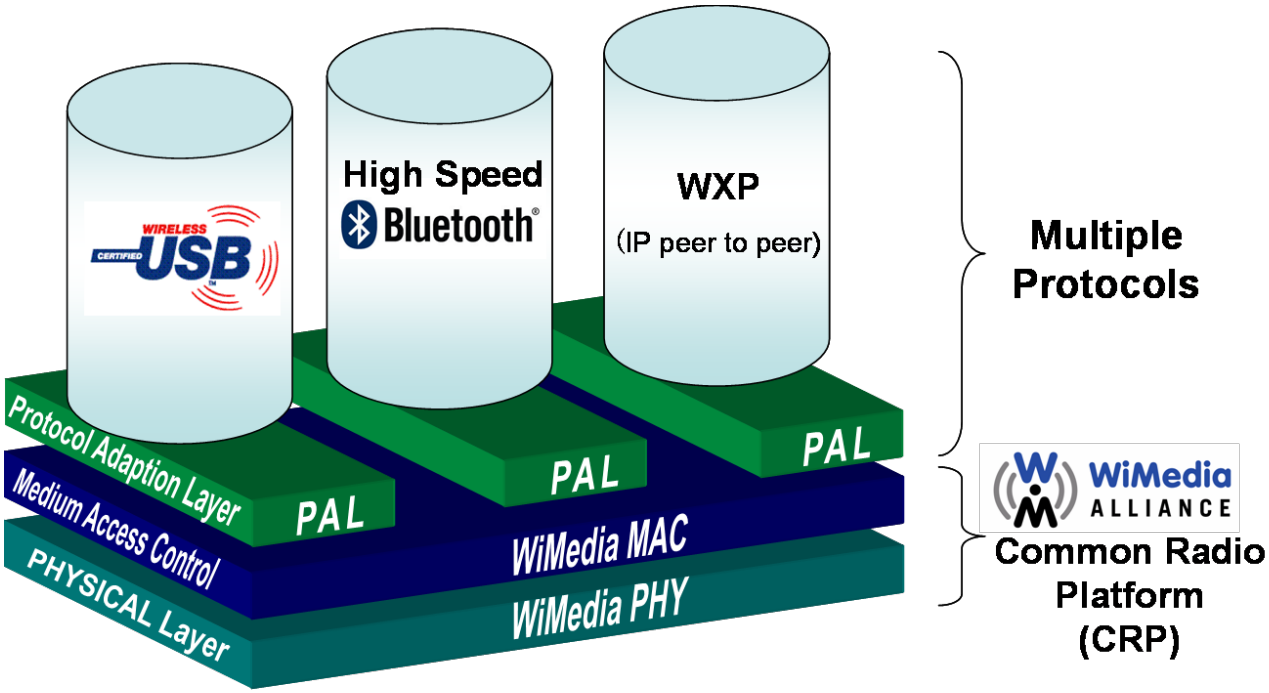

Figure 1: Multiple WiMedia-based UWB Connectivity Protocols

The WiMedia UWB platform is the wireless technology foundation for a number of wireless Personal Area Network (PAN) technologies, including Wireless USB, High Speed *Bluetooth®*, and Wireless TCP/IP. Wireless USB works very well for computer-oriented applications, such as the computer-to-peripheral data exchange currently handled by USB cables, like printers, storage and displays. In addition, Wireless USB is well-suited for portable consumer electronics, such as digital still cameras, camcorders and mobile phones, many of which already include wired USB capabilities.

For manufacturers that want to get their products to market quickly with the lowest end-product cost, Wireless USB component developers are addressing a number of design issues, including application-specific designs, power consumption, software integration, chip interface options, and component-level certification.

Application-specific designs

While Wireless USB integration in some devices, such as external hard disk drives, may be as simple as embedding a plug-in card, other designs are more complicated and include system software integration. Generic adapter reference designs or developer kits can offer insights into implementation, but chipset vendors are starting to offer application-optimized components and sub-systems to save manufacturers valuable engineering resources and accelerate time-to-market.

For example, Wireless USB is used in both mains-powered and battery-powered designs, each with very different configuration requirements. It is possible to not only get battery-optimized designs, but also pre-integrated designs that are focused on specific consumer products, such as a digital still camera platform. This kind of application-specific design, including ICs and software, allows rapid market entry of products with minimal design resources.

Lower power consumption

Power consumption is extremely important for battery-powered devices using Wireless USB. Although UWB is the most efficient radio solution ever in terms of Mbps/mW, not all components and implementations are created equal. This means battery-powered applications should rarely be implemented in an always-on mode, even though the WiMedia MAC will place the radio into its lowest power states whenever possible to minimize power and extend battery life.

Most computers can accommodate the standby power consumption required, and provide "always-on" Wireless USB for device connection. However, the limited battery capacity of small portable products, like a digital still camera, means the radio should normally be completely powered down until the user initiates a transfer, by pressing a button on the camera to start the transfer to a computer or another device. When the task is completed, the radio is once again shutdown and no power drawn. Most handheld device transfers and synchronization tasks fall in to this category.

The proposed High Speed Bluetooth standard automates this process, by using the existing low power 2.4 GHz Bluetooth radio to discover devices and initiate connections, and then wake up the UWB radio to transfer the data only when required. Designers should therefore consider software-defined UWB platforms, which can be updated in order to take advantage of future power consumption enhancements, and to offer new capabilities such as High Speed Bluetooth.

Generally, the most power efficient way to use a UWB-based Wireless USB system is to run it at the highest usable data rate, allowing file transfers to complete as quickly as possible. A UWB radio uses about the same power whatever over-air speed is possible, whether 48Mbps or 480Mbps. The receiver also uses about the same power as the transmitter, so power isn't reduced by slowing data transfer. This means consumer device developers need to select a Wireless USB solution that can operate at the highest possible date rates at the host and device ends, especially battery-powered devices.

Manufacturers cannot compromise on the specification of their chipset and related external components, such as band pass filters, antenna, etc., that might reduce radio performance. Reduced radio performance will also reduce data rates, making transfers take longer and increasing battery consumption. Some Wireless USB ICs now offer "smart MAC" designs to optimize power consumption in power-sensitive applications.

Software/Device Integration

In early stage wireless implementations, software is extremely important to help optimize overall system throughput and ensure compliance with changing regulatory developments. While this will eventually become fully-integrated, today much of the required software is delivered separately for integration into the system/host processing stack. However, there are new Wireless USB ICs that include on-board software and the additional processing power required to offload the I/O processing burden from the system CPU.

The most significant benefit of on-board software is reducing the software integration workload for manufacturers who need to source and integrate Wireless USB into a consumer device. This is compounded during the early stages of a wireless market, since it can be difficult for manufacturers to allocate significant resources to develop a product when the market size is growing, but still somewhat small, or if they are test-marketing a new product.

In a resource-constrained device, such as a mobile phone or personal media player, this kind of on-board intelligence in the Wireless USB IC is critical, since the host system is likely to be resource constrained without room for significant software and processing capabilities. Wireless USB ICs with dedicated I/O processing capabilities can also improve overall system performance and optimize power consumption.

Selecting the Bus Interface

The Wireless USB and WiMedia UWB specifications do not define any hardware interfaces. Since Wireless USB's high data rates can turn the bus interface into a bottleneck for overall throughput, the right interfaces should be considered for device designs. Some common bus options include USB, SDIO and Host Processor Interface (HPI). See Table 1.

nterface	Speed	nterface Power Consumption	Comments
JSB 2.0 (analog PHY)	480Mbps	~200mW	Used with externally cabled USB connections.
SDIO (4 bit)	200Mbps	~50mW	Four bit, 50MHz bus interface.
HPI (16bit)	480Mbps	~20mW	UWB device appears as memory mapped slave with16 bit parallel bus

Table 1: Wireless USB Bus Options and Power/Performance

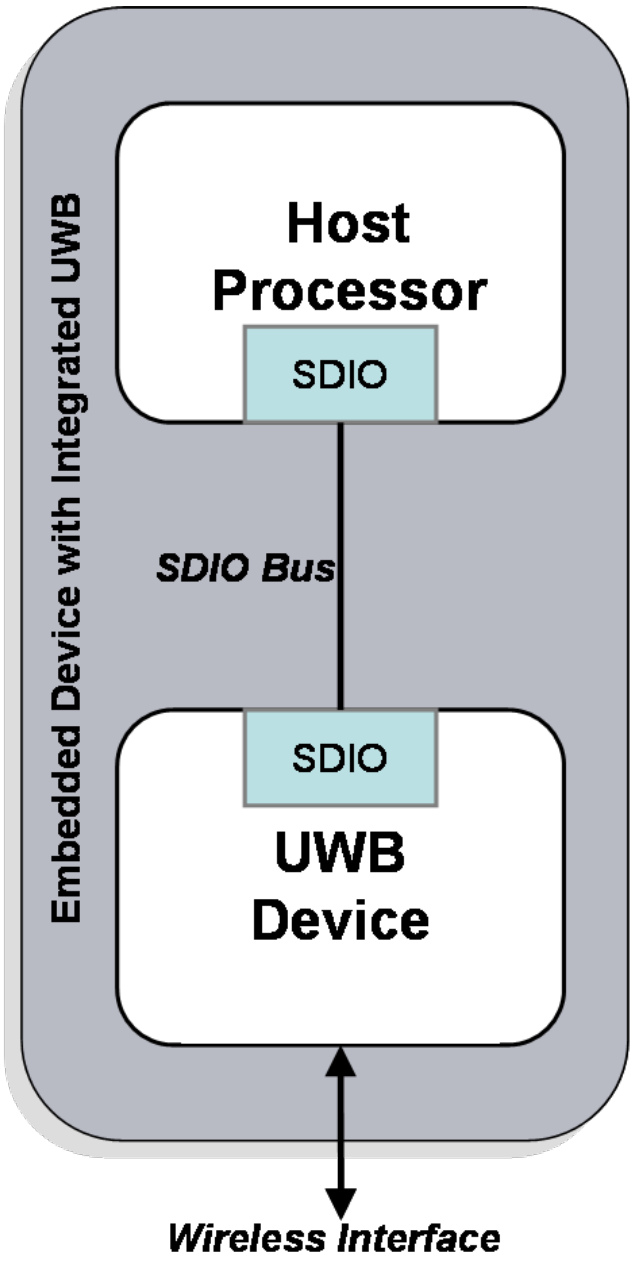

Figure 2: SDIO System

While wired USB 2.0 is well-defined, and supports the data rates necessary for Wireless USB, it can be complex. Wired USB also consumes a fair amount of power, approximately 150-200mW, so this may be an issue in battery powered applications when using USB between two devices inside a product.

HPI, a parallel host processor interface, is another choice for most device applications. This bus makes the Wireless USB device look like a memory mapped device for ease of integration. HPI also has the potential to offer the highest bandwidth data bus and the highest system throughput, but it is the most challenging in terms of software integration.

In the end, SDIO may be the best option for most developers. In devices that use 4-bit SDIO, with a bus speed of around 200Mbps and power consumption approximately 50mW, designers can expect a real user throughput of around 80-180Mbps for Wireless USB. There is also a lot less power dissipation using SDIO than USB.

Device Certification

Finally, there is product certification. The USB-Implementers Forum (USB-IF) has expanded on the success of the wired USB certification program with Certified Wireless USB (CWUSB). CWUSB consumer devices also undergo testing for interoperability and backwards compatibility with wired USB.

In addition to this consumer device certification program, there is also certification of components. Chips can be certified as a silicon building block for Wireless USB devices. This gives manufacturers a head-start on gaining product-level CWUSB status, since certified silicon building blocks increase the success of overall consumer product-level CWUSB certification and interoperability.

Conclusion

UWB-based Wireless USB offers extremely high throughput and low power consumption for bulk data transfer in consumer electronic devices. While incorporating wireless connectivity can be complicated, selection of the right Wireless ICs can reduce engineering demands, accelerate time-to-market for Wireless USB products and offer consumers a great user experience.

Resources:

- Bluetooth SIG – http://www.bluetooth.org [1]
- USB Implementers Forum – http://www.usb.org [2]
- WiMedia Alliance – http://www.wimedia.org [3]

Links:
[1] http://www.bluetooth.org/
[2] http://www.usb.org/
[3] http://www.wimedia.org/