

A Summary of Short-Range Wireless in 2003

Ten years ago, the founders of the Infrared Data Association (IrDA) asked themselves a simple question: what's the best way to link two devices without a cable? This simple idea has now blossomed into several industries offering a bewildering assortment of products and protocols. In this article we'll explore the world of wireless communications mechanisms.

The three most popular standards for short-range wireless data communication are IrDA, Bluetooth, and Wi-Fi. Each allows battery-powered devices to communicate without wires. Each is backed by an industry organization that manages a set of specifications and qualification programs. But the similarities end there!

Bluetooth

In 1994, Ericsson Mobile Communications began research on a radio module that could link mobile phones and accessories, especially headsets. Four years later, the Bluetooth SIG was launched by Ericsson, Nokia, IBM, Intel, and Toshiba, broadening the concept beyond mobile phones to include connections between PCs and other devices. Bluetooth-enabled wireless headsets started to emerge in 2000, but component cost, power usage, and even regulatory barriers prevented widespread adoption. Since then, cost and power usage have gradually shrunk, making Bluetooth a valuable add-on feature for high-end PDAs and mobile phones.

802.11 (“Wi-Fi”)

The first IEEE 802.11 specification was introduced in 1997 with the primary goal of providing wireless LAN access. At first, component costs were expensive, interoperability was chancy, and security was a major concern. Together, these factors prevented widespread adoption. But, over time, component cost has dropped, many security concerns have been addressed, and new specification versions (such as 802.11b, 802.11a, and 802.11g) have emerged that increase throughput. In 1999, the Wi-Fi Alliance was launched to certify implementations and alleviate interoperability concerns.

Because of the large physical range and “always-on” connection model, Wi-Fi technology consumes a lot of power, limiting its use in PDAs, phones, and other lightweight mobile devices.

IrDA

The IrDA was launched in 1993 as a cable replacement technology. But as the industry developed, the IrDA realized that it was necessary to provide specifications that went beyond the basics of cable replacement. In early 1997, the IrDA introduced the first version of the OBEX protocol, allowing IrDA-enabled devices to wirelessly exchange business cards, calendar items, and other object types. A year later, 3COM's Palm III revolutionized the PDA by allowing first-time users to easily swap applications and information. Today, virtually every PDA shipped supports IrDA, as do many mobile phones, laptops, printers, and other products.

	IrDA	Bluetooth	Wi-Fi
Organization launched	Mid 1993	Early 1998	Mid 1999
Communications medium	980 nm light	2.4 GHz RF	2.4 GHz RF
Physical range	1 m directional	10 m	100+ m
Maximum data rate	4 Mbps	1 Mbps	11 Mbps
Effective data rate	3 Mbps	400 Kbps	3 Mbps
Power Consumption	Minimal	Low	High
Approximate component cost	\$2	\$4	\$20
Shipments (2002)	118 M	48 M	35 M
Access to specifications	Free of charge	Product qual. required	License fee required
Qualification costs	Not required	\$5k+	\$15k+
Applications supported	Data, WLAN	Audio, WLAN, Data	LAN only
Host protocol stack size, ROM	15 - 30K	60 - 150K	100-250K

Figure 1. A quick summary of short-range wireless protocol characteristics.

Other Standards

These three standards may be the most pervasive, but they aren't alone, especially in the Radio Frequency world. **HomeRF** was a long-time competitor to the 802.11 standard for wireless LANs, but it has recently been abandoned. **RFID** is a wireless alternative to barcode scanners, allowing an component costing 25 cents or less to identify itself without a power source. Finally, there are a number of proprietary solutions sending short-range audio and data over unlicensed RF bands, such as cordless telephones, baby monitors, infrared remote controls, and other devices.

New standards are also emerging. **ZigBee**, like Bluetooth, uses the unlicensed RF band for data communication, but targets applications that demand lower power, lower throughput, and higher physical range such as home automation, remote control, and device monitoring. Specifications are still being generated and may be available mid-2003. **Ultra Wide Band** uses a unique signalling mechanism that allows extremely high throughput (100Mbps or more) using a simplified design and very low power requirements. So what's the catch? Because UWB technology transmits over a wide swath of radio frequencies, including licensed bands, it will take many years to achieve world-wide regulatory approval.

Making the Choice

With so many wireless technologies available, how can you decide on the right technology to use? To make the right choice, you must understand the benefits and limitations of each available technology and compare this to your application's needs. In cases where an ad-hoc, point-to-point exchange is required, IrDA is the clear winner. If low-power audio or directionless connections is required, Bluetooth has the edge. For always-on network connectivity, Wi-Fi has the advantage.

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