NetworkMagazine.com
THE COMPETITIVE EDGE IN BUSINESS TECHNOLOGY

Wireless Wonders Coming Your Way

Published May 2000, Network Magazine.

HiperLAN2 wireless LANs and the Bluetooth specification promise to revolutionize connectivity. By Peter Rysavy.

Wireless LAN technology is about to undergo dramatic advances, and the number and types of applications that wireless LANs will enable will sprout like weeds. Two technologies pushing the rapid evolution of this market are High Performance Radio LAN (HiperLAN) and Bluetooth (named after a 10th century Danish king).
HiperLAN, which comes in several flavors, is a next-generation, high-speed wireless LAN technology that offers end users throughputs as high as 25Mbits/sec. This article will focus on one particular version: HiperLAN2. Bluetooth is more of a personal productivity wireless technology, with a range of about 10 meters. It is designed to eliminate all those pesky cables that hamper the use of high-tech gadgetry. Both technologies are huge innovations in applying state-of-the-art methods to practical ends.

A lot has happened recently in the local wireless market, so this article will briefly survey these developments. Also, because HiperLAN and Bluetooth are not the only games in town, this article will stack them up against some of the competing technologies before examining them on their own merits.

LANSCAPE

A number of forces are driving the wireless LAN market. One force is product pricing, which has plummeted to as low as $200 per adapter for office products and half of that for home versions. For example, Apple's IEEE 802.11b card lists for $99. Such low prices make wireless LANs a more cost-effective proposition.
Standards, whether official or from industry consortiums, are also driving the market, as is the fact that the PC Card form factor is now common. In addition, large networking companies like Cisco Systems, Nortel Networks, Nokia, and Ericsson are all in the game, most through recent acquisitions.

In addition, home use for sharing peripherals and broadband Internet connections is shaping up to be the killer application. Increasing numbers of users are standardizing on laptops as their only computer, making mobile connectivity highly desirable. The market doesn't stop there, however: Hundreds of millions of cell phones are about to become Internet-enabled, and users will want to link up to laptops, headsets, hands-free kits in cars, and LAN access points.

Clearly a need exists for low-cost, high-speed, local-area wireless connections, and numerous technologies are becoming available for these connections. The wireless LAN space has a variety of proprietary approaches, industry consortium standards (including OpenAir and HomeRF), IEEE 802.11 standards, and HiperLAN standards. The table contrasts the major technologies.

HIPERLAN2

HiperLAN2 represents the most sophisticated wireless LAN technology so far defined. It also has strong industry backing. Will it be the only standard deployed in that class? Probably not, as HiperLAN1 products will precede HiperLAN2, and IEEE 802.11a products will offer comparable performance. In fact, IEEE 802.11a and HiperLAN2 have the same Physical layer, so they can share the same components and reduce costs.
The European Telecommunications Standards Institute (ETSI) is developing HiperLAN standards as part of an effort called Broadband Radio Access Network (BRAN). This effort includes four standards: HiperLAN1; HiperLAN2; HiperLink, designed for indoor radio backbones; and HiperAccess, designed for fixed outdoor use to provide access to a wired infrastructure.

The HiperLAN1 standard is complete, and leading Wireless LAN vendor Proxim (www.proxim.com) is now delivering products based on it. HiperLAN1 offers the fastest route to market for a high-speed wireless LAN technology while minimizing the complexity of the radio technology.

HiperLAN1 uses Gaussian Minimum Shift Keying (GMSK) modulation, which is well understood and broadly used in Global System for Mobile Communications (GSM) cellular networks and CDPD. In contrast, HiperLAN2 uses a new type of radio technology called Orthogonal Frequency Division Multiplexing (OFDM), which imposes significant technical challenges.

Spectrum plays a crucial role in the deployment of next-generation wireless LANs. Currently, most local area wireless products operate in the unlicensed 2.4GHz band, which has several limitations: The band is only 80MHz wide, it mandates the use of spread spectrum technology, and wireless LAN users must not interfere with primary license holders.

Recognizing the limitations of the 2.4GHz spectrum, licensing authorities around the world have allocated large blocks of spectrum in the 5GHz band. In the United States, 300MHz is available from 5.15GHz to 5.35GHz and 5.725GHz to 5.825GHz. In Europe, 300MHz is available from 5.15GHz to 5.35GHz and from 5.470GHz to 5.725GHz. Japan is considering a similar allocation.

These broad blocks, combined with more lenient rules of operation, enable high-speed operation by large numbers of users. Both HiperLAN standards enjoy one key advantage over IEEE 802.11a in that they are approved standards for the European spectrum. IEEE 802.11a products may not be usable in Europe.

HiperLAN2 is being promoted by an industry group called the HiperLAN2 Global Forum (www.hiperlan2.com), which features such heavyweights as Bosch, Dell Computer, Ericsson, Nokia, Telia, TI, and Xircom. The HiperLAN2 standard will be completed in 2000, but the first HiperLAN2 products will not appear until 2001 and will not be widely available until 2002.

The most compelling feature of HiperLAN2 is its high speed, which is sometimes misleadingly quoted at 54Mbits/sec. The raw over-the-air rate is indeed 54Mbits/sec, but sustained throughput for applications is closer to 20Mbits/sec. Another key feature is support for QoS, which will be important for applications like video and voice.

The HiperLAN2 architecture provides for connections to multiple types of network infrastructures, including Ethernet (which will be the first one supported), IP, ATM, and PPP. Security features include authentication and encryption. An especially innovative feature is automatic frequency management, which significantly simplifies deployment. Each of these features is examined in the next section of this article.

With its combination of high speed and QoS, HiperLAN will open up entire new classes of applications, such as video signal distribution into homes.

UP THE STACK

Like other wireless LAN technologies, HiperLAN2 lets mobile terminals connect to access points that bridge traffic to wired networks. It is also possible for mobile nodes to communicate directly with each other, though in practical deployments this will likely be the exception. HiperLAN2 works as a seamless extension of other networks, so wired network nodes see HiperLAN2 nodes as other network nodes. All common networking protocols at layer 3 (IP, IPX, and AppleTalk, for example) will operate over HiperLAN2, permitting all common network-based applications to operate.

As Figure 1 shows, HiperLAN2 defines a Physical layer and a Data-link layer. Above these is a Convergence layer that accepts packets or cells from existing networking systems and formats them for delivery over the wireless medium.

The first unique aspect of HiperLAN2 is OFDM. Though OFDM has been used before—in the European Digital Audio Broadcast (DAB) standard and in Asymmetric Digital Subscriber Lines (ADSLs)—it has never before appeared in a wireless LAN standard.

OFDM is extremely effective in a time-dispersive environment where signals can take many paths to reach their destinations, resulting in variable time delays. At high data rates, these time delays can reach a significant proportion of the transmitted symbol (a modulated waveform), resulting in one symbol interfering with the next in what is called "intersymbol interference."

OFDM combats this by dividing a radio channel into multiple subcarriers and transmitting data in parallel on them (see Figure 2). The aggregate throughput ends up being the same, but the data rate of each subcarrier is much lower, making each symbol longer—thus practically eliminating the effect of the variable time delays. However, OFDM demands extremely linear power amplifiers, which increase the cost of the radio. Consequently, HiperLAN2 products will likely cost more than lower-speed alternatives.

In the spectrum allocation for Europe, HiperLAN2 channels will be spaced 20MHz apart—for a total of 19 channels. Each channel will be divided into 52 subcarriers, with 48 for data and four as pilots that provide synchronization. Synchronization enables coherent (in-phase) demodulation. Through digital signal processing, subchannels are divided through mathematical processing, rather than in the analog domain.

OFDM by itself does not fully describe the Physical layer. There is also the question of how data is encoded and the type of modulation used in each subchannel. Encoding involves the serial sequencing of data, as well as Forward Error Correction (FEC). Most lower-speed wireless LANs do not employ FEC, but HiperLAN2 provides multiple levels, each capable of protecting against a certain percentage of bit errors.

HiperLAN2 also employs multiple types of modulation. By dynamically adapting the FEC and modulation according to varying conditions, HiperLAN2 can transmit at higher data rates with a strong signal relative to noise; it can also transmit data at lower throughputs under adverse conditions.

The next layer is the Data-link layer. In HiperLAN2, the Data-link layer is connection-oriented, which differentiates it from other wireless LAN technologies. Before a mobile terminal transmits data, the Data-link layer communicates with the access point in what is called the signaling plane to set up a temporary connection. This connection approach permits the negotiation of QoS parameters like bandwidth and delay requirements. It also assures that other terminals will not interfere with the subsequent transmission.

By contrast, a mobile terminal that conforms to the IEEE 802.11 standards will communicate when the radio channel becomes available, and it may experience packet collisions from other terminals. It should be mentioned, however, that IEEE 802.11 does provide a separate mechanism for synchronous applications like voice.

HiperLAN2 implements QoS through time slots. QoS parameters include bandwidth, bit error rate, latency, and jitter. The original request by a mobile terminal to send data uses specific time slots that are allocated for random access. Collisions from other mobile terminals can occur in this random-access channel, but since these messages are brief, this is not a problem.

The access point grants access by allocating specific time slots for a specific duration in what are called transport channels. The mobile terminal then sends data without interruption from other mobile terminals operating on that frequency. A control channel provides feedback to the sender, indicating whether data was received in error and whether it needs to be retransmitted.

Above the Data-link layer is the Convergence layer, which responds to service requests from higher layers and formats data as required. This layer supports both packet-based (Ethernet) or cell-based (ATM) communications. When implemented for Ethernet, the Convergence layer preserves Ethernet frames and uses either conventional best-effort communications or the IEEE 802.1p priority scheme.

HiperLAN2 also comes with Automatic Frequency Allocation (AFA). To provide continuous coverage, access points need to have overlapping coverage areas. Coverage typically extends 30 meters indoors and 150 meters in unobstructed environments. Access points monitor the HiperLAN radio channels around them and automatically select an unused channel. This eliminates the need for frequency planning and makes deployment relatively straightforward.

When a mobile terminal roams from the coverage area of one access point to another, it initiates a handoff to the new access point after detecting a better signal on another radio channel. The new access point obtains details of the mobile terminal's connection from the old access point, and communications continue smoothly.

HiperLAN secures communications for a mobile terminal, creating a session (called an association) with an access point by first using a Diffie Hellman key exchange to negotiate a secret session key, then a mutual authentication process via either a secret key or a public key, if a PKI is available. Data traffic is encrypted using DES or Triple DES.

With these security mechanisms, communication over HiperLAN should be as secure—if not more so—as over a wired LAN.

BLUETOOTH

Whereas HiperLAN2 is a powerful LAN technology, Bluetooth connects devices in a user's immediate vicinity.
Bluetooth promises to be an industry force. Its major selling points are its extremely low cost (it may eventually go as low as $5 per device) and its impending ubiquity (huge numbers of devices will soon incorporate it).

In addition, Bluetooth enjoys wide industry support from approximately 1,400 companies that now belong to the Bluetooth Special Interest Group (SIG). And unlike most other wireless technologies, Bluetooth does not have direct competition (other than cables). The Bluetooth specification could become an official standard if adopted by IEEE 802.15, which seeks to develop a standard for Personal Area Networks (PANs).

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | sales@docketalarm.com | 1-866-77-FASTCASE

fastcase® Smarter legal research.