Wireless LANs, Status and Future

In the next three years, Wireless Local Area Networking is expected to grow from under a \$100 million to more than a \$1 billion industry. The author describes why the wireless LAN market is growing so quickly and what we can expect.

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In the next three years, Wireless Local Area Networking is expected to grow from under a \$100 million to more than a \$1 billion industry. Why now, and why so quickly? Where has this technology been deployed, to date? Where will it be used in the near future and which technology will be the winner?

Why have wireless LANs emerged and what is contributing to their rapid growth? Give credit to five factors, all of which have converged within a very short period of time:

- 1) the proliferation of portable computers.
- 2) a 1985 decision by the FCC,
- 3) advances in spread spectrum radio technology,
- 4) the Personal Computer Memory Card International Association (PCMCIA), and
- 5) a general desire by the public for portable communications.

Portable Computer Development

Over the past 10 years, the PC platform has evolved from desktops to lugables (desktops with handles), and then from laptops to sub-notebooks and now to handhelds

Key Forces at Work

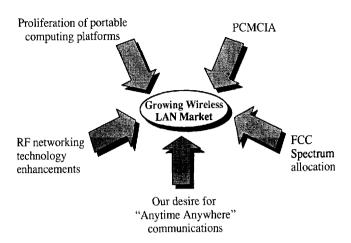


Figure 1. Key forces in the emergence of Wireless LANs.

(personal digital assistants). Portable computers are now the fastest growing segment of the personal computer platform industry, representing 16% of all personal computers shipped in 1992 and estimated to grow to 31% by 1997[1]. This proliferation of new computing platforms has created a new "paradigm" of computing, a model of computing performance easily carried along in the briefcase or pocket. But it also implies a companion step forward in communications technology, wireless LANs, because being connected by wire is not practical for a computer which, by design, moves around a lot.

The PCMCIA Communications Slot

The second factor is an enabling one. The PCMCIA (Personal Computer Memory Card International Association)has provided a standard computer bus interface within which current and future wireless devices can operate. Without this new slot for portable computers, manufacturers would have had to design separate products for each vendor's portable computing platform, delaying the Wireless LAN emergence perhaps by five or ten years.

In 1991 our firm developed a wireless LAN adapter specifically for the Compaq LTE and Contura notebook computers. While these computers were successful, the market for our adapter was limited to only those two computer platforms. This was prior to the general adoption by the industry of the PCMCIA specification. One year later, with the adoption of the PCMCIA standard communications slot a similar product development effort yielded our firm the industry's first PCMCIA wireless LAN adapter, one which could be used by the numerous computer vendors' products which incorporated one or more of these versatile slots.

Spread Spectrum Bandwidth FCC Allocations

The third factor is the allocation of bandwidth. In 1985, the FCC allocated three portions of the radio spectrum (902- 928 MHz, 2.4-2.483 GHz, and 5.725-5.850 GHz) for unlicensed spread spectrum use. These bands have

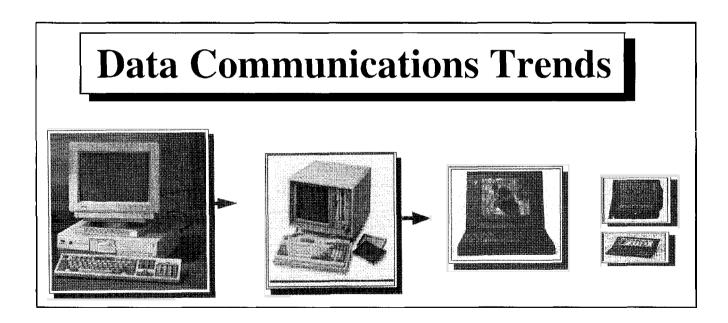


Figure 2. PCs, Desktop to Lugable to Notebook.

become, over the past several years, home to a variety of wireless LAN products. As a part of their airwave allocation, the FCC authorized companies to manufacture and sell wireless products without placing the burden on the end user of obtaining radio licenses to operate the products.

This important provision comes with a condition, that the products use spread spectrum technology--a method of transmitting radio signals which greatly reduces interference with similar systems operated in the same bandwidth and vicinity[2,3,4]. This provision makes it practical for firms to develop "off-the-shelf" products for Wireless LAN communications.

Advances in Spread Spectrum Technology

The use of spread spectrum radio communication has its origins in World War II, with one of the first recorded uses being the U.S. Navy, to send difficult-to-intercept messages between battleships. The very nature of the technology is that it provides privacy and resistance to interference. The physics of the technology is such that there is an inverse relationship between range and speed (of the transmission of a given amount of data). The recent challenge has been to develop a product that has acceptable "local area range" and correspondingly acceptable "local area speed."

While there are no universally accepted definitions for either spread spectrum's range or speed of transmission, a benchmark often used is a minimum of 300' of range with a minimum of 1 Maps of speed. Today, these levels have been reached, and in the case of Proxim's Rangeland product family, exceeded.

Wireless LANs to date

Wireless "in-building" connectivity is not entirely new. A number of applications have made their way into large vertical application areas in the past several years. The largest of these is data collection and inventory tracking by workers using radio frequency equipped handheld devices to communicate with a central computer (Figure 3).

These products have been provided by various companies but have generally been designed around proprietary operating systems and have been priced in the \$4,000 -\$5,000 range per hand held unit.

Other more recent applications include uses within the healthcare industry such as "bedside computing" (doc

Case Study: Simmons



- Major bedding products company
- Mobile inventory control system
- RXA-1000 RF Transceiver
- Proxim partner: Intermec

Figure 3. A wireless LAN used to complete the inventory in a mattress warehouse.

tors and nurses completing patient charting information using a portable computer) and emergency room check-in.

Case Study: USC Hospital



- · Large university hospital
- Mobile E.R. admissions;
 Bedside data entry/access
- RangeLAN/PCMCIA; RangeLAN/Roaming

Figure 4. A doctor uses a handheld communication device to interview the patient at bedside.

Another area that has received attention is point-of-sale or point-of-service. If you have returned a rental car within the last year you may have been greeted by an employee who provides you with your receipt immediately, using again, a handheld computer terminal with a radio link to a central billing computer. Similar applications will be seen at restaurants and other retail establishments, all providing potentially more efficient, convenient and accurate methods of business administration.

These are examples of very "vertical" applications, designed for one specific use. The reason for their proliferation is their communication bandwidth, or data transmission speed. To date, wireless LANs have been designed for applications such as these which require

the transfer of relatively small amounts of data. Our own original product operated at throughput rates of 40 - 50 Kbps, speeds that were quite adequate for the vertical applications examples described, but generally inadequate for a broader base of general purpose computing applications.

Wireless LANs' Future

What is now emerging, and what will generate the new billion dollar industry, are wireless LAN products that are much faster, enabling more "horizontal" applications, or those which will provide much more generic uses of computer communications. E-mail, printer access and file access from the server are all "horizontal" applications which most of us use, and which often require more bandwidth for information transfer. For example, our new product family Rangeland operates at speeds 10 times that of its older family member.

Wireless LAN Market Growth

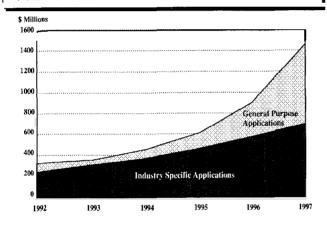


Figure 5. Anticipated Areas of Wireless LAN Market Growth.

Wireless LAN products will help extend the reach of the existing wired LAN infrastructure, not replace it with a new wireless network infrastructure. The goal of wireless local area networking technology will be to provide new flexibility for workers who, by becoming more mobile while staying connected to a common network, can become more productive.

Replacing previous investments in wired technology with wireless is not the best course. Rather, wireless LANs are poised to play an important role in an emerging industry which will serve to enhance through a naturally complementary role, and in so doing, spur the growth of this important new wireless industry.

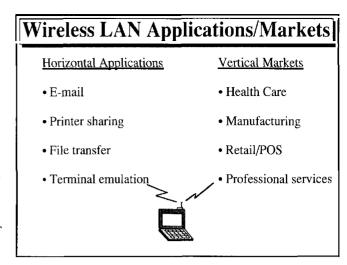


Figure 6. Wireless LAN Applications/Markets.

Transitional horizontal

Today, network administrators are planning new applications for their companies that fall into "transitional horizontal" application categories. These are "walk before you run approaches." Two examples are, first, adding a PCMCIA adapter into a fully loaded 486 notebook which will be loaned to visitors who need access to the LAN. This way, the users can be location independent.

The second is to accommodate personal moves, changes and additions within the LAN. To ensure that all users are kept "up and running" at all times, desktop wireless LAN adapters will be used to provide access for people who are re-located within a building to a place which has not previously been wired. The user can then decide if his or her needs mandate running a cable, or whether the wireless connection is adequate as a long term solution. The advantage gained is that a wait of a week or more for a wired LAN connection is eliminated.

Horizontal Wireless LANs

Soon, however, the transition will take place more completely, and usage will become much more common place. Users will see the benefits of this type of untethered access to the LAN and will begin choosing this type of product as their primary connection into the LAN. Many small businesses are already considering this move, due to the nature of their LAN access, and the likelihood of their business expanding into a new facility. This new usage is a part of a change in behavior that may happen as early as late 1994.

Which wireless LAN technology?

As shown below in Figure 7, there are currently three wireless LAN communication technologies: Infrared light, narrowband radio and spread spectrum radio. Each has its advantages, but spread spectrum has emerged as the technology of choice for the emerging wireless LAN general purpose communications industry.

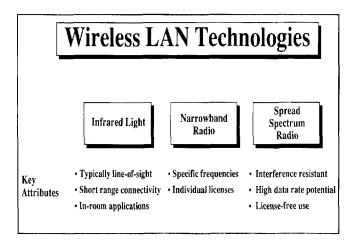


Figure 7. Infrared, Narrow band and spread spectrum.

Infrared works well for short distance communications (5 - 10 feet) where their are no obstructions between transmitter and receptor. This has been used by Hewlett Packard in its Omnibooks and by Apple Computer in its Newton. Each application has the intention of providing users with a quick and easy way to "zap" information to a single point, such as a printer.

Apple is fond of their business card application example (i.e. "Oh, I forgot to give you my business card. Here, let me zap it from my Newton to yours.)

Narrowband radio works well and is without the "in room" limitations of infrared, but has the flaw of requiring an individual license from the FCC for a location specific use.

Spread spectrum, on the other hand, operates through and around obstacles and requires no radio license. Also, it is inherently private and resistant to interference from like transmissions occurring in the same locality. One spread spectrum approach employs frequency hopping. Data is transmitted in bursts over a pre-defined number of frequencies, each at a different time depending on its order in the sequence. This makes the signal extremely difficult to intercept and inherently resistant to potential sources of radio interference.

This new industry of wireless LANs will be pervasive, exciting and big. The technology will be useful, versatile and rapidly improving. Although no standards exist yet, there is an aggressive effort afoot by the IEEE to finalize a standard by early 1995. Current products are fast enough and affordable enough to meet many needs in the market, enabling companies to get started today in the employment of wireless LAN technology in their current environments.

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Editor's Note

The author's firm markets a wireless LAN product using spread spectrum called Rangeland.