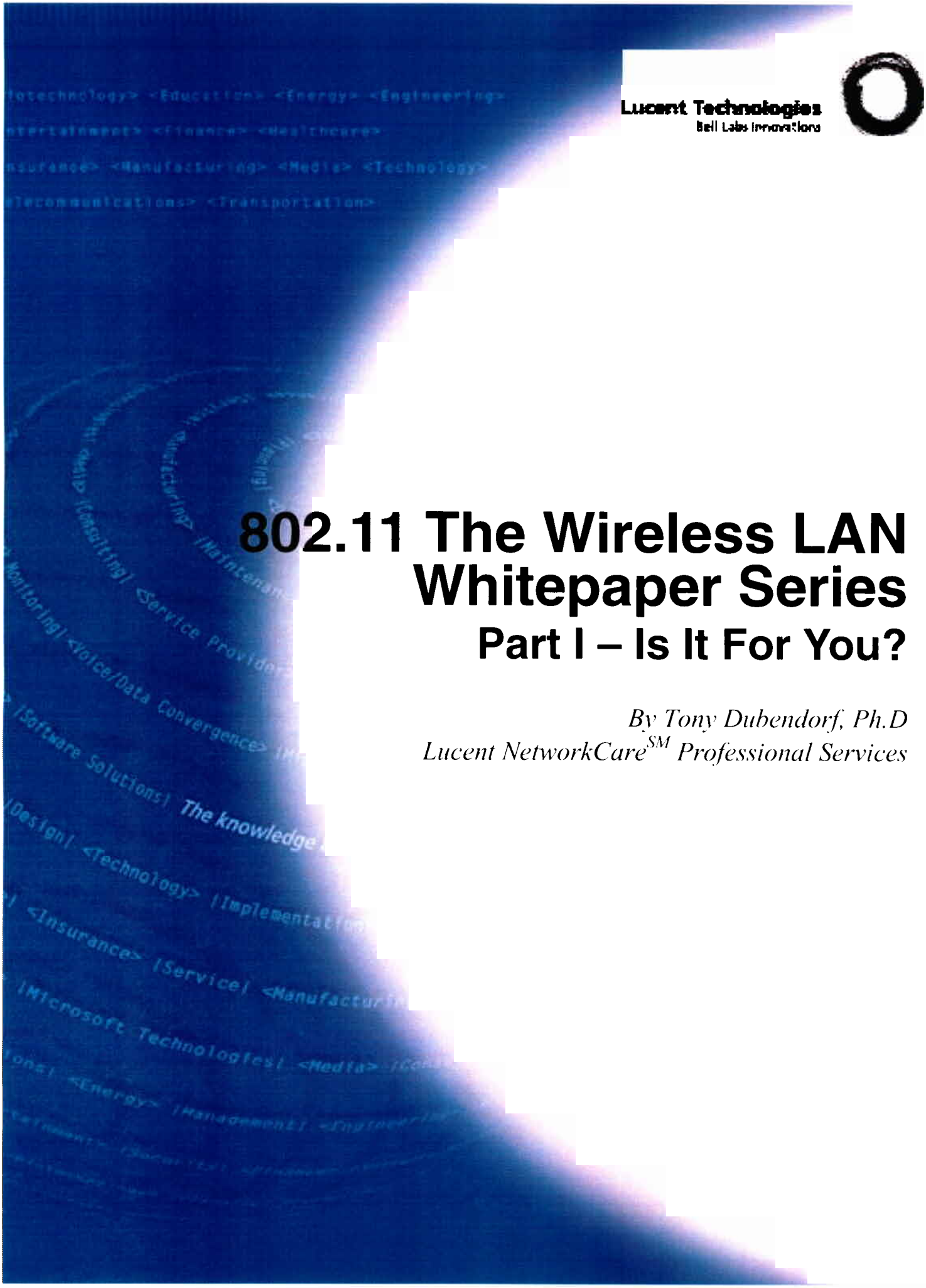

802.11 The Wireless LAN Whitepaper Series

Part I – Is It For You?

By Tony Dubendorf, Ph.D
Lucent NetworkCare℠ Professional Services



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Introduction

Wireless usage and capabilities continue to grow, changing the very nature of the corporate LAN and presenting all types of new challenges and opportunities for IT managers. More and more users are requesting the ability to cut the cord for all types of communications. They want to be able to respond to email messages from a hammock in their backyards or access your company's intranet from any location within your company.

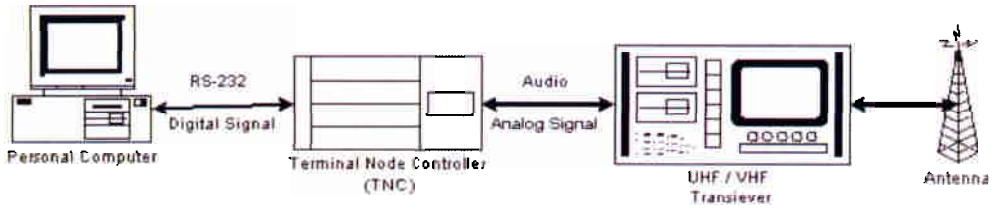
These abilities are becoming common place today, and will be as normal as using a cordless phone over the next 5 years, as wireless LAN adoption continues its rapid expansion, growing from a solid base of data collection applications to much larger opportunities represented by office and home applications.

These same wireless technologies offer the IT managers the benefits of easier moves, adds and changes, as well as removing problems often caused by cable plants and connectors. However, a fundamental challenge faces the information technology decision maker: they need to identify and implement architectures, technologies, and processes that reduce the total cost of ownership (TOC) of corporate networks. One way is the wireless LAN. We believe that if companies and individuals understand the true costs and economic benefits of wireless LAN solutions, they will generate quicker return on investments.

Basic 2.4 GHz access points with an RJ-45 Ethernet connector costs between $400.00 and $2,000.00 depending on desired options. Client adapters tend to cost between $75.00 and $350.00, depending on configurations.

Introduction and History of Wireless Networks

Wireless LAN access is taking the corporate world by storm. Current projections call for the number of remote users — road warriors and other mobile users — to grow by 40 percent to 60 percent annually as Wireless LAN access continues to penetrate both residential and business segments.
Wireless networks are not new. In 1971, the research project named ALOHANET was established by the University of Hawaii to connect the data centers of 7 campus sites located across 4 islands, to the main data center located on the island of Oahu without the use of phone lines.
The network was designed in a "star" topology that provided bi-directional communications allowing each remote site to communicate with each other through the central site at Oahu.
In the 1980's, Amateur Radio Operators or "hams", designed and built terminal node controllers (TNC's) so that they could connect their computers through their radio equipment. TNC's are similar to modems in that they are in essence, modulator/demodulators. TNC's concert the digital signal from the computer to analog signals that the radio can modulate and transmit using packet switching techniques.



FCC and the Frequency Range

In 1985 the FCC authorized the public use of the *Industrial, Scientific, and Medical* (ISM) bands with a range of frequencies between 902MHz and 5.85GHz, which is just above the cellular range. One of the attractive points of the ISM band is that end users are not required to obtain FCC licenses in order to operate in this range.

902 – 928MHz
2.4 – 2.483GHz
5.725 – 5.875GHz

Table of Industrial, Scientific and Medical (ISM) Frequencies (IEEE and the 802.11 Standard)

On July 26, 1997 the *Institute of Electrical and Electronics Engineers, Inc.* (IEEE) approved the 802.11 standard that was published on November 18, 1997. This prompted the release of 802.11 compliant wireless cards from several manufacturers throughout 1998. The 2.4GHz band allows for relatively fast data throughput, between 1 Mbps and 11 Mbps, for a large number of users.

Wireless LAN Benefits (Overview)

The continual growth and enhancements that are being made in wireless networking are being fueled by the need to lower the costs associated with network infrastructures and the need to support mobile networking applications that provide increased accuracy and efficiency while decreasing business costs. Wireless connections can add flexibility, scalability and security to your network while cutting down on overall costs. Users no longer have to search for a place to plug in to the wired network in order to gain access to shared information. Network managers no longer need to disconnect or reinstall wiring.

What is needed?

A wireless LAN requires as few as 2 components: access points and adapters.
Wireless access points are external transmitters and receivers, or transceivers, which use an RJ-45, serial or other connection to link to a wired network. These access points are usually remotely manageable using Simple Network Management Protocol (SNMP) management software.

Wireless adapters, equipped with transmit/receive capabilities and antennas, are normally found in 2 formats, PC cards for notebook computers and internal ISA/PCI cards for desktop computers.
Several Antenna options are available for the wireless LAN that can improve the direction, rang or quality of the signal between access points and adapters.

Benefits

According to the Wireless LAN Alliance, which is, a manufacturers' consortium located in Redwood City, CA, there are 5 major benefits of wireless LAN technology.

Mobility

Wireless LANs give users access to real-time information anywhere in their organization.

Installation speed and simplicity
Installing a wireless LAN can be fast and easy because there is no need to pull cable through walls and ceilings.

Reduced Cost of Ownership
The initial investment costs for wireless LAN equipment may be slightly higher than the cost of wired LAN hardware, but overall installation expenses and lifecycle costs can be significantly lower.

In 1999, the Wireless LAN Alliance commissioned a study into wireless LAN technology. They found that the average return on investment for a wireless LAN was 8.9 months compared to 20.2 month for a traditional wired LAN. And because wireless LANs supply all the benefits of wired LANs with few of the constraints, business owners have fallen in love with them.

Security
By virtue of the spread-spectrum technology that most radio frequency LANs are built around, they are inherently more secure than wired LANs.

Scalability
Wireless LANs can be configured in a variety of topologies to fit changing user needs. The configuration options can take two forms: independent peer-to-peer LANs and infrastructure LANs.

How do users feel
According to a study from the Wireless LAN Alliance, Ninety-seven percent of users questioned said wireless LANs met or exceeded their expectations, with 92 percent reporting a definite payoff from their use. Another 92 percent have made plans to deploy more wireless LANs in the future.

Capabilities

Running the Distance
The accessible distance for most 2.4GHz LANs that run from 1 Mbps to 11 Mbps range from 500 feet indoors to as much as 5 kilometers outdoors. There are several factors that come into play here such as the type of antenna, interference sources, number of users and topography. These must all be entered into the equation.

The Signal
2.4 GHz wireless LANs use the spread-spectrum technology that had been developed by the military many years ago. In a nutshell, spread spectrum trades off bandwidth efficiency for security and reliability. There are 2 types of spread-spectrum techniques used today in wireless LAN technology, Direct Sequence Spread Spectrum (DSSS) –and Frequency Hopping Spread Spectrum (FHSS) .

DSSS
This technology produces a redundant bit pattern called a chip or chipping code for each bit to be transmitted. The longer the chip, the easier it is to recover the original data if it becomes contaminated. DSSS also appears as low-power wideband noise when being picked up by unintended receivers. DSSS proponents claim it is the logical pathway to the 11 Mbps throughputs of the future. Lucent's ORiNOCO™ product is based on DSSS technology as well as the other major manufacturers.

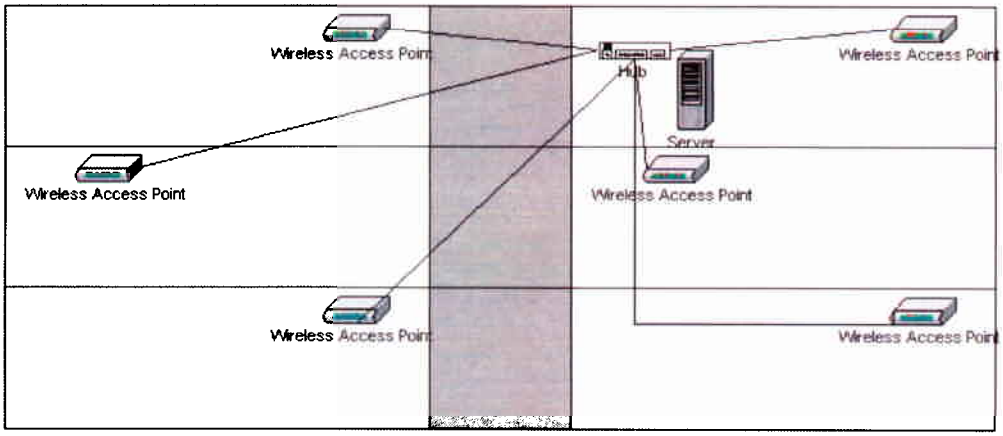
FHSS
This technology uses a narrowband carrier that hops, or changes frequencies, in a pattern known to both the transmitter and receiver. When synchronization is established, the signal occurs clearly and appears as if it were on a single, logical channel. When it is not synchronized, the signal then appears as an indecipherable short-duration noise.

FHSS is less expensive to implement than DSSS, but it can require several more access points to achieve the 11 Mbps throughput. DSSS transceivers are more expensive, but provide longer distances and require fewer access points.

Examples of Implementations

Example A - Wireless LAN

In this first example we have customer A who has decided that there is a need to expand their internal LAN. The company has grown and now resides on three floors with their server room located on the top floor. Instead of running bundles of Category 5 cable, the Information Technology Department has decided to start moving to an 802.11b wireless network. They perform an RF Site Survey to find the optimal location for wireless access point and also to determine the amount of access points that will be needed. Once the placement has been determined, a single Category 5 cable is pulled to those locations and connected to the patch panel or hub in the server room. The wireless access point is installed and wireless cards such as the Lucent ORiNOCO WaveLAN card are installed in each workstation or notebook. The workstations or notebooks are powered up and with little or no configuration requirements, the end user is connected to the network. Since the IT department has installed wireless to provide full coverage on all floors, workers have the ability to take their notebook computers along with them to conference rooms or other offices and remain connected.

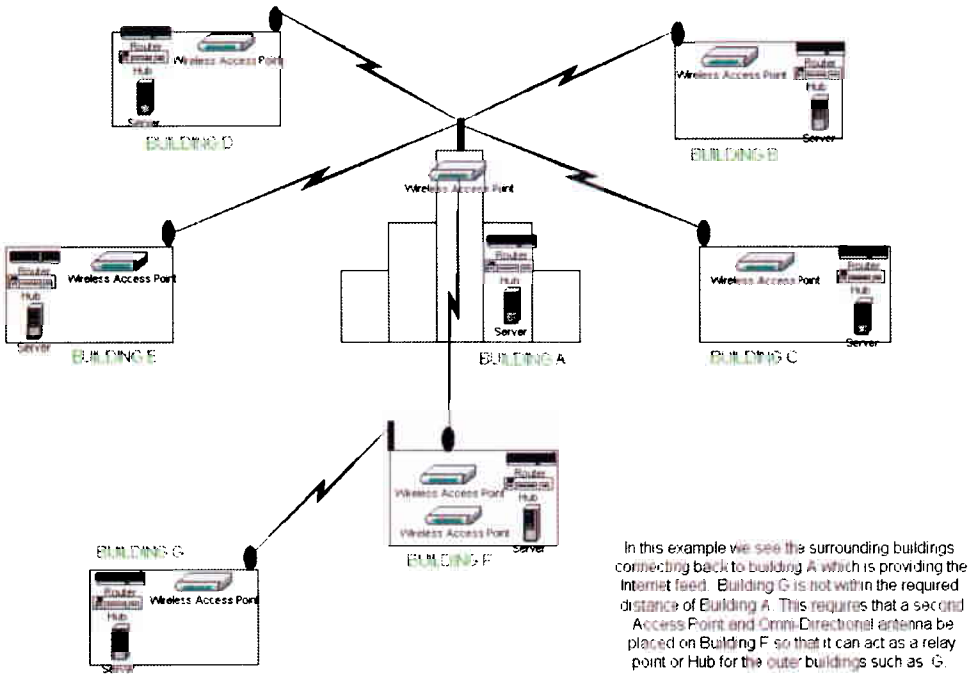


Example of Placement for Full Coverage.
Coverage Areas will overlap

Example B - Point-to-Multipoint

In this example, we have an educational campus that has a need to connect the separate LANs located in buildings around the campus, to a central hub for Internet Access. Do to the high cost of copper and fiber cable along with the cost to dig trenches to bury the cable, the IT Department has decided to use the 802.11b standard wireless connectivity to provide backhaul circuits to the main Internet feed. In this example, an Omni Directional antenna is placed on the roof of the main building where the Internet point-of-presence is located, and parabolic (direction) antennas are on top of each remote building. An RF Site Survey is done on each building to determine the correct placement and alignment of the

antennas. A Roof Top Survey is completed to designate the mounting of the antenna, the cable runs for the antenna cable, power cable and the category 5 cable which will connect to the building hub.



Conclusions

Implementing a wireless LAN requires a clear understanding of business objectives, careful analysis of the alternatives and a sound implementation plan. Even then problems may occur. It's a fact of life. How the organization deals with those problems, and the amount of time, money and resources spent in the process, will determine how effective the overall wireless access solution really is. The question is, can the company deliver the performance and reliability to make remote access a sound investment?

It is often worthwhile working with a firm that has experience in this area. At Lucent Technologies NetworkCare[SM] Professional Services, (Lucent NPS), our primary focus is to relate technology strategies to your business objectives. We understand that technology is meaningless unless it helps businesses run more efficiently or do the things they couldn't do before.

For further information, see Lucent NetworkCare's website at http://www.lucentnps.com or call 1-888-767-2988 in the U.S. or 1-650-318-1020 outside the U.S.

Glossary

Access Point
A wireless device that transports data between a wireless network and a wired network.

Adapter
A wireless device that provides an interface between client hardware and the airwaves.

DSSS
Direct Sequence Spread Spectrum, one of two technologies used in 2.4 GHz radio frequency wireless LANs.

FHSS
Frequency Hopping Spread Spectrum, the other technology used in 2.4GHz radio frequency wireless LANs.

IEEE 802.11
An Institute of Electrical and Electronic Engineers set of standards for wireless LANs.

Independent network
A wireless network that provides temporary peer-to-peer connectivity without relying on a complete network infrastructure.

Industrial Scientific Medical
Unregulated 900 MHz, 2.4 GHz and 5.7 GHz bands that are license free.

Packet radio network
Often used by state and local law enforcement agencies. Provides relatively slow 19.2 Kbps throughput.

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