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FOCUS

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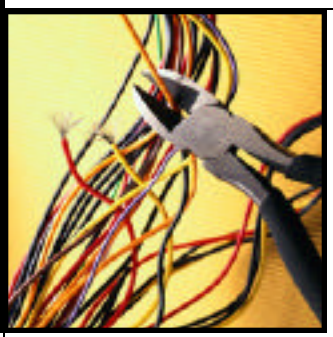

Evaluating Wireless LANs

There are many different ways to cut the cord and still be connected to your local area network and your applications. In this edition of CDW Focus, we explore the world of wireless LANs and ways to evaluate these particular technologies.

What is a wireless LAN?

In the past year, the prices on wireless LANs have dropped and features increased, making cutting the cord all the more attractive. Wireless LANs can extend the reach of your corporate networks to buildings difficult, expensive, or impossible to wire. They are useful for ad hoc networks that aren't going to be permanent, such as for traveling workgroups of audit or consulting teams, or for users who don't have a fixed location or room to hook up a desktop PC. They also can make it easier for visiting colleagues to gain network access and set up networks on the fly, without having to worry about where to run wires and how to setup hubs.

And products are getting better. The latest crop of wireless LANs, including Lucent's Orinoco, 3Com's AirConnect, Apple's AirPort and others have better features, faster throughputs, and easier setups. So here are a few things to consider before picking one of these products for your production network.

Before you figure out what part of your network will be wireless, realize that any wireless LAN is composed of two different elements: the wireless **Access Point** (the bridge between the wired and wireless segments), and various wireless **LAN adapter cards,** which can take the form of PC Card or ISA/PCI network adapters. Many of the vendors make Access Points which are just a connector box with a wired Ethernet port and an empty PC Card socket or two – you might have to purchase an extra adapter card to fit inside this socket or not, depending on how the product is packaged. Some vendors, like Apple, make Access Points that have both Ethernet and analog phone modem connectors on them. This means you can either use the Access Point (Lucent/Avaya calls theirs the WavePOINT-II Access Point) as a bridge to an existing wired Ethernet network, or as a dial-up router that can be shared among wireless Macintosh users.

There are three basic types of wireless LANs:

-- *A mixture of wired and wireless users.* Here you have some roaming users and some fixed wired users. You'll need to manage where the users will roam and how many Access Points you'll need to support the signals to reach to these places. Placing one or more Access Points around your enterprise requires some understanding of the obstacles that will block the radio waves – the thicker your walls or more steel inside your buildings, the shorter the range your users can roam. And just like cellular phones can find "dead spots" as you travel around your neighborhood, the same is true with wireless LANs – there may be places that the radio signals can't reach, such as a conference room deep inside your building.

-- *Peer to peer wireless networks.* Here every desktop or laptop user is wireless, and connects to others with wireless LAN adapters installed in each computer. There are essentially no wired parts to the network. This is useful for ad hoc networks, such as traveling workgroups that need to quickly set up shop.

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-- Two wired networks that are bridged with a wireless connection between them. Here you have two different wired network segments, separated by a street or a short distance that would be difficult to wire. You need to purchase two wireless LAN access points and install them on each wired segment. You might also need to purchase extended antenna options to increase the wireless range between the two access points.

In addition to these three general types of networks,there is a wide range of technology from over a dozen different vendors. Until relatively recently, most wireless LANs didn't interoperate with each other, meaning that you needed to buy all your equipment from the same vendor. With the advent of the latest technology, called 802.11b, this is no longer an issue, and now you can mix and match components, or buy equipment from one vendor with some assurance that it won't be obsolete. (See interoperability ssection below)

The 802.11b stands for the number of the newest standards used for wireless LANs. This standard operates at 11 Mbps, the equivalent speed of the original wired Ethernet connections. Wireless LANs make use of one of two differing technologies, called frequency hopping and direct sequence. The 802.11b networks are the latter, and some of the earlier networks and the 802.1a standard use the former technology. Both technologies are based on spread-spectrum radio transmission in the unlicensed 2.4-GHz band, meaning that they send several concurrent radio signals over nearby frequencies for better throughput and security.

But 802.11 is just one of many developments in the wireless LAN arena. There are several future technologies that will bear products in the next few years (see article on futures on p.5.)

Direct sequence products provide for slightly higher throughput and range, as well as better overall interoperability. Frequency hopping products offer superior protection from interference and have more features, and are also better when you need to support numerous machines in limited physical space.

Direct sequence products can operate at speeds ranging from 1 to 11 Mbps, and most products automatically can negotiate connection speeds between access units and network adapters, depending on the quality of the connection or the capabilities of the particular products. Frequency hopping products operate at either 1 or 2 Mbps. A thorough description of these two technologies, along with a complete description of the various standards, can be found at **http://www.wlana.com.**

Just because you have a wireless connection doesn't mean you can roam anywhere around your enterprise. If you have one IP subnet on floor 11 and another subnet on floor 8 of your building, you'll find none of the wireless LAN products will allow you to move easily between floors and different subnets. That is something to look forward to when these products support Mobile IP. For now, you'll have to design a single subnet if you want users to roam far and wide.

Finally, you'll want to consider your security policy when setting up your wireless LAN topology. You can allow anyone with a wireless adapter to connect to your network; or restrict users using a variety of security tools including knowing the correct network name, having a listed network adapter, and using the right encryption key. Each product has different kinds of tools for managing security -- see the following Orinoco tour screen shots on how this is set up on p.3, along with the section on security issues p.4.

Interoperability isn't always easy

Setting up wireless LANs with components from more than one vendor is possible, thanks to better implementations of the 802.11b standards. But it isn't always easy. There are several things to consider, if you do intend to mix and match components from different vendors. Here are some pointers as you go about testing the various products:

First off, *make sure that you have a working setup:* try connecting an Access Point and a wireless adapter from the same vendor to make sure that both products function as intended.

Next, *turn off any encryption.* Wireless LAN products have implemented encryption in many different mechanisms, with multiple parameters to adjust to get it working properly. To increase your chances of getting things to work,turn off encryption at both the Access Point and in the wireless LAN adapter settings. Once you get everything working, you can try to turn it back on for increased network security.

Understand that *each network uses the same ID number,* and make sure that you have specified these consistently and correctly among the Access Point and adapter settings. Different products call this ID number different things, such as an SSID, a Network Name, an ESS ID, or a Wireless LAN ID number. The trick is to find the right number (usually printed on the bottom of the Access Point) and typing it in correctly (some products are case sensitive, to make matters even more difficult) in the right place in the configuration screen.

Keep things close together for testing. Don't try to setup your wireless computer too far away from your access point: indeed,try setting them up initially side-by-side on the same desktop to facilitate the entire configuration. Otherwise, you may be running around your enterprise with little to show for it.

Adjust the channel/frequency settings and transmission rates when in doubt. Most products allow you to specify one of the 11 channels that are used in the frequency-hopping radio spectrum: if you are having trouble communicating between Access Points and adapters,try to set them to the same frequency and see if you can get a signal. If not, then adjust the data transmission rate downwards: most products allow you to set this as well, and it could be that the products are too far apart to maintain a signal that can support 11 Mbits.

Make sure you have the right network setting. Wireless LAN adapter cards can be setup in one of two modes: ad hoc or infrastructure. Ad hoc refers to peer-to-peer networks with-out any access points'; infrastructure refers to networks that make use of access points.

Finally, when in doubt, *try to install the product on Windows 98 Second Edition.* Other versions of Windows don't have the best support for drivers for wireless LANs, but most support Windows 98.

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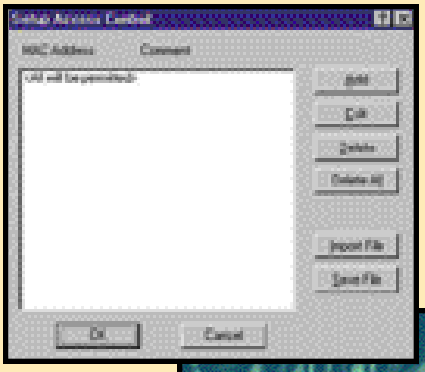
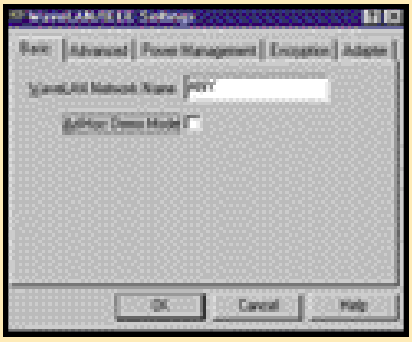
Orinoco quick tour

The hardest part about Orinico is picking the right product: Lucent offers several different models, including older pre-802.11b standards cards that ran at slower speeds and were marketed under the WaveLAN name. They offer Silver and Gold labeled PC Cards – the Gold card supports the same functions as the silver and also provides an enhanced data encryption model based on the RD4 algorithm.

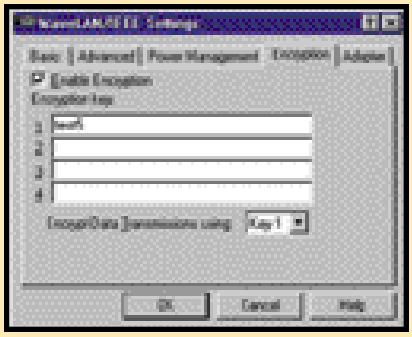
Setting up Lucent's Orinoco wireless adapters involves two basic efforts.First, you need to install the access point and set up its security appropriately. If you are concerned that only certain users have wireless access to certain access points, you'll need to note the media access control numbers of their particular wireless adapters and enter them in the Access Control screens in the WaveManager/AP program by pressing the Add button in the screen below:



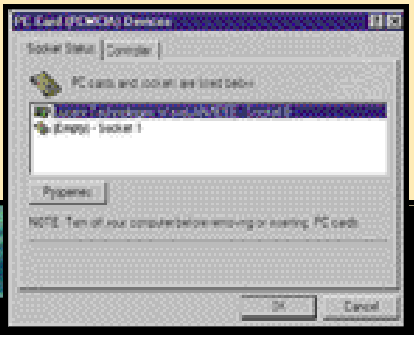
Next, you need to install the appropriate driver on each of your laptops that will use the wireless PC cards. If you are running Windows 98 or 2000, it should detect the card automatically. If it doesn't or if you are running Windows NT, go to the Control Panel, add new hardware, and select the Have Disk option, and point to the driver file on the software disk supplied with the card. Once you install the driver, you should be able to click on the adapter properties sheet and see the screen below. Choose the network name "ANY" (in all capitals) if you want to be able to roam around your entire enterprise without restriction. The "Ad-Hoc Demo Mode" check box is useful if you want to setup a peer-to-peer network without using any access points.



For added security, you can also setup the adapter to encrypt and decrypt all data transmissions. In this case, you need to enter a specific and identical five-character key on both the sending and receiving stations, using the Encryption properties sheet shown below.You can preset four different encryption keys and switch among them when communicating with different users, although only one key at a time can be active:



When you are done, your PC Card Control Panel properties sheet should look something like this, indicating that the wireless card is working properly:



Comparing Wireless Standards

Keeping track of the various wireless networking standards is getting tougher, particularly as they continue to multiply. Here are the three latest versions and what is involved in each.

	802.11 Wireless LAN	HomeRF	Bluetooth
Speed	1-54 Mbps	1-10 Mbps	30-400 Kbps
Range	100-300 feet	150 feet	30 feet
Radio Technology	Direct sequence and frequency hopping	Frequency Hopping	Frequency Hopping
Typical vendors	Cisco, Lucent, 3Com	Apple, Intel, Motorola	Ericsson, Nokia
Types of devices	PC and notebook connections	PC and notebook connections	Cell phone and handheld connections
Web site for more information	wirelessethernet.com hiperlan2.com	homerf.org	bluetooth.com

The 802.11 wireless networks standards actually encompass two very different sets of products and standards: 802.11a and 802.11b. While the 802.11b series has received the most attention and is the first to reach product maturity, the 802.11a series isn't far behind and should actually reach the market within the next year. (see article on wireless futures on p. TK) The 802.11b products are also called WiFi, for wireless fidelity, or wireless Ethernet in various places. The design goal for these types of networks is to replace wired Ethernet cabling with radio waves, but still be able to deliver the traditional office and network applications, including web browsing, email, and document sharing. A good discussion of the various wireless LAN standards and technologies, written by long-standing wireless LAN vendor Proxim, can be found here at **http://www.proxim.com wireless/whiteppr/wlangde.shtml**

HomeRF, for Home Radio Frequency, is another wireless standard. With products from Intel, Proxim, Compaq and others, it is geared towards lower-cost and shorter distances than the WiFi 802.11b product line, and thus more suitable for home uses. It also was designed from the start to support low-latency integrated voice/data applications, something that the 802.11 products are not designed for. It extends the European standard for wireless telephones called Digital Enhanced Cordless Telephony, which is used in wireless PBX equipment there.

The HomeRF standard is different from the HomePNA standard, or Home PhoneLine Network Architecture. PNA is strictly a wired connection, making use of two wires as would be found in almost every modern home. Ordinary twisted-pair Ethernet wiring uses four wires: PNA enables PCs to be connected over standard telephone lines, and more importantly, to share the phone line concurrently with regular voice calls. Another advantage of PNA over ordinary Ethernet is that no hub is required: it is a daisy-chain connection from one PC to another, similar to the original PhoneTalk wiring from Apple.

What is WiFi?

The Wireless Ethernet Compatibility Alliance has assembled an interoperability series of tests and certification procedures for wireless LAN 802.11b products. Founded by 3Com, Cisco Systems, Intersil, Lucent Technologies, Nokia and Symbol Technologies, WECA is now supported by more than 60 leading companies. When a vendor's product passes all tests, which are independently administered by a California testing laboratory, they are allowed to use a Wi-Fi logo, which stands for wireless fidelity. This is a good indication that products will interoperate with each other, although you will still need to adjust their configuration parameters to make them work (see sidebar on Interoperability Isn't Easy p. 2).

Wi-Fi offers plenty of promise and will expand the geographic availability of wireless LANs substantially as its popularity spreads and as broadband providers such as MobileStar (see the On the Road sidebar on p. 5). Already frequent travellers are seeing wireless access points in major airports and some hotels, making it easier than ever to connect when on the road.

Even Starbucks is getting into the wireless scene. Working with Microsoft and MobileStar, they will deploy wireless networks in several stores across the country. This means customers can work on their email and enjoy a fresh latte.

As interoperability issues are resolved and as more products come to market, prices will continue to drop, making wireless networks more affordable to wider audiences, including homes. Analysts are predicting wireless network adapters for under $100, which will be a big milestone in the minds of many consumers. Cahners In-Stat Group predicts more than ten million Wi-Fi products will be installed by the end of 2001.

Wireless Security Issues

While wireless LANs are a tremendous means of adding mobility to your network users and increasing the reach of your networks, they can also create security problems since anyone with a laptop and a wireless LAN adapter can gain access to your corporate network. Here are some tips to keep your network secure, and still enjoy the freedoms of cordless computing:

-- *Does your product support access control lists?* If so, then you can limit your network to particular user names. Of course, as your network grows and changes, maintaining these access control lists can be time consuming.

-- *Does your product authenticate individual adapter cards?* Some products can authenticate individual adapters by Ethernet addresses or tie them to particular user names. Again, this helps increase overall network security.

-- *What are the various key lengths supported for encrypted conversations?* Each wireless LAN product supports a variety of encryption key lengths and pass phrases. The idea here is the longer the key and pass phrase, the better your chances are of keeping your data secure. Regardless of whatever encryption scheme you use, you increase your security significantly, since you make it harder for someone to walk or drive by your enterprise and obtain a network connection if all communications must be secured. All products must support a 40-bit key if they are to be WiFi certified, but a potential network hacker can break a 40-bit key. Thus, many of the products support longer keys, such as 64-bit and 128-bit. The 128-bit keys are almost impossible to break, and used by the banking industry to secure their communications. And, you need to make sure that encryption is enabled on all of your access points if it is to be effective.

-- *Can your product support restricting access points by specific MAC addresses?* Some of the products require the media access controller address of the access point before you can connect to the network. While this isn't as good as encrypting the entire conversation, you can prevent people walking through your building from gaining casual network access with these products.

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Laptops with integrated wireless LAN adapters

The most noticeable part of any wireless LAN is the actual wireless network adapter. This usually takes the form of a PC Card with a small antenna sticking out the side. Depending on the vendor, the antenna can be anywhere from a short tab to something that is integrated into the laptop.

There is also a range of wireless desktop network adapters available. These typically are PCI adapter cards that can have room for a PC Card adapter that sits inside the computer housing. Some products, such as Netgear's NetBlaster, have externally mounted antennas with a short cable, which can help improve reception and increase overall network throughput when compared to those products that come with fixed,internal antennas.

Toshiba and IBM have taken this level of integration a step further, and now sell several of their laptops with built-in wireless LAN adapters:there is nothing further to add to the computer to have it make a wireless connection. Models include the Satellite Pro 4600 and IBM Thinkpad i series models, among others.

Apple has taken a middle ground in terms of integration: their latest laptops come with built-in antennas, but still need an additional $100 AirPort card to function on wireless networks. For example, in the iBook portables you need to install the card underneath the removable keyboard to provide a complete wireless LAN setup.

Applications for wireless LANs

Wireless LANs have many different applications,from reaching into locations around your enterprise that are impossible or expensive to wire to connecting new users and enhancing new methods of computing.Here are some of the more significant applications:

• *Doctors and nurses in hospitals* are more productive because hand-held or notebook computers with wireless LAN capability deliver patient information instantly.

• *Consulting or accounting audit engagement teams* or small workgroups increase productivity with quick network setup.

• *Network managers in dynamic environments* minimize the overhead of moves,adds, and changes with wireless LANs,thereby reducing the cost of LAN ownership.They can also add network connections in older buildings that can be expensive to wire, and provide *mission-critical backups* for wired networks.

• *Training sites at corporations and students at universities* use wireless connectivity to facilitate access to information,information exchanges, and learning.

• *Retail store owners* use wireless networks to simply frequent network reconfiguration.

• *Trade show and branch office workers* minimize setup requirements by installing preconfigured wireless LANs needing no local MIS support.

• *Warehouse workers* use wireless LANs to exchange information with central databases and increase their productivity.

• *Senior executives in conference rooms* make quicker decisions because they have real-time information at their fingertips.

On the Road With Wireless

Need to find a wireless Internet connection when you are on the road? For a small monthly fee, you can subscribe to MobileStar's publicly available wireless Internet locations at many airports and hotels. Go here for more information: **http://www.laptoptravel.com/wireless/**

Wireless Futures

The 802.11 series of products may be getting th e most attention, particularly as prices drop and interoperability improves, but there are other developments in wireless LANs worth considering.

Despite the numbering scheme, there are two distinct standards and work is progressing on both fronts. The 802.11a standard-based products transmit data at 5 GHz and uses frequency division multiplexing. This differs from the 802.11b standard products, which transmit data at 2.6 GHz and use direct sequence spread spectrum multiplexing. The 802.11a products can be more office-friendly since they are less prone to interference from other radio devices, and also because they transmit at a higher frequencies than the 802.11b products. The 802.11a standard supports data rates up to 54 Mbps, which is five times as fast as the 802.11b products.

Two of the chipset manufacturers for the 802.11a standard will support several slower connection speeds as well,including 6,12,24,36, and 48 Mbps. This makes products build with these chipsets more flexible, and able to adapt to a wide range of environmental conditions, including longer distances for wireless connections and able to connect through denser walls and other structural elements. The 802.11a and 802.11b technologies can coexist, however, because they use different signaling. This means you can mix both products in the same office as your bandwidth needs increase.

As both sets of 802.11 products become more popular, prices will continue to decrease. In the past year, the 802.11b products have dropped by several hundred dollars per unit, making them more and more attractive to a wider audience.

Another technology is called HiperLAN2. It features several improvements over the 802.11 products, including having a connection-oriented protocol that can support quality of service metrics,along with higher throughputs and automatic frequency allocation. Why is this important? Quality of service is used to build multiservice networks,meaning networks that support a wider array of applications. HiperLAN2 networks will also incorporate improvements in security and better handovers when moving between local and wide areas as well as between corporate and public environments.Finally, they will offer increased throughput for the ever-demanding need for better performance for video-streaming applications, among other bandwidth-hungry uses.

HiperLAN2 operates at 54 Mbs and at 5 GHz on the radio spectrum. To achieve these high data rates, HiperLAN2 makes use of a modularization method called

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Orthogonal Frequency Digital Multiplexing (OFDM) to transmit the analogue signals. OFDM is very efficient in time-dispersive environments, e.g within offices, where the transmitted radio signals are reflected from many points, leading to different propagation times before they eventually reach the receiver. Above the physical layer, the Medium Access Control (MAC) protocol is all new which implements a form of dynamic time-division duplex to allow for most efficient utlilization of radio resources.

The 2Wire Home Portal: A Wireless Swiss Army Knife

2Wire makes an Access Point called the 100W Home Portal. It contains a variety of different connectors for both wired and wireless networks, in a small reasonably priced package. In addition to the 802.11b Access Point integrated into the unit, it is also an Ethernet-to-Ethernet firewall/router, meaning that you can use it to protect your home or small office network from incoming hackers. And it offers a bridge to PhoneLine networks as well, so you can use it to connect up wired computers with this networking topology. On top of all of this is a USB port, which means you can also use this to connect to computer that doesn't have an existing networking adapter, with a standard USB cable.

Given all these different connection possibilities, you would think setting up the Home Portal would be a challenge,

CDW product features chart

	Cisco 340	3Com Aironet	Nortel Networks	Linksys
Access Point				
Model #	AIR-AP342E2C	3CRWE74796B	DR4000E02	WAP11
Wi-Fi™ Certified	Yes	Yes	Yes	Pending
Available Data Rates (Mbps)	1, 2, 5.5, 11	1, 2, 5.5, 11	1, 2, 5.5, 11	1, 2, 5.5, 11
Claimed range (feet):				
Indoors (11Mbps)	80	300	80	164
Outdoors (11Mbps)	300	Info not available	300	820
Supports roaming between Access Points?	Yes	Yes	Yes	Yes
Supports SNMP	Yes	Yes	Yes	No
Supported encryption	40-bit, 128-bit	40-bit, 128-bit	128-bit	64-bit
Maximum # of clients	2048	63	500	32
Includes Site Survey Tool?		Yes	Yes	Yes
Warranty	One Year	Three Year	One Year	One Year
Adapters				
PC Card Model #	AIRPCM342	3CRWE73796B	DR4000001	WPC11
PCI Card Model #	AIRPCI342	3CRWE777A	DR4000005	WDT11
PCI Card - include PC Card?	Yes	Yes	No	No

and it isn't as easy as setting up a single-purpose wireless Access Point. However, 2Wire has done a solid job of distilling all the key points on a single page document, along with good step-by-step instructions.

Other products, such as those available from Linksys, incorporate print servers and other communications equipment as part of the Access Point. All of this is good news, particularly for remote office workers who are not networking experts and who benefit from this increased integration.

Feature checklist

When shopping for a wireless LAN, here are some of the features you should consider:

- List price of the adapter?
- List price of the access point?
- Types of adapters available: PC Card, ISA, PCI?
- Access point mounts on walls?
- Access point requires additional PC card adapters?
- High-gain antenna available for access points?
- Adapters have separate antennas?
- Which version of Windows supported (CE, 95, 98, NT, 2000, Me)?
- Macintosh and NetWare drivers available (3.x, 4.x, 5.x)?
- Network protocols supported (IPX, IP, NetBEUI, AppleTalk)?
- Supports DHCP networks?
- Support for SNMP management consoles?
- Signal strength meter and channel displays?
- Maximum number of concurrent users per access point?

Intel PRO/Wireless 2011	SMC	D-Link	Lucent ORiNOCO	Xircom
WEAP2011	SMC2652W	DWL-1000AP	AP-1000	APWE1120
Yes	No	Yes	Yes	Yes
1, 2, 5.5, 11	1, 2, 5.5, 11	1, 2, 5.5, 11	11	1, 2, 5.5, 11
100	82	114	80	100
400	524	328	525	300
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
40-bit, 128-bit	64-bit, 128-bit	40-bit	40-bit, 128-bit	40-bit
25	128	Info not available	60	64
Yes	No	Yes	Yes	Yes with PC card or kit
Three Year	Limited Lifetime	Lifetime	One Year	Limited-Lifetime
WPC2011	SMC2632W	DWL-650	848441556	CWE1120
WPCR2011WW	SMC2602W	DWL500	848463055	
No	Yes	Yes	No	

Wireless LANs explained!

- How to pick the right technology
- Understanding the various standards and what they mean for you

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