



The Wireless Networking Starter Kit 802.11g Update

802.11g's "Extreme" Emergence

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By Adam Engst and Glenn Fleishman (1/17/2003; revised 2/5/2003)

In 2002, Wi-Fi--mostly in the form of 802.11b equipment--ruled the land. The faster, 54 megabit-per-second (Mbps) 802.11a devices that shipped during 2002 seemed interesting, but because they used a different frequency than 802.11b and also cost more, only a small number of early adopters and testers bought in.

More promisingly, 802.11g winked at us from the horizon. That standard runs, like 802.11a, at 54 Mbps but with full backward compatibility with 802.11b. Because of political and technical conflicts, the specification's IEEE committee work dragged on, but a final version appears likely to be ratified by summer or fall 2003.

Technology doesn't wait for engineering groups, though: against some industry experts' better judgment, several companies have started to ship equipment based on chipsets that use a draft version of 802.11g to achieve the higher speed and better indoor signal characteristics.

Apple, of course, was one of the first out of the gate--just like with 802.11b--announcing new products under the AirPort Extreme name in January 2003 at the Macworld Expo. But Linksys, Buffalo, and Belkin--in roughly that order-- beat Apple to the punch by shipping a variety of gateways and adapters in December 2002 and January 2003, but Apple has released substantially more detail about their equipment while also offering a few interesting features in their new wireless gateway that may tempt people with no Macintoshes in sight.

In this addendum to [The Wireless Networking Starter Kit](#), we discuss the forward and backwards compatible issues with 802.11g and Apple's AirPort Extreme, and run through Apple and other vendor's equipment.

Moving Forward and Backwards

The 802.11g specification uses a relatively new method of encoding bits onto radio waves in such a way as to squeeze up to 54 Mbps of raw data across a single channel. (For the technical among you, this method is called Orthogonal Frequency Division Multiplexing or OFDM, and is similar to how DSL puts bits onto copper wire.)

As is the case with most theoretical network throughputs, the net throughput of real data--the actual contents of files or transactions--provides somewhere between 20 and 30 Mbps. In contrast, 802.11b's 11 Mbps raw throughput generally translated to 4 to 6 Mbps at best, and it wasn't uncommon to drop below that as distance from the base station increased.

802.11g is attractive because it includes full backwards compatibility with 802.11b. This compatibility isn't optional for manufacturers, but rather is a mandatory part of the spec. 802.11g also has several intermediate steps for speed, so you don't just drop from 54 Mbps all the way down to 11 Mbps.

One of 802.11g's big advantages over 802.11b is that it better handles the inevitable signal reflection. Radio signals bounce off different pieces of matter--floors, metal, even the air around you--at different angles and speeds. A receiver must reconcile all the different reflections of the same signal that arrive at slightly different times into a single set of data. 802.11g (like 802.11a) slices up the spectrum in a way that enables receivers to handle these reflections in a simpler but more effective way than 802.11b.

As of early 2003, 802.11g has not been finalized and ratified by the IEEE, the engineering group that develops new standards. Ratification should happen relatively soon, in summer or fall 2003. Until then, the 802.11g "standard," as Steve Jobs called it so confidently, remains in draft form, although that hasn't stopped several chip manufacturers from shipping the silicon necessary to implement the current draft of 802.11g. (Apple's Web site now calls 802.11g a draft, reflecting reality.)

Also note that the Wi-Fi Alliance hasn't included 802.11g as part of its certification suite. The Wi-Fi Alliance tests equipment to make sure it works according to spec and is interoperable with all other certified equipment, and if so, the maker is allowed to use the Wi-Fi logo. Until 802.11g is finished, the Wi-Fi Alliance has no way of guaranteeing that different 802.11g devices will work with one another, meaning that it will likely be some time after ratification that the Wi-Fi Alliance considers adding 802.11g to the Wi-Fi certification suite. Some of our sources speculate that a testing program could be in place as early as summer, but final certification almost certainly wouldn't start until at least late 2003.

That's not to imply that compatibility is likely to be a major problem. Manufacturers have significant motivation to maintain compatibility with other makers. No one wants to sell equipment that won't play nice with others because to do so would undermine confidence in the entire technology. In the worst case, unless a piece of hardware is designed extremely poorly, two incompatible 802.11g devices should be able to talk at 802.11b speeds.

Compatibility problems are particularly unlikely among different devices from the same manufacturer. Apple AirPort Extreme Base Stations will happily communicate with AirPort and AirPort Extreme cards, for instance. However, good compatibility likely goes farther. Apple's equipment relies on chips from Broadcom, as does 802.11g gear from Linksys. For that reason, and because Apple and Linksys represent the largest early 802.11g consumer market share, it's likely that Apple and Linksys equipment will be compatible. Later equipment makers will have to meet Broadcom's specs rather than vice-versa. Sometimes standards are set merely by shipping the most devices.

One way or another, compatibility will not be an issue in the long run, whether you buy hardware now or later. Apple has promised firmware upgrades as the standard stabilizes, and Apple has done a good job thus far providing these kinds of updates to the older AirPort equipment.

On a related front, several companies have not yet committed to or rejected support for WPA (Wi-Fi Protected Access), the security update that fixes encryption problems and removes complexity from securing local wireless network connections. Apple, for instance, said that they will monitor whether

Sidebar: Is 802.11a Dead?

Apple has chosen to not support the existing 802.11a specification as part of AirPort Extreme. 802.11a operates in the 5 GHz band and its use of a different frequency means that it is not backwards compatible with 802.11b. Several companies offer dual-band 2.4/5 GHz radios now, but that approach increases cost and complexity.

Because of this lack of compatibility with millions of 802.11b devices currently in use, Apple CEO Steve Jobs said that 802.11a is doomed to failure, but it's more appropriate to say that 802.11a is now relegated to niche status for particular purposes, such as dense installations in corporations, server room backup links, or high-speed point-to-point bridges.

Because 802.11a has 12 distinct channels that can be used without interference in the same place, it offers an advantage for scenarios in which avoiding interference is important.

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WPA becomes widely adopted and evaluate their response based on usage; their support would appear in the form of a free firmware update. D-Link, by contrast, says their new 802.11g devices will support WPA with a firmware upgrade by the second quarter of the year.

Apple AirPort Extreme Base Station

Apple offers two different AirPort Extreme Base Station models, priced at \$200 and \$250. Both units have 10/100 Mbps WAN and LAN ports, sport a USB port for printer sharing (but not spooling), and can bridge to other AirPort Extreme Base Stations, acting as an access point and a bridge simultaneously. The \$250 unit also includes a 56K modem and a jack for an external antenna.

(Early reports from Apple don't make clear whether the company will only offer a Macintosh configuration utility, or provide an unsupported or supported Windows console as well, as they do with the older "snow" Base Station.)

The 10/100 Mbps bump up in speed on the WAN port recognizes that some users might be hooking into wide-area networks or broadband connections that provide more than 10 Mbps of bandwidth (that's unfortunately not true for us, so we can't test that feature). If you're only running a 10 Mbps wired Ethernet, it might also be time to upgrade to 10/100 Mbps switches if you're also installing AirPort Extreme equipment to take full advantage of the intra-network speed.

The addition of USB printer sharing enables a network of Macs to share a printer without connecting the printer to a Mac that must be turned on whenever anyone on the network wants to print. However, the printer itself must be turned on: Apple confirmed that this feature is indeed "printer sharing," which means makes it seem just like the printer is connected to each machine, rather than "printer spooling," in which print jobs are sent to the print spooler, stored in a file, and then printed out whenever the printer becomes available. (Adam absolutely adores print spooling because his printer is seldom on, and whenever he turns it on, his print spooler immediately prints all the waiting print jobs.)

In the past, adding an external antenna to an AirPort Base Station required serious surgery that made a mockery of your warranty and required significant manual dexterity. Now, with the \$250 model of the AirPort Extreme Base Station, you can simply plug an external antenna into the Apple-proprietary antenna jack.

Don't blame Apple for yet another proprietary jack--the FCC mandates that any wireless networking equipment that can take an antenna must feature a hard-to-find connector. That's because the FCC doesn't want just anyone attaching uncertified antennas that could spew more than the legal amount of signal. (An uncertified antenna is anything that the manufacturer didn't have the FCC test with a given gateway or card.)

You'll be able to buy two external antennas for the AirPort Extreme Base Station. Both initial models are made and marketed by veteran Mac firm [Dr. Bott](#). Apple said that they didn't want to get into the antenna business, but Apple is having the entire \$250 AirPort Extreme Base Station plus Dr. Bott antenna system certified by the FCC. (Companies pay a separate fee for each certification--which may account for part of why the cheaper AirPort Extreme Base Station doesn't have an external antenna jack.)

The Dr. Bott ExtendAIR Omni (\$100) is a 3.5 dBi omnidirectional antenna suitable for extending the range of an AirPort Extreme Base Station in all directions; the ExtendAIR Direct (\$150) is a 6.5 dBi 70-degree directional antenna. (For more on antennas, read Chapter 8, *Going the Distance*, pages 223-256.)

Although you can still use the 56 Kbps modem (v.90, not v.92, unfortunately) to connect via a dialup Internet connection, you might still want the modem-equipped version of the AirPort Extreme Base Station even if you have a broadband connection to the Internet. That's because the AirPort Extreme Base Station also supports PPP dial-in connections. Forget a file while you're traveling? As long as your Mac is turned on and has file sharing enabled, you can use your laptop's modem to dial up your AirPort Extreme Base Station and retrieve that file. Exactly how this feature will work won't be clear until we can test the hardware, but it could be a welcome addition. (Of course, this assumes a phone line dedicated to incoming data calls.)

The AirPort Extreme Base Station's bridge feature (see illustration) is unique for equipment in this price range. It enables you to extend the range of a network without wires. Just buy two AirPort Extreme Base Stations, connect one to your Internet connection, and set the other to work in bridge mode. The bridge unit connects both to the master AirPort Extreme Base Station and act as an access point for computers within range. In the past, you would have had to spend well over \$500 to buy a single device that could act an access point and bridge simultaneously, or combine separate pieces of equipment like the Linksys WAP11 and WET11 to achieve the same effect. (See pages 152-160 for more on bridging.)

Remember that even if you don't have a single AirPort Extreme card or 802.11g adapter on your network that two AirPort Extreme Base Stations can connect to each other at the full 54 Mbps raw speed of 802.11g. If your wired network runs at 100 Mbps, the high-speed bridging is another reason for the 10/100 Mbps WAN port on the new units.

With AirPort Extreme Base Stations, you could locate islands of wired and wireless access in various locations without running wire among those islands. This could allow you to create larger coverage area or connect neighboring buildings or homes.

Although the AirPort Extreme Base Station bridging works with up to four units at once, you cannot daisy chain the AirPort Extreme Base Stations in bridging mode; all the bridged units must each connect back to the master unit. In more extensive installations, you could run Ethernet among several master AirPort Extreme Base Stations and still use bridging on the edges of the network.

Apple AirPort Extreme Card

The new AirPort Extreme Card is based on the mini-PCI Card form factor, and has a new shape and connector. The card is built into every 17-inch PowerBook G4, and is a user-expandable or build-to-order option with the 12-inch PowerBook G4, 17-inch LCD iMac, and all PowerMacs. The PowerBooks were announced at the same time as AirPort Extreme, while the revised iMac and PowerMacs appeared in late January and early February.

These two PowerBook models also have built-in Bluetooth and a pair of antennas. Apple said that the two antennas reconfigure themselves

reserved in the upper end of the 5 GHz band for 802.11a outdoor, point-to-point use can employ higher power levels, which may provide a better throughput than 802.11g in the same circumstances.

A recent compromise in the US between the military and the wireless industry should open up even more 5 GHz spectrum, which could increase speeds or extend coverage.



dynamically to provide either antenna diversity for better reception of Wi-Fi or 802.11g signals, or for one antenna to be dedicated to Bluetooth and the other to 802.11 depending on what's needed. (The 17-inch iMac has had two antennas since its introduction in January 2002. Both it and the PowerMacs have optional internal Bluetooth support.)

The antenna redesign also solves a problem inherent in the Titanium PowerBook G4 design which restricted the signal strength entering and leaving the computer. In the new PowerBook G4 aluminum case design, the antennas are located at the top of both sides of the LCD display with rubber seals providing radio "transparency."

Will there be an upgraded AirPort Extreme card for older Macs? The answer is a firm no. Greg Joswiak, Apple's VP of hardware product marketing, confirmed for us that the older AirPort card relied on a too-slow bus, or communications channel, inside each Mac. This slow bus can't operate at the speed required by 802.11g, thus making it impossible to revise the card or plug a different card into that slot.

We originally expected that Apple would take months to release revised motherboard designs to support AirPort Extreme, but they quickly pushed out new models. The 15-inch iMac, 15-inch PowerBook G4 Titanium, the eMac line, and the iBook line still offer no Apple support for Extreme at this writing.

It's certain that other companies will step up to the plate as well, such as Asanté, Proxim, MacWireless, and Belkin, all of which have a history of supporting Macintosh networking. These companies typically release PC Cards first, meaning that only certain PowerBook models would handle 802.11g. PCI card adapters are already shipping, and we might see Ethernet or even FireWire (USB is too slow for 802.11g) converters as well.

Other 802.11g Makers

Although Apple is early with 802.11g, it's not the first to ship products. Linksys gets that honor, having pushed out its first "54G" gateways and cards before the end of 2002, with Buffalo shortly behind. D-Link and Belkin aren't far behind. (Prices are all the lowest price at Amazon.com or via the companies' online stores.)

Belkin: Many Mac users know Belkin as a cable company, but the firm has been shipping a variety of networking products, including inexpensive Bluetooth adapters, for some time. By the time you read this, the company plans to ship four devices: a wired/wireless gateway (F5D7230-4, retail price \$150), a plain access point (F5D7130, \$140), a PC Card (F5D7010, \$80), and a PCI card (F5D7000, \$80). Belkin has promised drivers for its 802.11g gear by February for Mac OS 8.6 and later.

Linksys: Linksys has two 54G gateways and two cards. The WRT54G is a combination wired switch and wireless gateway which updates their BEFW11S4 model (\$130). The WAP54G is a simple access point that adds 802.11g support to the WAP11 (\$130). The WPC54G PC Card (\$70) is available now, and the WMP54G PCI adapter (\$70) is coming soon. Linksys has little to no Macintosh support for any of its existing products.

D-Link: D-Link is offering products under the complicated brand name of AirPlus Xtreme G. They also have a wired/wireless gateway (DI-624, \$150), plain access point (DWL-2000AP, \$140), PC Card (DWL-G650, \$80), and PCI Card (DWL-G520, \$90). D-Link has offered limited AppleTalk support in its previous offerings, and Mac drivers are unlikely.

Buffalo: Buffalo has its AirStation G54 Broadband Router Access Point (WBR-G54) for a retail price of \$200 and a PC Card (WLI-CB-G54) for \$100. Street prices should be less. The company has offered limited Mac support in the past.

Future of G

The future of 802.11g is bright given its advantages, and the early rush to push products into the marketplace. Buying equipment now should cost only a slight premium over later prices: Apple probably won't adjust its prices much, if at all, based on its history, and 802.11g devices from other manufacturers will probably drop only \$10 to \$30 over the course of 2003 unless major manufacturing breakthroughs occur or chip prices plummet.

We're bullish on 802.11g because it's backwards compatible, and because it doesn't rely on unproven technology. Faster speed at about the same price? Count us in.