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Wi-Fi tweaks for speed freaks

How to get the most out of your home or small-business wireless network

Brian Nadel

August 19, 2008 ([Computerworld](#)) One thing you can depend on these days is that the claims made for wireless routers, like 300Mbit/sec. throughput and 1,000-foot range, are nothing more than digital pipe dreams. The plain and simple truth is that these speeds and distances just aren't going to happen in your home, office or any place on this planet.

If you're disappointed by the speed and reach of your wireless network -- and who isn't? -- there's a lot you can do to grab every last bit of data and foot of range. I spent a few hours optimizing my network and more than doubled its indoor range from 90 to over 200 feet (with an additional 150-foot extension into my backyard) while increasing performance fifteenfold -- all with a two-year-old 802.11g router.

Some of the techniques I used are basic, like where and how to set up the router. Others are more involved and require special equipment, but they can make a world of difference. Plus, for those who don't know what to do when the data connection goes south, I've also included a troubleshooting checklist that can help get your network back into the fast lane.

The beauty of modern Wi-Fi equipment is that it all works together, so you can build a network with best-of-breed gear. For instance, my network has a router from one maker, antennas from another, a print server from a third and client radios from several different companies. Think of it as the [U.N.](#) of wireless: the world cooperates to make your online life a little easier.

Setup: Location, location, location

Where you put the router and how it's set up are two of the most important -- and often ignored -- aspects of creating an efficient wireless network. Most people put the router in the first place that comes to mind. Big mistake.

Think of the router as the center of a sphere of connectivity that extends out in all directions from its antennas. My advice is to put the router as close as possible to the physical middle of the home or small office it needs to cover. Start with a building floor plan or rough drawing, and draw diagonal lines from the corners to mark the center.

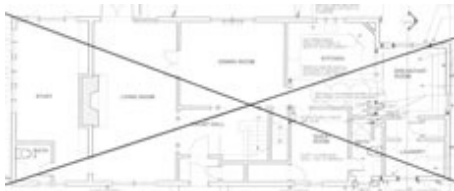
Of course, some people -- including me -- can't follow that advice. Perhaps you have a stone wall or a brick chimney in the middle of the building, or, as in my case, the cable line enters the building in the worst place possible. If for these or other reasons you can't put the antenna in the ideal center location, don't despair; I have solutions for you later.

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Using a floor plan to find the center of the building. [Click to view larger image.](#)

Now, look around and find a good home for the router. Avoid corners (particularly in older buildings), which diminish the signal as it passes through, and don't put the router in a closet. A great place to stash a router unobtrusively is in a bookcase or an entertainment center.

The router will need an AC outlet and connection to your cable or Digital Subscriber Line data source, but if the building's DSL or cable modem line is in an inconvenient place, don't panic. You can use a directional antenna (see "Antennas and boosters: Blasting the signal," below) or extend your DSL or cable line.

If you choose the latter, you'll find that snaking wires through walls to put your router exactly where it needs to be is dirty and expensive work, and it can cause damage. Instead, consider FlatWire TV Inc.'s [thin coaxial](#) or [Ethernet cables](#). Enclosed in a tape one-hundredth of an inch thick, the cable sticks right onto the wall.



FlatWire sticks right on the wall.

After routing the FlatWire to where it needs to be, cover it with a thin coat of joint compound or plaster and then paint right over it; it'll be your secret. The cable comes in 10- and 20-foot lengths, and the whole project should cost between \$80 and \$120.

Configuring the router: Details, details

Now that everything's in the right place, turn on the router and enter your security settings (see our story "[How to protect your wireless network](#)" for details). Next, adjust the router to operate at full power. Many routers come with it set to 75% or -- worse -- to automatically adjust. I've found it's much better to just blast as much signal as you can.



Setting the router to a single Wi-Fi protocol.

[Click to view larger image.](#)

Finally, set the router to use only one 802.11 protocol. Using mixed-mode operation, which is the Esperanto of Wi-Fi because it works with 802.11b, g and n clients, slows the data down. By working with just 802.11g clients, my router's performance nearly doubled, from 1Mbit/sec. to 2Mbit/sec. throughput at 70 feet. (Of course, you'll need to make sure all your connected devices are set to use the protocol you choose. If they don't all support that protocol, you'll need to forgo this tip or invest in new equipment.)

Antennas and boosters: Blasting the signal

Almost every wireless equipment maker uses cheap antennas for its products. While the typical wireless router comes with dinky stub antennas that are rated at a gain of 2dBi, there are devices available that are many times more powerful at transmitting and receiving data.

(For those of us who slept through high school math and science classes -- myself included -- the [dBi scale](#) for measuring an antenna's power uses the logarithmic scale. Every increase of 3dBi translates into a doubling of the power.)

Installing a better antenna is easier than you might think -- that is, if your antennas are removable. It's a crapshoot, but if your antenna or antennas are on the outside of the router and come off when you gently twist them counterclockwise several rotations, you're in luck. If not, your router's antennas can't be easily upgraded.

If your antennas are removable, installing new ones doesn't involve any software. After removing the old antennas, just screw the new ones on, and power up the router. That's it.

Picking the right antenna can be hard because there are so many to choose from. The simplest ones are broadcast the signal out in all directions, ideal for setups where the router is placed near the middle of the building. For instance, Cisco-Linksys LLC's [HGA7S high-gain stalk antennas](#) (\$50 a pair) are about three times bigger than the devices that come with a typical router and are rated at 7dBi, which more than doubles the signal's power. The problem is that they're so big they flop over; fortunately, the company includes a clip to keep them up.

But let's say you're like me and you can't put the router at the center of your building. There's help, because a directional antenna aims the signal to a specific part of the building in a cone-like pattern. These antennas are not perfect -- there's always some leakage out of the back -- but that leakage can actually be an advantage by providing connectivity behind the antennas.



Hawking Technologies' HAI7MD Hi-Gain 7dBi directional compact antenna.

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For example, I have my router and antennas situated about eight feet from one end of a long, narrow house. My main work area is behind and to the left of the antennas, but I still get great connectivity in that area.

For my setup, I use a pair of Hawking Technologies Inc. [HAI7MD Hi-Gain 7dBi directional compact antennas](#) (\$40 each) that push the signal across the building to cover the entire structure. Using them raised my router's range from 90 to 125 feet, although one end of the basement, which has several stone walls, was still a dead zone.

If you have dead spots that a powerful antenna still can't fill, as I did, it's time to investigate amplifiers, also known as signal boosters. These devices, which plug in between the router and the antenna, boost the network's broadcast power.



The Hawking HSB2 Hi-Gain signal booster.

[Click to view larger image.](#)

I use a Hawking [HSB2 Hi-Gain signal booster](#), which increases the network's broadcast power to 500 milliwatts, about 10 times the output of the typical router.

To add a signal booster, unscrew the antenna from the router and screw the antenna cable into the input of the booster amp. (If your router has internal antennas or external ones you can't remove, your best bet is to

[use a wireless or powerline extender](#) instead of an amp.) Next, plug the output of the amp into the router and fire it all up.

With the directional antennas and the amp, my network's range rose to over 200 feet, and the signal now reaches throughout the basement.

One last tip for indoors: It takes two to tango wirelessly, and the client receiver is just as important as the router. The dirty secret of notebooks with built-in Wi-Fi is that they often have low-gain antennas that are buried inside the case.



Hawking's HWUN1 Wireless-300N USB adapter.

[Click to view larger image.](#)

A good way around that problem is to use an external radio -- a solution that does the trick for desktop computers as well. I chose Hawking's [HWUN1 Wireless-300N USB adapter](#) (\$75), which has a pair of stub antennas and can work with 802.11b, g and n networks. It raised the signal strength on the margins of my network from 15% to 80%.

The best part is that those antennas can be replaced with high-gain antennas (as outlined above) to push the digital envelope even further.

Results: Boosting the signal indoors

	Range	Bandwidth 70 feet from router
802.11g router plus ...	90 feet	2Mbit/sec.
Included 2dBi stub antennas	125 feet	10Mbit/sec.
7dBi directional antennas	200 feet	15Mbit/sec.
7dBi directional antennas and 500mW amp	225 feet	17Mbit/sec.
7dBi directional antennas, 500mW amp, and external radio on notebook		

Source: Author's testing

Repeaters: Taking it outside

Now that my home and office are bathed in Wi-Fi, what about the patio? One of the best ways to coax Wi-Fi into new places is to retransmit the signal. It generally works, but the setup and configuration are a little more complicated than just playing around with antennas and signal boosters.

Manufacturers use different terms for their devices, but extenders, bridges, expanders and repeaters all do essentially the same thing: send the signal into new parts of your building (or outside it). For instance, the [Linksys WRE54G range expander](#) (\$80) receives the router's signal and retransmits it with the full power of an access point.



The Linksys WRE54G range expander.

[Click to view larger image.](#)

Placement is critical. Unfortunately, my first choice, right by the back door to the patio, was out of range of the router. As a result, the configuration software couldn't find the device.

I moved it closer to the router, and the software went through its configuration sequence without a problem. After I entered my network's details, the repeater started sending the signal an extra 150 feet into my yard.

Repeaters can be frustrating to use if you let the router pick its IP address. The device will need to be restarted fairly often. My advice is to give the repeater a static IP address using the router's setup screens. To avoid IP conflicts, pick an address that's not likely to be used; my favorite is 192.168.1.240.

Another approach is to use a powerline repeater, which sends the data over the building's AC power lines and then broadcasts a fresh signal. These systems have two parts: a sender, which plugs into a network port of your router and a nearby AC outlet, and a receiver that plugs into an outlet where you need the Wi-Fi signal broadcast. In other words, the systems use a combination of Ethernet cable (from the router to the powerline sender), AC wires (from the sender to the receiver) and Wi-Fi (from the receiver to the remote computer).



Netgear's WGXB102 powerline extender kit.

[Click to view larger image.](#)

Like wireless repeaters, powerline repeaters won't work everywhere. Because they rely on the [HomePlug AV](#) standard, communication between the sender and receiver is limited to about 200 feet of behind-the-wall electrical wiring. The result is that, particularly for old buildings, rooms that are on different circuits might not be able to communicate.

It's also important that the sender and receiver are plugged directly into their respective AC outlets, because surge suppressors can interfere with putting the data cleanly onto and taking it off of the power line.

I tested Netgear Inc.'s [WGXB102](#) (\$130 for the kit). Rather than coming with Dynamic Host Configuration Protocol (DHCP) automatic IP addressing enabled, the WGXB102 comes set up with the static address of 192.168.1.121, which should be just fine for most users. Just change the configuration to your network name and security settings, and it's ready.

Well, almost. I tried plugging the receiver into the same outlet that worked for the Linksys wireless repeater, but it was a nonstarter. Ironically, the outlet closer to the back door and farther from the router worked just fine. It turns out that while the outlet next to the router and the one by the back door are on different floors, they share the same circuit breaker and are able to connect cleanly, extending my network an additional 175 feet.

In my tests, the powerline extender gave me a slightly greater range but a slightly slower speed than the wireless extender, as shown below.

Results: Extending the range outside

	Range	Bandwidth 70 feet from extender
802.11g router plus... 7dBi directional antennas, 500mW amp and wireless extender	350 feet	10Mbit/sec.
7dBi directional antennas, 500mW amp, wireless extender, and external radio on notebook	380 feet	12Mbit/sec.
7dBi directional antennas, 500mW amp and powerline extender	375 feet	9Mbit/sec.
7dBi directional antennas, 500mW amp, powerline extender, and external radio on notebook	390 feet	11Mbit/sec.

Source: Author's testing

Note that the data throughput is slower outside than inside the house. For one thing, the directional antennas and amp are set up for maximum effect inside the building, not outside. We're also now quite far from the router, and you lose some bandwidth by running the data through an extender. Using the Hawking 300N radio client, which clips right onto the notebook, helps a bit, but you still won't see the kind of speeds you do indoors.

Warning: There's a dark side to extending a network. Now that the wireless signal extends past my physical home or office, I'm more vulnerable to a rogue hacker stealing my bandwidth or -- worse -- taking over my network. It's doubly important to use the router's security abilities to their fullest.

Software: Keeping an eye on your connection

While much of optimizing a Wi-Fi network involves hardware, software can play an important part. Some routers, like those from Linksys, come with monitoring software that keeps track of the hardware that's connected and can do simple repairs; you typically set up this software during the initial network configuration.

Several other programs can be helpful as well. There's nothing like knowing how fast your network is, and an online bandwidth monitor like Speedtest.net or Alken (both free) can show your IP address as well as how fast data is flying -- or crawling -- into and out of your computer.

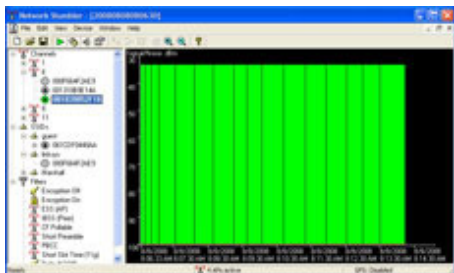
Dozens of these services are available online, and they all give wildly different speeds, so it's important to pick one and stick with it to compare speeds as you tweak your network configuration.



Speedtest.net provides an online bandwidth meter. [Click to view larger image.](#)

If things are moving slowly on your computer, [JiWire Inc.](http://JiWire.com)'s free [Wi-Fi Security Test](#) might figure out why. After interrogating your system, it displays your encryption type, signal strength and channel you're using, plus any obvious security holes you have.

If all you want is the basics of your network's operations, try [NetStumbler](http://NetStumbler.com), which is also free. It has been around for years and is technically still a beta, but it's still the best way to see what networks are active in your area and what channels they're using so you can avoid interference.



NetStumbler knows all and tells all about your network. [Click to view larger image.](#)

It'll also show how your signal strength has changed over time with a cool bar graph.

Wi-Fi troubleshooting checklist

Using the tips outlined above, your wireless network's range and speed should increase dramatically. But that doesn't mean your network will be completely without hiccups. Here are 10 steps to try if you've got a dead or weak connection:

- Make sure that the cable or DSL modem and your router are connected and that everything's powered up.
- Restart the router and PC to renew DHCP licenses.
- Call your Internet service provider to see if it's doing maintenance or repairs to its network.
- Got the latest firmware and client software? Get it.
- Try to connect to the Net with a LAN cable. If that works, there's something wrong with the wireless portion.
- Interference from cordless phones, baby monitors or even a powerful nearby network can knock your network out. Try a different channel.
- Slow connections can occur when too many clients are connected or someone is a data hog. If you notice a sudden slowdown, scout around on your network to see if somebody might be watching videos or otherwise hogging bandwidth. You could ask that person to cool it while other users are connected, or try quality-of-service (QOS) software such as [JDSoft Bandwidth Manager](#), which lets you monitor network traffic and prioritize data flow across it.
- Getting "IP conflict" error messages? Consider using static IP addresses.
- If all else fails, it's easy to reset the router to its factory configuration and start all over again.
- Think you're done? Not yet. Before you forget it all, draw a map of the network with all the details scribbled in -- log-in names, passwords, IDs, static addresses and so on. Even if it's not completely up to date the next time you have a problem, the map will help you figure out what's what -- that is, if you remember where you put it.

Have Your Say

[Share your Wi-Fi tips and tweaks](#)

Brian Nadel is a freelance writer based near New York and is the former editor in chief of Mobile Computing & Communications magazine.