

IT INFRASTRUCTURE

Mixing Wired and Wireless Networking in Your Home

David Chernicoff presents an overview of wired and wireless networking configurations for your home.



David Chernicoff

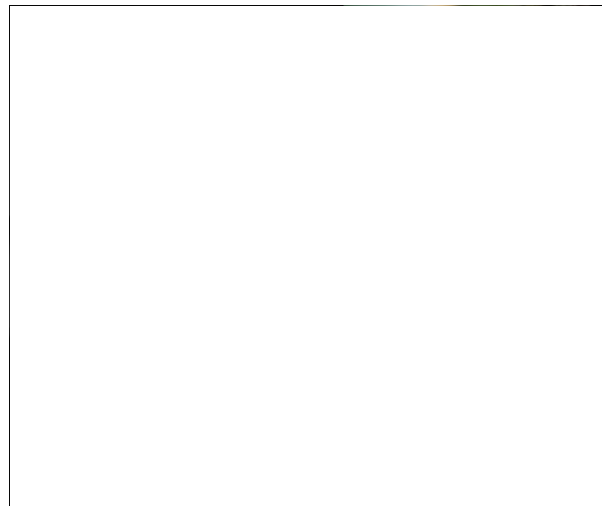
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Although the idea of a completely wireless home network is compelling, in most cases, a mixed wired/wireless environment will serve your needs better. This week, I outline the basic differences between the two network topologies and give you some guidelines for using and combining them for the best performance.

The most obvious difference between wired and wireless networking is speed. Wired Ethernet is 100Mbps (100Base-T) or 10Mbps (10Base-T). Wireless Ethernet is either 11Mbps (802.11b) or 54Mbps (802.11a). Few people use 10BaseT any longer; 100Base-T has replaced it in almost every product. Most network hubs use auto-switching or auto-sensing; the hub can determine the highest performance available to the attached network card and can switch between the two speeds. 10Base-T and 100BaseT technologies are compatible with each other; with the appropriate hub, you can use them in mixed networks.



The two wireless Ethernet standards aren't compatible with each other. Select the standard you want to use and purchase appropriate equipment for all your computers. As I write this, 802.11a devices cost two to three times more than 802.11b devices. Although 802.11a and 802.11b standards are in place, you should purchase all your wireless equipment from the same vendor. Experience has shown me that mixing flavors of 802.11 devices and software can add significant complications. For this story's wireless testing, I used access points and client devices from [Belkin Components](#).

In terms of network performance, wireless can't compete with wired networking, even when you compare 11Mbps wireless with 10Mbps wired. (The best you can hope for is equivalent performance, and you'll rarely receive that.) Wireless-network performance can vary widely

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from published specifications. My own experiences have convinced me to expect performances that are about half of the published performance specifications.

Even when a wireless network works properly, large file transfers are problematic. I hear numerous complaints from wireless users about copying large Outlook .pst files from a desktop to a notebook using a wireless link. As file size increases (greater than 100MB), wireless file transfers tend to fail.

The second difference between wired and wireless networks is convenience: Not needing to run wires is obviously an attractive proposition. But although wireless vendors want you to believe that wireless networking is as simple as plugging in their devices, the reality is quite different. To help, I've written an overview of wired and wireless networking configurations.

Wired and Wireless Networking Configurations

Before I outline a basic configuration for mixed wired and wireless networking, I'm going to make two presumptions: Your network is connected to the Internet, and you use the network for more than sharing Internet access. If you simply want to share an Internet connection among multiple computers, little can go wrong. Regardless of how fast your Internet connection is, it will be slower than even a slow wireless connection, so your bottleneck will always be that Internet connection. Because of the nature of networking, performance doesn't become a concern until you start moving files between machines on the internal network.

Ethernet is a shared-bandwidth technology: The available network bandwidth is divided by the number of users on that segment. Let's look at the math; an 11Mbps network pipe can move, at best, a little less than 1.4MB of data per second (the reality is that you'll rarely exceed more than 1MBps). A common bandwidth for LAN-based streaming video is 300Kbps, so at best, you can play four concurrent streams at full bandwidth. In reality, you'll likely be limited to three streams, presuming there isn't other network traffic.

How about playing music? The average MP3 track is about 3MB, so copying the MP3 file will take about 4 seconds if you have the wireless network to yourself. As you add additional traffic, the copy time increases. If you're playing streaming audio, you have the same problem as when you play streaming video: If you don't have enough bandwidth to play the stream you selected, you'll start to get drop outs, or the selection will stop playing.

A wired 100Mbps network gives you at least nine times the theoretical network bandwidth, but pulling network cable might not be practical or possible in your networking environment. The trick is to combine wired and wireless networking in a manner that maximizes the advantages of each, while minimizing the disadvantages. To help you, I'll walk you through a typical home-networking scenario using examples from my home-networking experiences.

For your wired network, use switched 100Mbps networking. Using a network switch, rather than a hub, can provide full 100Mbps bandwidth to each port on the box. Switches are available from several vendors for less than \$200. Most business-grade computers come with a built-in 10/100 network card; otherwise, you can buy one for less than \$25 from major vendors. Make sure that the switch you buy has enough ports for your existing network and any planned expansion.

For your wireless network, you might choose networking equipment according to what your company office uses if you transport your wireless-capable notebook between office and home. In my case, I swap wireless cards between home and office because my office wireless network uses a high-security model, which isn't necessary in my home. And swapping network cards (one shows up as Network Connection #2, the other as Network Connection #3, and their connection information is specific to each card) is easier than reconfiguring a card each time I switch wireless environments.

Now let's look at how to use your equipment. First, determine your wired network's central location, which might be the location of your file server or where your Internet connection enters the house—the more central the location, the better. (In my case, the central point is my home office because that's where my Internet connection and file servers are.) Then determine where your wired connections can reach.

My home is a contemporary wood frame structure with a full basement, which makes wiring the house much easier. I placed a network switch in the basement and measured the distance from the switch to where I wanted to come back up to the first floor. I bought premade cables in the required lengths (inexpensive Cat5 cables are available in lengths up to 100 feet) and was able to string wire to all the desired locations on the first floor (e.g., stereo rack, kitchen, family room, living room).

The network switch in my office connects to my Internet edge device, (a desktop computer running Windows XP and Internet Connection Sharing—ICS—which provides a firewalled Internet connection for all networked computers through my satellite Internet connection), my primary office desktop system, and a collection of servers I use for testing. My home network also includes two laser printers and two inkjet printers that connect to computers on my network's wired section. My music server contains two network cards—one attached to each of my 100Mbps switches, even though the switches themselves are connected through an uplink port. This setup gives all my connected computers enough bandwidth for playing music.

This configuration worked well until my kids decided that they needed computers in their bedrooms, which are on the house's second floor. I didn't want to pull cable through the walls from the first floor, so it was time to go wireless. I also wanted network connectivity in my garage for my custom car-programming hobby, and the garage doesn't have the advantage of basement connectivity.

My first attempt at wireless connectivity didn't go well. With the wireless access point on the highest shelf in my office, I had an effective range of about 30 feet, which didn't reach either child's bedroom. I could get a wireless connection in the guest bedroom directly above my office, but even though the access point was less than 10 feet from the notebook in the guest bedroom, I couldn't connect at speeds greater than 2Mbps (as reported by the wireless NIC's configuration utility). I tried a higher-gain antenna to increase the access point's range, but it offered little improvement. And I couldn't get any wireless connectivity in my garage, even though the access point was less than 15 feet away.

The garage problem offered clues that helped me diagnose why my network range was so limited. My house's insulation includes multiple layers of aluminum backing, and when I pulled aside one of the accessible layers of insulation in my garage, a weak signal got through. My entire house has the same insulation, but with two sets of exterior walls between the access point and the garage, a reliable wireless connection wasn't possible. I've seen this type of problem in my company office. My desk is less than 20 feet from our departmental access point, but I could never connect faster than 2Mbps and rarely had a signal strength greater than 65 percent. Between the access point and my office are two solid steel-studded walls and a lot of fluorescent fixtures. I recently moved my office to the other side of the building, approximately 60 feet from the same wireless access point, yet I get a good 11Mbps

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connection and a signal strength greater than 80 percent. The difference is that the new office has a straight shot through open doorways to the wireless access point. Minimal electrical and metal interference made this location more effective for wireless connectivity.

To deal with my home's poor overall connectivity, I decided to use two access points—one on each end of my house. I set up a 4-port 100Mbps hub and a second access point in the corner of the breakfast area, which already had a wired connection. This configuration let me cover the kids' bedrooms above and the deck behind the house. I also plan to add a third wireless access point so I can have wireless connectivity in the garage and driveway, which will make accessing stored data used for programming my car much simpler.

You probably don't have or want to buy the test equipment to evaluate where to locate network access points, so here's a suggestion: Buy a 100-foot Cat5 cable and use the cable to test your access points in various locations. Place the access point, then walk around your house with a notebook computer with a wireless card installed and the network link application running. This process shows you how well the wireless connection will work.

Note that the wireless access points I'm using are attached to dedicated ports on 10/100Mbps network switches. All the computers in my home office are on their own switched connections. The computers in the kitchen are on a 4-port 10/100 hub along with one of the wireless access points, making the hub the most congested connection on the network, but the computers connected through this hub are rarely used at the same time.

Here are some key points for wiring your home or small office/home office (SOHO):

1. Use wired connections where possible.
2. Use switches, rather than hubs.
3. Test your wireless connectivity before committing to it.
4. If wireless connectivity is necessary, consider using multiple access points for complete coverage.
5. Locate servers on wired connections.
6. Make sure your primary Internet connection has a wired connection to your internal network.
7. Consider usage patterns before installing your network.
8. Plan the installation. Cables are inexpensive, so lay out connections, both wired and wireless, before pulling cables through walls.

If you have specific questions about your networking installation, post them to our online forum. I'll be there to answer your questions and share my experiences.

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David Chernicoff

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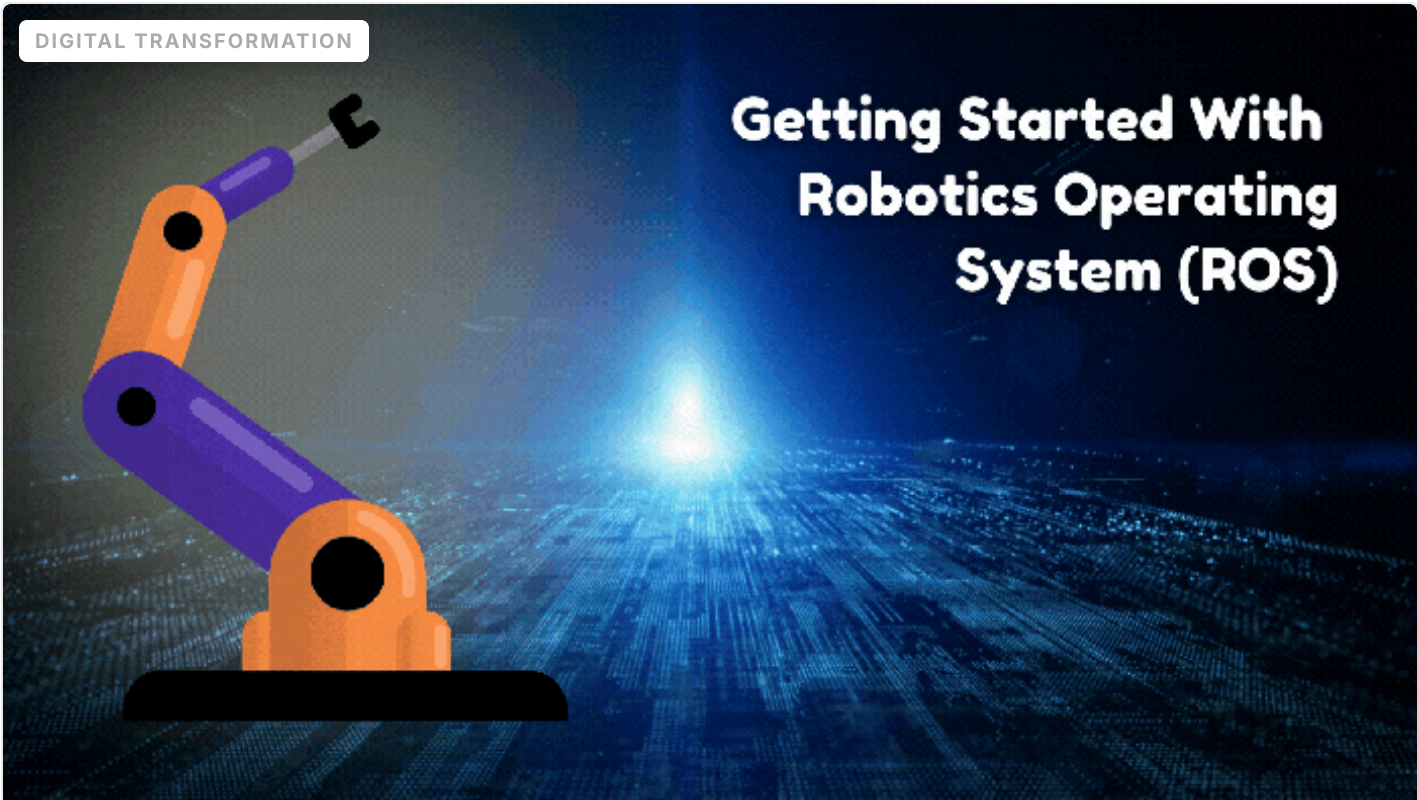
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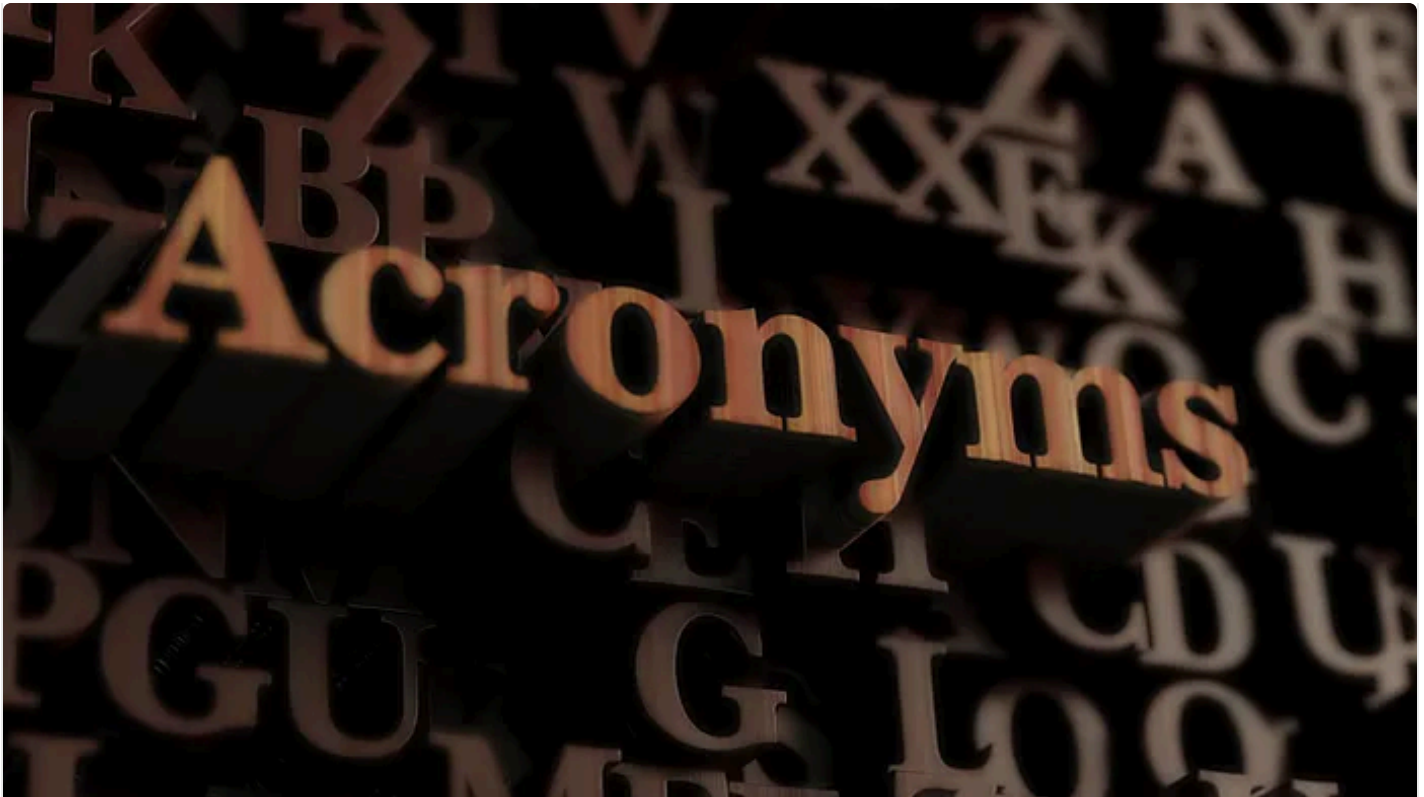
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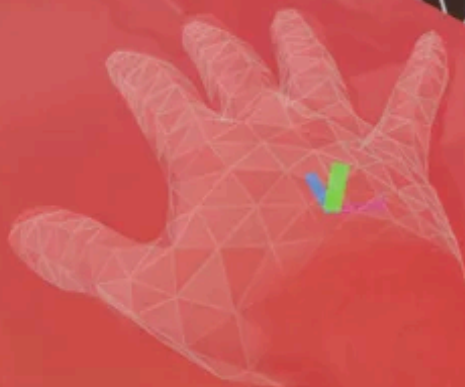
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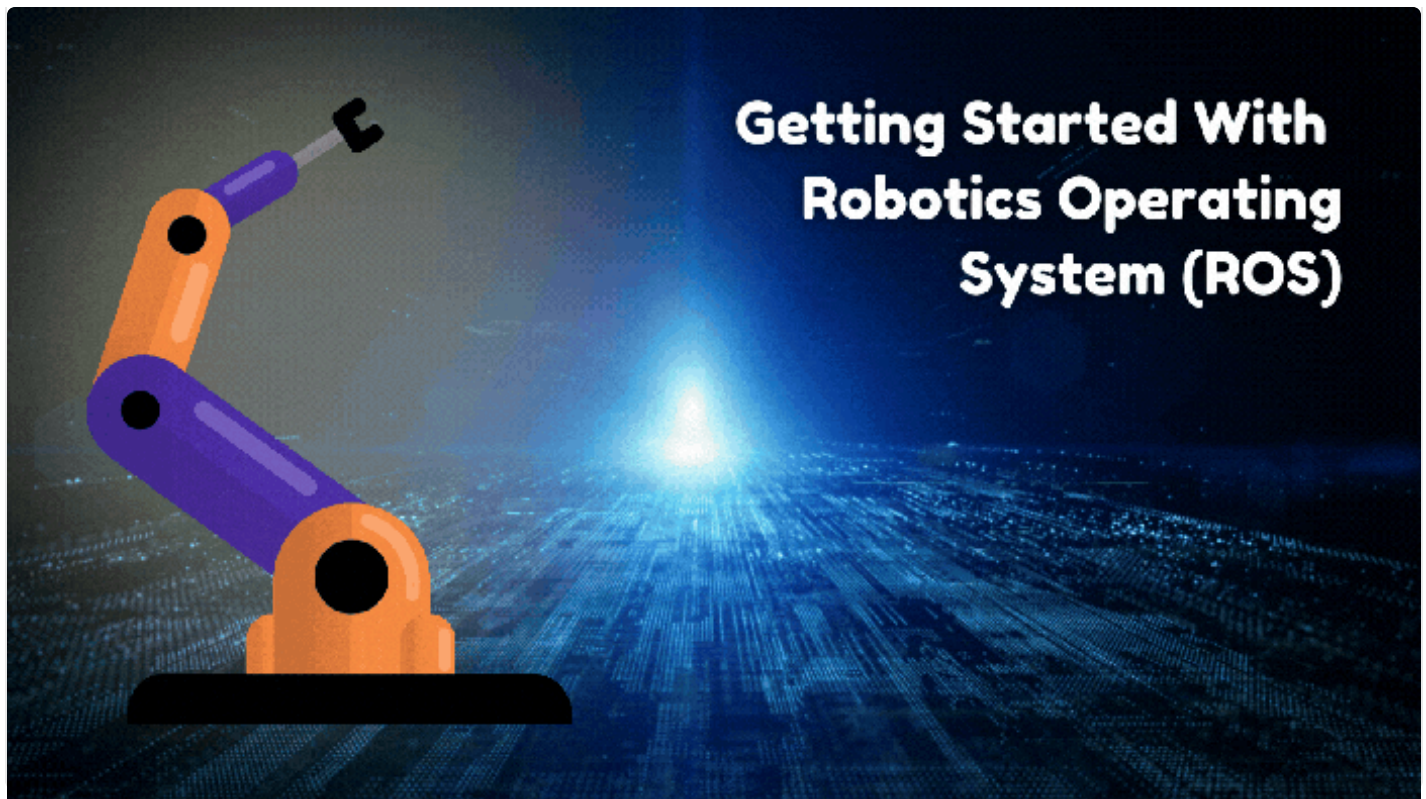
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