Building a simple network, part 1

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What it's all about
Planning and building your simple network.

What you take away
An overview of the essential components that make up a simple network and a walkthrough of the building process.

Summary
More and more people want to wire up their hodge-podge of equipment into working networks. In this Daily Drill Down, Brien Posey examines the reasons for setting up a simple network and the primary components you'll need to complete your project.

There are many reasons for building a simple network. For one thing, you'll be able to share resources from individual workstations. For example, you probably don't have separate printers for each workstation. Wouldn't it be nice to print from anywhere? Or maybe access the Internet from multi-workstations simultaneously?

Once you've made the decision to create a simple network, you need to decide on the scope of your project. How many PCs will you be attaching to the server? Will there be a server, or will each workstation serve up its individual resources as necessary? Most importantly, are you going to purchase any new components to upgrade your existing equipment? Do you need to purchase network cards, and what type of cabling needs do you have? If you plan on incorporating more than two workstations into your network, you'll need to get a hub. Hubs enable information to be distributed across the network by passing the information across the network according to your requests.

After you decide on the answers to these pressing questions, it's time to decide on the network software that you want to use. For simple networks, you can always enable the built-in networking components for Windows 95/98. Or, if you need a little more power, you can investigate Microsoft Windows NT Server or Novell's NetWare.

As computer prices fall, it's becoming more common for people to own more than one PC. PCs (for example, home PCs) can now be networked similarly to an office system. In this Daily Drill Down, we'll discuss whether a simple network is right for you and what the most important parts of a simple network are. Later in the series, we'll show you how to put the pieces in place, one at a time.

Why network?
There are many reasons for building a simple network. For example, you may need to share a single printer between PCs. You may also need several PCs to access the same files. Other reasons for building a simple network include wanting to share Internet use among PCs or playing multi-player games.

Before you decide to build a network, you'll want to know what purpose it will serve. If all you want to

do is share a printer, it may be more feasible to buy a switch box than to invest in a network. If, on the other hand, you want to exchange large files between PCs, you'll want to build a network.

The components
First, determine how many PCs you plan to network. Take the number of PCs that you own (or plan to buy) and multiply by two. As technology improves and prices drop, you may buy more computers. You should always plan for expansion.

Except for the case of connecting two PCs only, networking requires that you connect each PC to a hub, a device that distributes information to each PC. Hubs can range in price from fifty dollars to many thousands of dollars.

If you only have two PCs and don't plan on buying new ones any time soon, you'll be able to network them with a crossover cable instead of a hub. A cross-over cable is exactly like the wire that connects a PC to a hub, except that two wires are reversed at one end. Rather than connecting one end to the PC and one end to the hub, the ends plug directly into the two PCs' network cards.

You'll need a network card for each PC on your network. Each PC will also require an operating system that facilitates networking. And finally, depending on your needs, you may want a server. The prices of these components vary greatly. Cheap and expensive components usually differ in performance and quality. In the section that follows, we'll discuss these components and what you can expect to get for your money.

Let's look more closely at the types of components that are available and the cost and performance issues associated with each.

The hub
Your hub is the backbone of your network, distributing traffic among all the connected computers. Hubs cost anywhere between about fifty dollars on up to many thousands of dollars, depending on features such as type, speed, number of ports, and whether the hub has diagnostic capabilities.

There are two basic types of hubs-active and passive. Passive hubs, which connect two or more PCs, are cheaper. Active hubs regenerate the inbound signal and pass that signal between all of the attached PCs. They also monitor collisions, which are caused when two PCs try to send a packet of information across the network at the same time. Because collisions destroy both packets, they must be regenerated. Active hubs can tell the PCs on the network that there has been a collision, so that they may resend their packet.

Hub speeds may be 10 Mbps (megabits per second), 100 Mbps, or a combination of the two (10/100 Mbps). 10 Mbps hubs are the cheapest and the 10/100 Mbps hubs that can switch between the two speeds are the most expensive because they use extra circuitry to regulate traffic.

To save some money, you can attach 10 Mbps or 10/100 Mbps network cards to a 10 Mbps hub. All cards will run in 10 Mbps mode. However, you can't connect a 10 Mbps card to a 100 Mbps hub. To use 10 Mbps cards, you must have either a 10 Mbps or a 10/100 Mbps hub.

You'll want to examine the number of ports available on the hub. Hubs typically have between 4 and 96 ports. It's always advisable to get a hub with more ports than you actually need in case you decide to

add computers to your network. Of course, if price is an issue, you could always buy a small hub now and link it to another small hub later.

For example, if you have three PCs on your network, a 4-port hub is fine. However, if you add two more PCs, you'll either have to buy a larger hub or have to buy another small hub (in this case 4 ports) and link the two together. Linking hubs doesn't require that the hubs be of the same brand or size, only that they are of compatible speed.

The final thing that you should look for on a hub is its diagnostic ability. A malfunctioning network card can flood your network with traffic and bring down the network. A hub with diagnostic capabilities can sense a malfunctioning network card and automatically isolate it from the rest of the network before it can do any harm. Expect to pay a premium for such functionality. A 16-port 10/100 Mbps hub with diagnostic capabilities typically costs around $800, although if you shop around, you can sometimes find generics for as little as $300. You can see an example of a high-cost 16-port hub in **Figure A**.

Figure A
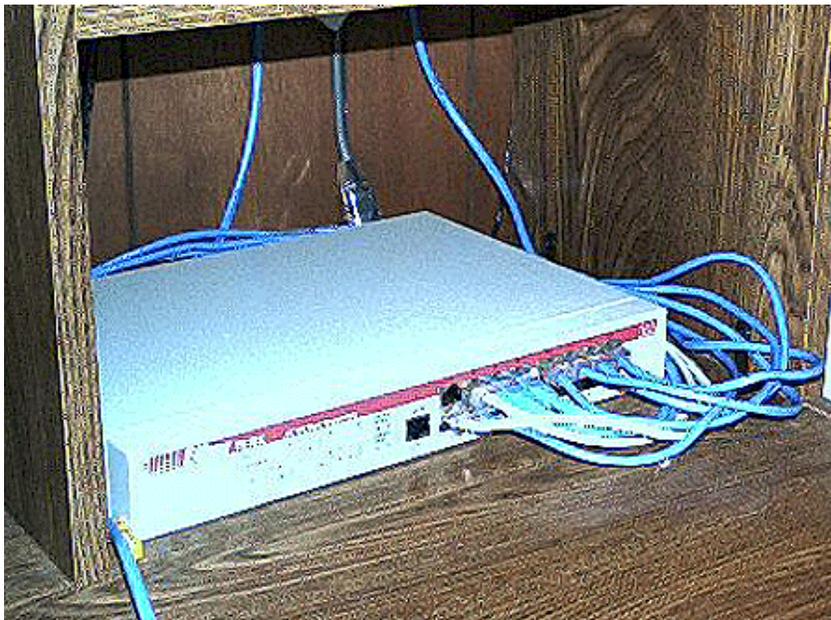
16-port hubs with dual speeds and diagnostic capabilities can be expensive.

Network cards
The type of network card you buy will be one of the limitations on your network's speed. Network cards are available in 10, 100, or 10/100 Mbps speeds. The 10/100 Mbps switching cards give you the most value. Surprisingly, there's little difference in price for generic PCI network cards. All network cards used must be the same speed, either 10 Mbps or 100 Mbps, unless the hub can switch between 10/100 Mbps. Or, if two PCs are being connected with a crossover cable, one 10/100 Mbps card may be used to connect with one 10 or one 100 Mbps card.

You can get a good quality generic PCI 10/100 network card for less than $20.00. If you decide to go with a name brand, the price goes up. For example, a 10/100 Mbps PCI network card from 3Com costs about $70.00. The only real differences in the cards are that 3Com drivers are much easier to track down and are often easier to install than generic drivers.

You'll also want to consider the type of PCs that you have. So far, we've given you estimates for PCI network cards, but some older machines are limited to using ISA cards. Generic ISA network cards cost around $30.00 and are usually (if not always) limited to running at 10 Mbps. You can see an example of such a card in **Figure B**.

Figure B
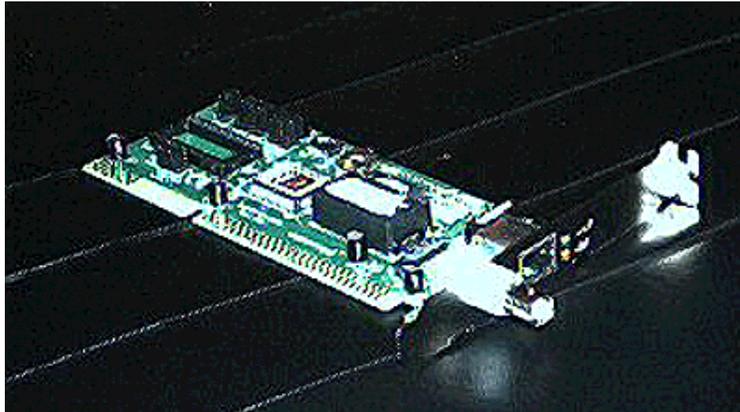
ISA network cards are usually limited to 10 Mbps speeds.

Notebook PCs require either a docking station that supports a network card, or a PCMCIA network card. A PCMCIA network card is a network card that's about the size of a credit card. It plugs into your notebook's PC card socket. PCMCIA network cards typically cost more than conventional cards. Expect to pay at least $100.00 for a PCMCIA network card. Unlike ISA cards, though, PCMCIA network cards are available in 10 Mbps and 10/100 Mbps designs. You can see a PCMCIA network card in **Figure C**.

Figure C

Notebooks require a PCMCIA network card.

Cable
Cable prices can vary drastically depending on the type of cable that you purchase and on the place that you order it from. Before we continue, we should clarify our use of the word cable. After all, there are countless varieties of computer cables. For the purposes of this Daily Drill Down, we'll be discussing twisted pair cable. Although other types of cable, such as fiber optic and coax, may be used for networks, they're usually impractical for simple network use. Both are expensive and somewhat more difficult to install than twisted pair.

With that said, you should also understand that there are several different types of twisted pair cable. The first difference is in the category number. Generally, category three and category five cable can be used for networks. The difference between the two is cost and the speed at which it can carry data. The category five cable has more twists per foot, thus making it less susceptible to radio interference.

Category three cable can carry data at 10 Mbps, while category five cable can carry data at 100 Mbps. Given the fact that category three cable is only slightly less expensive than category five cable, you're usually better off with category five.

If you shop around, you can find category five cable for about ten cents per foot, or for about $100.00 for a box containing 1,000 feet of cable. However, there are various types of category five cable, some of which may cost around $2.50 per foot.

The differences in cable are mainly in the type of shielding that it contains. Standard twisted pair is commonly referred to as UTP or unshielded twisted pair. Since this type of cable contains no shielding, you're limited to running the cable 100 meters or less. For longer spans, you can use STP or shielded twisted pair cable.

Connectors

When you buy a box of cable, you get just that-a box of cable. Unfortunately, you can't plug a raw cable into your PC. Instead, you must attach RJ-45 connectors. These connectors resemble the ones used on telephone cords, except they are larger.

As with most items, the cost of RJ-45 connectors depends on where you buy them. Typically, prices on connectors range from twenty-five cents to $1.00 each. There's usually no difference in quality, so shop around for the cheap ones.

When you buy RJ-45 connectors, remember you'll need one for each end of each cable that you run. For example, if you're running five cables, you'll need ten connectors.

Buy plenty of extra connectors. It takes a certain amount of skill to correctly place the connectors onto the cable. And once a connector is crimped in place, it can't be reused.

Finally, you'll need a crimper. You can buy a crimper from the same place that you buy the RJ-45 connectors. RJ-45 crimpers, such as the one shown in **Figure D**, usually cost around $40.00.

Figure D

You must use a special crimper to connect RJ-45 ends to network cables.

Operating systems
So far, we've examined the hub, network cards, and cabling for your network. However, your PCs are just as important. Unless you plan on installing a dedicated server, your PCs must be running Windows for Workgroups, Windows 95, Windows 98, or Windows NT because of their file and print sharing abilities (your PCs can be running a mixture of these operating systems). For the purposes of this and future Daily Drill Downs in the series, we'll assume that you're running Windows 98.

Server
Most simple networks don't use a server. You can easily accomplish file and print sharing, Internet sharing, and multi-player games without one. Such an arrangement is called a peer-to-peer network. A peer-to-peer network allows each user to determine which of their PC's resources, if any, they wish to share.

A network using a server is called a client/server network. The advantage of a client/server network is

that it is much easier to manage than a peer-to-peer network. Naturally, a client/server network is more expensive to install than a peer-to-peer network.

For starters, you'll need a fairly powerful PC to act as the server. Although this PC doesn't have to have multiple processors or a RAID array, like commercial servers, it should have plenty of memory and disk space.

However, the machine is cheap compared with the cost of the server software. A copy of Windows NT Server or of Microsoft BackOffice and five user licenses can set you back anywhere from about $800 to $3,000, depending on what you get. If you really want a server but are on a shoestring budget, there's a way of getting the server software at a huge discount.

No, we're not talking about bootlegging or piracy. We're talking about getting the software for educational purposes. If you own a business or belong to a company that's primary focus is in certain areas of information technology, you can get such software at huge savings.

To do so, simply go to the Microsoft Direct Access site. The Direct Access software collection frequently changes, but it's not uncommon to find great prices on Windows NT Server or Microsoft BackOffice.

If you try the Direct Access site, but still have no luck, simply buy an MCSE training kit from Microsoft. The majority of these kits contain evaluation copies of the software that they train you on. You can get these training kits directly from Microsoft Press or from most bookstores.

Conclusion
Building a simple network is easier than ever. However, before you start building a network in your basement, you need to do some serious planning. In this Daily Drill Down, we've discussed the hardware requirements and the costs associated with building a simple network. In part 2, we'll explain the types of network connections available, as well as the costs involved.

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