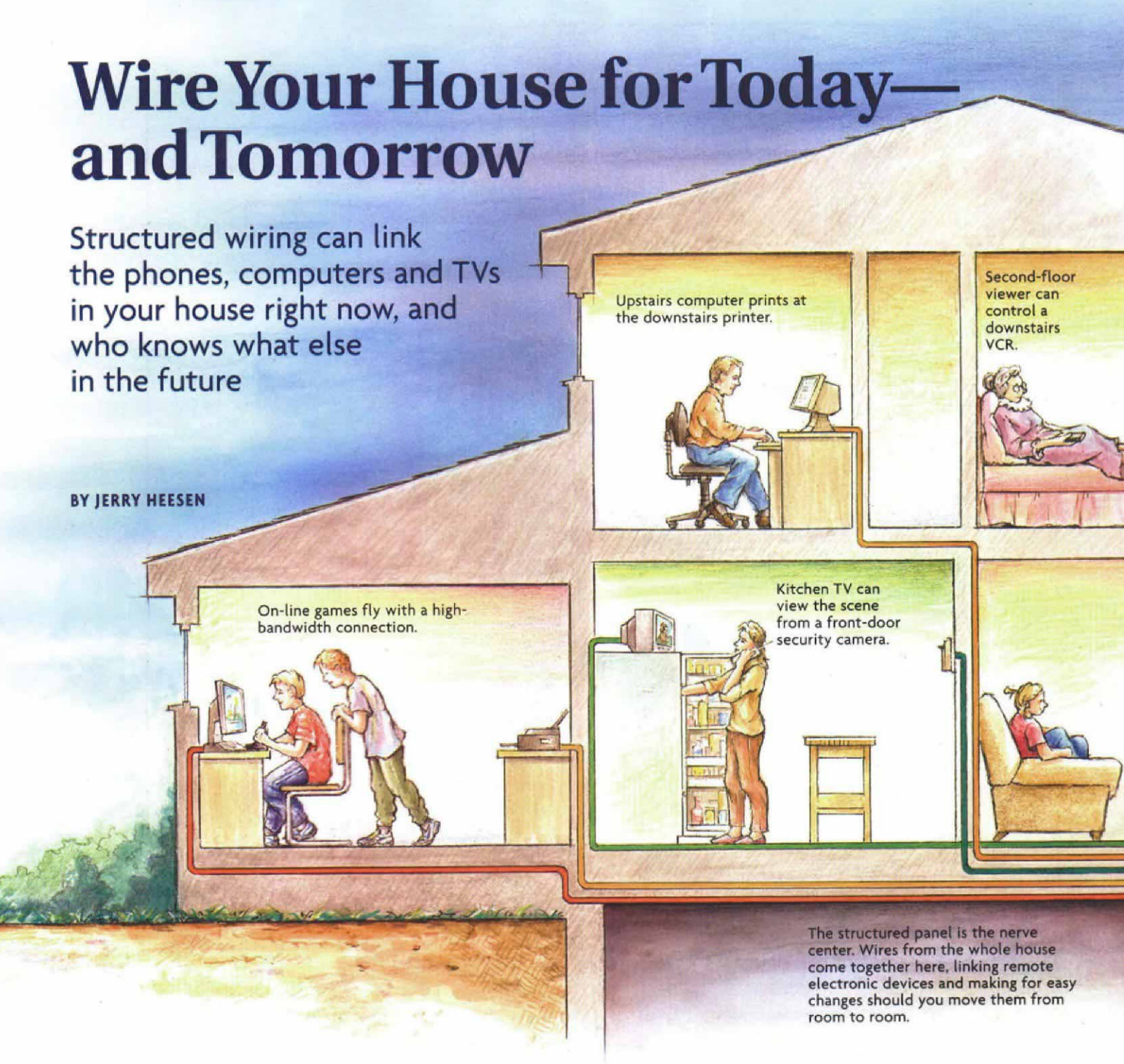
Wire Your House for Today—and Tomorrow

Structured wiring can link the phones, computers and TVs in your house right now, and who knows what else in the future

BY JERRY HEESEN



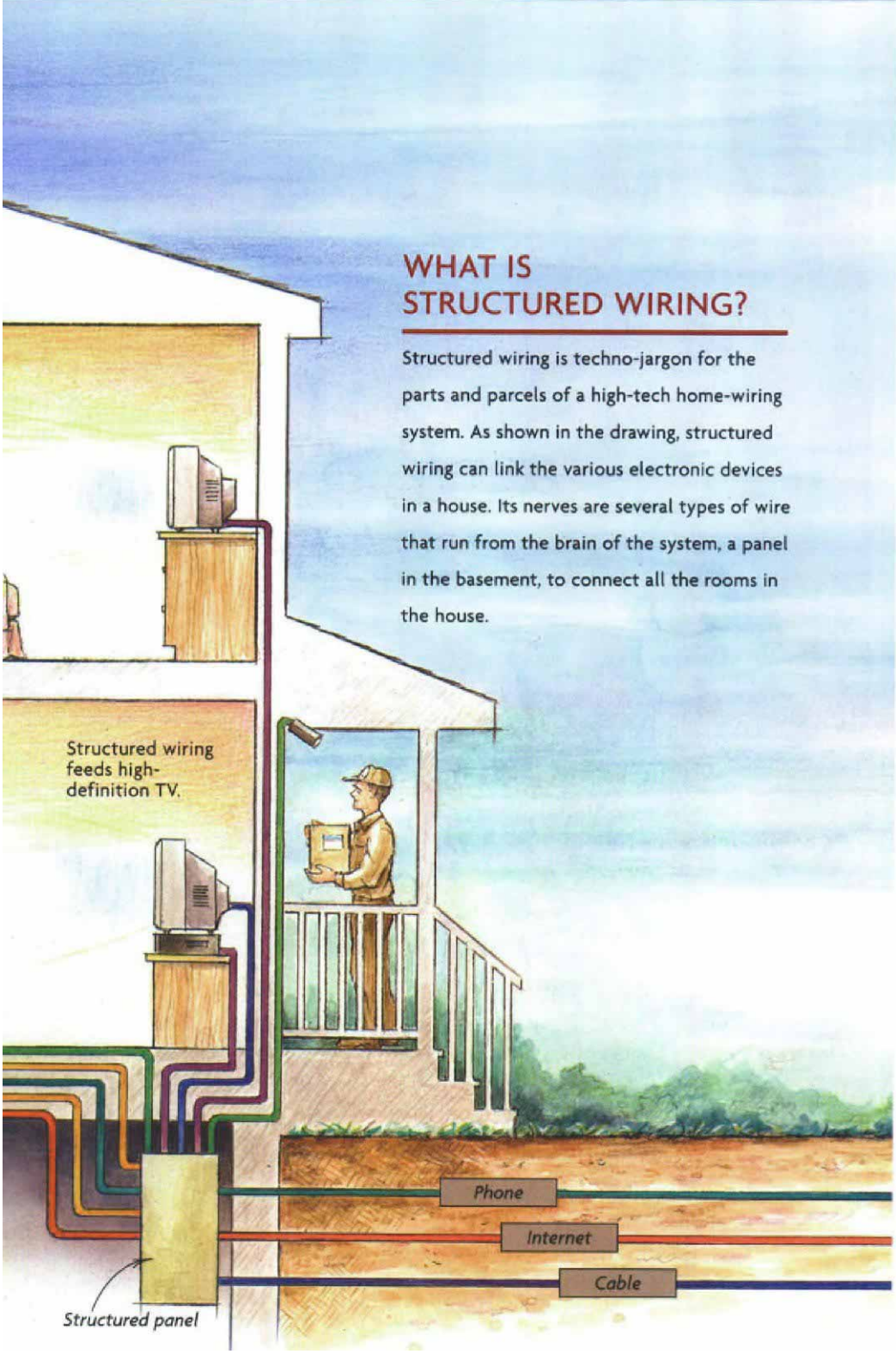
Most residential phone wire differs little from the wire over which Alexander Graham Bell summoned Watson in history's first phone call. That's not a problem if you use the wire only for phone service. However, Internet service, unimagined by Bell, can slow to a crawl on regular phone wire (or bell wire). And although the RG 59 coaxial cable used in most houses since the advent of cable TV is a big step up from the flat 300-ohm cable that brought Lucy and Ricky into our lives, it can't handle high-definition digital TV.

Structured wiring can handle all this and more. A structured-wiring network in your walls permits multiple telephone and fax lines and supports high-speed modems and computer networking from any room you choose. It can create the ability for one VCR or DVD player in, say, the living room to be controlled by and provide a movie to watchers in the master bedroom. It can link security cameras to TVs in whatever room you'd like. Very likely, structured wiring can handle electronic needs that you haven't even considered yet.

No one knows what electronic gizmos we'll have in five years, but a good structured-wiring system should be able to support most anything. The trick is to run more wires to more locations throughout the house than are currently needed. The wires all come together at a junction box, or structured panel (photo left, p. 95), placed in a basement or utility closet, and any wired location in the house can link to any other when the need arises.

Sounds complicated, doesn't it? Simply put, however, structured wiring is little more

Drawings: Don Mannes



than turbocharged phone wire and coaxial cable. My company installs miles of the stuff. The biggest factor to keeping down installation costs is to get the wiring in before drywall goes up. The cost of doing a structured-wiring system later can be up to four times the cost of installation while the home is under construction.

What's wrong with the phone wire and coax cable I already install?

I'm mystified why builders still use bell wire for telephone service (photo top right, p. 95). Bell wire handles telephone calls adequately, and millions of homes still have it. But bell wire's low bandwidth (data capacity, or the ability to transfer signals quickly) makes viewing a Web site over it frustrating. Also, bell wire is limited to just two telephone lines and is susceptible to interference from outside signals (mostly radio waves and electromagnetic fields from nearby house wiring).

The replacement for bell wire is category 5 wire, commonly called cat 5, which blends four insulated wire pairs that are twisted to minimize interference or cross talk (photo

What about wireless technology?

by Walter H. Horowitz

Thinking of structured wiring for your home? Perhaps you should also consider not wiring it. Wireless networking is available from a number of vendors, and an international standard, 802.11(b), helps to ensure component compatibility. About $400 worth of wireless hardware will run a computer almost anywhere in most houses.

Wireless products must compete with other devices that use the same frequencies, including your old microwave and perhaps your new wireless telephone. Also, wireless security isn't bulletproof, so you may find yourself providing Internet service for your neighbor. However, changing the default settings on the equipment that you're using can increase security greatly.

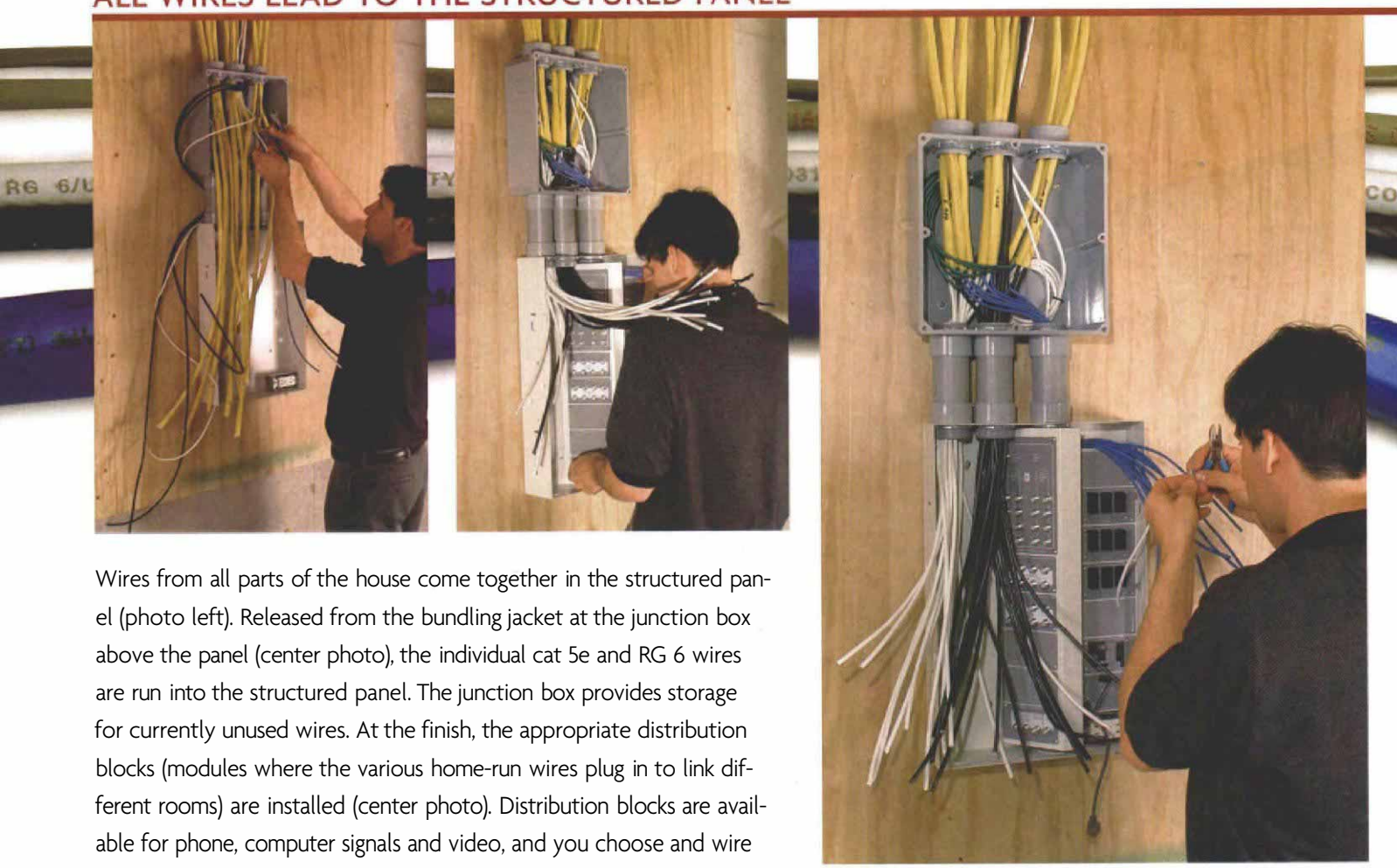
The range of wireless products can be 80 ft. or less, depending on building construction. Although the signal goes through wallboard without much difficulty, plaster walls with metal lath may block the signal.

Most wireless networks run one 10-megabit datastream, enough to share an Internet connection. A single video stream may run, but don't ask it to do much else while doing that. Category 5e cables can move data 1000 times faster than standard wireless networks. A wireless network can't be used to add a new telephone extension as cat 5e cables can. And with cat 5e cables, you won't risk losing your Internet connection when someone microwaves dinner.

If your house is difficult to wire, a wireless network may be the answer. It can be tough to place a cat 5e jack everywhere you want one when planning your wiring. By adding a wireless network, you needn't worry if there is a jack nearby when you sit on the couch with your laptop computer.

—Walter H. Horowitz owns Mardovar Networking in Newtown, CT.

ALL WIRES LEAD TO THE STRUCTURED PANEL



Wires from all parts of the house come together in the structured panel (photo left). Released from the bundling jacket at the junction box above the panel (center photo), the individual cat 5e and RG 6 wires are run into the structured panel. The junction box provides storage for currently unused wires. At the finish, the appropriate distribution blocks (modules where the various home-run wires plug in to link different rooms) are installed (center photo). Distribution blocks are available for phone, computer signals and video, and you choose and wire the ones you need (photo right).

right, facing page). Each pair is capable of a separate function, such as a phone, fax or computer-network link. We don't install regular cat 5 anymore, preferring the broader bandwidth available with cat 5e *(e for enhanced)* cable. Cat 5e costs only about $9 more per 1000 ft. than does cat 5, and it dramatically increases bandwidth. Cat 5 and cat 5e each cost more than twice what bell wire does. Although that sounds like a lot, the difference amounts to maybe $50 for a house.

The other half of structured wiring is RG 6 coaxial cable (photo right, facing page). We always install two RG 6 cables to provide the bandwidth for high-definition TV, cable modems and video distribution, such as security cameras. RG 6 is the replacement for the old standard coax, RG 59. Sometimes we install fiber-optic cable in anticipation of future needs, although doing so drives up the material cost significantly. Because cat 5e currently far exceeds the bandwidth requirements of even the most sophisticated home system, fiber-optic lines are probably overkill.

Cat 5e and RG 6 are available separately or bundled (photo top right, facing page). We prefer bundled because of the labor savings involved in pulling one bundle of wires, as opposed to pulling even two single wires. The upcharge for bundled wire isn't great; a standard cable bundle containing two cat 5e wires and two RG 6 coaxial cable wires costs about 60¢ per ft. The combined cost of the separate wires is about 50¢ per ft., but then you have to pull four wires instead of one.

Planning the layout

We consider planned and alternate furniture placement as well as room function when placing structured-wiring outlets, or tech ports (photo right, p. 97). I suggest that homeowners not limit themselves; multiple outlets assure maximum flexibility in the future. Typically, we place tech ports at the same height as electrical outlets. Generally, we like to place one or two tech ports in any room that's remotely likely to be home to a computer or TV, as determined by the homeowner's budget.

Although tech ports can be fitted with jacks for phone, fax, data and video, most people don't need all these options at each location. They can save a bit of money by selecting and installing the jacks that they currently need. As long as the wire is in the wall, they can upgrade the tech port later.

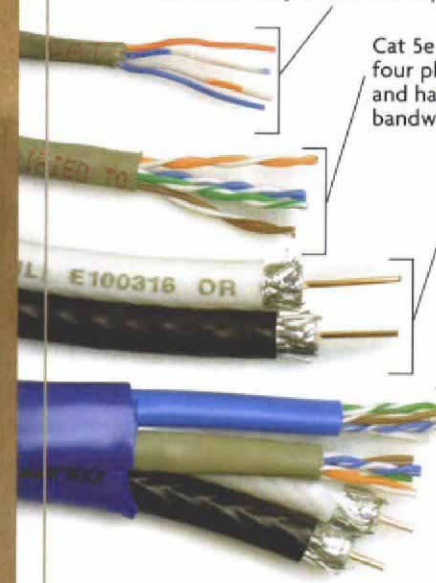
Install the structured wire after the electrical rough in

We rough in the structured wiring after the electrical, HVAC and plumbing rough ins are done. We're especially concerned about coming in after the electrician because even though all the wires we install are shielded to minimize electromagnetic interference, staying away from 110v and 220v lines (particularly those that power motors, ceiling fans, HVAC and garage-door openers) is good practice. Our rule of thumb is not to run structured wire parallel to and within about 1 ft. of house wiring for more than a couple of feet (photo left, p. 96).

The first step at rough in is to find a spot for the structured panel. The best spot is in the mechanical room at least 4 ft. to 6 ft. from the electrical panel. This location allows us to bring 110v power easily to the structured panel and puts it close to where

WHAT'S IN A WIRE

It's all about bandwidth, or the ability of a wire to transfer lots of data signals quickly without interference.



Bell wire links the phones in millions of homes, but it has limited bandwidth for data and only a two-line capacity.

Cat 5e wire can handle four phone or data lines and has many times the bandwidth of bell wire.

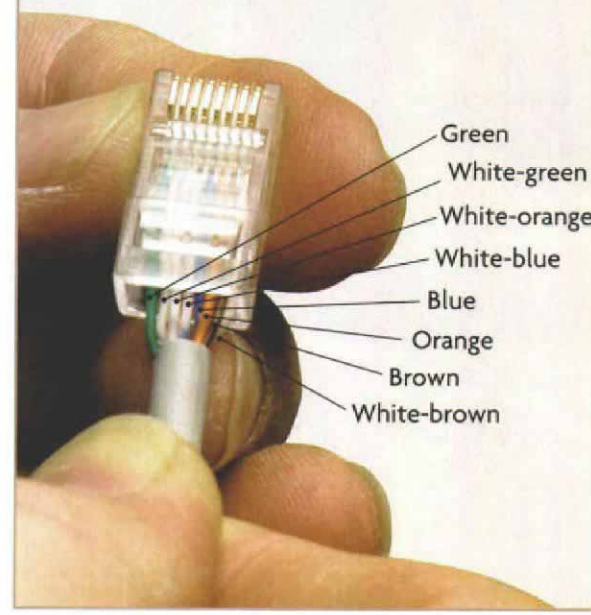
RG 6 is the current standard for video transmission. It's capable of delivering high-definition TV and cable-Internet service.

If you're running cat 5e and RG 6 to a room anyway, the 10¢ per ft. or so extra for bundled wires allows you to pull one wire instead of three or four.

Change is easy. Once the modules are in place, rerouting a network or video connection between rooms is as simple as moving jacks in the panel.

Terminating cat 5e

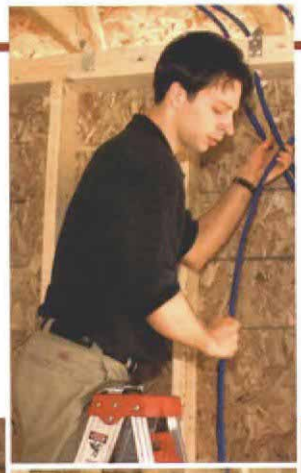
With four wire pairs in a cat 5e cable, it's important to keep them ordered as they terminate in an RJ 45 jack. Fortunately, the wires are color-coded to simplify this task, and there is an industry standard for arranging the colors that most installers follow.



Photos bottom right this page: Andy Engel

EASY DOES IT

Bundled cable is installed most easily with one person pulling and another person feeding. Pulling too hard can damage the cable and reduce its bandwidth. Stapling and curves should both be gentle, too, to avoid kinks. To minimize the chance of electromagnetic interference, don't run any type of structured wire parallel to and within 1 ft. of house wiring for more than a couple of feet.





A P-ring and a wire loop set up for the finish.

the phone and TV cables enter the house. At that distance from the electrical panel, there's no risk of electromagnetic interference.

Most panels today are modular, meaning that they're a basic box with frames in place to hold modules designed to join RG 6 and cat 5e. The module selection depends on the homeowner's immediate need for phone, computer-network and video wiring. It's a good idea to buy a structured panel with extra room in the cabinet for adding more modules later.

The second order of business is to nail on the plaster rings or, more commonly, P-rings, that serve as the tech-port enclosures (inset photo left). You can use the same P-rings as those commonly used by electricians to mount switches or outlets to 4-in. square boxes. However, we use P-rings without a box behind to provide room to work with the stiff bundled cable and because they have rings to capture the loop of cable that we leave behind the P-ring.

Once the P-rings are in place, we begin to drill holes for the wire bundles from the structured panel outward. We usually use ¾-in. or 1-in. auger bits with corded drills. As we drill through floor and wall plates, studs and ceiling joists, we carefully align the holes to make straight, sensible lines. We try to take the shortest path between the panel and the tech ports. When it's unavoidable, we cross the structured-wire bundle over 110v lines, preferably at right angles.

All cables are home runs. That is, each tech port is linked directly with the panel, with no

TYING CABLES TO PORTS



Crimping in style. Once the wires are ordered in the jack, this specialty RJ 45 crimping tool squeezes the jack's tiny contacts tight to the wire.

Photo right this page: Andy Engel

stops between. The only exception is when there are jumps within the same room for TV or telephone. As long as one or two main ports are in a room, we'll sometimes run less expensive single cat 5e and RG 6 cables to several locations to provide more flexibility for the owner to arrange furniture.

Bringing each cable from each room back to the panel gives structured wiring its flexibility. The connections that allow a computer in one room to print on a printer in another, or for a VCR in the living room to send a movie to a bedroom TV, are made in the panel. (Controlling that VCR from a remote location is one benefit of having these cables in place: One cable carries the signal to the TV, and one carries instructions from a remote sensor back to the VCR.) If you ever want to rearrange computer and printer or TV and VCR, you can by rearranging the connections in the panel.

Pulling structured wire takes a gentle touch

Whether you're installing a bundled cable or individual runs of RG 6 and cat 5e, pulling the cables is usually a two-person job. One installer feeds cables upward while the other draws them into the destination rooms. The reasons for the team approach are twofold.

First, the wires in cat 5e cable are twisted. These twists keep the wires out of parallel with each other, avoiding cross talk and signal bleed between the wires. Apply more than 25 lb. of pulling tension, and these critical twists begin to straighten out. RG 6 is tougher, and bundled cable isn't as susceptible to stretching as are single runs or cat 5e.

Second, sharp bends or kinks degrade the cable's performance. Having one person pulling and one person feeding keeps the cable running freely, avoiding both of these problems. To reduce stress on the cable, it's also important to loop cables generously when they make 90° turns (photo left, facing page).

When affixing any structured wire to framing, we use insulated staples and keep the cable in about 1¼ in. from the face of the stud to avoid errant drywall screws. Staples shouldn't be driven hard. Crushing damages structured wire's performance. We nail-plate over cable runs through studs and plates where there may be risk of a screw or nail penetrating the cable.

At the panel, we cut the cable long and mark each one's destination. Then we let the bundle dangle until we return for the finish.

Finishing up

To finish, we install tech ports on the P-rings. The tech ports have a combination of jacks, usually two RG 6 jacks (photo bottom right) and two RJ 45s, which look like regular phone jacks but are designed to accommodate cat 5e cable (photo bottom right, facing page).

We ask that homeowners meet with us on the job site as we begin the finish work. It's important that they confirm exactly where the phones, computers and peripherals go so that we know which lines to activate.

In most cases, we've run more cable and hooked up more tech ports than we actually will activate at the finish of the project. This fact leaves us with a bunch of cable at the structured panel that isn't tied into anything just now. We label each of the cables with its destination at the rough in, and those cables that we don't hook up, we coil away neatly into a box above the structured panel (photo right, p. 94).

Having structured wiring installed before the drywall goes up adds a few thousand dollars to the cost of most new houses. Considering the possibilities that structured wiring opens today, though, and given the likelihood of new bandwidth-hungry technologies coming on the market, I think that it's money well spent. □

Jerry Heesen owns GNT Stereo in Lancaster, PA.
Photos by Charles Bickford, except where noted.

A sampling of structured-wiring suppliers

Leviton
leviton.com
(800) 832-9538

Lucent
lucent.com
(888) 458-2368

Lutron
lutron.com
(610) 282-3800

OnQ
onqtech.com
(800) 321-2343

Pfas
amx.com
(800) 222-0193

Thomas & Betts
tnb.com
(901) 252-8000

Tyco Electronics
tycoelectronics.com
(800) 522-6752

US Tech
ustecnet.com
(800) 836-2312



F-connectors terminate RG 6 cable. Having seen a 27-in. TV dangling from one, the author prefers the F-connectors made by Augat (Thomas & Betts; www.tnb.com). These connectors require an Augat IT1000 tool, which costs about $60 but does the entire job from stripping the cable to crimping the F-connector.



Interface with this. Really. This tech port is set up to handle phone and video. Other options are myriad, and a Decora-style plate finishes off the installation.

Photo left this page: Andy Engel