NETWORK TECHNOLOGY WITH ADMINISTRATION AND MAINTENANCE

Name : _____ ID number : _____

Installing a Physical Network

In the real world, you need to deal with physical obstacles like walls and ceilings. You also need to deal with those annoying things called people. People are incredibly adept at destroying physical networks. They unplug switches, trip over cables, and rip connectors out of NICs with incredible consistency unless you protect the network from their destructive ways. Although the simplified switch-and-a-bunch- of-cables type of network can function in the real world, the network clearly has some problems that need addressing before it can work safely and efficiently.

Understanding Structured Cabling

If you want a functioning, dependable, real-world network, you need a solid understanding of a set of standards, collectively called structured cabling. These standards, defined by the Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA) give professional cable installers detailed standards on every aspect of a cabled network, from the type of cabling to use to the position of wall outlets.

The idea of structured cabling is to create a safe, reliable cabling infrastructure for all of the devices that may need interconnection. Certainly this applies to computer networks, but also to telephone, video—anything that might need low-power, distributed cabling.

Cable Basics

No law of physics prevents you from installing a switch in the middle of your office and running cables on the floor to all the computers in your network. This setup will work, but it falls apart spectacularly when applied to the real-world environment. Three problems present themselves to the real-world network tech. First, the exposed cables running along the floor are just waiting for someone to trip over them, causing damage to the network. Possible accidents aside, simply move and stepping on the cabling will, over time, cause a cable to fail due to wires breaking or RJ-45 connectors ripping off cable ends. Second, the presence of other electrical devices close to the cable can create interference that confuses the signals going through the wire. Third, this type of setup limits your ability to make any changes to the network.

Structured Cable Network Components

Successful implementation of a basic structured cabling network requires three essential ingredients: a telecommunications room, horizontal cabling, and a work area. All the cabling runs from individual PCs to a central location, the telecommunications room. What equipment goes in there—a switch or a telephone system—is not the important thing. What matters is that all the cables concentrate in this one area.

All cables run horizontally (for the most part) from the telecommunications room to the PCs. This cabling is called horizontal cabling. A single piece of installed horizontal cabling is called a run. At the opposite end of the horizontal cabling from the telecommunications room is the work area. The work area is often simply an office or cubicle that potentially contains a PC and a telephone.

Each of the three parts of a basic star network—the telecommunications room, the horizontal cabling, and the work area(s)—must follow a series of strict standards designed to ensure that the cabling system is reliable and easy to manage. The cabling standards set by TIA/EIA enable techs to make sensible decisions on equipment installed in the telecommunications room.

Horizontal Cabling

A horizontal cabling run is the cabling that goes more or less horizontally from a work area to the telecommunications room. In most networks, this is a CAT 5e or better UTP cable, but when we move into the world of structured cabling, the TIA/EIA standards define a number of other aspects to the cable, such as the type of wires, number of pairs of wires, and fire ratings.

Choosing Horizontal Cabling

In the real world, network people only install CAT 5e , CAT 6 or CAT 7 UTP. Installing higher-rated cabling is done primarily as a hedge against new network technologies that may require a more advanced cable. Networking caveat emptor warning: many network installers take advantage of the fact that a lower CAT level will work on most networks, and bid a network installation using the lowest- grade cable possible.

The Telecommunications Room

The telecommunications room is the heart of the basic star. This room—technically called the intermediate distribution frame (IDF)—is where all the horizontal runs from all the work areas come together. The concentration of all this gear in one place makes the telecommunications room potentially one of the messiest parts of the basic star. Even if you do a nice, neat job of organizing the cables when they are first installed, networks change over time. People move computers, new work areas are added, network topologies are added or improved, and so on. Unless you impose some type of organization, this conglomeration of equipment and cables is bound to decay into a nightmarish mess.
Fortunately, the TIA/EIA structured cabling standards define the use of specialized components in the telecommunications room that make organizing a snap. (See figure 4.1).

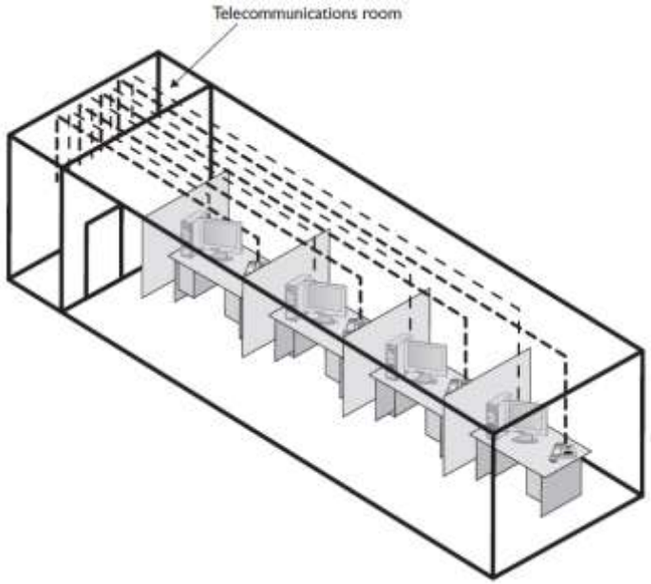

Figure 4.1 – Telecommunications Room

Equipment Racks

The central component of every telecommunications room is one or more equipment racks. An equipment rack provides a safe, stable platform for all the different hardware components. All equipment racks are 19 inches wide, but they vary in height from two- to three-foot-high models that bolt onto a wall (Figure 4.2), to the more popular floor-to-ceiling models (Figure 4.3).

You can mount almost any network hardware component into a rack. All manufacturers make rack-mounted switches that mount into a rack with a few screws. These switches are available with a wide assortment of ports and capabilities. There are even rack-mounted servers, complete with slide-out keyboards, and rack-mounted uninterruptible power supplies (UPSs) to power the equipment (Figure 4.4).

All rack-mounted equipment uses a height measurement known simply as a U. A U is 1.75 inches. A device that fits in a 1.75-inch space is called a 1U; a device designed for a 3.5-inch space is a 2U. Most rack-mounted devices are 1U, 2U, or 4U. The rack in Figure 6-10 is called a 96U rack to reflect the total number of Us it can hold.

Figure 4.2 – A short rack

Patch Panels and Cables

Ideally, once you install horizontal cabling, it should never be moved. As you know, UTP horizontal cabling has a solid core, making it pretty stiff. Solid core cables can handle some rearranging, but if you insert a wad of solid core cables directly into your switches, every time you move a cable to a different port on the switch, or move the switch itself, you will jostle the cable. A patch panel is simply a box with a row of female connectors (ports) in the front and permanent connections in the back, to which you connect the horizontal cables (Figure 4.5).

The most common type of patch panel today uses a special type of connecter called a 110-punchdown block, or simply a 110 block. UTP cables connect to a 110-punchdown block using a punchdown tool. Figure 4.6 shows the punchdown tool punching down individual strands.

The punchdown block has small metal-lined grooves for the individual wires. The punchdown tool has a blunt end that forces the wire into the groove. The metal in the groove slices the cladding enough to make contact.

Figure 4.3 – A Floor to ceiling rack

Not only do patch panels prevent the horizontal cabling from being moved, they are also your first line of defense in organizing the cables. All patch panels have space in the front for labels, and these labels are the network tech's best friend. Simply place a tiny label on the patch panel to identify each cable, and you will never have to experience that sinking feeling of standing in the telecommunications room of your nonfunctioning network, wondering which cable is which. If you want to be a purist, there is an official, and rather confusing, TIA/EIA labeling methodology called TIA/EIA 606, but a number of real-world network techs simply use their own internal codes (Figure 4.7).

Figure 4.4 – Rack mounted UPS

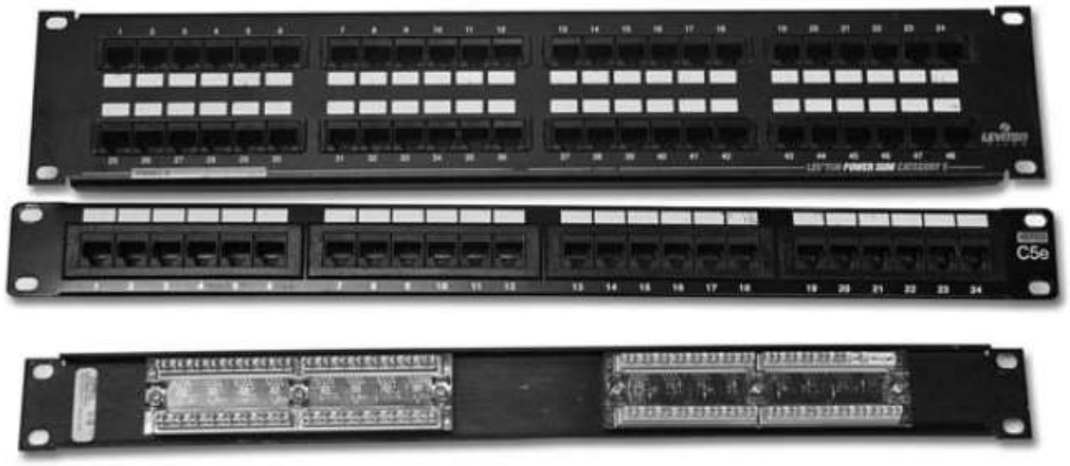

Figure 4.5 – Patch panels

Patch panels are available in a wide variety of configurations that include different types of ports and numbers of ports. You can get UTP, STP, or fiber ports, and some manufacturers combine several different types on the same patch panel. Panels are available with 8, 12, 24, 48, or even more ports. UTP patch panels, like UTP cables, come with CAT ratings, which you should be sure to check. Most manufacturers display the CAT level right on the patch panel.

Figure 4.6 – Punching down a 110 block

Patch cables use stranded rather than solid cable, so they can tolerate much more handling. Buying patch cables enables you to use different colored cables to facilitate organization (yellow for accounting, blue for

sales, or whatever scheme works for you). Most prefabricated patch cables also come with a reinforced (booted) connector specially designed to handle multiple insertions and removals.

A telecommunications room doesn't have to be a special room dedicated to computer equipment. You can use specially made cabinets with their own little built-in equipment racks that sit on the floor or attach to a wall, or use a storage room, as long as the equipment can be protected from the other items stored there. Fortunately, the demand for telecommunications rooms has been around for so long that most office spaces have premade telecommunications rooms, even if they are no more than a closet in smaller offices.

Figure 4.7 – Typical patch panels

The Work Area

From a cabling standpoint, a work area is nothing more than a wall outlet that serves as the termination point for horizontal network cables: a convenient insertion point for a PC and a telephone. A wall outlet itself consists of one or two female jacks to accept the cable, a mounting bracket, and a faceplate. You connect the PC to the wall outlet with a patch cable.

The female RJ-45 jacks in these wall outlets also have CAT ratings. You must buy CAT-rated jacks for wall outlets to go along with the CAT rating of the cabling in your network. In fact, many network connector manufacturers use the same connectors in the wall outlets that they use on the patch panels. These modular outlets significantly increase ease of installation. Make sure you label the outlet to show the job of each connector. A good outlet will also have some form of label that identifies its position on the patch panel. Proper documentation of your outlets will save you an incredible amount of work later.

The last step is connecting the PC to the wall outlet. Its stranded cabling stands up to the abuse caused by moving PCs, not to mention the occasional kick.

The work area may be the simplest part of the structured cabling system, but it is also the source of most network failures. When a user can't access the network and you suspect a broken cable, the first place to look is the work area.

Structured Cable

It's hard to find a building today that isn't connected to both the Internet and the telephone company. A typical building-wide network consists of a high-speed backbone that runs vertically through the building, and connects to multispeed switches on each floor that in turn service the individual PCs on that floor. A dedicated telephone cabling backbone that enables the distribution of phone calls to individual telephones runs alongside the network cabling. While every telephone installation varies, most commonly you'll see one or more strands of 25-pair UTP cables running to the 66 block in the telecommunications room on each floor (Figure 4.8).

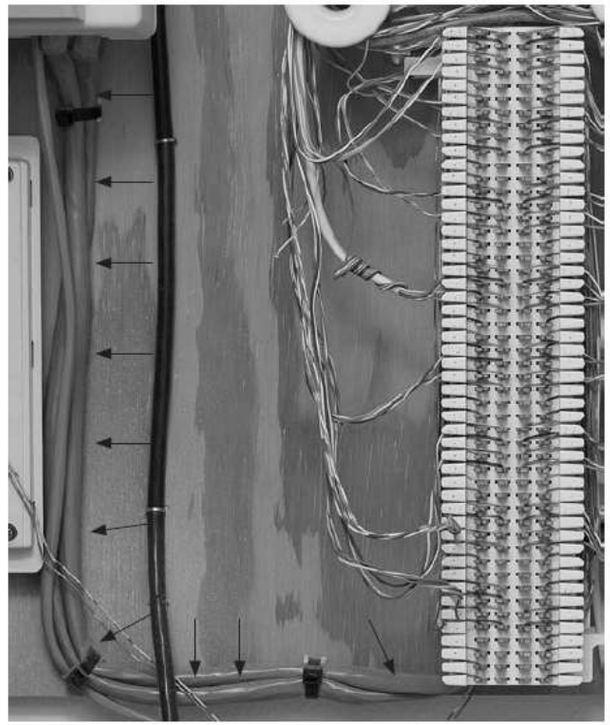

Figure 4.8 - 25-pair UTP running to local 66 block

Demarc

Connections from the outside world—whether network or telephone—come into a building at a location called a demarc, short for demarcation point. The term "demarc" refers to the physical location of the

connection and marks the dividing line of responsibility for the functioning of the network. You take care of the internal functioning; the person or company that supplies the upstream service to you must support connectivity and function on the far side of the demarc.

In a private home, the DSL or cable modem supplied by your ISP is a network interface unit (NIU) that serves as a demarc between your home network and your ISP, and most homes have a network interface box, that provides the connection for your telephone.

In an office environment the demarc is usually more complex, given that a typical building simply has to serve a much larger number of telephones and computers. Figure 4.9 shows the demarc for a midsized building, showing both Internet and telephone connections coming in from the outside.

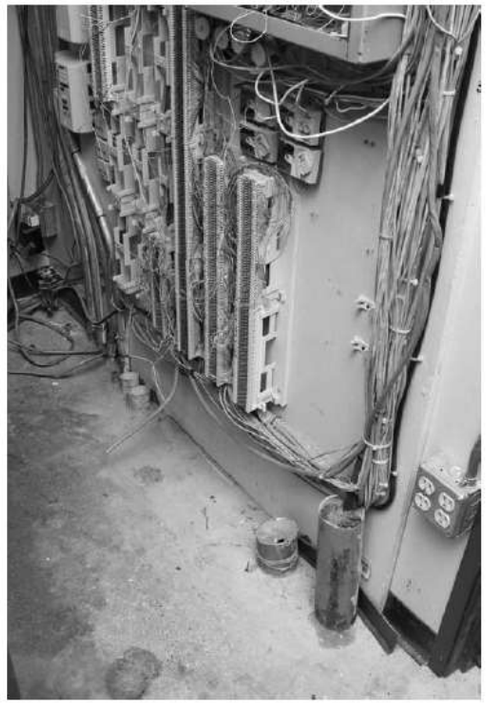

Figure 4.9 - Typical office demarc

One challenge to companies that supply ISP/telephone services is the need to diagnose faults in the system. Most of today's NIUs come with extra "smarts" that enable the ISP or telephone company to determine if the customer has disconnected from the NIU. These special (and very common) NIUs are known as smart jacks. Smart jacks also have the very handy capability to set up a remote loopback—critical for loopback testing when you're at one end of the connection and the other connection is blocks or even miles away.

Installing Structured Cabling

A professional installer always begins a structured cabling installation by first assessing your site and planning the installation in detail before pulling a single piece of cable. As the customer, your job is to work closely with the installer. That means locating floor plans, providing access, and even putting on old clothes and crawling along with the installer as he or she combs through your ceilings, walls, and closets. Even though you're not the actual installer, you must understand the installation process, so you can help the installer make the right decisions for your network.

Structured cabling requires a lot of planning. You need to know if the cables from the work areas can reach the telecommunications room—is the distance less than the 90-meter limit dictated by the TIA/EIA standard? How will you route the cable? What path should each run take to get to the wall outlets? Don't forget that just because a cable looks like it will reach, there's no guarantee that it will. Ceilings and walls often include hidden surprises like firewalls—big, thick, concrete walls designed into buildings that require a masonry drill or a jackhammer to punch through. Let's look at the steps that go into proper planning.

Getting a Floor Plan

First, you need a blueprint of the area. If you ever contract an installer and they don't start by asking for a floor plan, fire them immediately and get one who does. The floor plan is the key to proper planning; a good floor plan shows you the location of closets that could serve as telecommunications rooms, alerts you to any firewalls in your way, and gives you a good overall feel for the scope of the job ahead.

Mapping the Runs

Now that you have your floor plan, it's time to map the cable runs. Here's where you run around the work areas, noting the locations of existing or planned systems to determine where to place each cable drop. A cable drop is the location where the cable comes out of the wall in the workstation.

While you're mapping your runs, you have to make another big decision: Do you want to run the cables in the walls or outside them? Many companies sell wonderful external raceway products that adhere to your walls, making for a much simpler, though less neat, installation than running cables in the walls. Raceways make good sense in older buildings or when you don't have the guts—or the rights—to go into the walls.

Determining the Location of the Telecommunications Room

While mapping the runs, you should decide on the location of your telecommunications room. When deciding on this location, keep five issues in mind:

1. **Distance**

The telecommunications room must be located in a spot that won't require cable runs longer than 90 meters. In most locations, keeping runs under 90 meters requires little effort, as long as the telecommunications room is placed in a central location.

2. Power

Many of the components in your telecommunications room need power. Make sure you provide enough. If possible, put the telecommunications room on its own dedicated circuit; that way, when someone blows a circuit in some parts of the building, it doesn't take out the entire network.

3. Humidity

Electrical components and water don't mix well. Remember that dryness also means low humidity. Avoid areas with the potential for high humidity, such as a closet near a pool or the room where the cleaning people leave mop buckets full of water. Of course, any well air-conditioned room should be fine.

4. Cooling

Telecommunications rooms tend to get warm, especially if you add a couple of server systems and a UPS. Make sure your telecommunications room has an air-conditioning outlet or some other method of keeping the room cool.

5. Access

Access involves two different issues. First, it means preventing unauthorized access. Think about the people you do and don't want messing around with your network, and act accordingly. Also, make sure to physically secure the premises.

One other issue to keep in mind when choosing your telecommunications room is expandability. Several considerations include:

- Will this telecommunications room be able to grow with your network?
- Is it close enough to be able to service any additional office space your company may acquire nearby?
- If your company decides to take over the floor above you, can you easily run vertical cabling to another telecommunications room on that floor from this room?

While the specific issues will be unique to each installation, always remember "expansion" as you design—your network will grow, whether or not you think so now.