

Increasingly Vital Links

Ethernet facts and options

By Chris Bushick

It used to be that the only time to worry about a network came with simulcasting and having to plug into the broadcast truck. Now, however, a mixing console may be hooked deeper into a network than even a laptop PC, and the vital links are much more finicky than good ol' XLR cables.

Many audio professionals and companies now embrace Ethernet-related technologies, such as CobraNet from Peak Audio. Digital mixing consoles, snakes and signal processors that make use of Ethernet capabilities are widely available.

Because Ethernet seems to be here to stay, it's a good idea to understand some of the basic elements of Ethernet data transfer and cabling.

SIZE AND SPEED

Early Ethernet configurations were 10Base-2 or 10Base-5, able to transfer data at a rate of 10 Megabits per second (Mbps) over coaxial (coax) cable. 10Base-2 and 10Base-5 were referred to as Thinnet and Thicknet, respectively, because of their cable sizes.

Because coax was bulky and expensive, networking companies

soon developed a twisted pair version of Ethernet called 10Base-T, which also supported speeds up to 10 Mbps. Improved versions of twisted pair cable run at 100 Mbps and 1000 Mbps, and these are called 100Base-T and 1000Base-T (Gigabit Ethernet) respectively.

As a result, 10Base-T is effectively obsolete in newer systems, and these days, you'll typically see only 100Base-T in new equipment. And Gigabit is coming down the line.

Ethernet cable is standardized and consists of four twisted pairs of wires in a jacket that may or may not be shielded. Tight twisting of the pairs improves noise margin and reduces crosstalk of the data, which is transmitted differentially (a data version of balanced audio).

Unshielded versions are called Unshielded Twisted Pair (UTP) and shielded versions are called Shielded Twisted Pair (STP). Each pair within the cable uses a standard color code and has a solid colored wire twisted with a white wire that has stripes of the same color.

Ethernet cables use RJ-45 8-pin telephone-type connectors, and have two standard pin-out configurations: straight-through and crossover. Industry associations have defined the T-568A and T-568B standards for Ethernet cables so that a Type A device, like a computer, connected to a Type B device, such as a hub, uses a simple straight-through cable. (Figure 1)

When a Type A device is connected to another Type A device, or a Type B device is connected to another Type B device, a crossover cable, which swaps the transmit and receive pins, must be used.

In a Type A to Type B connection, say a computer to a hub, the comput-

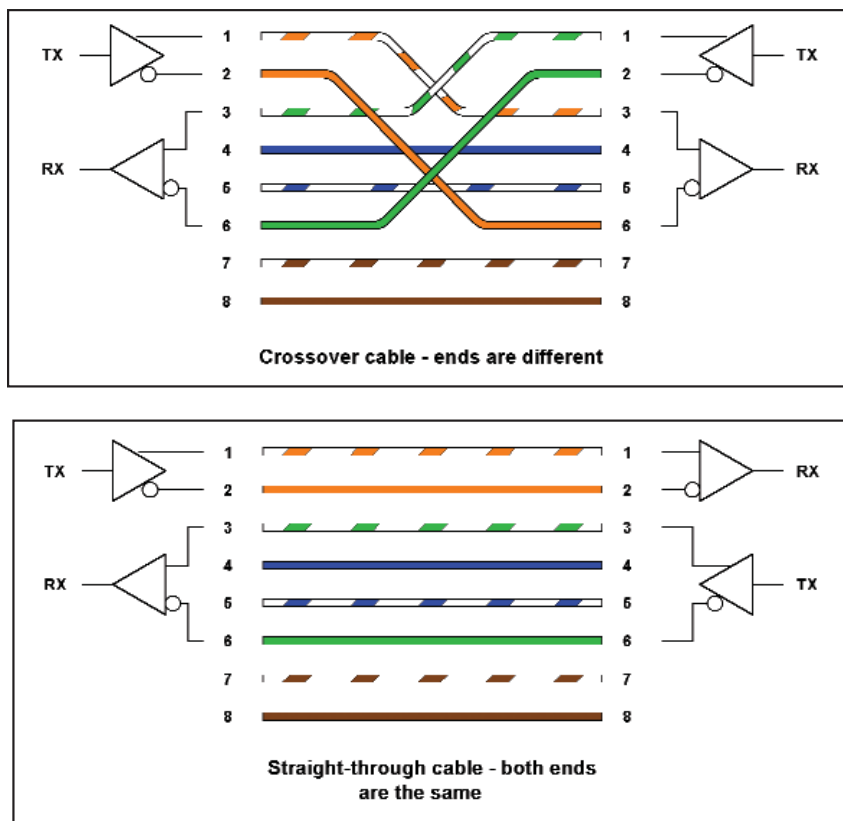


Figure 1: "Yes, Virginia, there is a standard!" Here's the color-code for wiring crossover and straight-through cables according to TIA/EIA standards.

Connect Corner

er uses pins 1 and 2 to transmit data and pins 3 and 6 to receive data, whereas the hub receives data on pins 1 and 2 and transmits on pins 3 and 6. In a connection between two Type A's or two Type B's, both want to use the same pair for transmission, so the pairs are swapped in the cable and both receivers now see a transmitter.

In either arrangement, the signal transmitted/received on pins 2 and 6 are inverted versions of the signals on pins 1 and 3, respectively. Also, odd-numbered pins always contain a striped wire, and even-numbered pins always contain a solid wire. Pins 4, 5, 7, and 8 are often not used, but they may be used to supply power to Ethernet devices. This configuration is called Power-over-Ethernet (PoE) or "Active Ethernet."

QUICK AS A CAT

Ethernet cables are classified into categories based on their specifications, and CAT5 and CAT5e are currently the most commonly used types. CAT5 cables can transmit/receive data up to a rate of 100 Mbs. CAT5e is an enhanced version of CAT5 and can unofficially handle data rates up to 1000 Mbs, or 1 Gigabit per second (Gbs).

CAT6 is the official Gigabit standard – relatively new and not yet widely implemented. It too transfers data at rates up to 1 Gbs and can properly be referred to as Gigabit Ethernet. The main differences between CAT5e and CAT6 is that CAT6 has better transmission performance and has twice the bandwidth.

Higher cable ratings have better electrical parameters and can carry

higher data speeds, but they also have a performance edge with slower signals when distances get long. If you're getting near the maximum 100-meter (about 325 feet) length, consider paying a few bucks more for the good stuff or adding a hub to serve as a repeater.

CAT5, CAT5e, and CAT6 cables come in a variety of jackets that are used under different environmental conditions.

Standard Ethernet cable is used for indoor runs between and along walls. A more durable outdoor variety of cable is also available and is more resistant to weather elements such as rain and ultraviolet light. It's only intended for short outside runs, such as the connection between a service box on the wall of a building and the location where the cable enters the building.

A third option is plenum cable, which is rated for use in the plenum areas of buildings. A plenum (pronounced PLEN-uhm) is the area between a structural ceiling and a drop ceiling or between a structural floor and a false floor, and is an area that frequently houses cables and air ducts.

Plenum cable has a low-smoke jacket so, in the event of a fire, it produces a minimal amount of smoke. Non-plenum cables should not be used in plenum areas because, when exposed to fire, they produce a large amount of toxic smoke that could get sucked into the ventilation system and be pumped throughout all areas of the building, including areas nowhere near the fire.

If you're concerned about the durability of those phone-like connectors and wonder whether they'll last long enough to get your data to its destination, rest easy knowing that several manufacturers now produce industrial versions of Ethernet connectors and cables. These heavy-duty connectors often feature a locking mechanism to prevent unintentional demates and may include a dust cover as well. Cables



Figure 3: Neutrik XLR-style NE8 series cable-mount plug along with a mating panel-mount female

made to withstand such hazards as water, harsh chemicals, ultraviolet radiation, mechanical abuse, and noise are also available.

TOUGH CUSTOMERS

Some companies that offer rugged connectors designed for various hazards include Amphenol, Graybar and Molex. **Figure 2** shows an Amphenol Socapex RJF-554 series cable-mount plug along with a corresponding panel-mount female. Neutrik also offers a durable series of connectors called EtherCon that are similar to their XLR connectors. **Figure 3** shows a Neutrik NE8 connector with a panel-mount female connector.

As of right now, there seems to be no standard for heavy-duty connectors, and products from the various manufacturers will not always intermate (though you can often remove the RJ45 insert from the environmental shell).

Super-durable Ethernet cables are also available for applications in weather-sensitive and high-traffic areas, there are also super-durable cables on the market. Amphenol, for example, produces a rugged cable with a polyurethane jacket, a coax-style copper braid shield, and a Kevlar strength member rated at 600 pounds. It's available under the trade name "ProPlex" from TMB Production and Supplies, which also distributes several brands of resilient connectors.

As with many types of cables, you can sometimes save money by purchasing the cable and connectors and assembling them yourself. Next time we'll look at how it's done. ■

Chris Bushick is an electrical engineer and sound engineer based in Austin, Texas, and can be reached at cbushick@hotmail.com.



Figure 2: Amphenol Socapex RJF-554 series cable-mount plug along with a mating panel-mount female.