

# Ethernet Over Twisted Pair Technologies

In this reading, you will learn about the importance of Ethernet over twisted pair technologies. Twisted pair Ethernet cable is the most commonly used Ethernet cable in business and home networks. An internet connection to a building or home is normally delivered through a coaxial cable and/or fiber-optic cable from an internet service provider (ISP). This connection is fed into a gateway modem located inside the building or home (for home internet customers, this hardware is often provided by the ISP). The modem then passes the internet connection through a twisted pair Ethernet cable to a router or a single computer. The router uses twisted pair Ethernet cables to distribute wired network connections internally to the business or home. These network cables are also called CAT cables. It is possible that you have purchased an Ethernet CAT5 or CAT6 cable for your home internet connection. Some routers also have the capability to provide wireless network connections to the internal network. In addition, Ethernet over twisted pair technologies can also supply telephone and television services to businesses and homes.

## Twisted pair cables

Originally, telephone and early data cables included two copper wires, one for transmitting data and one for receiving data. The two wires laid parallel to one another. This configuration was affected by electromagnetic interference (EMI), radio frequency interference (RFI), and crosstalk between the two copper wires. One of the initial engineering steps to resolve these issues involved twisting the wire pair together, which reduced some of the extra noise on the lines.

Twisted pair Ethernet cables are commonly used in LANs because:

- They offer multiple levels of protection against EMI, RFI, and crosstalk.
- The lower levels of interference protection provide low-cost options, which are generally more accessible to home users and small businesses.
- The cables are thin, light weight, and malleable enough to install and move easily.
- The transmission range of the cable is suitable for short distance connections inside of buildings and homes.
- The cable's frequency range is able to transmit both data and telephone/voice communications.

## UTP, STP, and FTP Ethernet cables

Twisted pair Ethernet cable uses four pairs of color-coded copper wires. Each colored pair, one solid and one striped, are twisted together. There are multiple types of twisted pair Ethernet cables available on the market. These types fall into three main categories:

- **Unshielded twisted pair (UTP)** - The most common and least expensive type of Ethernet cable found in business and home networks. UTP cables offer very basic protection against EMI, RFI, and crosstalk interference.
- **Shielded twisted pair (STP)** - Used in environments where electromagnetic interference (EMI), radio frequency interference (RFI), and crosstalk with nearby cables have been identified as a problem for network communications. An STP cable uses a braided aluminum and/or copper shielding to encase the four twisted pairs underneath the outer jacket.
- **Foiled twisted pair (FTP)** - Also used in environments where EMI, RFI, and crosstalk are a problem. An FTP cable uses a thin foil shield that wraps around the bundle of twisted pair wires underneath the outer jacket.

The STP and FTP labels are often used interchangeably to reference shielded and/or foiled cables. STP and FTP braided and foiled shields can also exist together in the same cable for extra protection against interference. It is important to check the manufacturer's description of the Ethernet cable to determine which interference-reducing method was used in the manufacturing of the cable. UTP, STP, and FTP Ethernet cables can also be manufactured to have braided and/or foil shields around each of the four twisted pairs. This configuration further reduces crosstalk amongst the twisted pairs, but is the most expensive of the Ethernet cable options. A shielded with foiled twisted pair (SF/FTP) would most likely be used in an industrial environment where EMI and/or RFI is much higher than normal.

## Straight-through cable

Straight-through cables are also known as patch cables. They are the primary type of Ethernet cable used in computer networks. Straight-through cables normally connect computers and routers to hubs and Ethernet switches. Ethernet cable can also connect servers to Ethernet switches.

Straight-through cables can be identified by comparing both ends of the cable with one another. The cable is a straight-through cable if the color and stripe order of the twisted pairs are in the same position on both ends of the cable. In a typical straight-through cable set-up, an orange-striped wire that appears in pin position 1 should also appear at that same position on the other end. This one-to-one pattern is continued for each color in pin

positions 2-8. Ethernet cables that use 100Base-T standards (common for home networks) do not use blue and brown cables. Networks using gigabit Ethernet have the option to use blue and brown cables for Power over Ethernet (PoE).

**Straight-through cable key:**

- Computers and routers use:
  - Pins 1 & 2 - Orange wires for sending data
  - Pins 3 & 6 - Green wires for receiving data
- Hubs and switches use:
  - Pins 1 & 2 - Green wires for sending data
  - Pins 3 & 6 - Orange wires for receiving data