LAN Technology:

- LAN (Local Area Network) technology is used within a company for connecting devices and sharing data.
- Ethernet LAN: It uses cables (like copper, fiber optic, or coaxial) to connect devices together.
- Wireless LAN: It uses radio waves instead of cables to establish connections.

Ethernet Standards

The term Ethernet refers to a family of LAN standards that together define the physical and datalink layers of the world's most popular wired LAN technology. The standards, defined by the Institute of Electrical and Electronics Engineers (IEEE), define the cabling, the connectors on the ends of the cables, the protocol rules, and everything else required to create an Ethernet LAN.

- Ethernet defines different standards for transmitting data over cables, including cable types and speeds.
- Common Ethernet connections involve using RJ45 connectors and ports.
- Ethernet standards specify the cable type (coaxial, optical fiber, or copper) and the speed, ranging from 100 Mbps to 400 Gbps.

The Variety of Ethernet Physical Layer Standards

The term Ethernet refers to an entire family of standards. All these Ethernet standards come from the IEEE and include the number 802.3 as the beginning part of the standard name. Ethernet supports a large variety of options for physical Ethernet links given its long history over the last 40 or so years. Today, Ethernet includes many standards for different kinds of optical and copper cabling, and for speeds from 10 megabits per second (Mbps) up to 400 gigabits per second (Gbps). The standards also differ as far as the types and length of the cables.

Speed	Common Name	Informal IEEE Standard Name	Formal IEEE Standard Name	Cable Type, Maximum Length
10 Mbps	Ethernet	10BASE-T	802.3	Copper, 100 m
100 Mbps	Fast Ethernet	100BASE-T	802.3u	Copper, 100 m
1000 Mbps	Gigabit Ethernet	1000BASE-LX	802.3z	Fiber, 5000 m
1000 Mbps	Gigabit Ethernet	1000BASE-T	802.3ab	Copper, 100 m
10 Gbps	10 Gig Ethernet	10GBASE-T	802.3an	Copper, 100 m

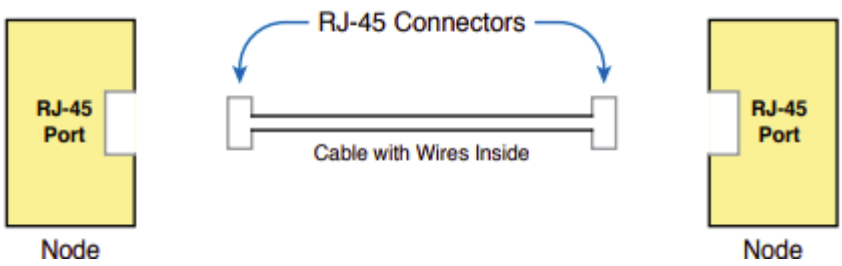
The IEEE also uses more meaningful shortcut names that identify the speed, as well as a clue about whether the cabling is UTP (with a suffix that includes T) or fiber (with a suffix that includes X)

Note: *Fiber cabling contains long thin strands of fiberglass. The attached Ethernet nodes send light over the glass fiber in the cable, encoding the bits as changes in the light.*

Twisted Pair Cable (UTP):

UTP cables transmit data over electrical circuits using twisted pairs of copper wires.

In UTP cable, the wires will be twisted together, instead of being parallel. The twisting helps solve some important physical transmission issues. When electrical current passes over any wire, it creates electromagnetic interference (EMI) that interferes with the electrical signals in nearby wires, including the wires in the same cable. (EMI between wire pairs in the same cable is called crosstalk.) Twisting the wire pairs together helps cancel out most of the EMI, so most networking physical links that use copper wires use twisted pairs.

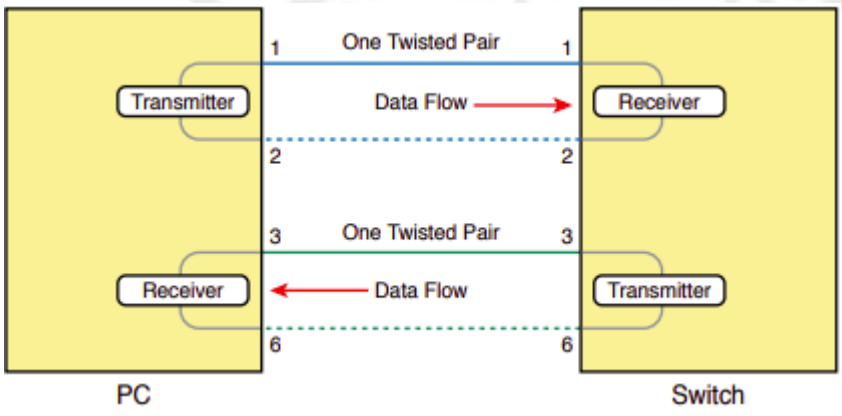


Many Ethernet UTP cables use an RJ45 connector on both ends. The RJ45 connector has eight physical locations into which the eight wires in the cable can be inserted, called pin positions, or simply pins. These pins create a place where the ends of the copper wires can touch the electronics inside the nodes at the end of the physical link so that electricity can flow.

UTP Cable Pinout For 100Mbps or 1000Mbps

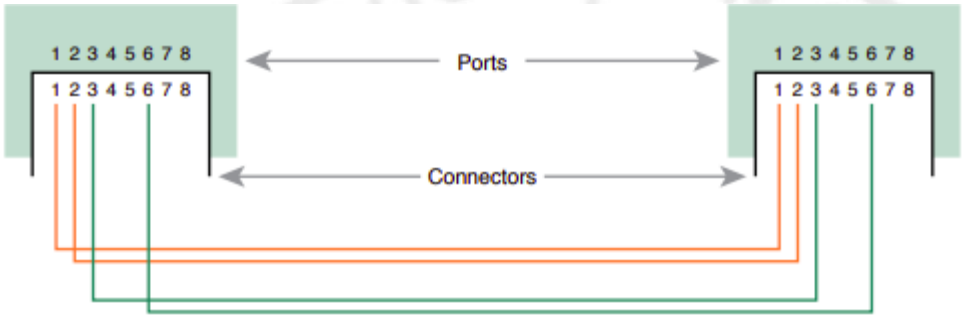
StraightThrough Cable

A straightthrough cable is a type of Ethernet cable commonly used to connect different types of devices, such as a computer to a switch or a PC. In a straightthrough cable, the pinouts on one end of the cable match the pinouts on the other end. This means that each wire at one end of the cable is connected to the same pin position on the other end. The Basic pinout for a straightthrough cable is as follows:



To understand the wiring of the cable—which wires need to be in which pin positions on both ends of the cable—you need to first understand how the NICs and switches work. As a rule, Ethernet NIC transmitters use the pair connected to pins 1 and 2; the NIC receivers use a pair of wires at pin positions 3 and 6. LAN switches, knowing those facts about what Ethernet NICs do, do the opposite: Their receivers use the wire pair at pins 1 and 2, and their transmitters use the wire pair at pins 3 and 6.

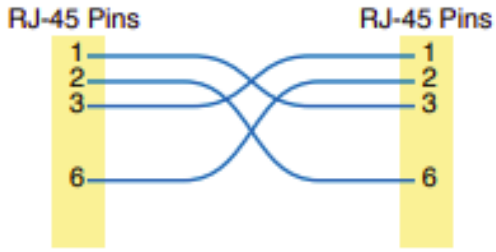
To allow a PC NIC to communicate with a switch, the UTP cable must also use a straightthrough cable pinout.



A straightthrough cable works correctly when the nodes use opposite pairs for transmitting data.

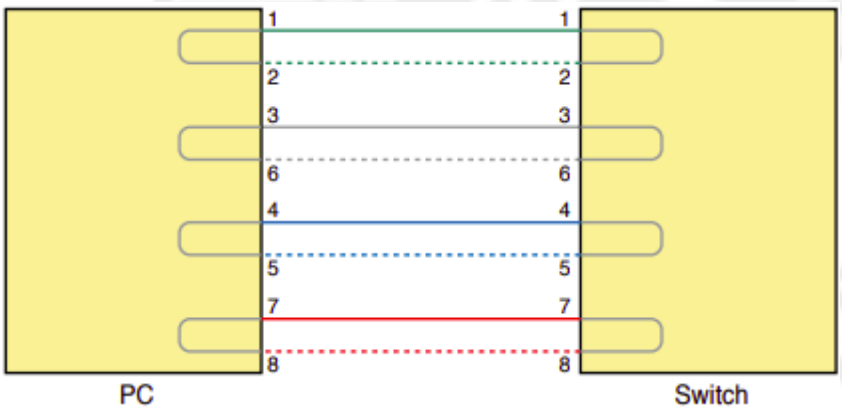
Crossover Cable

A crossover cable is a type of Ethernet cable used to directly connect two similar devices, such as two computers or two switches, without the need for an intermediate device like a router. In a crossover cable, the pinouts on one end of the cable are reversed compared to the other end. This reversal allows the transmitting signals from one device to be received by the other device, and vice versa. The pinout for a crossover cable is as follows



UTP Cabling Pinouts for (Gigabit Ethernet)

1000BASET(1000Mbps) (Gigabit Ethernet) differs from 10BASET and 100BASET as far as the cabling and pinouts. First, 1000BASET requires four wire pairs. Second, it uses more advanced electronics that allow both ends to transmit and receive simultaneously on each wire pair. However, the wiring pinouts for 1000BASET work almost identically to the earlier standards, adding details for the additional two pairs.



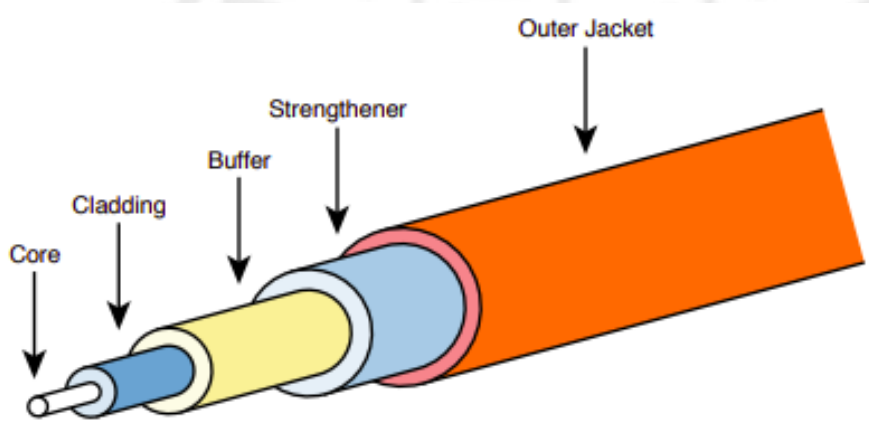
The Gigabit Ethernet crossover cable crosses the same twowire pairs as the crossover cable for the other types of Ethernet (the pairs at pins 1,2 and 3,6). It also crosses the two new pairs as well (the pair at pins 4,5 with the pair at pins 7,8).

The capability of many UTP based Ethernet standards to use a cable length up to 100 meters means that the majority of Ethernet cabling in an enterprise uses UTP cables.

Fiber Optic Cable:

Fiberoptic cabling uses a flexible glass material called fiberglass as the medium to transmit data using light signals. Unlike the hard and brittle glass used in windows, fiberglass allows for the creation of a long, thin and flexible fiber. This fiber is placed at the center of the fiberoptic cable, allowing light to pass through it, which is crucial for transmitting data.

Although glass fibers are effective for transmitting data, they require protection and reinforcement. To prevent breakage, the glass fiber is surrounded by protective layers within the cable. These layers ensure the integrity and durability of the fiber.



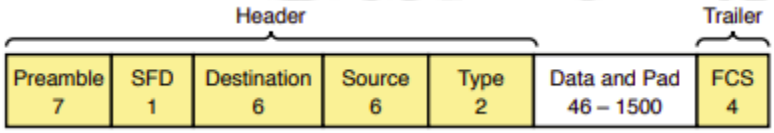
Summary Points

- Fiber optic cables transmit data using light signals through fiberglass strands.
- They require protective layers, including an outer jacket, cladding, and a core.
- A light source called the optical transmitter, Two types of fiber optic cables are:
- ***Multimode fiber:*** Allows light to travel in multiple angles, suitable for shorter distances.
- ***Singlemode fiber:*** Allows light to travel in a single angle, suitable for longer distances.

Ethernet Addressing:

Ethernet uses Media Access Control (MAC) addresses, which are unique 48-bit binary numbers often represented as 12-digit hexadecimal values. These MAC addresses consist of an Organizationally Unique Identifier (OUI) and a vendor-assigned portion. Ethernet supports various addressing modes, including unicast (one-to-one), multicast (one-to-many), and broadcast (one-to-all).

Ethernet DataLink Protocol:



Ethernet datalink protocols define the structure of Ethernet frames, which are the data packets used in Ethernet communication. These frames include various fields, such as the preamble for synchronization, the start frame delimiter, destination and source addresses, and the type field. The type field is particularly important as it identifies the network layer protocol being used, such as IPv4 or IPv6.

Error Detection with FCS:

The Frame Check Sequence (FCS) is an Ethernet trailer field utilized for error detection. Its primary function is to determine if the frame bits have altered during transmission. To ensure the integrity of the received frame, mathematical formulas are applied to verify its accuracy.

Full Duplex and Half Duplex:

Full Duplex allows simultaneous two-way communication, meaning data can be sent and received at the same time, much like a telephone conversation where both parties can speak and listen simultaneously. This mode enhances efficiency and reduces latency in data transmission.

Half Duplex permits communication in both directions but not simultaneously; data transmission occurs in one direction at a time, similar to a walkie-talkie where one person speaks while the other listens.