Government College of Engineering, Jalgaon

(An Autonomous Institute of Govt. of Maharashtra)
Department of Computer Engineering

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Experiment No. ____

Title: - Comparative analysis of different types of network cables with specifications

Aim: - Study of different types of cables – CAT 5, CAT 6 with their specifications comparisons

Theory:

Common Ethernet network cable are straight and crossover cable. This Ethernet network cable is made of 4 pair high performance cable that consists twisted pair conductors that used for data transmission. Both end of cable is called RJ45 connector.

The cable can be categorized as Cat 5, Cat 5e, Cat 6 UTP cable. Cat 5 UTP cable can support 10/100 Mbps Ethernet network, whereas Cat 5e and Cat 6 UTP cable can support Ethernet network running at 10/100/1000 Mbps. You might heard about Cat 3 UTP cable, it's not popular anymore since it can only support 10 Mbps Ethernet network.

Straight and crossover cable can be Cat3, Cat 5, Cat 5e or Cat 6 UTP cable, the only difference is each type will have different wire arrangement in the cable for serving different purposes.

For the communication to take place, cables play important role. Cable is the medium through which information usually moves from one network device to another. There are several types of cable which are commonly used with LANs. The type of cable chosen for a network is related to the network's topology, protocol, and size.

There are various types of cables used in networks as follows.

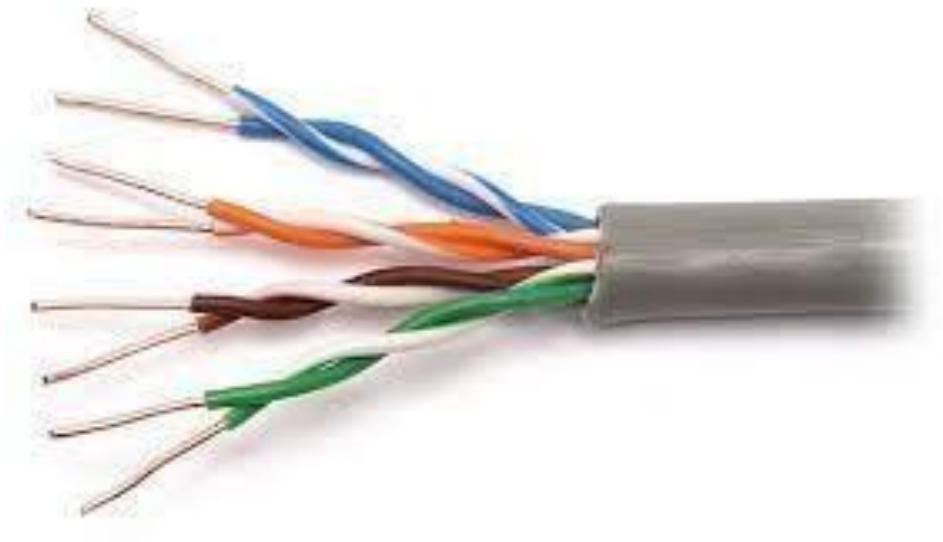
- Unshielded Twisted Pair (UTP) Cable

- Shielded Twisted Pair (STP) Cable
- Coaxial Cable
- Fiber Optic Cab

Twisted Pair Cables:

Twisted pair cabling is a type of wiring in which two conductors of a single circuit are twisted together for the purposes of canceling out electromagnetic interference (EMI) from external sources; for instance, electromagnetic radiation from unshielded twisted pair (UTP) cables, and crosstalk between neighboring pairs. In balanced pair operation, the two wires carry equal and opposite signals and the destination detects the difference between the two. This is known as differential mode transmission. Noise sources introduce signals into the wires by coupling of electric or magnetic fields and tend to couple to both wires equally. The noise thus produces a common-mode signal which is cancelled at the receiver when the difference signal is taken.

Unshielded twisted pair Cable(UTP):



Unshielded twisted-pair is the most common network cabling used. It is similar to telephone cabling but uses four pair of wire instead of two. Shielded twisted-pair is cabling similar to UTP but, as the name implies, it includes shielding to protect electromagnetic interference (EMI). Twisted wires ensure that the noise is the same on each wire. The common noise is then canceled at each end. Both UTP and STP are rated at 100 meter (328 feet) maximum segment lengths because of attenuation or loss of signal strength. UTP has a PVC or plenum coating, but no foil shield. UTP comes in seven grades to offer different levels of protection against electrical interference:

Category 1 is for voice-only transmissions and is in most phone systems today. Itcontains two twisted pairs.

Category 2 is able to transmit data at speeds up to 4Mbps. It contains four twisted pairs of wires.

Category 3 is able to transmit data at speeds up to 10Mbps. It contains four twisted pairs of wires.

Category 4 is able to transmit data at speeds up to 16Mbps. It contains four twisted pairs of wires.

Category 5 is able to transmit data at speeds up to 100Mbps. It contains four twisted pairs of copper wire to give the most protection.

Category 5e is able to transmit data at speeds up to 1Gbps. It also contains four twisted pairs of copper wire, but they are physically separated and contain more twists per foot than Category 5 to provide maximum interference protection.

Category 6 is able to transmit data at speeds up to 1Gbps and beyond. It also contains four twisted pairs of copper wire, and they are oriented differently than in Category 5 or 5e. You can use it as a backbone to connect different parts of your network together, such as those on different floors of a building. If you‟re going to install a new network, there's no reason to use anything but CAT-6 unless you choose to use fiber. Each of these levels has a maximum transmission distance of 100 meters.

Shielded twisted pair cable (STP):-

Shielded Twisted pair Cable

Categories of UTP Cable:

It has been categorized into three categories based on the equipment that are being connected through these wires.

i. Straight Through Cable

ii. Cross Over Cable

iii. Roll Over Cable

Explanation:

Straight through Cable:

Straight through cables are used to connect different devices like Switch to PC. Switch to Router. Router to Switch etc. Straight-through cables are used when each end of the communication transmits and receives on different pairs.

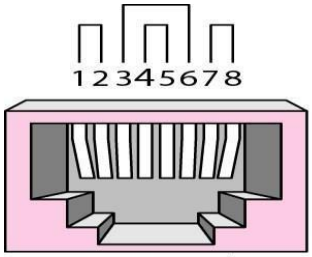
Cross Over Cable:

In a cross over the cable, the send and receive wires are "crossed over", meaning the wires are opposite on each end. This allows two PCs to talk to each other, has it connects the send of one computer to the receive of the other. Hence, the cross over cables are used to connect similar devices like PC to PC , Router to Router, Switch to Switch, Hub to Hub etc.

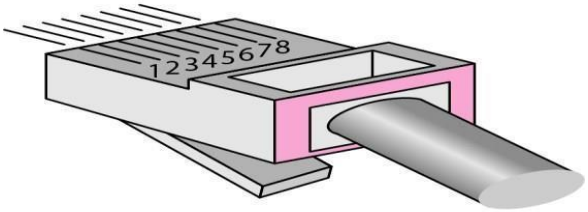
Roll Over Cable:

Roll over cables are used to connect to the console port of the device. It gets the name rollover because the pin outs on one end are reversed from the other, as if the wire had been rolled over and you were viewing it from the other side.

RJ-45 CONNECTOR:-



RJ-45 Female



RJ-45 Male

RJ45 connector standardized as the 8P8C modular connector (and the similar RJ45S with a keyed 8P2C)RJ45 (computers), an unkeyed 8P8C modular connector used for Ethernet computer network cables (incorrectly referred to as RJ45)

The RJ45 connector is standardized as the IEC 60603-7 8P8C modular connector with eight conductors. The RJ45S, a similar standard jack once specified for modem or data interfaces, uses a mechanically-keyed variation of the 8P8C body with an extra tab that prevents it from mating with other connectors; the visual difference from the more-common 8P8C is subtle. The original RJ45S keyed 8P2C modular connector had pins 5 and 4 wired for tip and ring of a single telephone line, and pins 7 and 8 shorting a programming resistor,[7][8] but is obsolete today.

An installer may wire the jack to an arbitrary pinout, or use it as part of a standardized generic structured cabling system such as ISO/IEC 15018 or ISO/IEC 11801, using 8P8C patch panels for both phone and data wiring.

Transmission Pins:

Devices that transmit on 1, 2 and receive on 3,6

1) PC
2) Router
3) Wireless Access Point AP
4) Networked printers

Devices that transmit on 3, 6 and receive on 1,2

1) Switch
2) Bridge
3) hub

Required Equipment's: In order to make a network cable you need the following equipment.

i. Cat5, Cat5e cable.

CAT5 cable usually contains four pairs of copper wire; Fast Ethernet communications onlyutilize two pairs. A newer specification for CAT5 cable -CAT5 enhanced ("CAT5e" or "CAT5e") - supports networking at Gigabit Ethernet [speeds (up to 1000 Mbps) over short distances by utilizing all four wire pairs, and it is backward-compatible with ordinary CAT5.

ii. A connector named RJ-45.

RJ45 connectors feature eight pins to which the wire strands of a cable interface electrically. Standard RJ-45 pin outs define the arrangement of the individual wires needed when attaching connectors to a cable.

iii. Crimping tool:

Use to crimp the cable inside RJ 45 connector.

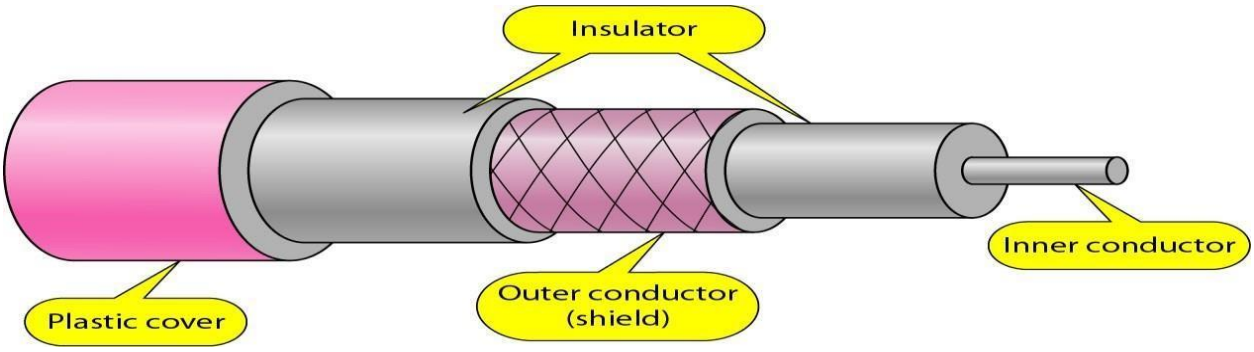
iv. Wire stripper or Knife:

You can use a knife too to cut the wire open. In order to make different combinations of it. We will have to cut the upper protective coating and bring out the eight wires.

Category	Speed	Use
1	1 Mbps	Voice Only (Telephone Wire)
2	4 Mbps	LocalTalk & Telephone (Rarely used)
3	16 Mbps	10BaseT Ethernet
4	20 Mbps	Token Ring (Rarely used)
5	100 Mbps (2 pair)	100BaseT Ethernet
5e	1,000 Mbps	Gigabit Ethernet
6	10,000 Mbps	Gigabit Ethernet

Auto MDIX: Auto-MDIX (automatic medium-dependent interface crossover) is a computer networking technology that automatically detects the required cable connection type (straight-through or crossover) and configures the connection appropriately, thereby removing the need for crossover cables to interconnect switches or connecting PCs peer-to-peer. When it is enabled, either type of cable can be used or the interface automatically corrects any incorrect cabling. For Auto-MDIX to operate correctly, the speed on the interface and duplex setting must be set to "auto".

Coaxial Cable: Coaxial cable, or coax as it is commonly referred to, has been around for a long time. Coax found success in both TV signal transmission as well as in network implementations. Coax is constructed with a copper core at the center that carries the signal, plastic insulation, braided metal shielding, and an outer plastic covering. Coaxial cable is constructed in this way to add resistance to attenuation (the loss of signal strength as it travels over distance), crosstalk (the degradation of a signal caused by signals from other cables running close to it), and EMI (electromagnetic interference). Figure shows the construction of coaxial cabling.



Coaxial cabling.

Networks can use two types of coaxial cabling: thin coaxial and thick coaxial. Both have fallen out of favor, but you might still encounter thin coax in your travels.

Thin Coax:

Thin coax is much more likely to be seen than thick coax in today's networks, but it isn't common, either. Thin coax is only .25 inches in diameter, making it fairly easy to install. Unfortunately, one of the disadvantages of all thin coax types are that they are prone to cable breaks, which increase the difficulty when installing and troubleshooting coaxial-based networks.

There are several types of thin coax cable, each of which has a specific use. Table 2 summarizes the categories of thin coax.

Cable	Type
RG-58 /U	Solid copper core
RG-58 A/U	Stranded wire core
RG-58 C/U	Military specification
RG-6	Used for cable TV and cable modems

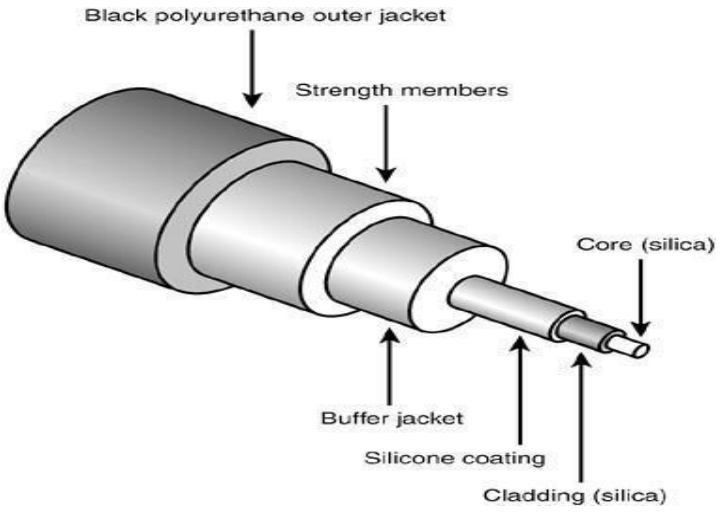
Table: Thin Coax Categories

Fiber optics Cable

In many ways, Fiber-Optic media addresses the shortcomings associated with copper-based media. Because fiber-based media use light transmissions instead of electronic pulses, threats such as EMI, crosstalk, and attenuation become a nonissue. Fiber is well suited for the transfer of data, video, and voice transmissions. In addition, Fiber-Optic is the most secure of all cable media. Anyone trying to access data signals on a Fiber-Optic cable must physically tap into the media. Given the composition of the cable, this is a particularly difficult task.

Unfortunately, despite the advantages of fiber-based media over copper, it still does not enjoy the popularity of twisted-pair cabling. The moderately difficult installation and maintenance procedures of fiber often require skilled technicians with specialized tools. Furthermore, the cost of a fiber-based solution limits the number of organizations that can afford to implement it. Another sometimes hidden drawback of implementing a fiber solution is the cost of retrofitting existing network equipment. Fiber is incompatible with most electronic network equipment. This means that you have to purchase fiber-compatible network hardware.

Fiber-Optic cable itself is composed of a core glass fiber surrounded by cladding. An insulated covering then surrounds both of these within an outer protective sheath. Figure 3 shows the composition of a Fiber-Optic cable.



Fiber-Optic cable.

Two types of Fiber-Optic cable are available: single and multimode fiber. In multimode fiber, many beams of light travel through the cable bouncing off of the cable walls. This

strategy actually weakens the signal, reducing the length and speed the data signal can travel. Single mode fiber uses a single direct beam of light, thus allowing for greater distances and increased transfer speeds. Some of the common types of Fiber-Optic cable include the following:

- 62.5 micron core/125 micron cladding multimode 50 micron core/125 micron cladding multimode
- 8.3 micron core/125 micron cladding single mode

In the ever-increasing search for bandwidth that will keep pace with the demands of modern applications, Fiber-Optic cables are sure to play a key role.

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