Computer Networks, IT-304

Autumn Semester 2012

Lab-0

Aim: To study and prepare LAN cables.

Theory:

Local Area Network

A local area network (LAN) is a group of computers and associated devices that share a common communications line or wireless link. Typically, connected devices share the resources of a single processor or server within a small geographic area such as home, school, computer laboratory, office building, or closely positioned group of buildings**.**

Transmission Medium

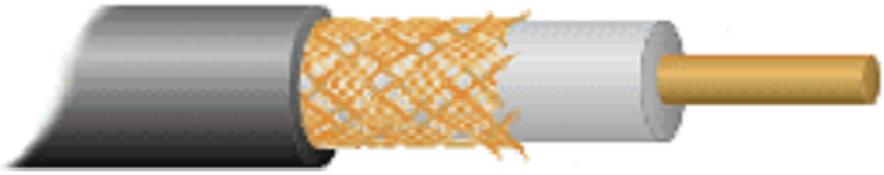
The means through which data is transformed from one place to another is called transmission or communication media. There are two categories of transmission media used in computer communications:

a) Guided Media
b) Unguided Media

1. **Guided Media**: Guided media are the physical links through which signals are confined to narrow path. These are also called guide media. Guided media are made up of a external conductor (Usually Copper) bounded by jacket material, which are called as cables. 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. In some cases, a network will utilize only one type of cable, other networks will use a variety of cable types. The type of cable chosen for a network is related to the network's topology, protocol, and size. Three common types of cables that are used for data transmission are:
    - Coaxial Cable
    - Twisted Pairs Cable
    - Fiber Optics Cable

Coaxial Cable:

Coaxial cable is very common & widely used commutation media. It got its name because it contains two conductors that are parallel to each other. The center conductor in the cable is usually copper. The copper can be either a solid wire or stranded material. Outside this central Conductor is a non-conductive material. It is usually white, plastic material used to separate the inner Conductor form the outer Conductor. The other Conductor is a fine mesh made from Copper. It is used to help shield the cable form EMI. Outside the copper mesh is the final protective cover.



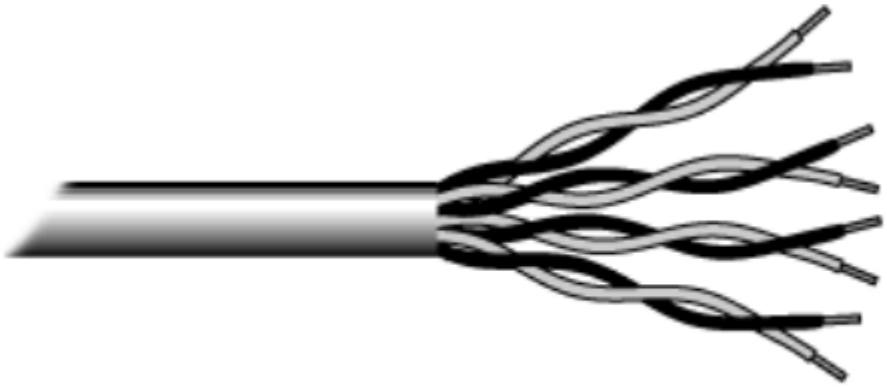
Coaxial cable

Twisted Pair Cable:

The most popular network cabling is twisted pair. It is light weight, easy to install, inexpensive and support many different types of network. It also supports the speed of 100 mps. Twisted pair cabling is made of pairs of solid or stranded copper twisted along each other. The twists are done to reduce vulnerably to EMI and cross talk. The number of pairs in the cable depends on the type. Twisted pair cabling comes in two varieties: shielded and unshielded.

UTP (Unshielded Twisted Pair Cable):

The cable has four pairs of wires inside the jacket. Each pair is twisted with a different number of twists per inch to help eliminate interference from adjacent pairs and other electrical devices. The tighter the twisting, the higher the supported transmission rate and the greater the cost per foot.



Unshielded twisted pair

In the context of the 100-ohm UTP (Unshielded Twisted Pair) type of cable used for Ethernet wiring the only categories of interest are Cat3, Cat4, Cat5, Cat5e, Cat6, and Cat7. CATx is an abbreviation for the category number that defines the performance of building telecommunications cabling as outlined by the Electronic Industries Association (EIA) standards. Some specifications for these categories are shown further down.

Category	Type	Spectral B/W	Length	LAN Applications	Notes
Cat3	UTP	16 MHz	100m	10Base-T, 4Mbps	Now mainly for telephone cables
Cat4	UTP	20 MHz	100m	16Mbps	Rarely seen
Cat5	UTP	100MHz	100m	100Base-Tx,ATM, CDDI	Common for current LANs
Cat5e	UTP	100MHz	100m	1000Base-T	Common for current LANs
Cat6	UTP	250MHz	100m		Emerging
Cat7	ScTP	600MHz	100m		

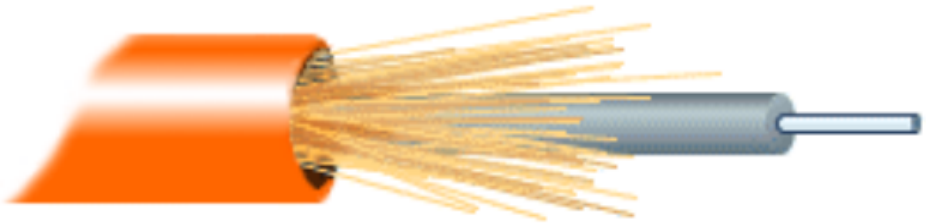
Shielded twisted pair (STP):

It is similar to UTP but has a mesh shielding that's protects it from EMI which allows for higher transmission rate. Shielded cables can also help to extend the maximum distance of the cables. Shielded twisted pair cable is available in three different configurations:

1. Each pair of wires is individually shielded with foil
2.There is a foil or braid shield inside the jacket covering all wires (as a group).
3. There is a shield around each individual pair, as well as around the entire group of wires (referred to as double shield twisted pair).

Fiber Optic Cable:

Fiber optic cabling consists of a center glass core surrounded by several layers of protective materials. It transmits light rather than electronic signals eliminating the problem of electrical interference. This makes it ideal for certain environments that contain a large amount of electrical interference. Fiber optic cable has the ability to transmit signals over much longer distances than coaxial and twisted pair. It also has the capability to carry information at vastly greater speeds. This capacity broadens communication possibilities to include services such as video conferencing and interactive services. The center core of fiber cables is made from glass or plastic fibers. A plastic coating then cushions the fiber center, and kevlar fibers help to strengthen the cables and prevent breakage. The outer insulating jacket made of teflon or PVC.



Fiber optic cable

There are two common types of fiber cables -- single mode and multimode. Multimode cable has a larger diameter; however, both cables provide high bandwidth at high speeds. Single mode can provide more distance, but it is more expensive.

Connectors:

Ethernet Category 5e (CAT5e) RJ45 Connectors

Ethernet CAT5e RJ45 Keystone Connectors; 110 punch-down type

RJ45 Jacks are the connector used for Ethernet cabling. These Inserts snap-in to our Keystone wall-plates, housings and Patch-Panels.

Ethernet CAT5e RJ45 Keystone Connectors; Toolless type

These RJ45 Ethernet Keystone Inserts don't need a 110 punch down tool to make connections, and snap-in to any of our Keystone wall-plates, housings, or patch-panels.

Ethernet CAT5e Adapters & Couplers

Ethernet Category 5e (CAT 5e) RJ45 Plugs & Boots

We have Ethernet CAT 5e male plugs and boots to fit them for various wiring applications.

CAT5e Ethernet Angled Wall Plates

We have multiple configurations of our Ethernet CAT5e Angled wall plates to fit your wiring needs.

RJ-45 connector

Crossover Cables vs Straight Through Cables:

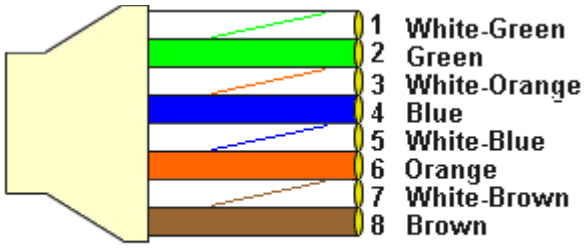
Ethernet patch cables can be wired in three different ways; the two main ways are called straight through and crossover. The third type is called rolled and has only specialized applications.

Generally speaking, straight through cables are used to patch between different types of equipment; for example, PCs to a hub. Conversely, crossover cables are generally used to patch between similar types of equipment; a PC to another PC for example Inside the UTP patch cable there are 8 physical wires although the network only uses 4 of them. The 8 wires are arranged in what's known as pairs and one pair is used to send information whilst the other pair is used to receive information.

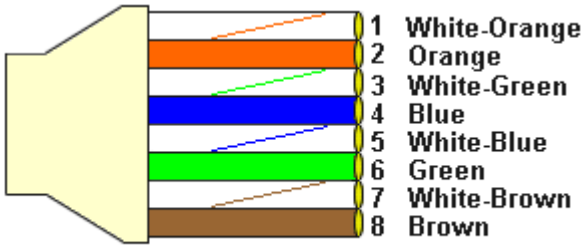
On a PC, the pair on pins 1 and 2 of the connector send information, while the pair on pins 3 and 6 receive the information. To make PCs talk to each we therefore need to connect the send pair of one PC to the receive pair of the other PC (and vice-a-versa). That means we need a crossover cable. If we used a straight through cable the both be listening on the one pair - and hearing nothing, and sending on the one pair - achieving nothing.

Color Codes

The standards say that Ethernet connectors should be cabled with specific colors on specific pins. There are two standard layouts - if a cable has the same layout on both ends it's a straight through cable. If a cable has one layout on one end and the other layout on the other end then it's a crossover cable. Whilst not universal, the color codes shown below are generally used on professional cables.



568A CABLE END



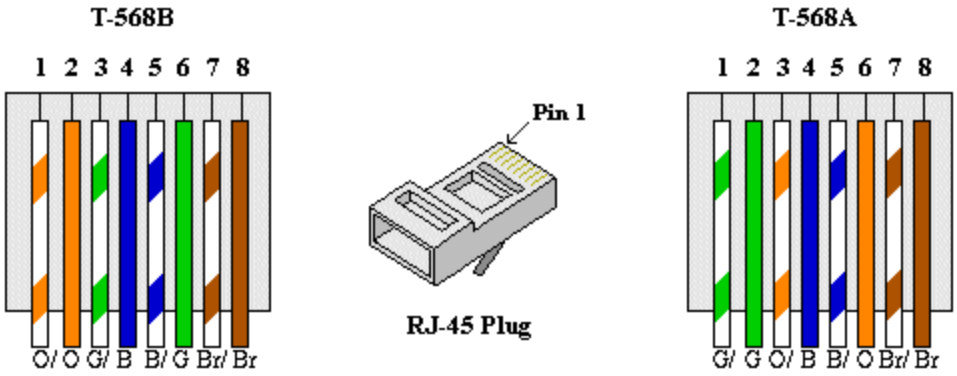
568B CABLE END

If a cable has 568A color wiring on both ends then it's a straight through cable
If a cable has 568B color wiring on both ends then it's also a straight through cable.
If a cable has 568A color wiring on one end and 568B color coded wiring on the other end, then it's a crossover cable.

Color Codes for RJ-45 Ethernet Plug :

Eight-conductor data cable (Cat 3 or Cat 5) contains 4 pairs of wires. Each pair consists of a solid color wire and a white and color striped wire. Each of the pairs are twisted together

The pairs designated for 10BaseT Ethernet are orange and green. The other two pairs, brown and blue, are unused. The connections shown are specifically for an RJ45 plug. The wall jack may be wired in a different sequence because the wires may be crossed inside the jack. The jack should either come with a wiring diagram or at least designate pin numbers that you can match up to the color code below.



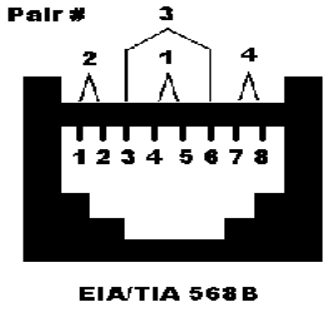
There are two wiring standards for these cables, called T-568A and T-568B. They differ only in pin assignments, not in uses of the various colors. The illustration above shows both standards. With the T-568B specification the orange and green pairs are located on pins 1, 2 and 3, 6 respectively. **The T-568A specification reverses the orange and green connections, so that the blue and orange pairs are on the center 4 pins, which makes it more compatible with the telco voice connections**.

T-568A is supposed to be the standard for new installations, and T-568B is the alternative. However, most off-the-shelf data equipment and cables seem to be wired to T568B.

Pin Number Designations
Here are the pin number designations for both standards:

T-568B

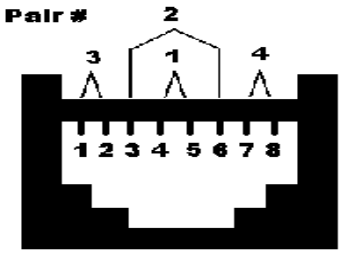
Pin	Color	Pair	Descrtipion
1	white/orange	2	TxData +
2	orange	2	TxData -
3	white/green	3	RecvData +
4	blue	1	Unused
5	white/blue	1	Unused
6	green	3	RecvData -
7	white/brown	4	Unused
8	brown	4	Unused



EIA/TIA 568B

T-568A

Pin	Color	Pair	Description
1	white/green	3	RecvData +
2	green	3	RecvData -
3	white/orange	2	TxData +
4	blue	1	Unused
5	white/blue	1	Unused
6	orange	2	TxData -
7	white/brown	4	Unused
8	brown	4	Unused



EIA/TIA 568A

Note: Odd pin numbers are always the striped wires.

Exercise: To make Straight through and Cross over UTP cable with RJ-45 Connector and test it with Cable Tester.

Suggested Reading:

1. Computer Networks, by Andrew S. Tanenbaum, Fourth edition, section 2.2 – An introduction to various physical media
2. http://hubpages.com/hub/Data-Communication
3. http://www.solutionsandsystems.com/Wiring%20&%20Cable%20Color%20Scheme.htm
4. *highiqsolutions.com/**Wiring**%20&%20**Cable**%20**Color**%20**Scheme**.pdf*

Sample Questions:

Q1. How twists in twisted pair give an advantage over coaxial cable? On what factors no. of twist depends?
Q2. Briefly, discuss about connectors available for coaxial cable and optical fiber?
Q3. List down different uses and applications of Coaxial cable?
Q4. Study about different types of networks: MAN, WAN, PAN, CAN, SAN, TAN?

To Submit: Prepare a log book for all the things done in the network lab. Complete log book with the answers for the above questions.