CABLE MEDIA

BY –Tripurari kumar

* Coaxial Cable * Fiber optic cable * Twisted-pair

Coaxial Cables

Coaxial cables were the first cable types used in LANs. Coaxial cable gets its name because two conductors share a common axis. The cable is most frequently referred as coax. It has better shielding than twisted pair, so it can span longer distances at higher speed two kinds of co-axial cable are widely used.

1. 50-ohm cable (Base band coaxial cables / Thinnet) is commonly used for digital transmission.

2. 75-ohm cable (Broad band coaxial cables / thicknet) is commonly used for analog transmission.

This distinction is based on historical, rather than technical, factors (e.g.- early dipole antennas had an impedance of 300 ohms, as it was easy to built 4:1 impedance matching transformers)

The components of the co-axial cable are as follows:

• A central conductor, although usually solid copper wire, this sometimes is also made of standard wire.

• An outer conductor forms a tube surrounding the central conductor. This conductor can consist of braided wires, metallic foil or both. The outer conductor, frequency called the shield, servers as a ground and also protects the inner conductor from EMI.

• An insulation layer keeps the outer conductor spaced evenly from the inner conductor.

• A plastic encasement (jacket) protects the cable from damage.

The construction and shielding of the co-axial cable give it a good combination of high bandwidth and excellent noise immunity. The possible bandwidth depends on the cable length.

Types of Co-axial cables

Baseband Co-axial cables (Thinnet)

This is light and flexible cabling-medium that is inexpensive and easy to install. Following table illustrate some thinnet classifications. Note that thinnet falls under the RG-58 family, which has 50 ohm impedance. Thinnet is approximately .25 inches (6 mm) in thickness.

Cable Description Impedance

RG-59/U Solid copper centre 50 ohm

RG-58A/U Wire stand centre 50 ohm

RG-58C/U Military version of RG-58 A/ U 50 ohm

Thinnet cable can reliably transmit a signal for 185 meters (about 610 feet). Although it's called 10Base2 to give the impression that it can run 200 meters,

Broadband Co-axial cables (Thicknet)

Thicknet is thicker in diameter that thinnet (approximate 0.5 inches). Because it is thicker and doesn't bend as readily as Thinnet. Thicknet cable is harder to work with. A thicker center core, however, means that Thicknet can carry more signals for a grater distance than Thinnet. Thicknet can transmit a signal approximately 500 meters (1650 feet). Thicknet cable is sometimes called Standard Ethernet (although other cabling types are also useful for Ethernet) Thicknet can be used to connect two or more small thinnet LANs into a larger network. Because of its greater size, Thicknet is also more expensive than thinnet It can be installed, safely outside, running from building to building, such as with cable TV.

Co-axial Characteristics

You should be familiar with the installation cost. Bandwidth and EMI cost, bandwidth and EMI resistance characteristics of coaxial cable.

A. Installation

Co-axial cable typically is installed in two configurations: daisy chain (from device to device-Ethernet) and star (ARC net)

The Ethernet cabling shown in the figure is an example of Thinnet, which uses RG-58 cable. Devices are connected to the cable by means of T. connectors. Cables are used to provide connections between T-Connectors. One characteristic of this type of cabling is that a special connector, called terminator, must terminate the ends of cable run. The terminator contains a resistor that is-matched to the characteristics of the cable. The resister prevents signals that reach the end of the cable from bouncing back and causing interference.

Co-axial cable is reasonably easy to install because it is robust and difficult to damage. In addition, connectors can be installed with inexpensive tools and a bit of practice. The device -to-device cabling approach can be difficult to reconfigure, however, when new devices cannot installed near an existing cabling path.

The co-axial cable used for Thinnet fall at the low end of the cost spectrum, whereas Thicknet is among the more costly options.

Bandwidth -

LANs that employ coaxial cable typically have a bandwidth between 8.5 mbps and 10 Mbps. Thicker co-axial cables offer higher bandwidth, and the potential bandwidth of co-axial is much higher than 10 Mbps. Current LAN technologies, however don’t take advantage of take of this potential.

EMI characteristic

All copper media are sensitive to EMI, although the shield in coax makes the cable fairly resistant, Coaxial cables, however, do radiate a portion of their signal, and electronic eavesdropping equipment can detect this radiated signal.

Connectors for Coaxial cables

Two types of connectors are commonly used with coaxial cable. The most common is the BNC corrector mainly used for thinnet cabling. In contrast Thicknet uses N-Connectors, which Screw instead of using a twist lock.

3.3.1. Check your progress.

1. Explain, difference between broadband and baseband coaxial cables?

……

……

2. What are important parts of co-axial cable?

……

……

3. Which types of connectors are required for co-axial cable?

……

……

3.3.2 Twisted pair

Although the bandwidth characteristics of magnetic tapes are excellent, the delay characteristics are poor. Transmission time is measured in minutes or hours, not milliseconds. For many applications an online connection is needed. The oldest and still most common transmission medium is twisted pair, which employs copper cable. One more reason for popularity of twisted pair is low cost. This type of cable is inexpensive to install and offers the lowest cost per foot of-any cable type.

A basic twisted pair cable consists of two strands of copper wire twisted together, as shown below. This twisting reduces the sensitivity of the cable to EMI and also reduces the tendency of the cable to radiate radio frequency noise that interferes with nearby cables and electronic components. This is because the radiated signals from the twisted wires tens to cancel each other out. Antennas, which are purposely designed to radiate radio frequency signals, consist of parallel, not twisted wires)

Twisting also controls the tendency of the wires in the pair to cause EMI each other. Whenever two wires are in close proximity, the signals in each wire tend to produce noise, called crosstalk, in the

other. Twisting the wires in the pair reduces crosstalk in much the same way that twisting reduces the tendency of the wires to radiate EMI.

Two types of twisted-pair cable are used in LANs :

- Shielded
- Unshielded

Shielded Twisted-Pair (STP) Cable

Shielded twisted-pair cabling consists of one or more twisted pairs of cables enclosed in a foil wrap and woven copper shielding as shown above. Diagram shows IBM type 1 cabling, the first cable type used with IBM token Ring. Early LAN designers used shielded twisted-pair cable because shield further reduces the tendency of the cable to radiate EMI and thus reduces the cable's sensitivity to outside interference.

Co-axial and STP cable used shields for the same purpose. The shield is connected to the ground is a portion of the electronic device to which the cable is connected. A ground is a portion of the device that serves as an electrical reference point. Usually it literally connected to a metal stake driven into the ground. A property grounded shield prevents signals from getting in to or of the cable.

In IBM Type 1 cable include twisted pairs of wire within a single shield Various types of STP cable exist. Some shield each pair individually, and others shield several pairs. The engineers who design a network's cabling system choose the exact configuration. IBM design, and each several twisted pair cable types to use with their Token ring network design, and each cable type is appropriate for a given kind of installation.

STP cables cost more than thin coaxial or unshielded twisted pair cable. STP is less costly, than thick coax or fiber-optic cable.

Capacity

STP cable has a therotical capacity of 500 Mbps, although few implementations exceed 153 Mbps with 100 meters cable runs. The most common data rate for STP cable is 16 Mbps, which is the top data rate for token Ring networks.

Attenuation

All varieties of twisted-pair cable have attenuation characteristics that limit the length pf cable runs to a few hundred teeters, although a 100-flfteter limit is most common.

EMI characteristics

The shield in STP cable results in good EMI characteristic for copper cable, comparable to the EMI characteristic of coaxial cable. This is one reason STP might be preferred to unshielded twisted-pair cable in some situations. As with all copper cables. STP is sensitive to interference and vulnerable to electronic eavesdropping.

Unshielded Twisted-pair (UTP) cable

Unshielded Twisted-pair cable does not incorporate a braided shield into its structure; however, the characteristics of UTP are similar in many ways to STP, differing primarily in attenuation and EMI. As shown in figure, several Twisted-pairs can be bundled in a single cable. These pairs typically are colour-coded to distinguish them.

Telephone systems commonly use UTP cabling. Network engineers can sometime use existing UTP telephone cabling (if it is new enough and of high-enough quality to support network communications) for network cabling.

UTP cable is a latecomer to high-performance LANs because engineers only recently solved the problems of managing radiated noise and susceptibility to EMI. However, a clear trend toward UTP is in operation, and all new copper based cabling schemes are based on UTP.

UTP cable is available in the following five grades, or categories :

• Categories 1 and 2 - These voice-grade cables are suitable only for voice and for low rates (below 4 mbps). Category 1 was once the standard voice-grade cable for telephone systems. The growing need for data-ready cabling systems, however, has caused Categories 1 and 2 cables to be supplanted by category 3 for new installation.

• Category 3 - As the tower data-grade cable, this type of cable generally is suited for data rates 10 mbps. Some innovative schemes, however, let the cable support data rates up to 100 mbps. Category 3, which uses four twisted pairs with three twists per foot, is now the standard cable used for most telephone installations.

• Category 4 - This data grade cable, which consist of four twisted pairs, is suitable for data rates up to 16 Mbps.

• Category 5 - this data grade cable, which also consist of four twisted pairs, is suitable for data range up to 100 mbps. Most new cabling systems; for 100 Mbps data rates designed around Category 5 cable.

DTP cable offers an excellent balance of cost and performance characteristics, a discussed in the following sections.

Cost

UTP cable is the least costly of any cable type, although properly installed Category 5 tends to be fairly expensive. In some cases existing cable in buildings can be used for LANs, although you should verify the category of the cable and know the length of the cable in the walls. Distance limits for voice cabling are much less

Installation

UTP cable is easy to install. Some specialized equipment might be required, but the equipment is low in cost and can be mastered with a bit of practice. Properly designed UTP cabling systems easily can be reconfigured to meet changing requirements.

As noted earlier, however, Category 5 cable has stricter installation requirements than lower categories of UTP. Special training is recommended for dealing with Category 5 UTP.

Capacity

The data- rates possible with UTP have increase from 1 Mbps; pat 4 and 16 Mbps, to the point where 100 Mbps data rate are now common,

Attenuation

UTP cable share similar attenuation characteristics with other copper cables. UTP cable runs are limited to a few hundred meters, with 100 meters as the most frequent limit.

EMI Characteristics

Because DTP cable lacks a, shield, it is more sensitive to EMI than coaxial or STP cables. The latest technology makes it possible to use UTP in the vast majority of situation, provided that reasonable care is taken to avoid electrically noisy devices such as motors and fluorescent lights. Nevertheless, UTP might not be suitable for noisy environments such as factories. Cross talk between nearby unshielded pairs limits the maximum length of cable runs.

Connectors for UTP

The most common connector use with UTP cables is the RJ-45 connector. These connectors are easy to install on cables and are also extremely easy to connect and disconnect. Advantages of UTP cable • Relatively inexpensive • Easily installed, managed, and reconfigured • Basic technology and standards are matured and stable Disadvantages of UTP cable • Only categories 5,6,7 UTP cables are capable of high-speed (> 100 Mbps) data transmission. • Relatively high rate of attenuation • Sensitive to EMI

Check your progress.

1. Explain the capacity of UTP and STP cables?

……

……

2. Note down the advantages and disadvantages of UTP cables?

……

……

Fiber-Optic cable

In almost every way, fiber-optic cable is the ideal cable for data transmission. Not only does this type of cable accommodate extremely high bandwidth's, but it also presents no problems with EMI and

supports durable cables an cable runs as long as several kilometers. The two disadvantages of fiber-optic, however, are cost difficulty of installation.

The center conductor of a fiber-optic cable is a fiber that consists of highly refined glass or plastic designed to transmit light signals with little loss. A glass core supports a longer cabling distance, but a plastic core is typically easier to work with. The fiber is coated with a cladding that reflected signals back into the fiber to reduce signal loss. A plastic sheath protects the fiber. See Figure

Optical fibers are much smaller and more lightweight than copper wires. Therefore, large fiber optic cables carry more conductors than similar sized copper cables. There are two types of optical fibers.
1. Multimode fiber 2. Single mode fiber

The following table shows the comparison between single mode and multimode fibers

Sr. No Single mode Fiber Multimode Fiber

1 High capacity Lesser capacity than single mode

2 More costlier Cheaper than single mode

3 Light pulses are generated by injection Laser diode (ILDs)

Light pulses are generated by light emitted diodes (LEDs)

4 Can sustain a transmission rate of 100 Mbps at distance of 20 KM

Pan sustain a transmission rate of 100 Mbps at distance of 2 KM

5 Has been, optimized to allow one light path

Has been optimized to multiple one light path

A fiber-optic network cable consists of two strands separately enclosed in plastics sheaths- one strand sends and the other receives. Two types of cable configuration are available:

- Loose configuration

Loose configuration incorporates a space between the fiber sheath and the outer plastic encasement; this space is filled with gel or other material.

- Tight configuration

Tight configuration contains strength wires between the conductor and the outer plastic encasement.

In both cases, plastic encasement must supply the strength of the cable, while the get layer or strength wires protect the delicate fiber from mechanical damage.

Fiber optic cable doesn't transmit electrical signals. Instead, the data signals must be converted into light signals. Light sources include lasers and light-emitting diodes (LEDs). LEDs are inexpensive but produce a fairly poor quality of light suitable for less-stringent application. The end of the cable that receives the light signal must convert the signal back to an electrical form. Several types of solid-state components can perform this service.

One of the significant difficulties of installing fiber-optic cable arises when two cables must be joined. The small cores of the two cables (some are as small as 8.3 microns) must be lined up with extreme precision to prevent excessive signal loss. As with all cable types, fiber-optic cable has their share of advantages and disadvantages.

Cost

The cost of the cable and connector has fallen significantly in recent years. However, the electronic devices required are significantly more expensive than comparable devices for copper cable. Fiber-optic cable is also the most expensive cable type to install.

Installation

Greater skill is required to install fiber-optic cable than to install most copper cables. However, improved tools and techniques have reduced the training required. Still, fiber-optic cable requires greater care, because the cable must be treated fairly gently during installation. Every cable has a minimum bend radius, for example, and fibers are damaged if the cables are bent too sharply. It is also important not to stretch the cable during installation.

Capacity

Fiber-optic cable can support high data fates (as high as 200,000 Mbps), even with long cable runs. Although UTP runs cable are limited to less than 100 meters with TOO Mbps data rates, fiber optic cable can transmit 100 Mbps signals for several kilometers.

Attenuation

Attenuation in fiber-optic cables is much lower than in copper cables. Fiberoptic cables can carry signals for several kilometers.

EMI Characteristics

Because fiber-optic cable doesn’t use electrical signals to transmit data, they are totally immune to electromagnetic interference. These cables are also immune to a variety of electrical effects that must be taken into account when designing copper cabling systems.

Because the signals in fiber-optic cable are not electrical in nature, they cant be detected by the electronic eavesdropping equipment that detects electromagnetic radiation. Therefore, fiber-optic cable is the perfect choice for high-security networks.

Advantages of Fiber optic cable

- Supports very high bandwidth- from 100 Mbps to >2Gbps

- Very low alteration
- Immune to EMI or eavesdropping

Disadvantages

- Very expensive cables
- More complex to install
- High precision required for connections

Cheek your progress.

1. Differentiate between loose configuration and tight configuration?

……

……

2. Explain the advantages and disadvantages of fiber optic cable?

……

……