UNDERSTANDING NETWORKS

Introduction

In this article I attempt to briefly discuss network topologies, transmission media, network cabling and some possible reasons for implementing networks.

Network Topologies

The topology is the map of a network that illustrates how nodes (computers) are interconnected and the way in which these nodes function throughout that network.

There are two types of topologies such as:

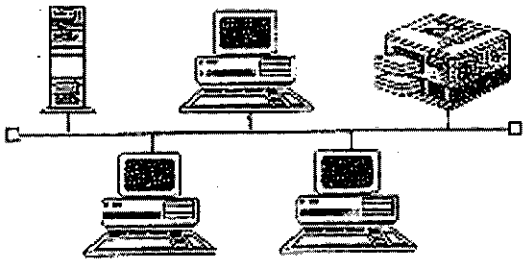
- Physical Topology
- Logical Topology

While Physical Topology describes the actual layout of the network transmission medium, Logical Topology describes the logical pathway of the signal that flows across the network nodes.

These topologies can take several forms and the most common three of these forms are:

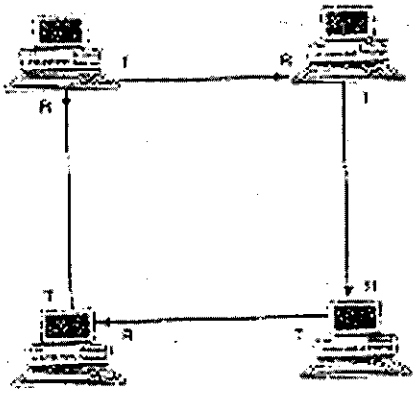
- Bus Topology
- Ring Topology
- Star Topology

Bus Topology



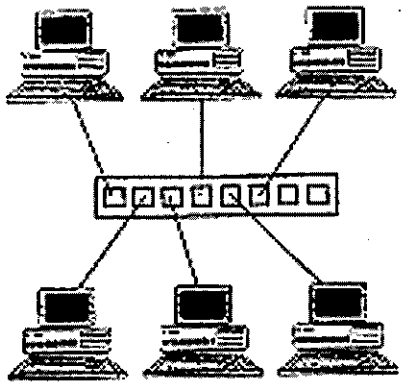
All the devices in a bus topology are connected to a single shared cable, which is known as the Backbone. Most bus networks broadcast signals in both directions through the backbone cable and it supplies data directly to the device. Both ends of the backbone cable are connected to a special connector called Terminator. Terminators are used to prevent signals from getting reflected through the cable and causing interference.

Ring Topology



This is wired in the form of a Ring or a Circle. Each node is connected with its neighbour on either side. In the ring topology, the data will pass in one direction only. Each node/device has one Receiving port and one Transmitting port. When signals pass across the nodes, each node may retransmit the signal until it finds the desired computer or device. The advantage in this retransmission is that the signal is regenerated or refreshed and therefore the signal degeneration becomes low.

Star Topology



As the above diagram describes all nodes are connected to a central hub/switch and the transmitted data are routed to the correct destination. Star topology can expand hierarchically.

Though this topology exists physically as a star, it can be configured logically to operate as a bus or ring logical topology.

Few things required to know before implementing a network

When designing a network it is important to figure out the following few things:

- What type of workstations and file servers will be connected?
- Is the network intended to be connected with other networks?
- What type of applications will be used in the network?
- Will the network be used to execute critical applications (Such as payroll or database systems)?
- Is the transmission speed important?
- What are the security issues?
- What is the expected growth of the network once it is setup?

Discussion of the Three types of Topologies

Bus Topology: The implementation cost of this type of network is relatively lower than others. But management cost of the network is higher due to the difficulty of isolating the failures of the nodes and cables.

Ring Topology: Though the ring topology is expensive to implement, it will be easier to manage than the bus topology and in that it is easier to locate defective nodes. Also, it is suitable for handling high volumes of network traffic than in a bus topology. But the Ring topology has the disadvantage that a defective node can cause the whole network down.

Star Topology: The implementation cost of this type of topology is comparatively high. It's mainly because this topology requires a central device known as hub or switch and requires more cabling from that point to each node. The most important advantage of this network is the ability to configure malfunctioning nodes quite easily.

These defective nodes do not affect the other active nodes and they will function properly without any disturbance.

Transmission Media

The media available for networking are:

- Thick Coaxial cable
- Thin Coaxial cable
- Shielded Twisted pair
- Unshielded Twisted pair
- Fibre Optics
- Wireless technology

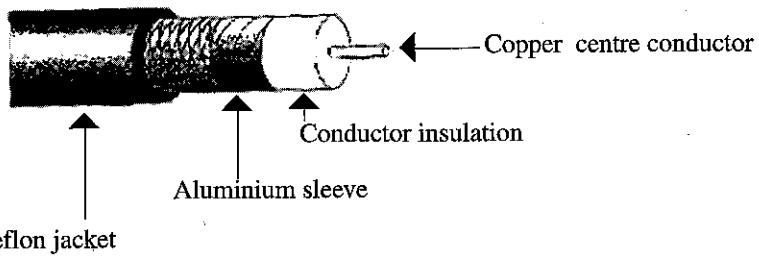
There are some characteristics that are required to be clarified before choosing a medium.

- Data transfer speed
- Distance requirement
- Network topology
- Flexibility of upgrading

Coaxial Cable

The two types of coaxial cables available are named as thick and thin. In many situations the thick cable is used as a backbone cable and/or to connect two networks together.

Thin coaxial cable is used to connect workstations and it has a smaller diameter while it is similar to a coaxial cable in appearance



The above diagram shows a cross-section of a coaxial cable.

Thick Coaxial cable known as RG-8 (Radio Grade), has an impedance of 50 Ohms. This cable runs up to 500 meters with 10Mbps transmission rate.

This cable is also known as 10BASE5 in shorthand specification. Here the value 10 represents the transmission rate 10Mbps. The maximum length is 500 meters in Baseband*[1] transmission. It can also be configured for Broadband*[2] transmission.

Thin coaxial cables are identified as RG-58 A/U or 'Thin net' or 10BASE2. It can operate at 10Mbps of Baseband transmission rate with the maximum cable run of 200 meters with impedance of 50 Ohms. But 185 meters is recommended for efficient and reliable communication.

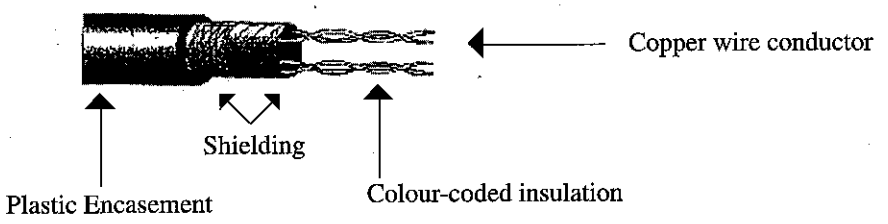
*[1] In this transmission method only one node transmits at a time. In other words at a time the entire channel is used to transmit one signal of data.

*[2] This can occupy many transmission channels over a single transmission medium. Therefore it allows many nodes to transmit at a given time.

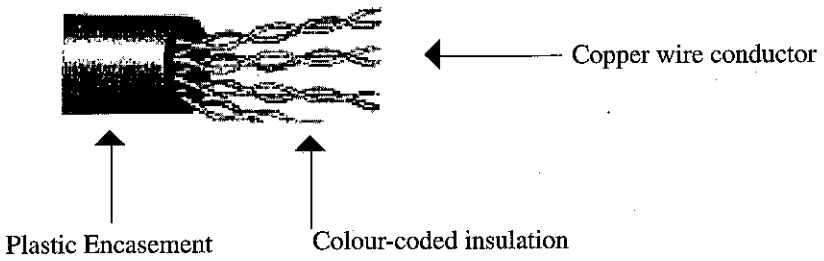
Twisted Pair

Two categories of twisted pairs exist. They are the Unshielded Twisted Pair (UTP) and the Shielded Twisted Pair (STP).

Shielded twisted-pair **(STP)**



Unshielded twisted-pair **(UTP)**

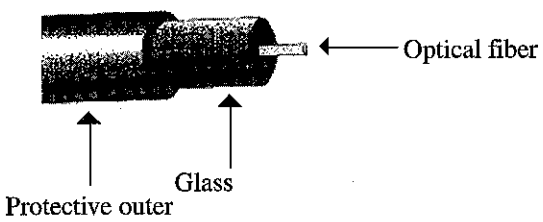


Braided or corrugated shielding is used for indoors and outdoors respectively when installing cables. The shield can protect communication signals from electrical interferences and twisted wire pairs also help to reduce electrical interferences.

Shielded twisted pair is more expensive than the unshielded twisted pair. This cable is commonly known as 10BASE-T or Cat-X (Category-X). As an example Cat-4 UTP has the maximum transmission rate of 20Mbps. The most commonly used twisted pair is Cat-5 and it can support up to 100Mbps of transmission rate with a maximum cable run of 100 meters.

Fibre Optic cable

The main advantage of fibre optic cable is its high bandwidth and low attenuation*[3] when transmitting over long distances. Also unauthorized taps into the fibre cable is difficult. The major disadvantages are that it is fragile and experts are required for cable installation.



*[3] The amount of signal that will be lost, when it is transmitted through a communication medium from source to destination.

Wireless Technology

Radio waves, Infrared and Microwave technologies are termed as wireless data transmission methods. All these technologies transmit signals through air. These are very good alternatives in places where laying cables is difficult. A major disadvantage in wireless communication is that there are many atmospheric disturbances such as interference from other signals and disturbances due to ionospheric changes etc.

References

1. Madden, Marry et al. (1997) *Windows NT Networking for Dummies.* Vol 2. New Delhi, Unique Colour Carton.
2. William A. Shay. (2001) *Understanding Data Communications & Networks.* 2nd edition. New Delhi, Vikas Publishing House Pvt. Ltd.

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