A computer network or data network is a telecommunications network that

allows computers to exchange data.

o In computer networks, networked computing devices pass data to each

other along data connections.

o Data is transferred in the form of packets.

o The connections (network links) between nodes are established using

either cable media or wireless media.

Types of Networks

• Local Area Network (LAN)– Small Network– Usually confined to a building or an office floor

• Wide Area Network (WAN)– Two or more LANs connected together– The Internet is an example

• Metropolitan Area Network (MAN)– Covers a large area, such as a city

What is P2P (Peer-to-Peer Process)?

A peer-to-peer network is a simple network of computers. . Here each computer acts as a node for file sharing within the formed network. Here each node acts as a server and thus there is no central server in the network. This allows the sharing of a huge amount of data. The tasks are equally divided amongst the nodes. Each node connected in the network shares an equal workload. For the network to stop working, all the nodes need to individually stop working. This is because each node works independently.

Features of P2P network:::

These networks do not involve a large number of nodes, usually less than 12. All the computers in the network store their own data but this data is accessible by the group.

Unlike client-server networks, P2P uses resources and also provides them. This results in additional resources if the number of nodes increases. It requires specialized software. It allows resource sharing among the network.

Since the nodes act as clients and servers, there is a constant threat of attack.

Almost all OS today support P2P networks.

P2P Network Architecture:::

In the P2P network architecture, the computers connect with each other in a workgroup to share files, and access to internet and printers.

Each computer in the network has the same set of responsibilities and capabilities.

Each device in the network serves as both a client and server.

The architecture is useful in residential areas, small offices, or small companies where each computer act as an independent workstation and stores the data on its hard drive.

Each computer in the network has the ability to share data with other computers in the network.

The architecture is usually composed of workgroups of 12 or more computers.

Network Components –

--Repeaters

• Used to amplify data signals due to attenuation

– Hubs

• Act as a concentrator to connect several computers

– Switches

• Intelligent hubs that segment traffic to avoid collisions

– Routers

• Must have to be able to access the Internet

1. Fiber Optic Cable:

Fiber Optic Cable is also known as the Optical Fiber Cable. It is made up of plastic or glass. It transmits signals in the form of light. There are 3 basic components of the optical transmission system which are as follows:

--Light source

--Transmission media (fiber optics)

--Detector

Advantages of Fiber optic cables:

High bandwidth: Fiber optic cables have a much higher bandwidth than copper wires, which means they can carry more data at faster speeds.

Long distance: Fiber optic cables can transmit data over long distances without signal loss or degradation. This makes them ideal for long-haul communication.

Immunity to electromagnetic interference: Fiber optic cables are immune to electromagnetic interference, which can be a significant problem for copper wires.

Security: Fiber optic cables are much more difficult to tap into or intercept than copper wires, making them more secure for sensitive data transmission.

Disadvantages of Fiber optic cables:

Cost: Fiber optic cables are generally more expensive than copper wires, which can be a significant factor in some applications.

Fragility: Fiber optic cables are more fragile than copper wires and can be damaged easily if not handled carefully.

Limited compatibility: Fiber optic cables are not always compatible with older network equipment and may require costly upgrades.

2. Copper wire:

Copper wire is used for the electrical wiring. It transmits data in the form of electronic signals. It is the single solid conductor.

Advantages of Copper wires:

Low cost: Copper wires are generally less expensive than fiber optic cables, which can make them more cost-effective for some applications.

Easy to install: Copper wires are easy to install and work with, which can make them a more convenient choice for some applications.

Compatibility: Copper wires are compatible with a wide range of network equipment, making them a versatile choice.

Durability: Copper wires are more durable than fiber optic cables and can withstand more physical abuse.

Disadvantages of Copper wires:

Limited bandwidth: Copper wires have a lower bandwidth than fiber optic cables, which means they can carry less data at slower speeds.

Signal loss: Copper wires are more susceptible to signal loss and degradation over long distances, which can limit their usefulness in certain applications.

Electromagnetic interference: Copper wires are susceptible to electromagnetic interference, which can cause signal distortion and other problems.

Security: Copper wires are more vulnerable to interception and eavesdropping than fiber optic cables.

Similarities between fiber optic cables and copper wires:

Both are used for data transmission: Both fiber optic cables and copper wires are used to transmit data in various applications such as telecommunications, networking, and broadcasting.

Both require connectors: Both fiber optic cables and copper wires require connectors to connect to devices and other cables.

Both can be used for power transmission: Copper wires can be used for power transmission, and fiber optic cables can be used to power some devices using light.

Both have different types: Both fiber optic cables and copper wires have different types designed for specific applications, such as single-mode and multi-mode fiber optic cables and stranded and solid copper wires.

Both require proper installation and maintenance: Both fiber optic cables and copper wires require proper installation and maintenance to ensure optimal performance and longevity.

Fiber optic cables offer higher bandwidth, longer distance transmission, and better security but come at a higher cost and require specialized equipment for installation and maintenance. Copper wires offer lower cost, easy installation and maintenance, but lower bandwidth, shorter distance transmission, and are more susceptible to signal loss and interference.

Bus Topology

Bus topology uses a single cable which connects all the included nodes. The main cable acts as a spine for the entire network. One of the computers in the network acts as the computer server. When it has two endpoints, it is known as a linear bus topology.

Advantages

Here are pros/benefits of using a bus topology:

Cost of the cable is very less as compared to other topology, so it is widely used to build small networks.

Famous for LAN network because they are inexpensive and easy to install.

It is widely used when a network installation is small, simple, or temporary.

It is one of the passive topologies. So computers on the bus only listen for data being sent, that are not responsible for moving the data from one computer to others.

Disadvantages

Here are the cons/drawbacks of bus topology:

In case if the common cable fails, then the entire system will crash down.

When network traffic is heavy, it develops collisions in the network.

Whenever network traffic is heavy, or nodes are too many, the performance time of the network significantly decreases.

Cables are always of a limited length.

Ring Topology

In a ring network, every device has exactly two neighboring devices for communication purpose. It is called a ring topology as its formation is like a ring. In this topology, every computer is connected to another computer. Here, the last node is combined with a first one.

This topology uses token to pass the information from one computer to another. In this topology, all the messages travel through a ring in the same direction.

Advantages

Here are pros/benefits of ring topology:

Easy to install and reconfigure.

Adding or deleting a device in-ring topology needs you to move only two connections.

The troubleshooting process is difficult in a ring topology.

Failure of one computer can disturb the whole network.

Offers equal access to all the computers of the networks

Faster error checking and acknowledgment.

Disadvantages

Here are drawbacks/cons of ring topology:

Unidirectional traffic.

Break in a single ring can risk the breaking of the entire network

Modern days high-speed LANs made this topology less popular.

In the ring, topology signals are circulating at all times, which develops unwanted power consumption.

It is very difficult to troubleshoot the ring network.

Adding or removing the computers can disturb the network activity.

Star Topology

In the star topology, all the computers connect with the help of a hub. This cable is called a central node, and all other nodes are connected using this central node. It is most popular on LAN networks as they are inexpensive and easy to install.

Advantages

Here are pros/benefits of start topology:

Easy to troubleshoot, set up, and modify.

Only those nodes are affected, that has failed. Other nodes still work.

Fast performance with few nodes and very low network traffic.

In Star topology, addition, deletion, and moving of the devices are easy.

Disadvantages

Here are cons/drawbacks of using Star:

If the hub or concentrator fails, attached nodes are disabled.

Cost of installation of star topology is costly.

Heavy network traffic can sometimes slow the bus considerably.

Performance depends on the hub’s capacity

A damaged cable or lack of proper termination may bring the network down.

Mesh Topology

The mesh topology has a unique network design in which each computer on the network connects to every other. It is develops a P2P (point-to-point) connection between all the devices of the network. It offers a high level of redundancy, so even if one network cable fails, still data has an alternative path to reach its destination.

Types of Mesh Topology

Partial Mesh Topology: In this type of topology, most of the devices are connected almost similarly as full topology. The only difference is that few devices are connected with just two or three devices.

Full Mesh Topology: In this topology, every nodes or device are directly connected with each other.

Advantages

Here, are pros/benefits of Mesh topology

The network can be expanded without disrupting current users.

Need extra capable compared with other LAN topologies.

No traffic problem as nodes has dedicated links.

Dedicated links help you to eliminate the traffic problem.

A mesh topology is robust.

It has multiple links, so if any single route is blocked, then other routes should be used for data communication.

P2P links make the fault identification isolation process easy.

It helps you to avoid the chances of network failure by connecting all the systems to a central node.

Every system has its privacy and security.

Disadvantages

Installation is complex because every node is connected to every node.

It is expensive due to the use of more cables. No proper utilization of systems.

Complicated implementation.

It requires more space for dedicated links.

Because of the amount of cabling and the number of input-outputs, it is expensive to implement.

It requires a large space to run the cables.

Tree Topology

Tree topologies have a root node, and all other nodes are connected which form a hierarchy. So it is also known as hierarchical topology. This topology integrates various star topologies together in a single bus, so it is known as a Star Bus topology. Tree topology is a very common network which is similar to a bus and star topology.

Advantages

Here are pros/benefits of tree topology:

Failure of one node never affects the rest of the network.

Node expansion is fast and easy.

Detection of error is an easy process

It is easy to manage and maintain

Disadvantages

Here are cons/drawback of tree topology:

It is heavily cabled topology

If more nodes are added, then its maintenance is difficult

If the hub or concentrator fails, attached nodes are also disabled.

Hybrid Topology

Hybrid topology combines two or more topologies. You can see in the above architecture in such a manner that the resulting network does not exhibit one of the standard topologies.

A hybrid topology is always produced when two different basic network topologies are connected.

Advantages

Here, are advantages/pros using Hybrid topology:

Offers the easiest method for error detecting and troubleshooting

Highly effective and flexible networking topology

It is scalable so you can increase your network size

Disadvantages

The design of hybrid topology is complex

It is one of the costliest processes

How to select a Network Topology?

Here are some important considerations for selecting the best topology to create a network in your organization:

Bus topology is surely least expensive to install a network.

If you want to use a shorter cable or you planning to expand the network is future, then star topology is the best choice for you.

Fully mesh topology is theoretically an ideal choice as every device is connected to every other device.

If you want to use twisted pair cable for networking, then you should build star topologies.

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