

Computer Hardware & Networking & Server Configurations (H7E3 04)

UNIT 03: Computer Network Fundamentals

NETWORK CATEGORIES



Networks

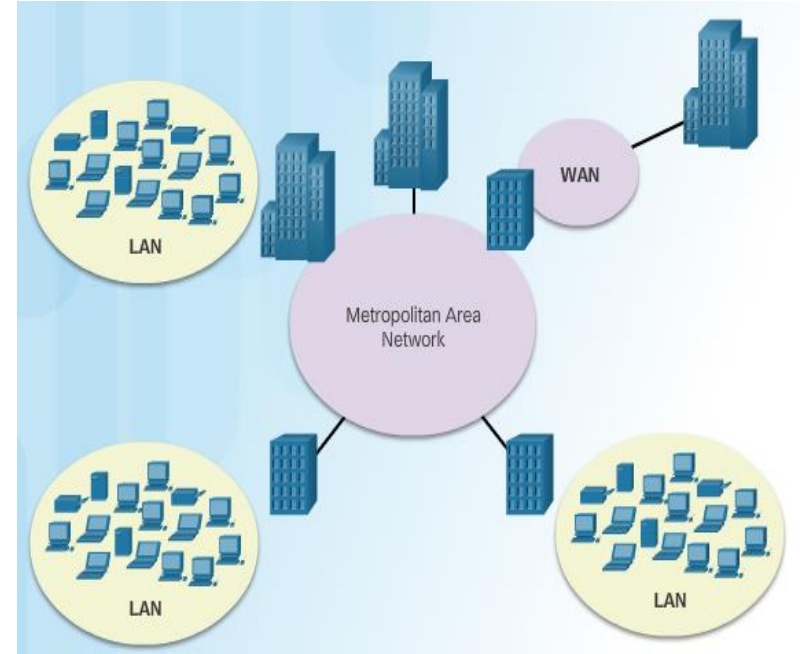
**Network Types/ Geographical
Network Classification**

Network Topologies

Operating Systems

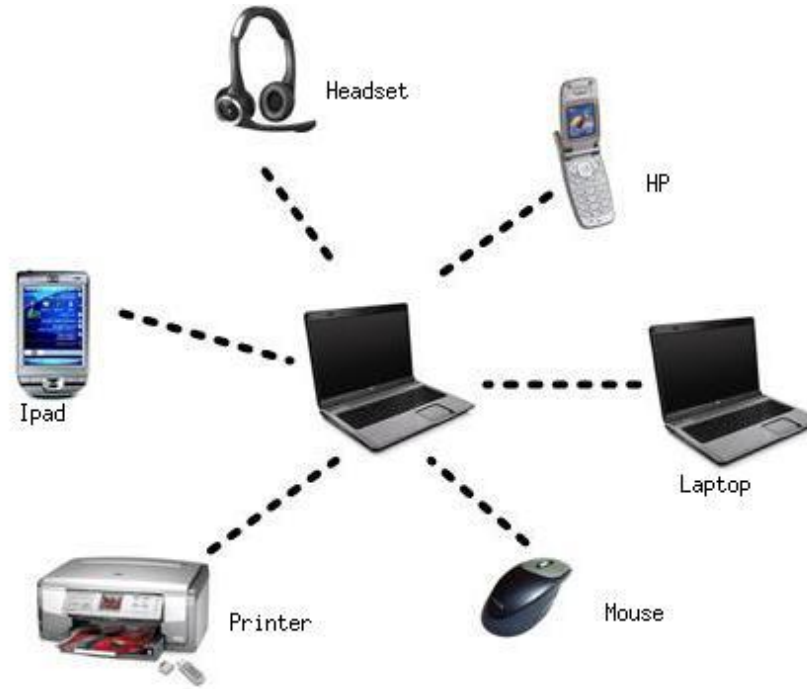
Types of Networks

- Major types of networks include:
 - Personal Area Networks (PANs)
 - Local Area Networks (LANs)
 - Wireless Local Area Networks (WLANs)



- Metropolitan Area Networks (MANs)
- Campus Area Network (CANs)
- Wide Area Networks (WANs)
- Storage Area Network (SANs)

PAN



- A personal area network (PAN) is a computer network used for data transmission amongst devices such as computers, telephones, tablets and personal digital assistants.

- PANs can be used for communication amongst the personal devices themselves (interpersonal communication), or for connecting to a higher level network and the Internet (an uplink) where one "master" device takes up the role as internet router.

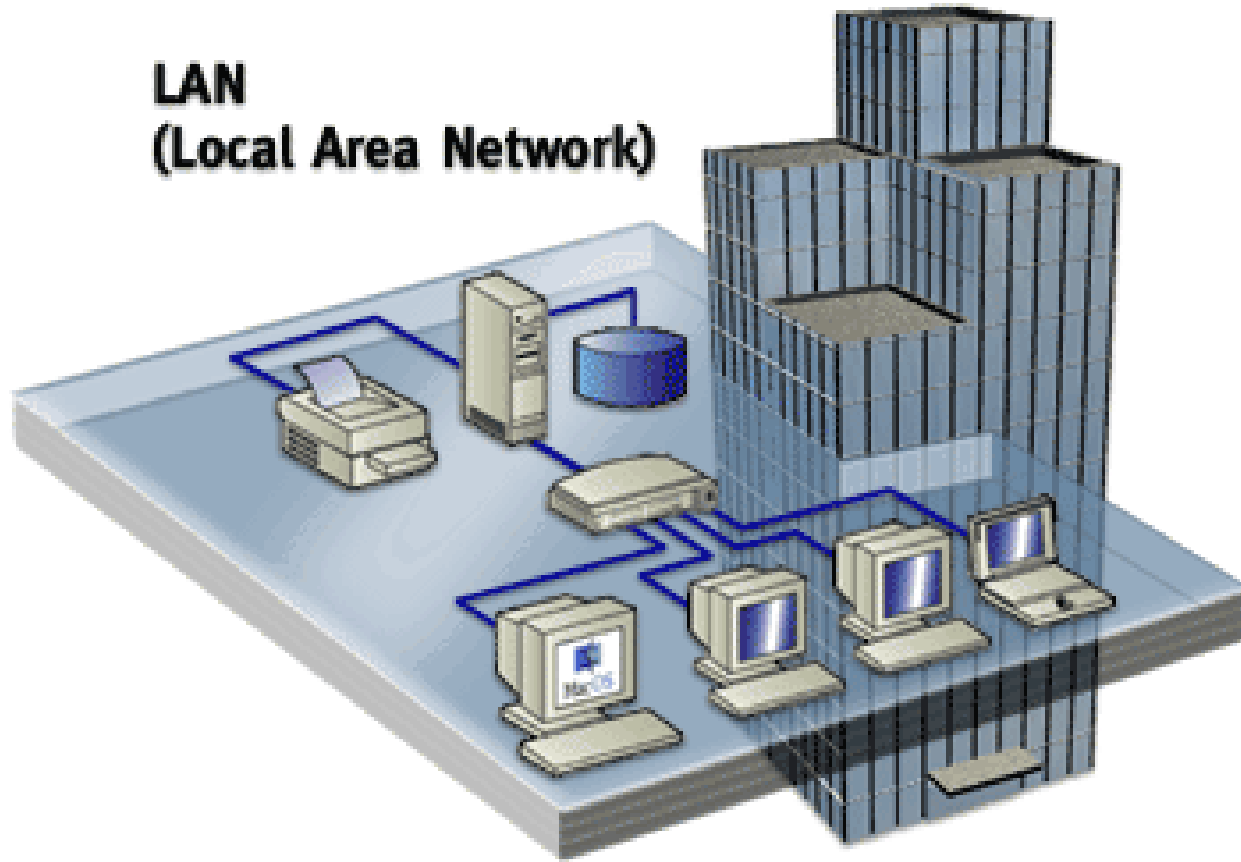
- A **wireless personal area network (WPAN)** is a low-powered PAN carried over a short-distance wireless network technology such as:
- INSTEON
- IrDA
- Wireless USB
- Bluetooth
- Z-Wave
- ZigBee
- Body Area Network

- The reach of a WPAN varies from a few centimeters to a few meters. A PAN may also be carried over wired computer buses such as USB and FireWire.
- Although a (secured) Wi-Fi tethering connection could be used by only one single user it is not considered to be a PAN

Local Area Network (LAN)

- A Local Area Network (LAN) is a network that is restricted to smaller physical areas e.g. a local office, school, or house. Approximately all current LANs whether wired or wireless are based on Ethernet. On a 'Local Area Network' data transfer speeds are higher than WAN and MAN that can extend to a 10.0 Mbps (Ethernet network) and 1.0 Gbps (Gigabit Ethernet).

LAN
(Local Area Network)



WLAN



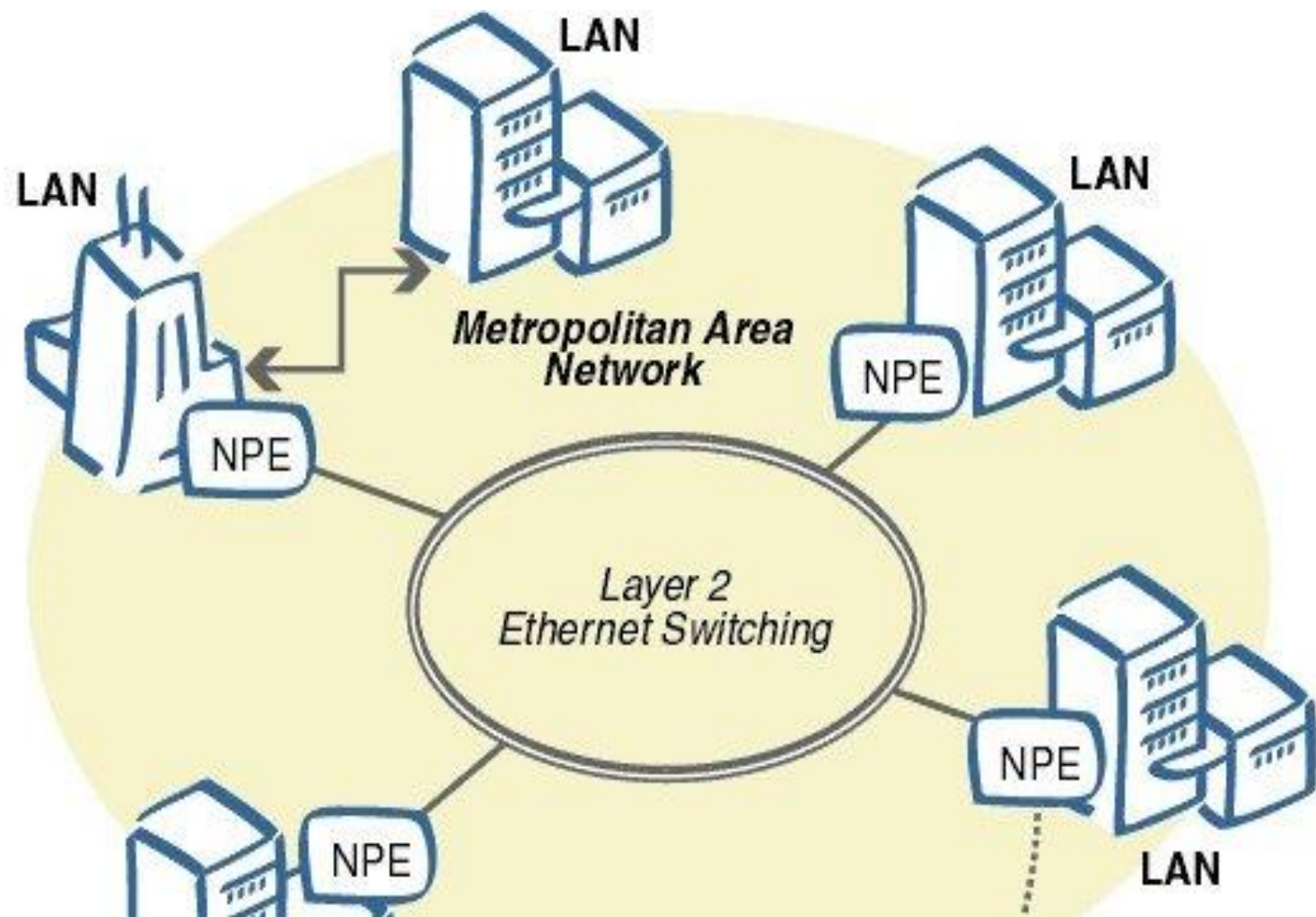
- A **wireless local area network (WLAN)** is a wireless computer network that links two or more devices using a wireless distribution method (often spread-spectrum or OFDM radio) within a limited area such as a home, school, computer laboratory, or office building.

- This gives users the ability to move around within a local coverage area and yet still be connected to the network. A WLAN can also provide a connection to the wider Internet.
- Most modern WLANs are based on IEEE 802.11 standards and are marketed under the Wi-Fi brand name.

- Wireless LANs have become popular for use in the home, due to their ease of installation and use. They are also popular in commercial complexes that offer wireless access to their customers (often without charge). New York City, for instance, has begun a pilot program to provide city workers in all five boroughs of the city with wireless Internet access

Metropolitan Area Network (MAN)

- A Metropolitan Area Network (MAN) is a network that connects two or more computers, communicating devices or networks in a single network that has geographic area larger than that covered by even a large 'Local Area Network' but smaller than the region covered by a 'Wide Area Network'. MANs are mostly built for cities or towns to provide a high data connection and usually owned by a single large organization.



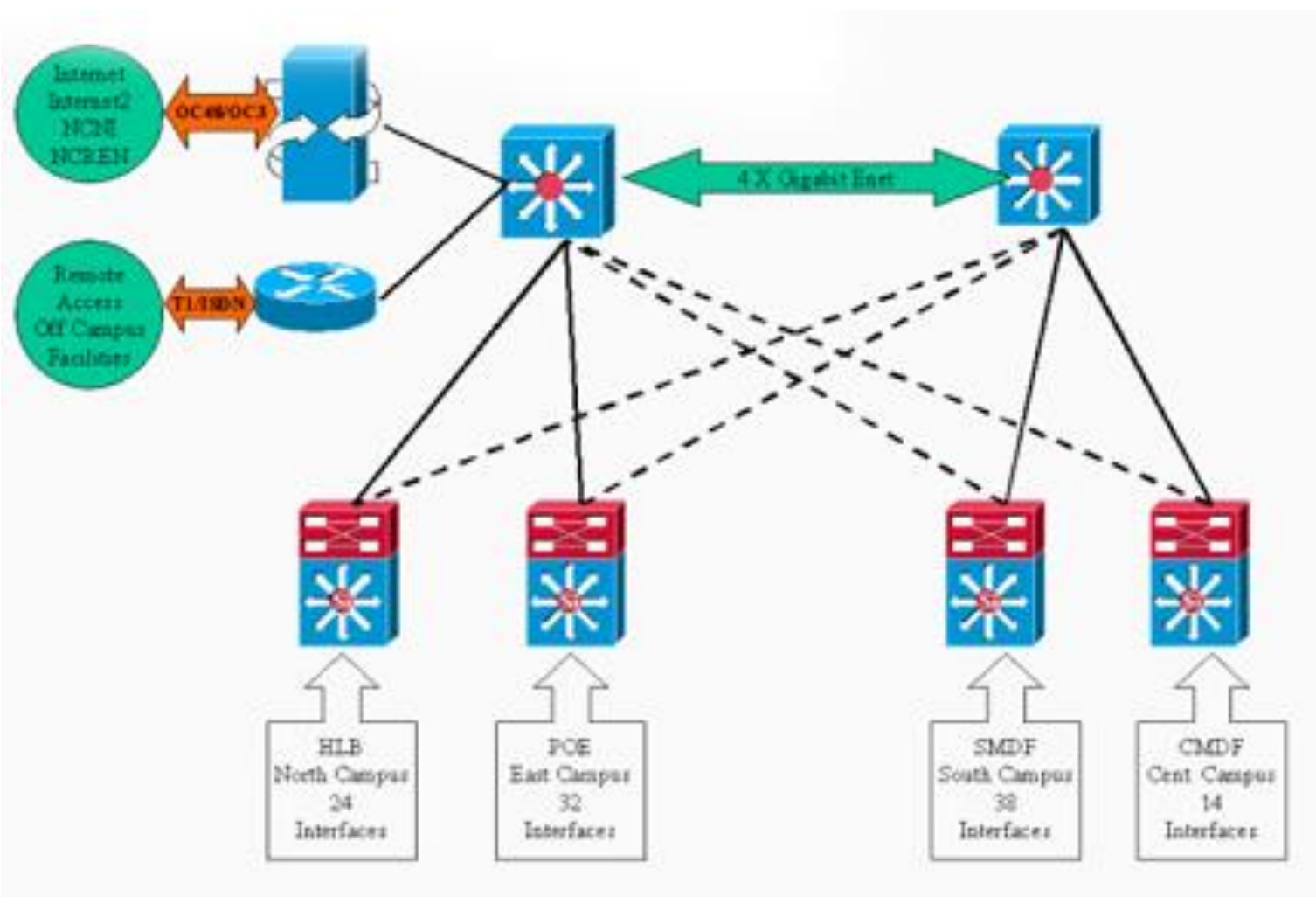
- A Metropolitan Area Networks bridges a number of 'Local Area Networks' with a fiber-optical links which act as a backbone, and provides services similar to what Internet Service Provider (ISP) provide to Wide Area Networks and the Internet.

- Major technologies used in MAN networks are 'Asynchronous Transfer Mode (ATM)', 'Fiber Distributed Data Interface (FDDI)' and 'Switched Multi-megabit Data Service (SMDS, a connectionless service)'. In most of the areas, these technologies are used to replace the simple 'Ethernet' based connections. MANs can bridge Local Area Networks without any cables by using microwave, radio wireless communication or infra-red laser which transmits data wirelessly.

- ‘Distributed Queue Dual Bus (DQDB)’ is the Metropolitan Area Network (MAN) IEEE 802.6 standard for data communication. Using DQDB, networks can extend up to 100km-160km and operate at speeds of 44 to 155Mbps.

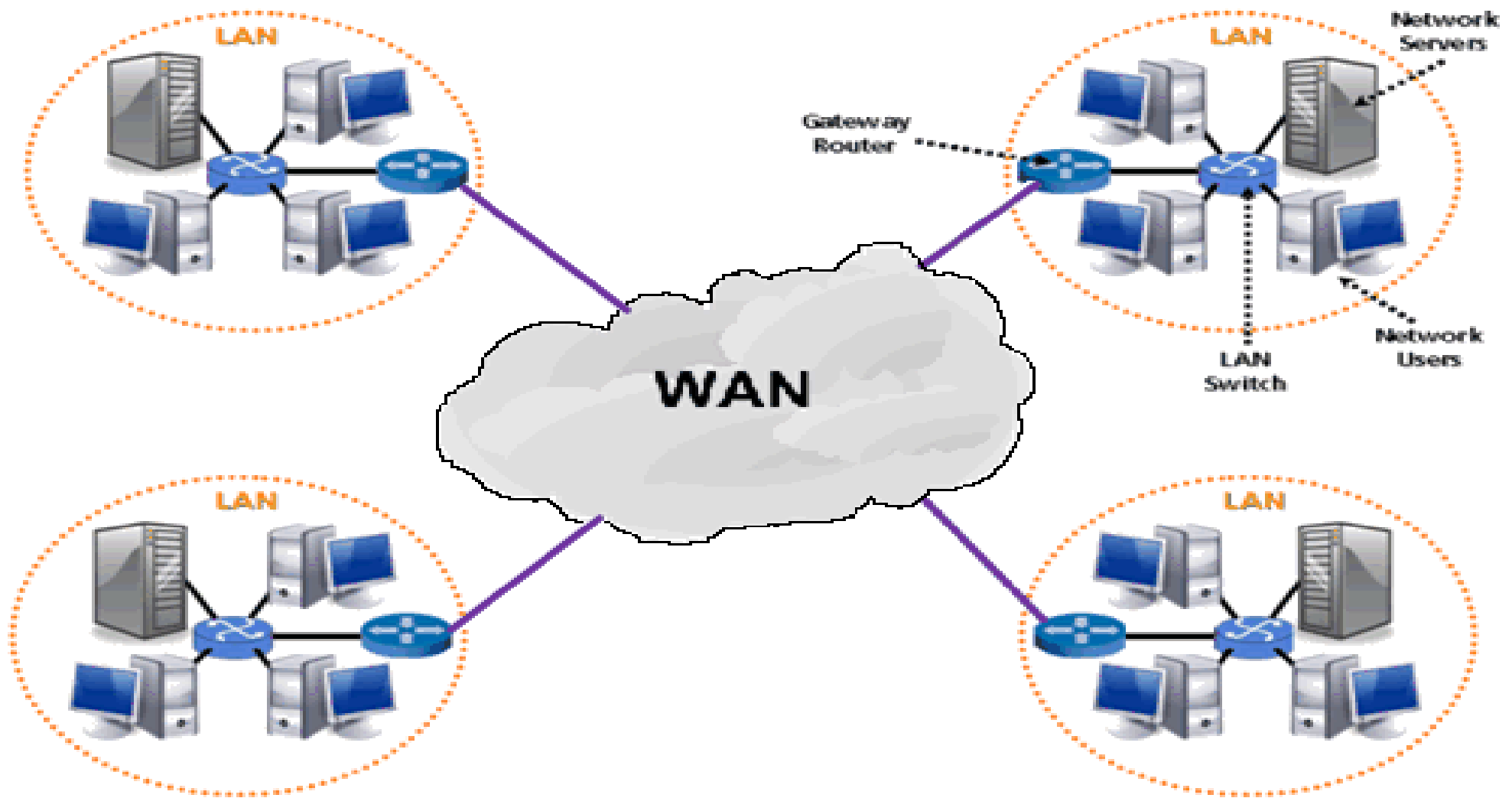
CAN

- A campus network, campus area network, corporate area network or CAN is a computer network made up of an interconnection of local area networks (LANs) within a limited geographical area. The networking equipment's (switches, routers) and transmission media (optical fiber, copper plant, Cat5 cabling etc.) are almost entirely owned by the campus tenant / owner: an enterprise, university, government etc.



Wide Area Network (WAN)

- Wide Area Network is a computer network that covers relatively larger geographical area such as a state, province or country. It provides a solution to companies or organizations operating from distant geographical locations who want to communicate with each other for sharing and managing central data or for general communication.

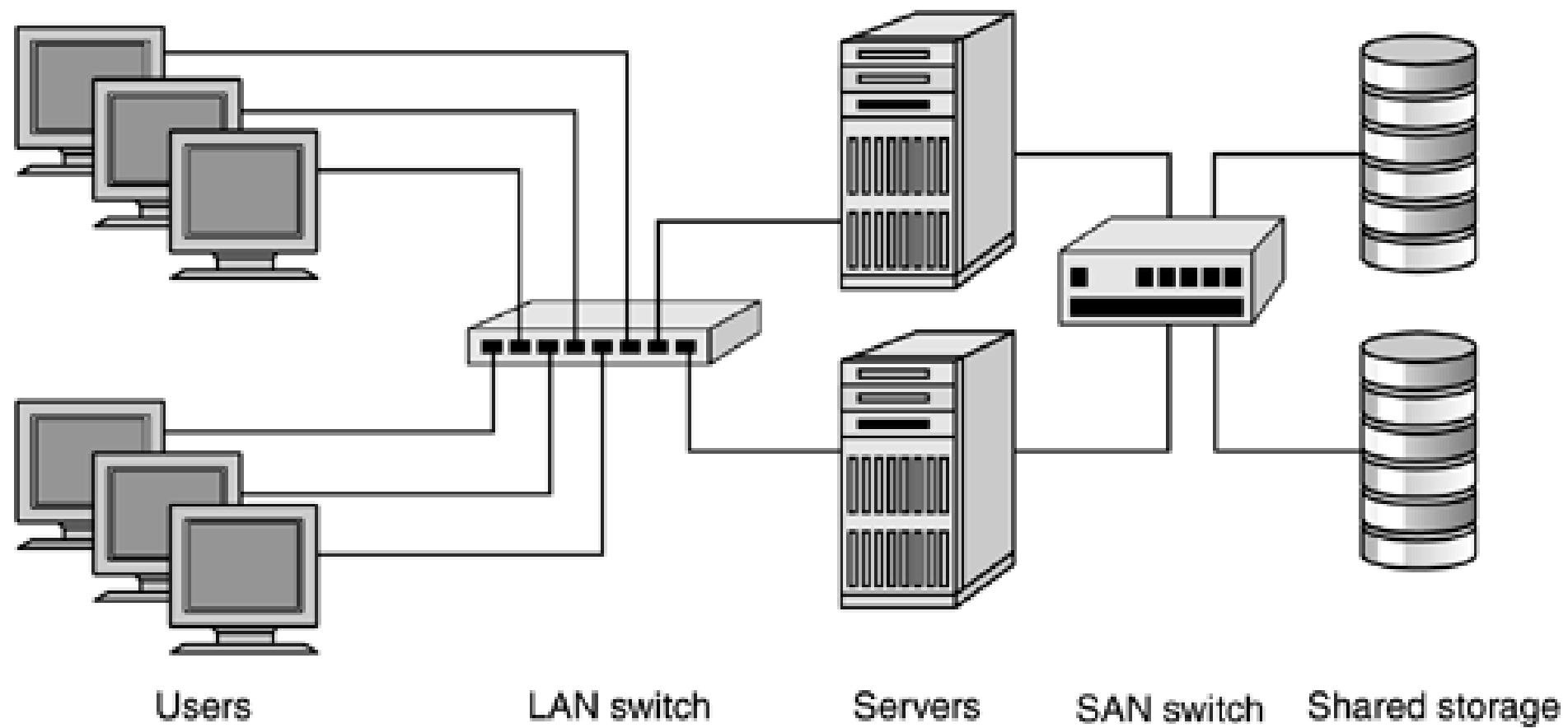


- WAN is made up of two or more Local Area Networks (LANs) or Metropolitan Area Networks (MANs) that are interconnected with each other, thus users and computers in one location can communicate with users and computers in other locations.

- In 'Wide Area Network', Computers are connected through public networks, such as the telephone systems, fiber-optic cables, and satellite links or leased lines. The 'Internet' is the largest WAN in a world. WANs are mostly private and are build for a particular organization by 'Internet Service Providers (ISPs)' which connects the LAN of the organization to the internet. WANs are frequently built using expensive leased lines where with each end of the leased line a router is connected to extend the network capability across sites. For low cost solutions, WAP is also built using a 'circuit switching' or 'packet switching' methods.

SAN

- SAN (**s**torage **a**rea **n**etwork) is a high-speed network of storage devices that also connects those storage devices with servers. It provides block-level storage that can be accessed by the applications running on any networked servers. SAN storage devices can include tape libraries and disk-based devices, like RAID hardware.



Network Classification

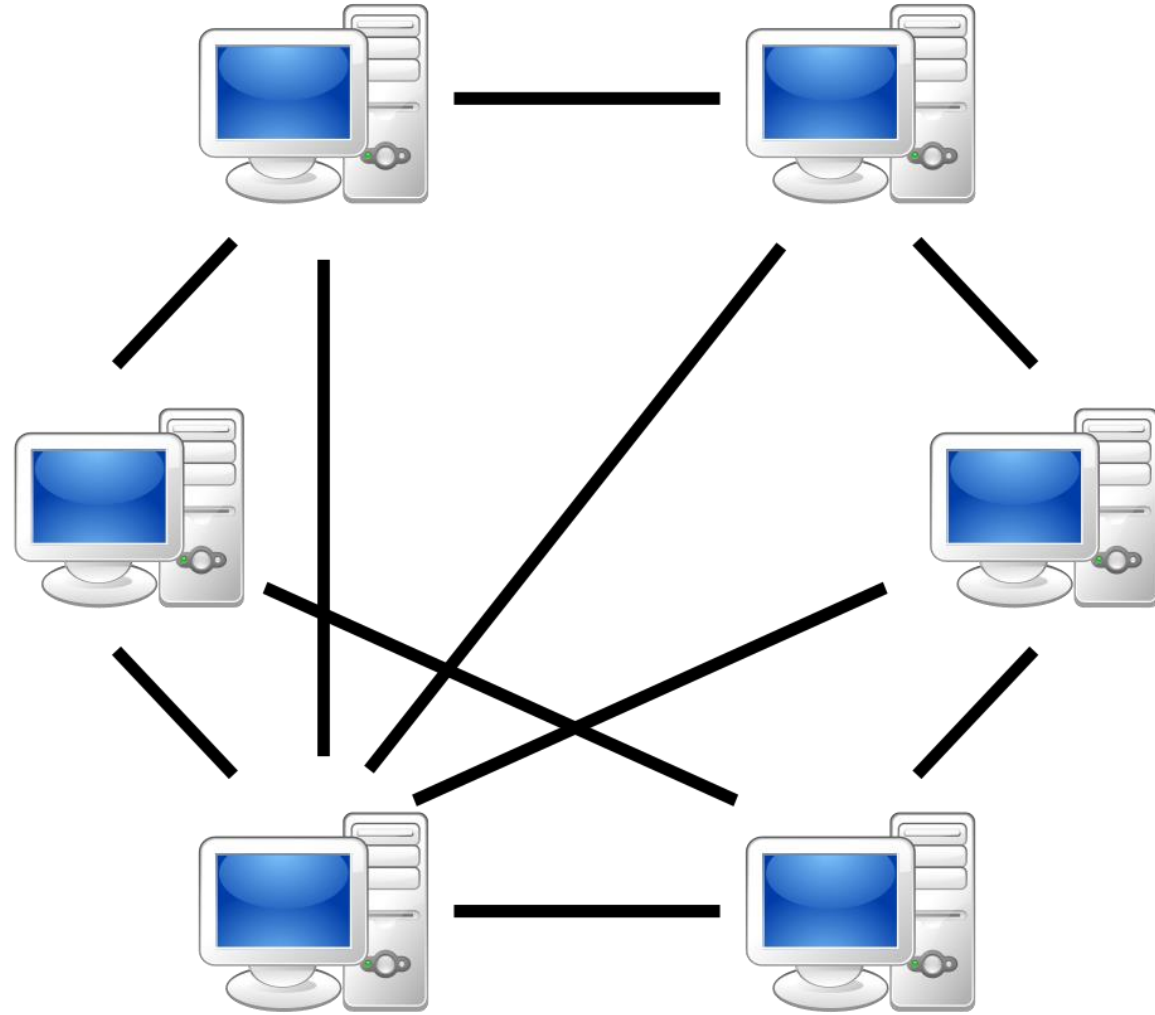
THERE ARE TWO PRIMARY TYPES OF NETWORKS
TODAY-CLIENT SERVER AND PEER TO PEER.

Peer to Peer Network

- This is a simple and inexpensive form of networking. Each computer (workstation) on the network acts as both a client (using information) and a server (providing information to others).

Each user can access data and other resources on other work stations and can share their own resources by setting share rights on their own directories through password protection known as share level security. This network is well suited to a smaller environment with ten workstations or less and where share level security is sufficient. In addition, all computers with Windows 95/98 or Windows NT as the operating system already have peer to peer networking built in.

- All you need to establish a network are network adapter cards, properly installed network cabling to connect them and, depending on the type of cabling you choose, a network hub.



Advantages and Disadvantages

Advantages

- Works well for smaller offices of ten or less workstations
- Easy to set up
- Easy to maintain as long as it stays small
- No need for a dedicated network administrator
- No need for a file server
- Software already built in

Disadvantages

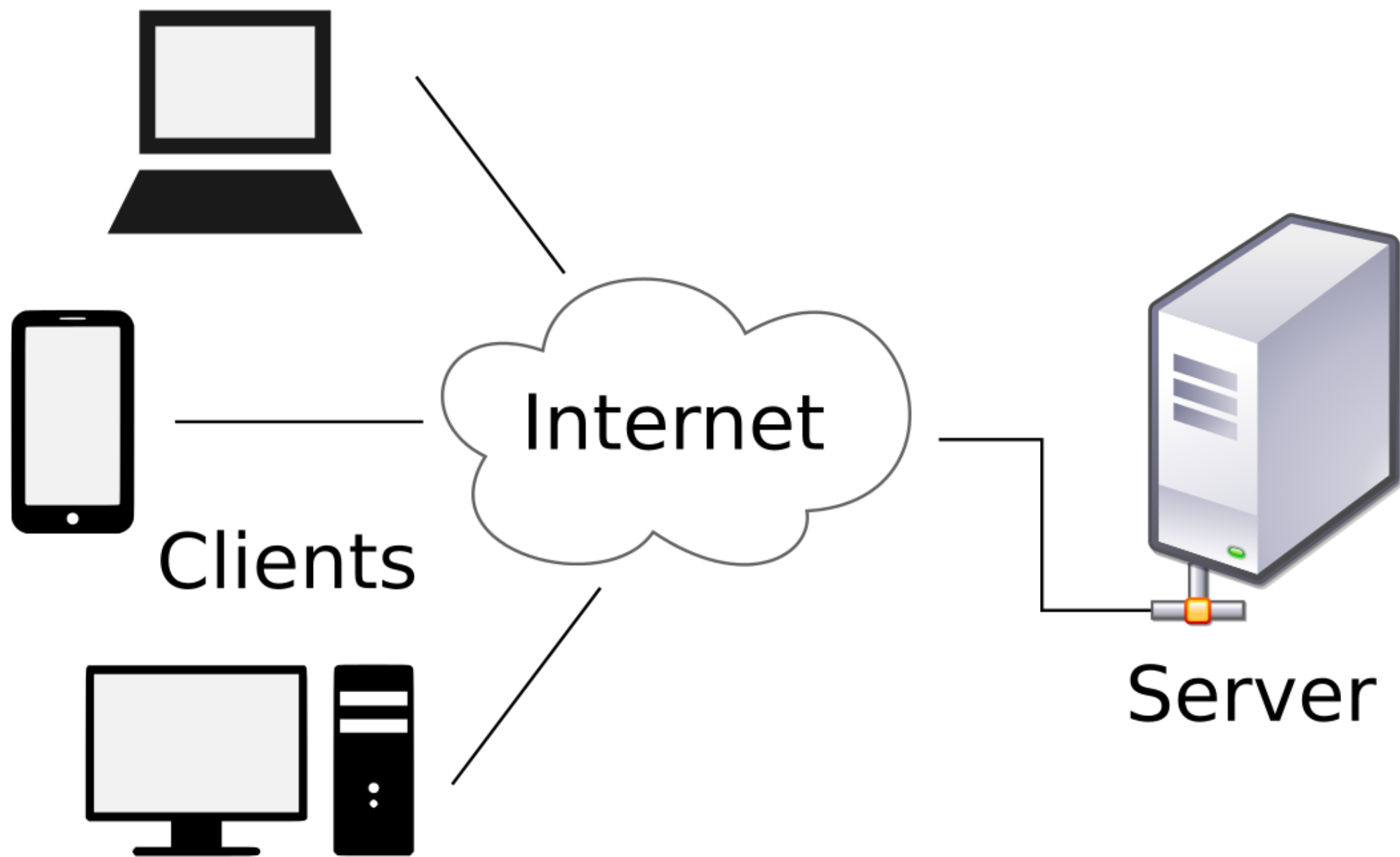
- Becomes more difficult to administrate as it gets larger
- Individual users must do data backups
- Share level security becomes inadequate as network grows
- More dependent on individual user training
- Not well suited for large database applications due to lack of dedicated file server

Client Server Network

- This is the most popular type of network today. In this type of network, one or more dedicated file servers will handle file requests from workstations, store and manage files, databases, printers and other network devices. This type of network is more suited for larger environments, where an integrated database is used to run operations and where tighter security is required..

The file servers are much more efficient at handling large numbers of file requests. In addition, critical data is stored and backed up at one central location. Finally, this type of network employs user level security. The password of each individual user defines which files, applications and other network resources the user is permitted to access throughout the entire network.

To establish this type of network, you will need to purchase a file server, network adapter cards for all workstation, client server software, a network hub and have network cabling professionally installed



Advantages and Disadvantages

Advantages

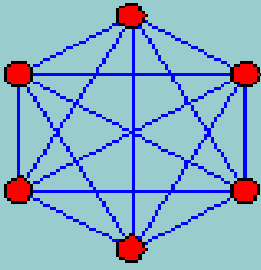
- Much more efficient at handling large databases and managing files
- User level security makes network easier to use while providing much tighter security
- Critical data is backed up at one central location

Disadvantages

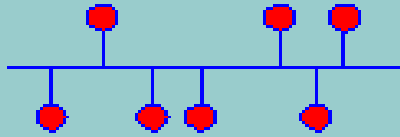
- Dedicated file servers are more expensive than workstations
- Need to have at least a part time administrator to maintain the network
- Need to purchase client server network software

Network Topologies

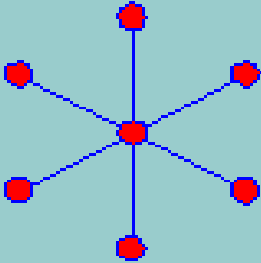
- o Point-to-point
- o Bus Topology
- o Ring Topology or Circular Topology
- o Star Topology
- o Tree Topology
- o Mesh Topology
- o Hybrid Topology
- o Daisy chain



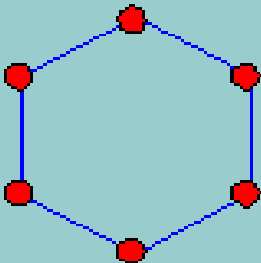
a) Fully Connected Topology



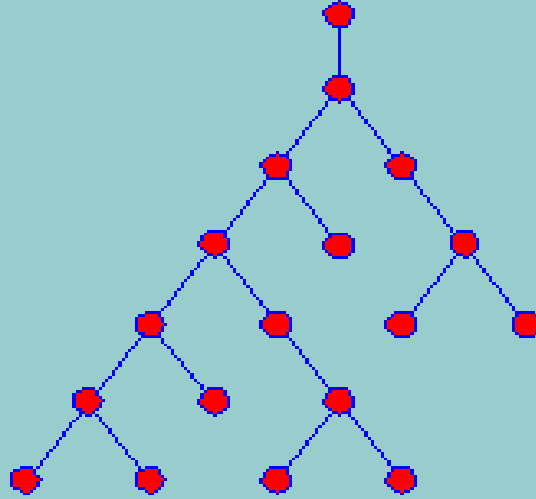
b) Bus Topology



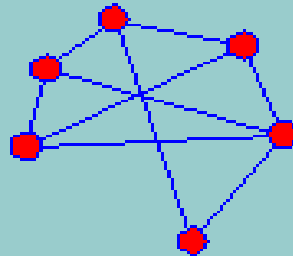
d) Star Topology



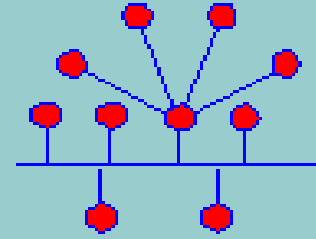
d) Ring Topology



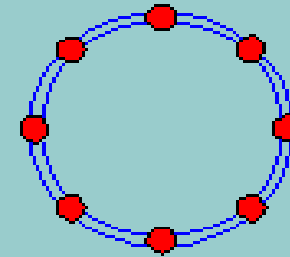
e) Tree Topology



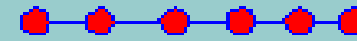
f) Mesh Topology



g) Hybrid Topology
(example: combination of
Star topology and Bus topology)



h) Dual Ring Topology

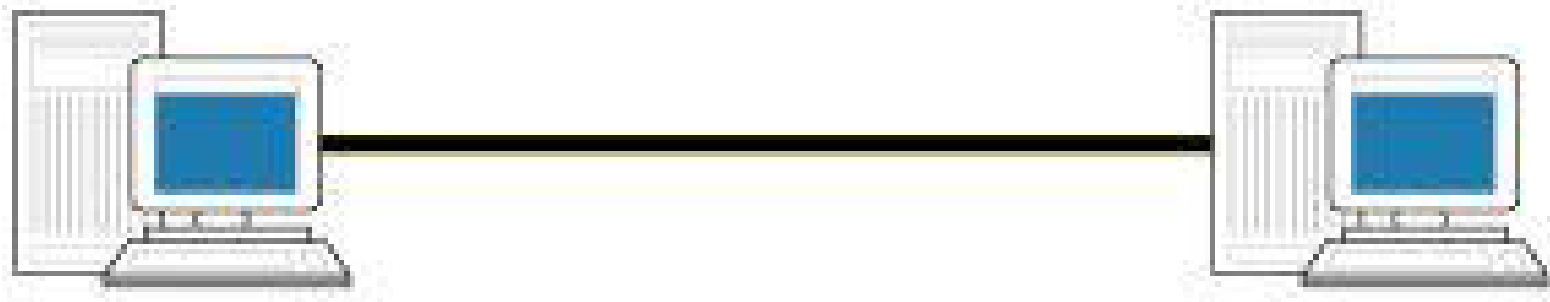


i) Linear Topology

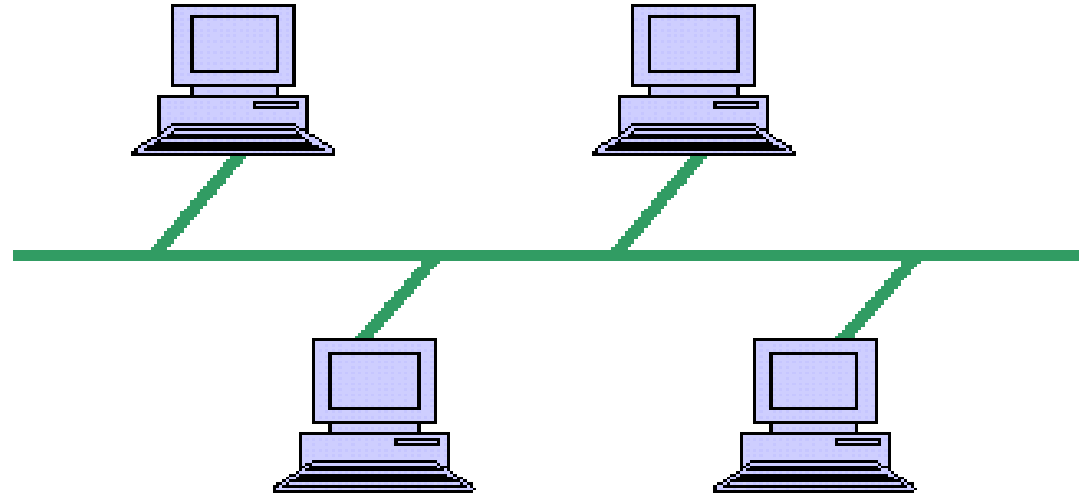
Nodes ● — Branches

Point to Point Topology

- The simplest topology is a permanent link between two endpoints. Switched point-to-point topologies are the basic model of conventional telephony. The value of a permanent point-to-point network is unimpeded communications between the two endpoints.



BUS Topology

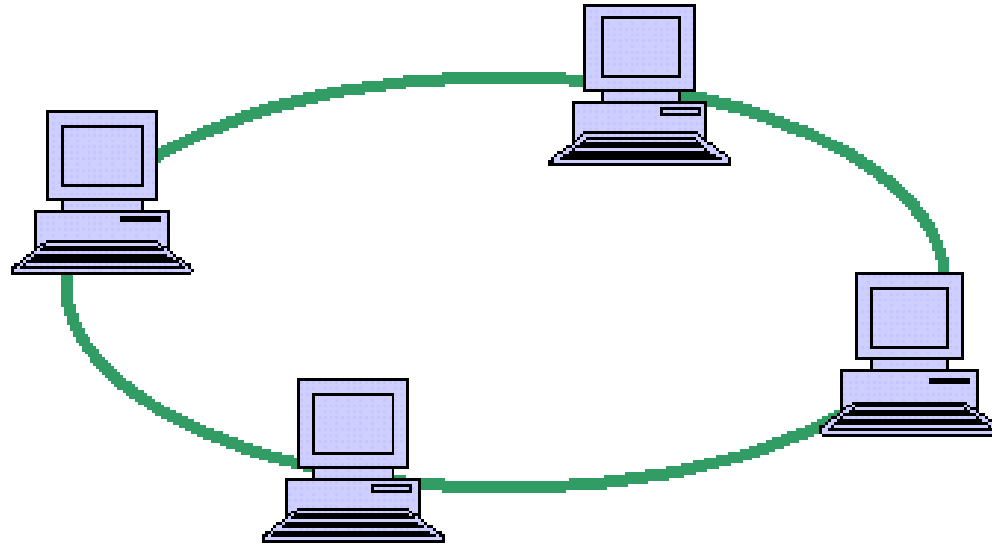


- Bus networks (not to be confused with the system bus of a computer) use a common backbone to connect all devices. A single cable, the backbone functions as a shared communication medium that devices attach or tap into with an interface connector.

A device wanting to communicate with another device on the network sends a broadcast message onto the wire that all other devices see, but only the intended recipient actually accepts and processes the message. Ethernet bus topologies are relatively easy to install and don't require much cabling compared to the alternatives. 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet") both were popular Ethernet cabling options many years ago for bus topologies.

However, bus networks work best with a limited number of devices. If more than a few dozen computers are added to a network bus, performance problems will likely result. In addition, if the backbone cable fails, the entire network effectively becomes unusable.

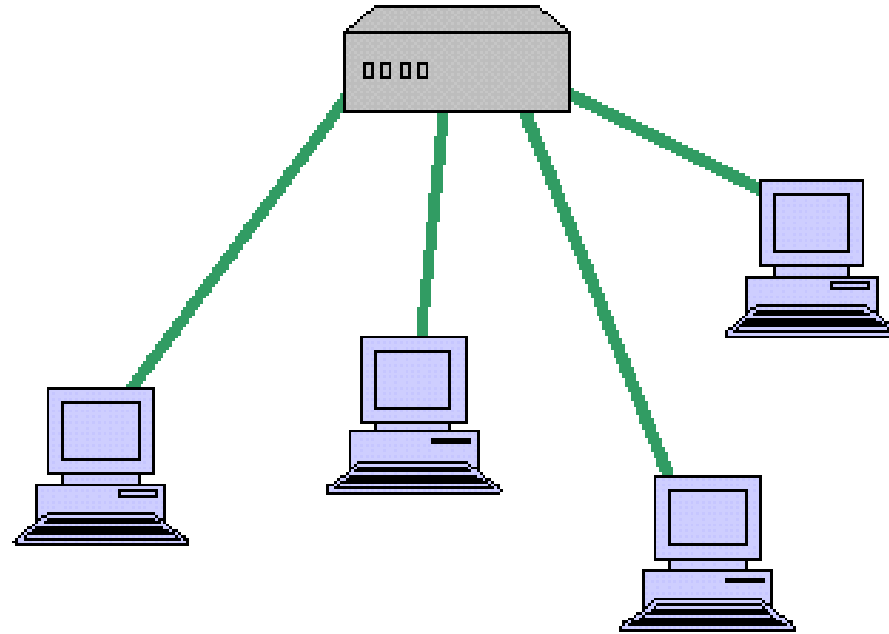
Ring Topology (Token Ring)



- In a ring network, every device has exactly two neighbors for communication purposes. All messages travel through a ring in the same direction (either "clockwise" or "counterclockwise").

A failure in any cable or device breaks the loop and can take down the entire network. To implement a ring network, one typically uses FDDI, SONET, or Token Ring technology. Ring topologies are found in some office buildings or school campuses.

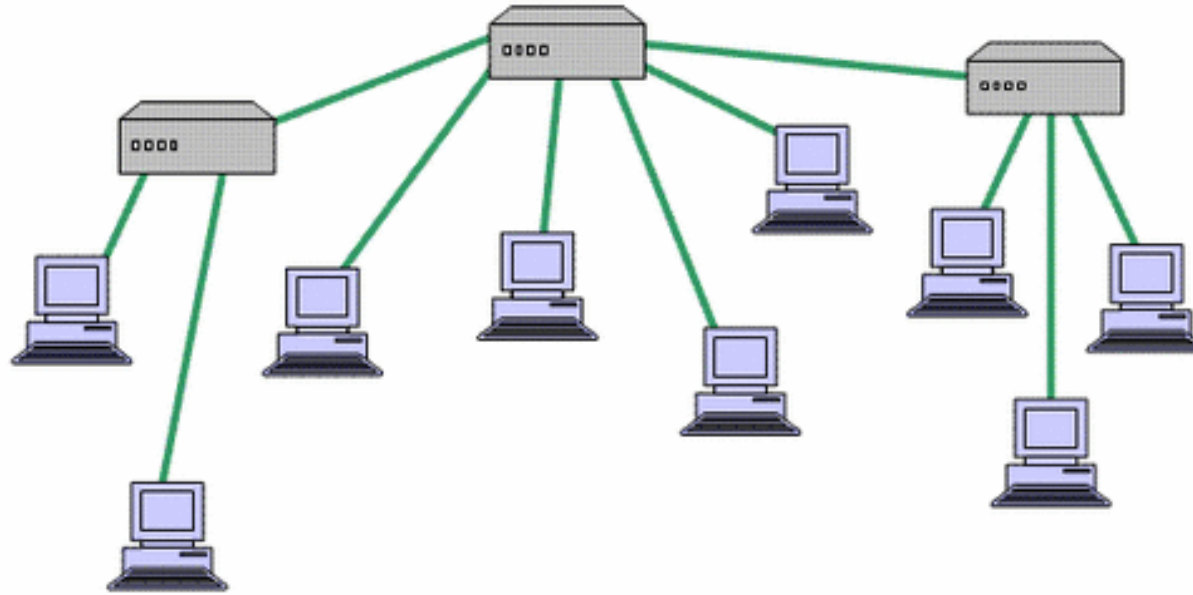
Star Topology



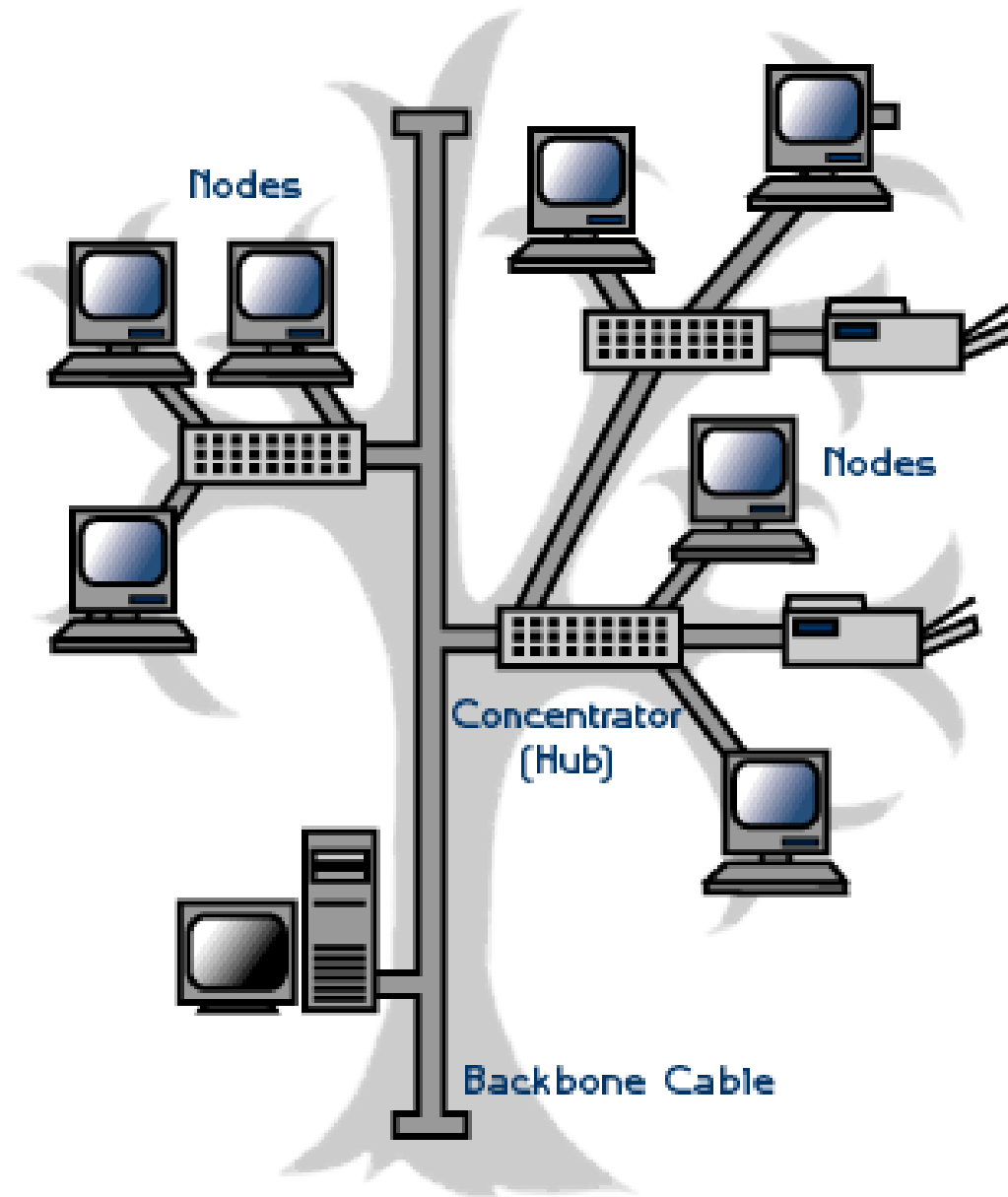
- Many home networks use the star topology. A star network features a central connection point called a "hub" that may be a hub, switch or router.

- Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet. Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN. (If the hub fails, however, the entire network also fails.)

Tree Topology

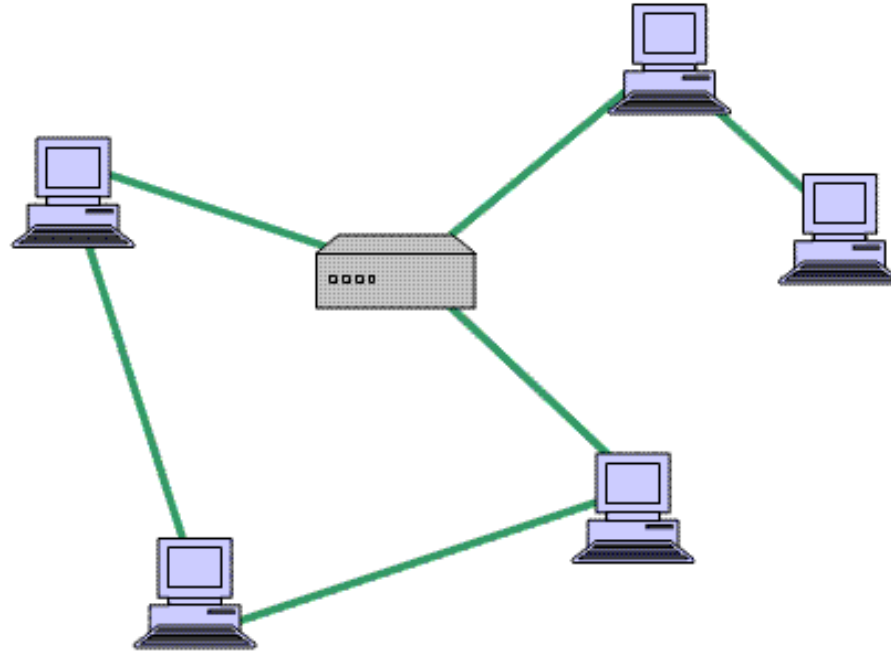


- Tree topologies integrate multiple star topologies together onto a bus. In its simplest form, only hub devices connect directly to the tree bus, and each hub functions as the "root" of a tree of devices.



This bus/star hybrid approach supports future expandability of the network much better than a bus (limited in the number of devices due to the broadcast traffic it generates) or a star (limited by the number of hub connection points) alone.

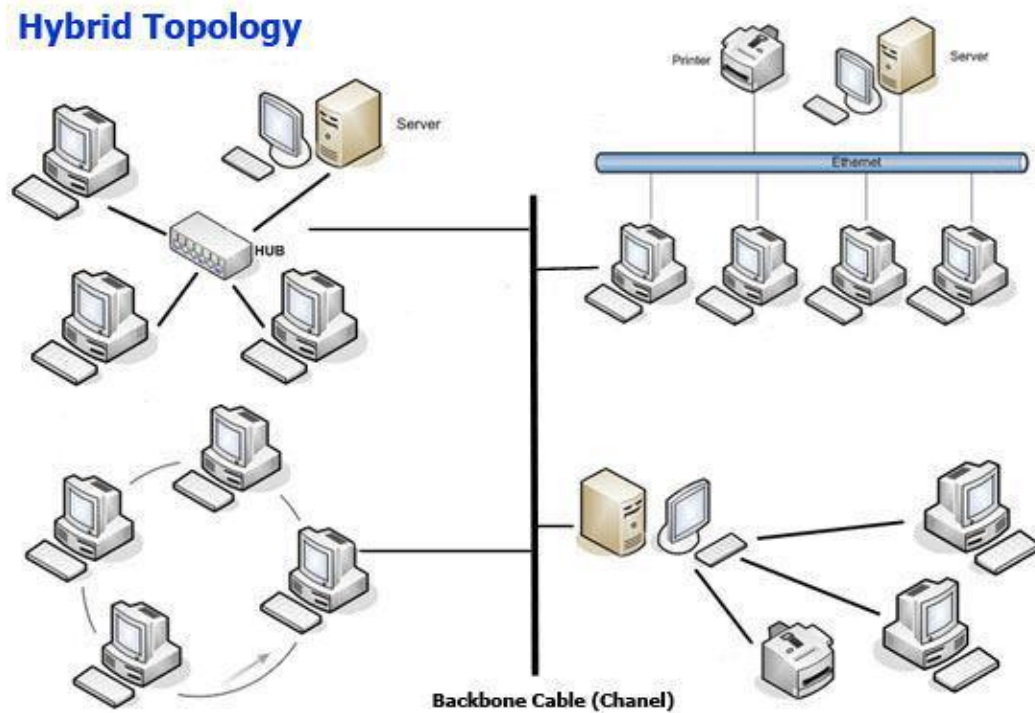
Mesh Topology



- Mesh topologies involve the concept of routes. Unlike each of the previous topologies, messages sent on a mesh network can take any of several possible paths from source to destination.

- (Recall that even in a ring, although two cable paths exist, messages can only travel in one direction.) Some WANs, most notably the Internet, employ mesh routing. A mesh network in which every device connects to every other is called a full mesh. As shown in the illustration below, partial mesh networks also exist in which some devices connect only indirectly to others.

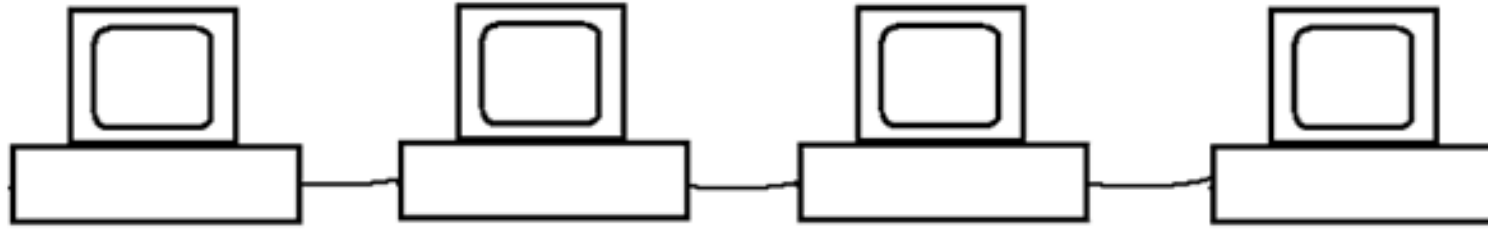
Hybrid Topology



- Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies (e.g., bus, star, ring, etc.).

- For example a tree network connected to a tree network is still a tree network topology. A hybrid topology is always produced when two different basic network topologies are connected. Two common examples for Hybrid network are: *star ring network* and *star bus network*

Daisy chain Topology



- Except for star-based networks, the easiest way to add more computers into a network is by daisy chaining, or connecting each computer in series to the next. If a message is intended for a computer partway down the line, each system bounces it along in sequence until it reaches the destination. A daisy-chained network can take two basic forms: linear and ring.

Summary

- Topologies remain an important part of network design theory. You can probably build a home or small business network without understanding the difference between a bus design and a star design, but understanding the concepts behind these gives you a deeper understanding of important elements like hubs, broadcasts, and routes

Operating Systems

Desktop Operating Systems

- Windows XP, Vista, 7, 8.1, 10
- Apple OS X El Capitan
- Linux, Ubuntu, Debian, Kubuntu

Network Operating Systems

- Windows 2003, 2008, 2012
- Apple OS X Server
- CentOS, Red Hat
- Proxy (Clear OS)
- Email (MS Exchange, Zimbra)

Mobile Operating Systems

- Apple
- Windows
- Android

Embedded OS or IOS (Internet OS)

- Juniper JUNOS
- Cisco IOS

NETWORKING STANDARDS

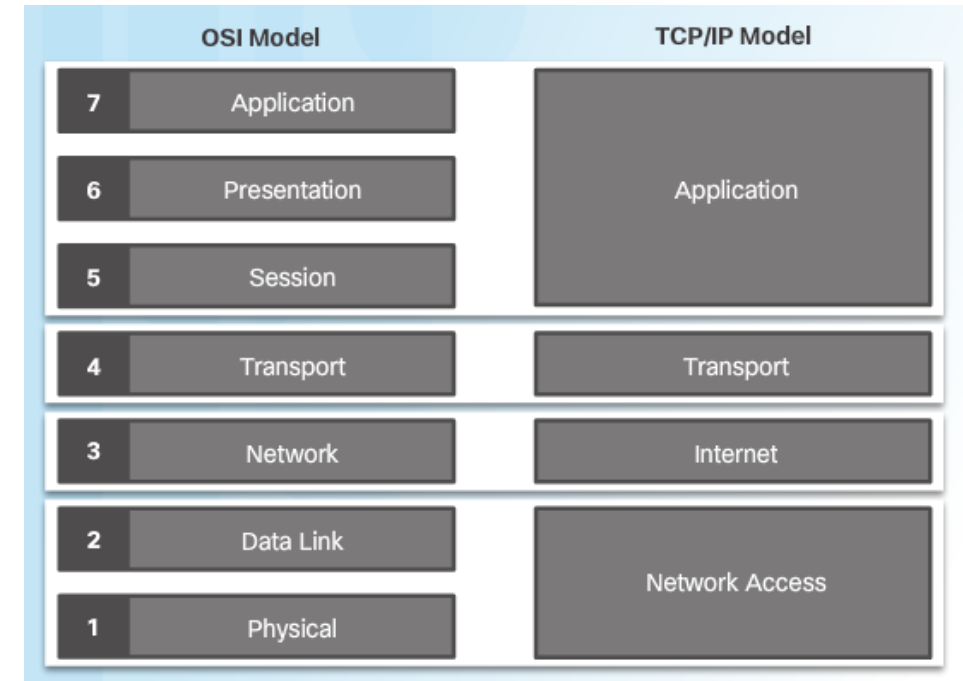
Reference Models

- Organizations, such as IEEE, IETF, and ISO, develop open standards for networks so that any client running any operating system can access network resources.
- The OSI model and the TCP/IP model are both reference models used to describe the data communication process.
- As application data is passed down through the layers, protocol information is added at each level. This is known as the encapsulation process.

IEEE - Institute of Electrical and Electronics Engineers

IETF - Internet Engineering Task Force

ISO - International Organization for Standardization

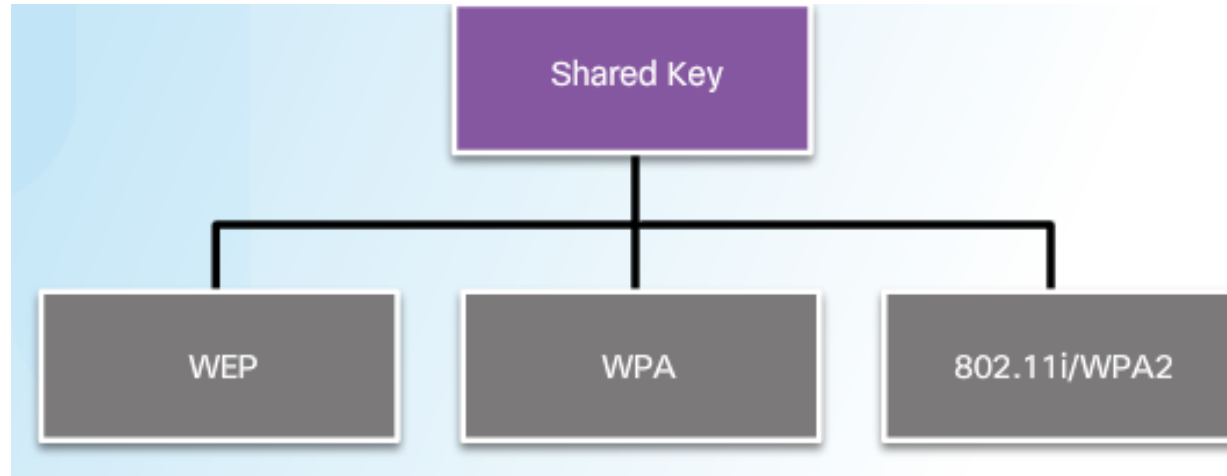


Wired Standards

When Ethernet operates in half-duplex, the IEEE **802.3** standard specifies that a network implement the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access control method.

- The 802.3 standard also specifies cable types for Ethernet including:
 - 10Base-T
 - 100Base-TX
 - 1000Base-T
 - 10GBase-T
- The IEEE 802.11 standard specifies that wireless LANs use Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).

Wireless Standards



- WLAN standards include 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac
- When configuring an 802.11 WLAN, use the strongest encryption available.
- Since 2006, the strongest encryption has been WPA2.

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THANK YOU