

CHAPTER 4:

COMPUTER NETWORK



Outline

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- **Definition & applications of computer network**
- **Types of Networks**
- **Networking Hardware**
- **Internet**
- **Intranet and Extranet**
- **Uses of Internet**
- **World Wide Web**

DEFINITION & APPLICATIONS

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□ DEFINITION:

A computer network is defined as the interconnection of two or more computers. It is done to enable the computers to communicate and share available resources.

□ APPLICATIONS:

- i. Sharing of resources such as printers, Hard disks**
- ii. Sharing of expensive software's and database**
- iii. Communication from one computer to another computer**
- iv. Exchange of data and information among users via network**
- v. Sharing of information over geographically wide areas.**

SHARING RESOURCES

□ **Types of resources are:**

- 1. Hardware: A network allows users to share many hardware devices such as printers , modems, fax machines, CD/DVD ROM players, etc.**
- 2. Software: sharing software resources reduces the cost of software installation, and saves space on hard disk.**

OTHER BENEFITS OF COMPUTER NETWORK

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- **Increased speed**
- **Reduced cost**
- **Centralized software managements**
- **E-Commerce**
- **Flexible and easy access to information**

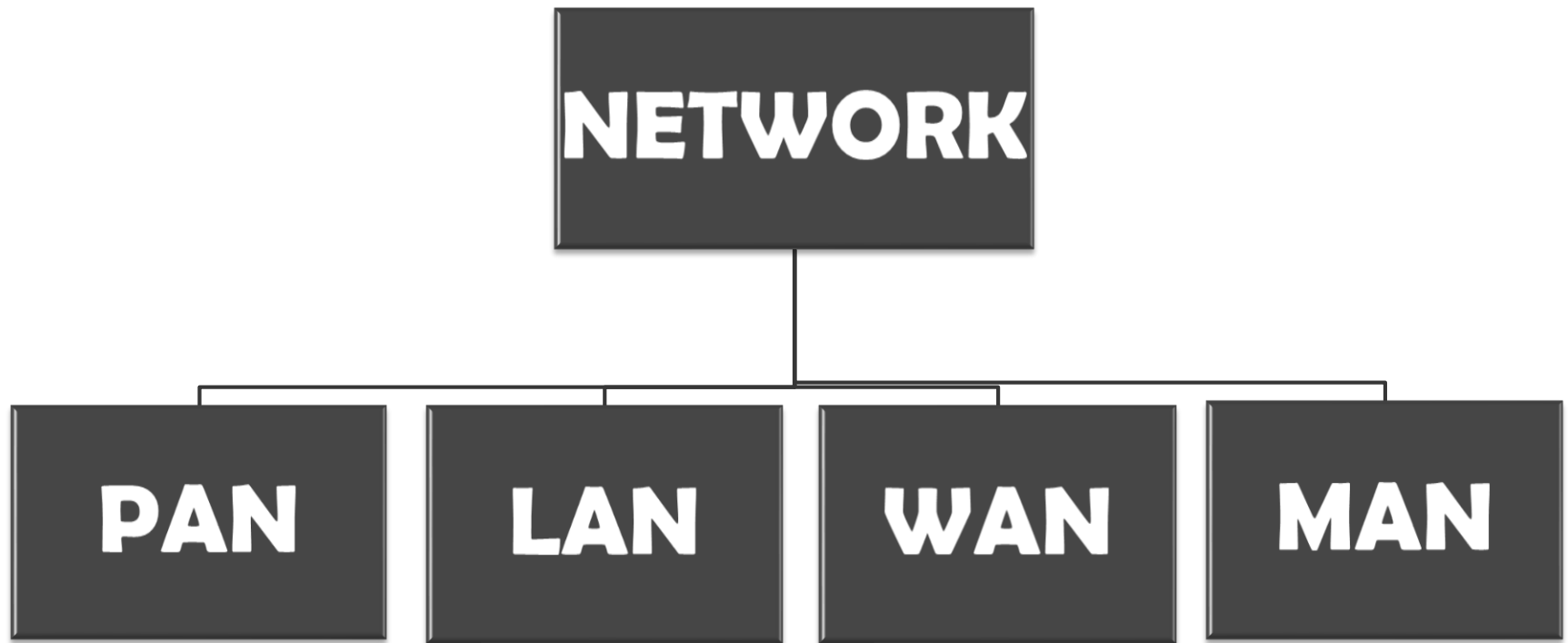
DISADVANTAGES OF NETWORKS

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- **High cost of installation**
- **Requires time for administration**
- **Failure of server**
- **Security**

CLASSIFICATION OF NETWORKS BY THEIR GEOGRAPHY

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PERSONAL AREA NETWORK (PAN)

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- ❑ **A personal area network is a computer network organized around an individual person.**
- ❑ **It generally consists of a mobile computer, a cell phone or personal digital assistant. PAN enables the communication among these devices.**
- ❑ **PAN is usually formed out of a wireless connection.**

LOCAL AREA NETWORK (LAN)

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- ❑ **LAN is a network which is designed to operate over a small physical area such as an office, school, college, factory or a group of buildings.**
- ❑ **LANs are easy to design and troubleshoot**
- ❑ **Exchange of information and sharing of resources becomes easy because of LAN.**
- ❑ **It is usually a privately owned network.**

METROPOLITAN AREA NETWORK(MAN)

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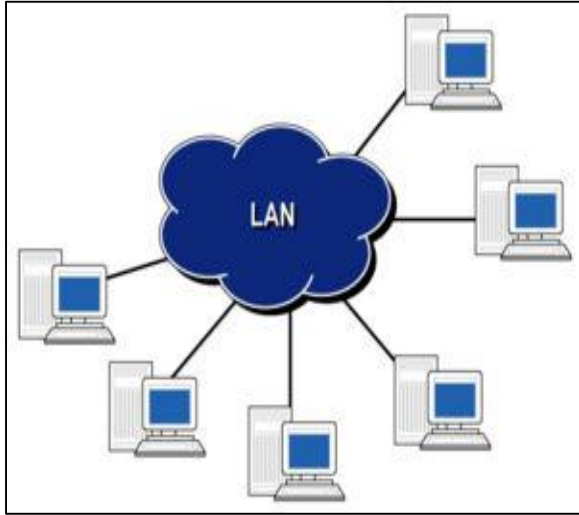
- ❑ **It is in between LAN & WAN technology that covers the entire city.**
- ❑ **It uses similar technology as LAN.**
- ❑ **It can be a single network such as cable TV network, or a measure of connecting a number of LAN's to a large network so that resources can be shared LAN to LAN as well as device to device.**

WIDE AREA NETWORK (WAN)

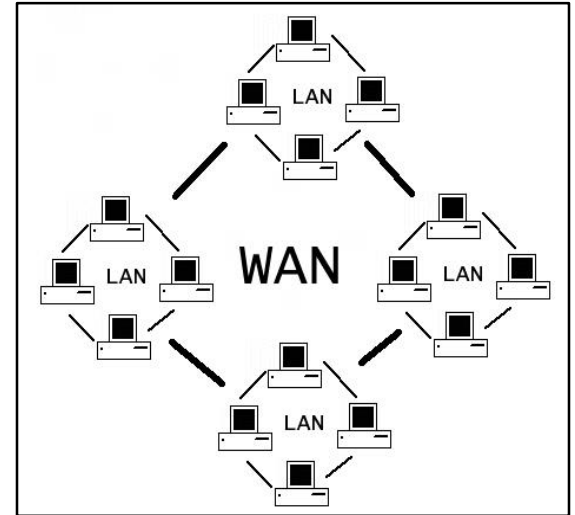
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- **When network spans over a large distance or when the computers to be connected to each other are at widely separated locations a local area network cannot be used. A wide area network(WAN) is installed.**
- **The communication between different users of WAN is established using leased telephone lines, satellite links and similar channels.**
- **Most WAN networks are used to transfer large blocks of data between its users.**

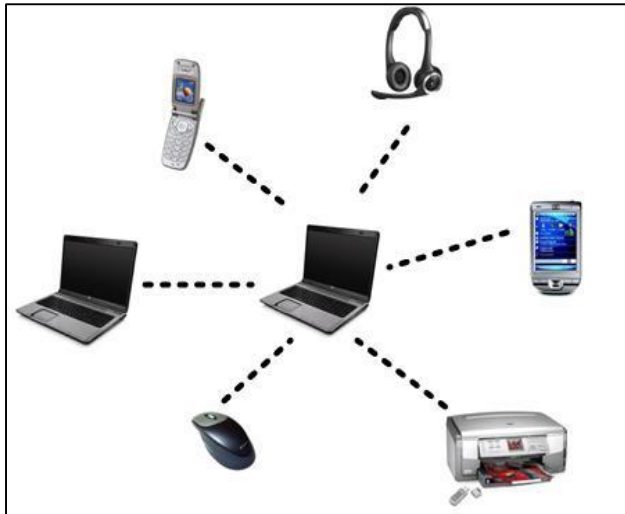
LAN



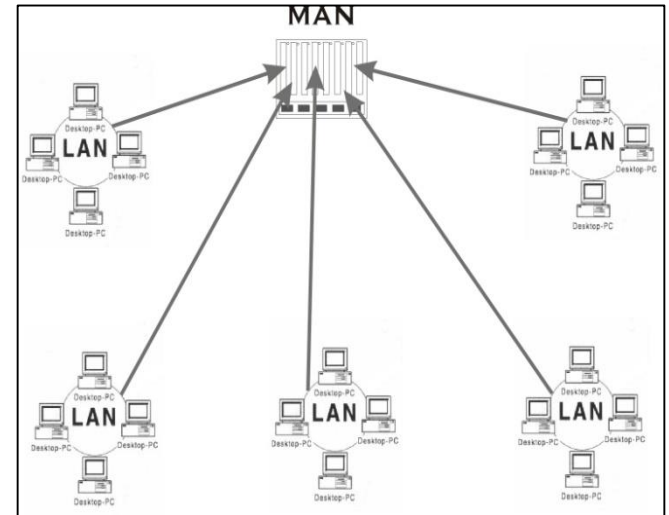
WAN



PAN



MAN



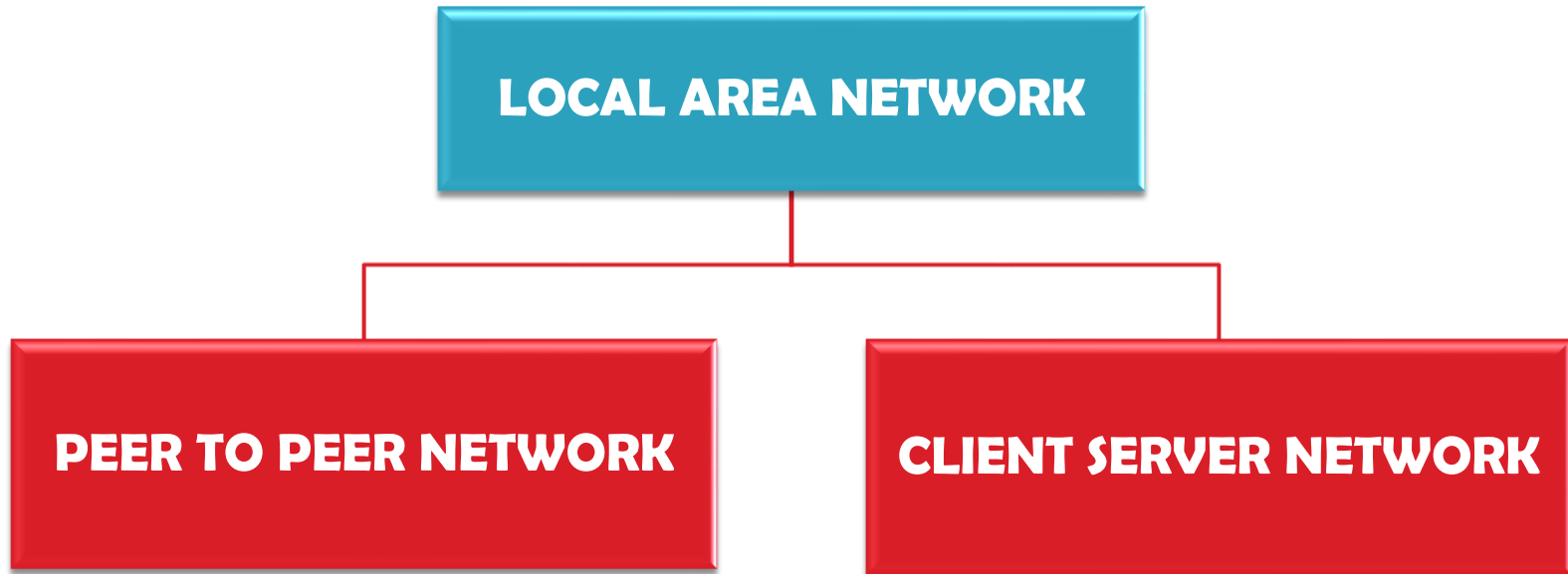
DISTINGUISH BETWEEN LAN,WAN,MAN

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PARAMETERS	LAN	WAN	MAN
Ownership of network	Private	Private or public	Private or public
Geographical area covered	Small	Very large	Moderate
Design and maintenance	Easy	Not easy	Not easy
Communication medium	WiFi, Coaxial cable, UTP cable	Satellite links, Microwave radio links, optical fibre	Coaxial cables, optical fibre,

NETWORK CLASSIFICATION BY ROLE OF COMPUTERS

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PEER TO PEER NETWORK

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- ❑ **In peer to peer network each computer is responsible for making its own resources available to other computers on the network.**
- ❑ **Each computer is responsible for setting up and maintaining its own security for these resources.**
- ❑ **Also each computer is responsible for accessing the required network resources from peer to peer relationships.**
- ❑ **Peer to peer network is useful for a small network containing less than 10 computers on a single LAN .**
- ❑ **In peer to peer network each computer can function as both client and server.**
- ❑ **Peer to peer networks do not have a central control system. There are no servers in peer networks.**

ADVANTAGES & DISADVANTAGES OF PEER TO PEER NETWORK

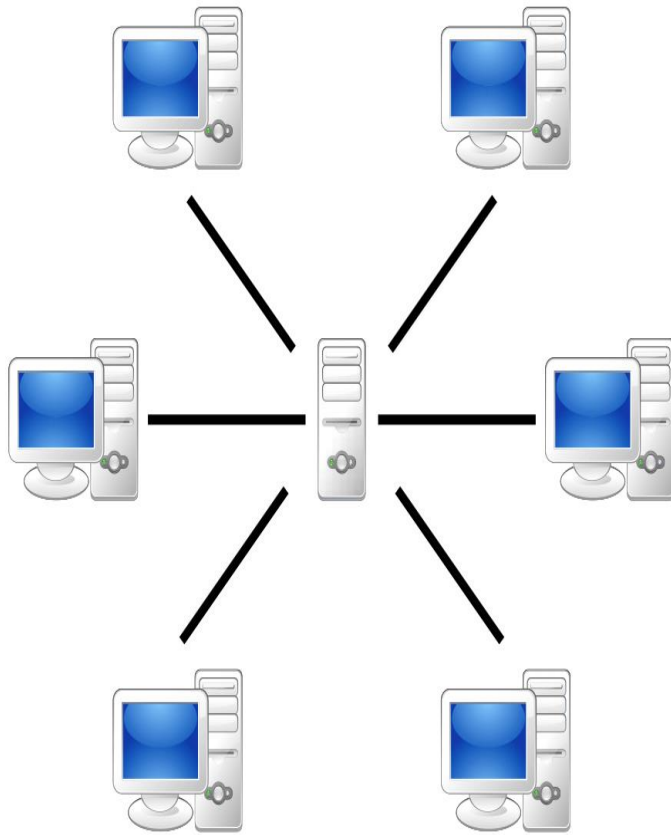
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Advantages:

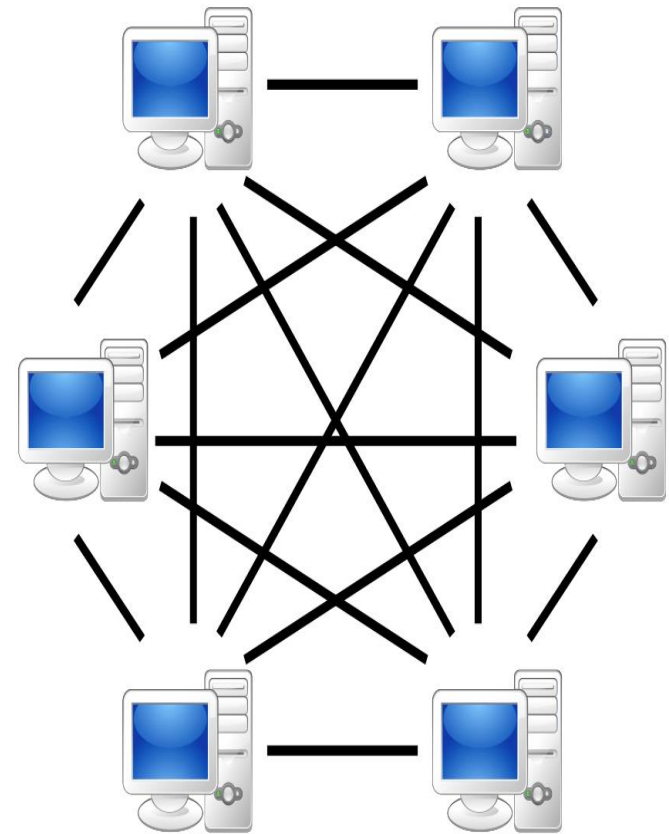
- **Use less expensive computer hardware**
- **Easy to administer**
- **More built in redundancy**
- **Easy setup & low cost**

Disadvantages:

- **Not very secure**
- **No central point of storage or file archiving**
- **Additional load on computer because of resource sharing**



Server-based



P2P-network

CLIENT/SERVER NETWORK

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- ❑ **In client-server network relationships, certain computers act as server and other act as clients.**
- ❑ **A server is simply a computer manages available resources in the network and provides service to other computers when they request it.**
- ❑ **A client is the computer that requests the service from a server.**
- ❑ **A client-server network is one in which all available network resources such as files, directories, applications and shared devices, are centrally managed and hosted and then are accessed by clients.**

ADVANTAGES AND DISADVANTAGES OF CLIENT-SERVER NETWORK

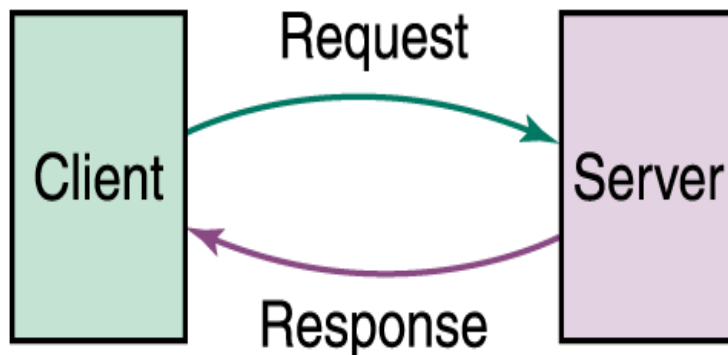
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Advantages:

- **Very secure**
- **Better performance**
- **Centralized backup**
- **Very reliable**

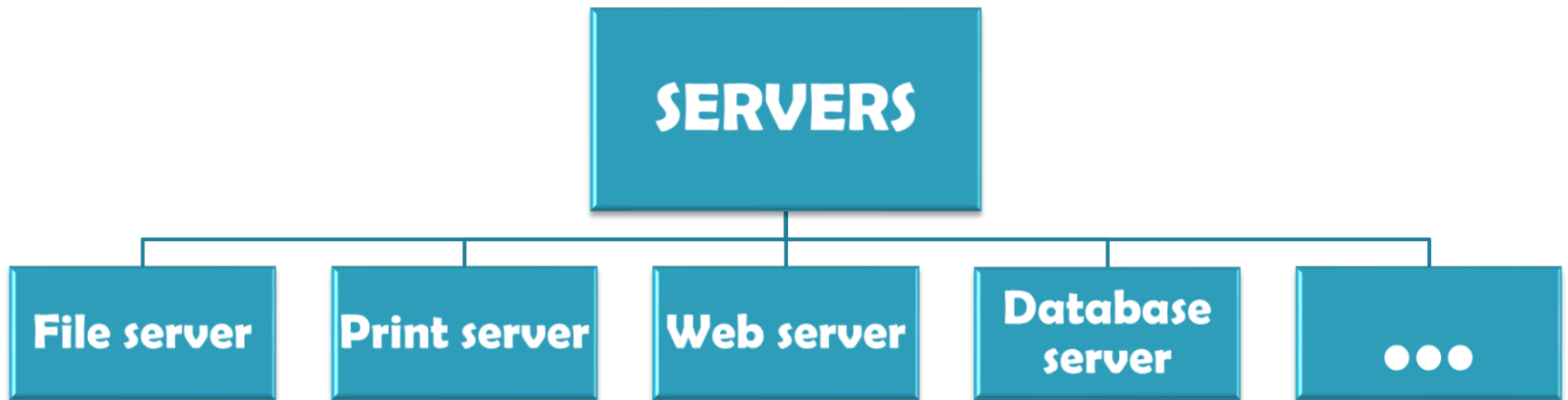
Disadvantages:

- **requires professional administration**
- **More hardware-intensive**
- **More software intensive**
- **Expensive dedicated software**



TYPES OF SERVERS

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Networking Hardware

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- ❑ **There are wide range of hardware systems used in a computer network**
- ❑ **The major networking hardware are:**
 - ❑ **Network Interface Card (NIC)**
 - ❑ **Network Cable**
 - ❑ **Hub**
 - ❑ **Switch**
 - ❑ **Router**
 - ❑ **Proxy Server**
 - ❑ **Bridge**
 - ❑ **Firewall**
 - ❑ **Modem**

Network Interface Card (NIC)

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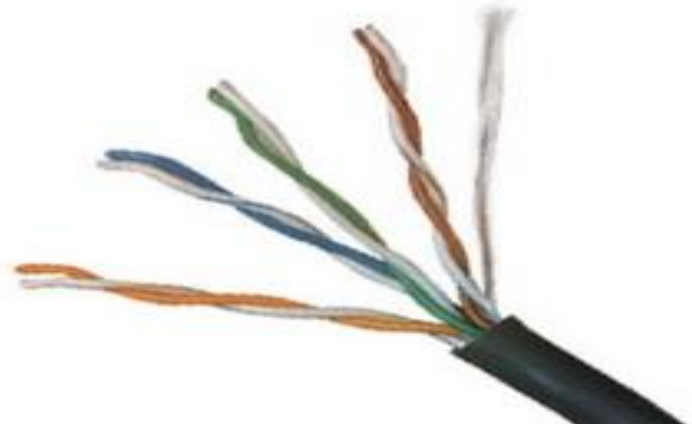
- ❑ **Any computer that is to be connected to a network, needs to have a network interface card (NIC).**
- ❑ **Most modern computers have these devices built into the motherboard**
- ❑ **Some computers, such as laptops, have two NICs: one for wired connections, and one for wireless connections (which uses radio signals instead of wires)**



Network Cable

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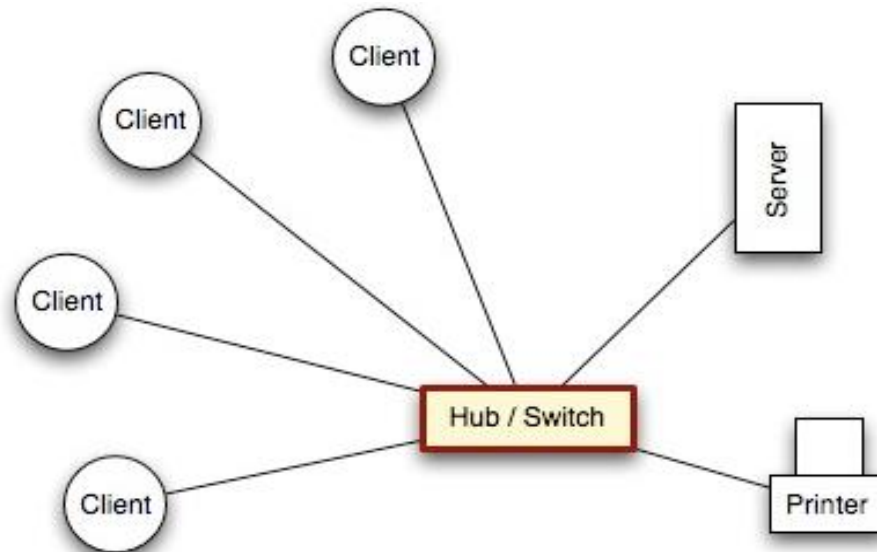
- ❑ **To connect together different devices to make up a network, you need cables.**
- ❑ **Cables are still used in most networks, rather than using only wireless, because they can carry much more data per second, and are more secure (less open to hacking).**
- ❑ **The most common type of network cable in use today looks like the one shown below**



Hub

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- **A hub is a device that connects a number of computers together to make a LAN.**
- **The typical use of a hub is at the center of a star network**
- **The hub has cables plugged into it from each computer.**



Cont'd..

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- ❑ **A hub is a 'dumb' device: if it receives a message, it sends it to every computer on the network.**
- ❑ **Hubs are pretty much obsolete now, having been superseded by cheap switches.**



Switch

- ❑ **A switch, like a hub, is a device that connects a number of computers together to make a LAN.**
- ❑ **The typical use of a switch is at the center of a star network - the switch has cables plugged into it from each computer.**
- ❑ **A switch is a more 'intelligent' device than a hub: if it receives a message, it checks who it is addressed to, and only sends it to that specific computer.**
- ❑ **Because of this, networks that use switches are more secure than those that use hubs, but also a little more expensive.**

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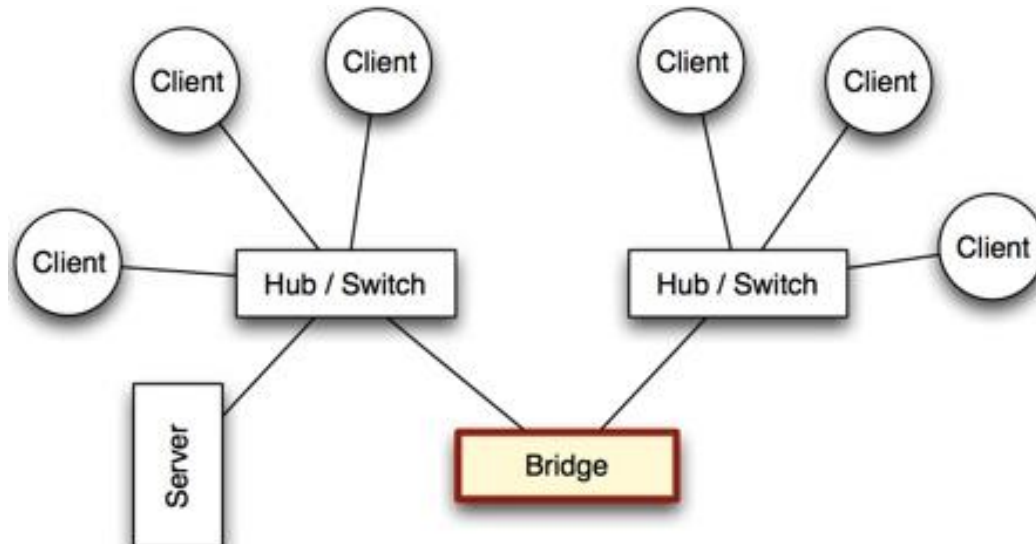
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Bridge

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- **A bridge is a network device that typically links together two different parts of a LAN.**
- **Whereas a router is usually used to link a LAN to a WAN (such as the Internet), a bridge links independent parts of a LAN so that they act as a single LAN.**

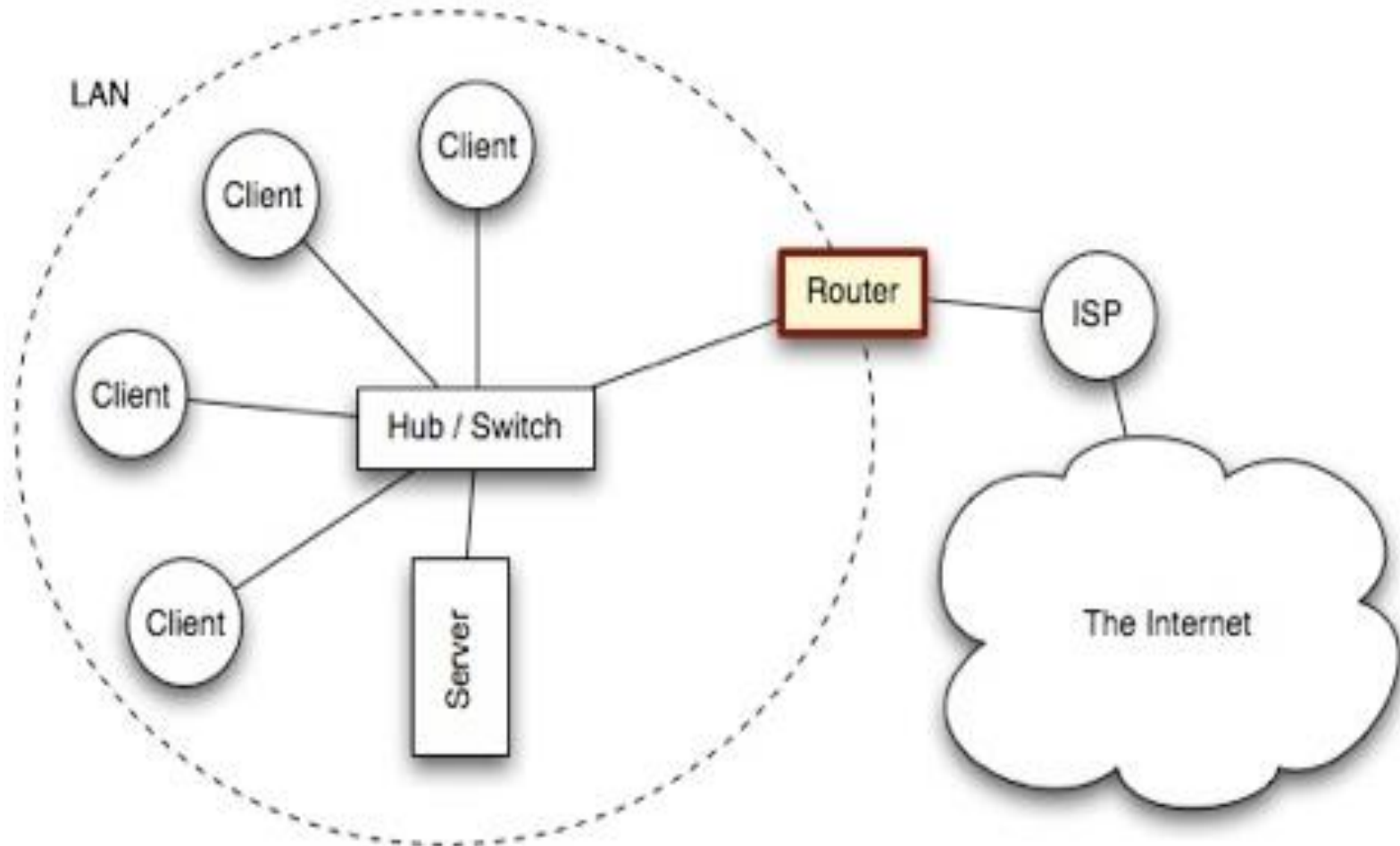


Router

- ❑ **A router is a network device that connects together two or more networks.**
- ❑ **A common use of a router is to join a home or business network (LAN) to the Internet (WAN).**
- ❑ **The router will typically have the Internet cable plugged into it, as well as a cable, or cables to computers on the LAN.**

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- **Alternatively, the LAN connection might be wireless (WiFi), making the device a wireless router.**
- **A wireless router is actually a router and wireless switch combined**



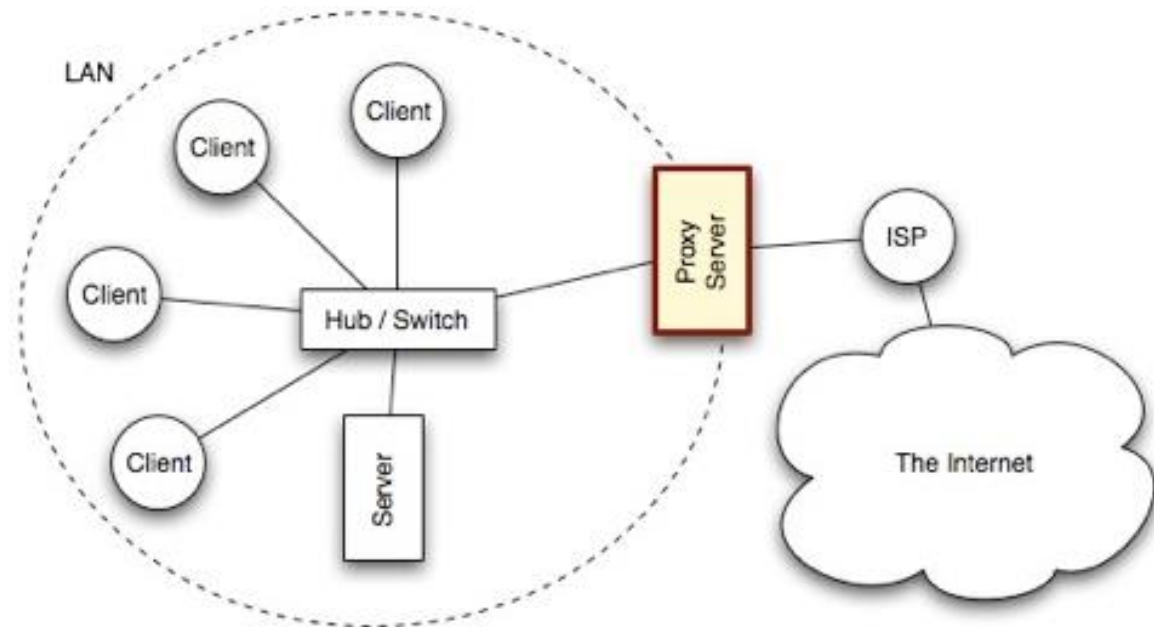
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- **Routers are the devices that join together the various different networks that together make up the Internet.**
- **These types of routers are much more complex than the one you might have in your home.**

Proxy Server

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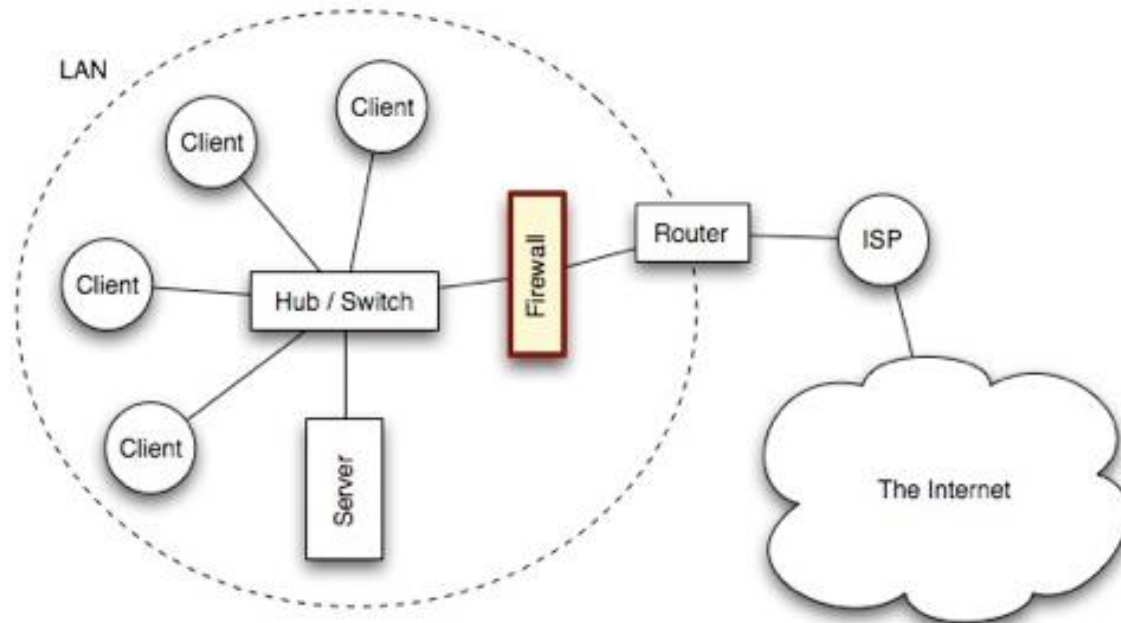
- ❑ **A proxy server is a computer setup to share a resource, usually an Internet connection.**
- ❑ **Computers in a local network can request a web page via the proxy server. The proxy server will then get the page using its Internet connection, and pass it back to the computer that asked for it.**



Firewall

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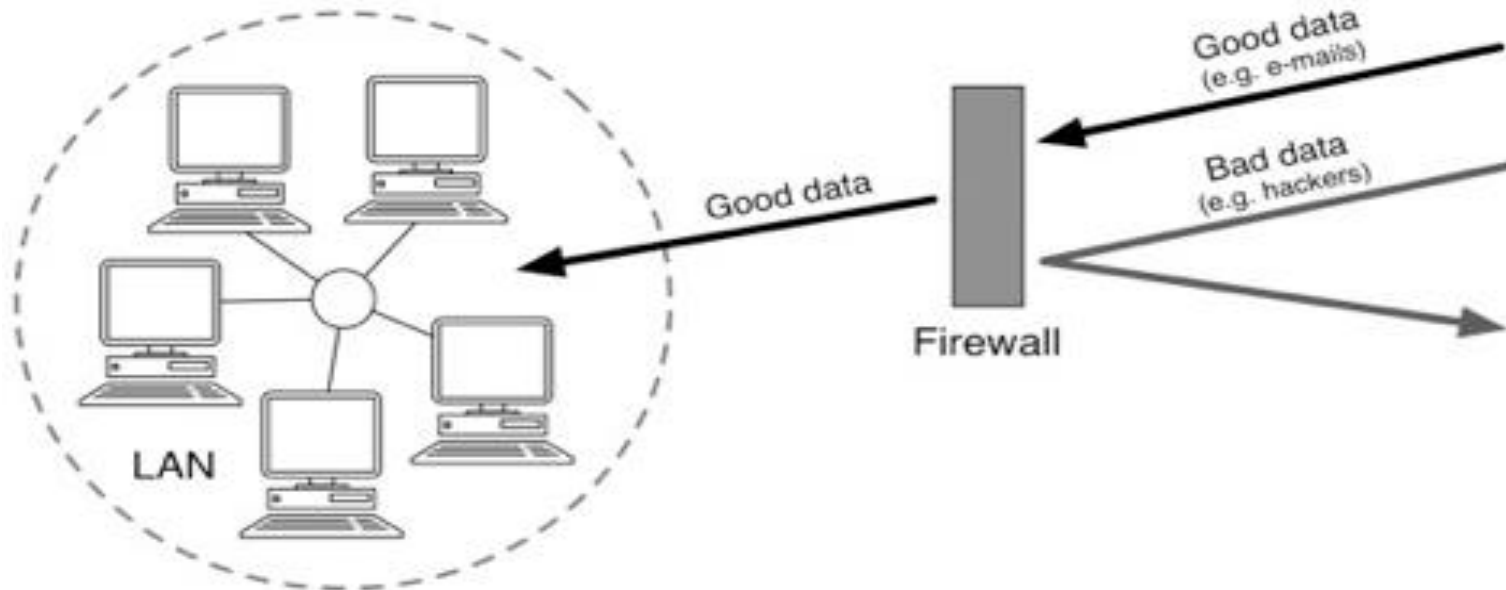
- **A firewall is a device, or a piece of software that is placed between your computer and the rest of the network (where the hackers are!)**
- **If you wish to protect your whole LAN from hackers out on the Internet, you would place a firewall between the LAN and the Internet connection.**



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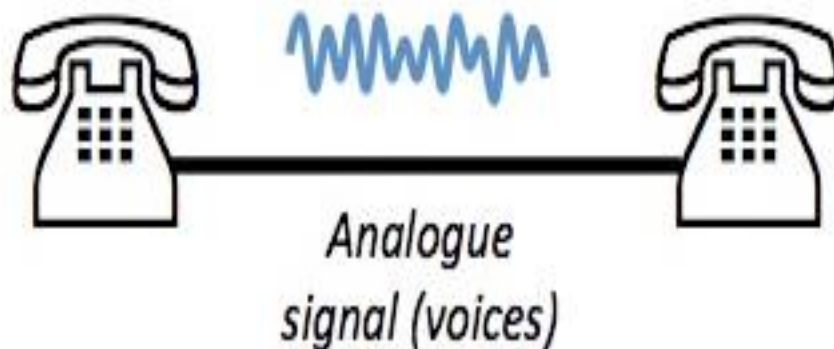
- ❑ **A firewall blocks unauthorized connections being made to your computer or LAN.**
- ❑ **Most computer operating systems have a software firewall built in (e.g. Windows, Linux and Mac OS)**



Modem

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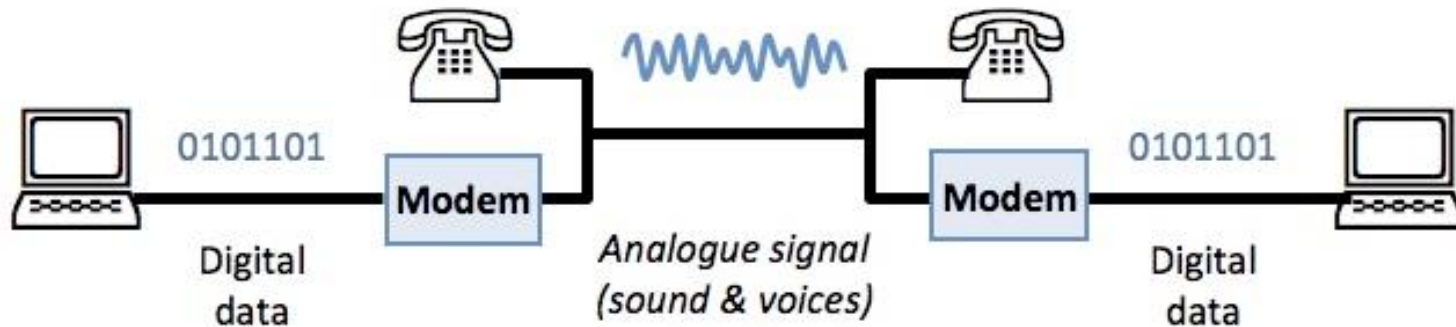
- **Before the days of broadband Internet connections, most computers connected to the Internet via telephone lines (dial-up connections).**
- **The problem with using telephone lines is that they are designed to carry voices, which are analogue signals. They are not designed for digital data.**



Cont'd..

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- ❑ **The solution was to use a special device to join the digital computer to the analogue telephone line. This device is known as a modem.**
- ❑ **A modem contains a DAC and an ADC.**
- ❑ **A modem simply converts data from digital to analogue and from analogue to digital.**



Physical Topologies

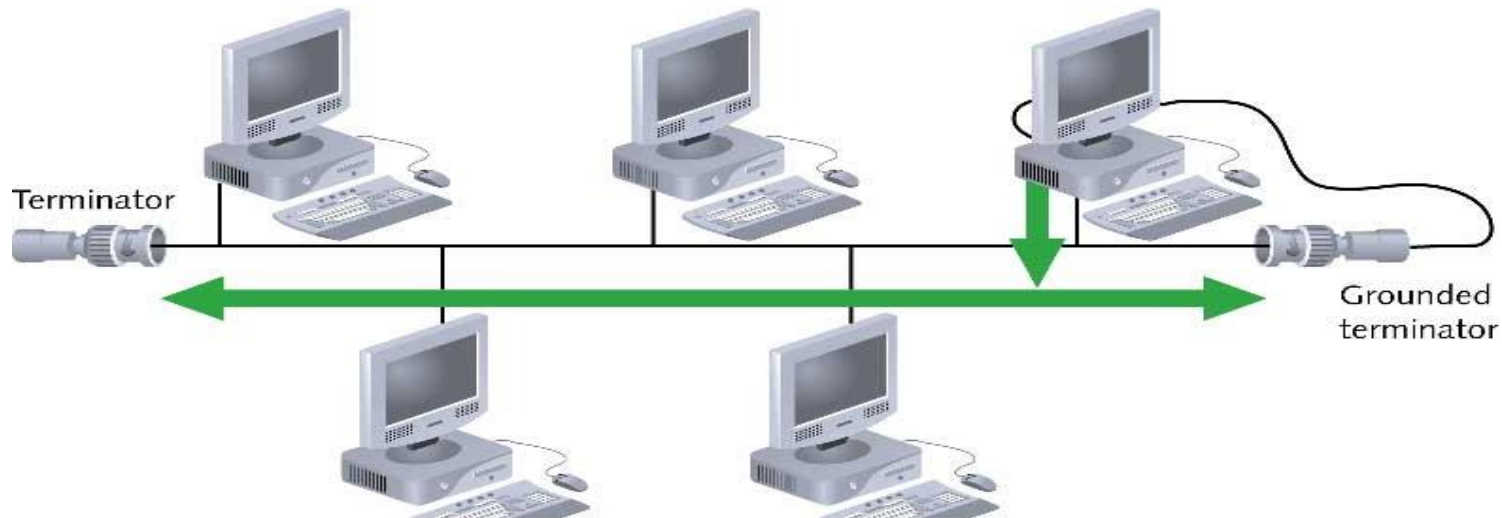
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- Four fundamental type of topology:
 - Bus
 - Ring
 - Star
 - Mesh
- May create hybrid/tree type topologies
- Topology integral to type of network, cabling infrastructure, and transmission media used.

Bus topology

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- A **Bus topology** consists of a single cable called a **bus** connecting all nodes on a network without intervening connectivity devices
- Devices share responsibility for getting data from one point to another



Merits and Demerits of Bus Topology

□ Merits

- ▣ Works well for small networks
- ▣ Relatively inexpensive to implement
- ▣ Easy to add to it

□ Demerits

- ▣ Management costs can be high
- ▣ Potential for congestion with network traffic
- ▣ Terminators must be there at every end
- ▣ Not scalable
- ▣ Difficult to troubleshoot, not fault-tolerant

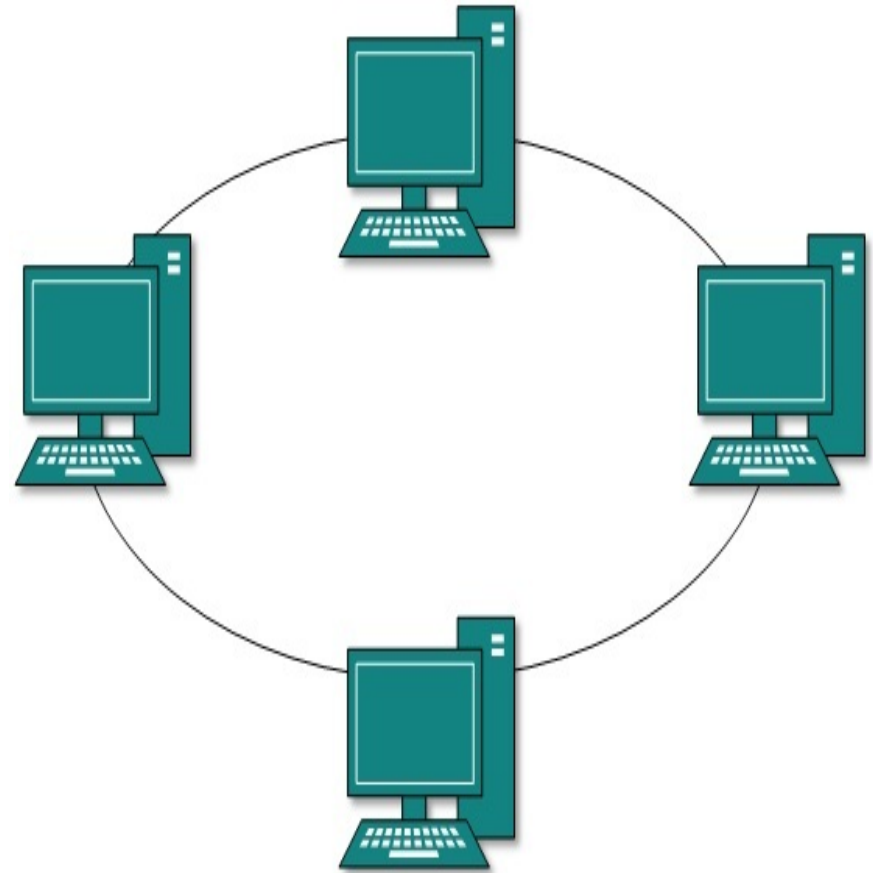
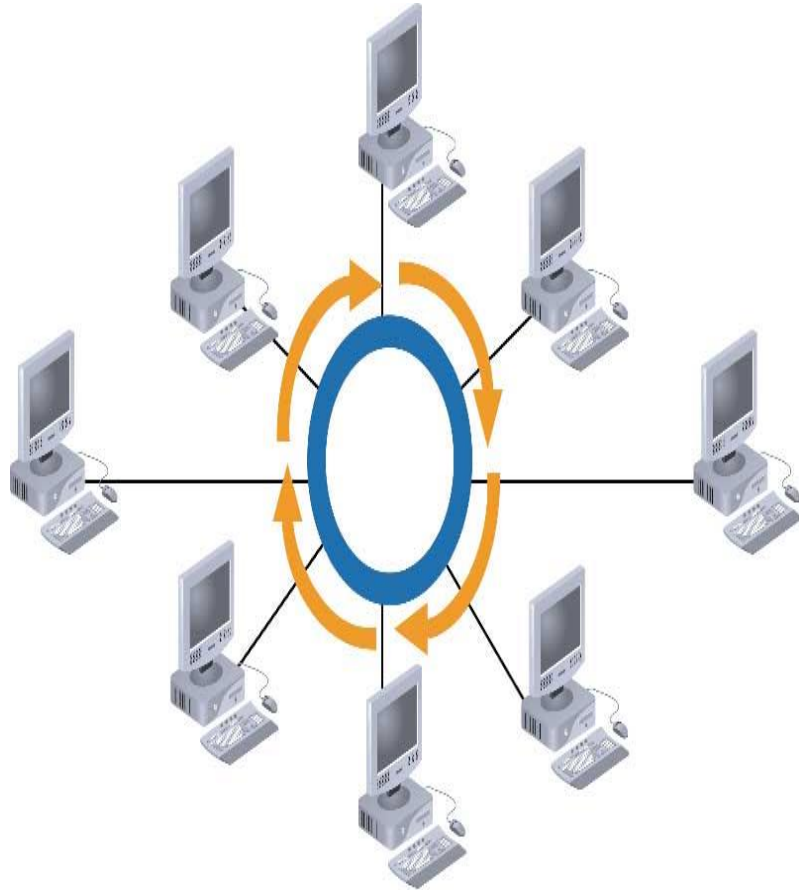
Ring Topology

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- Ring topology
 - ▣ Each node is connected to the two nearest nodes so the entire network forms a circle
 - ▣ One method for passing data on ring networks is **token passing**
- Active topology
 - ▣ Each workstation transmits data

Ring Topology

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Merits and Demerits of Ring Topology

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- Merits
 - ▣ Easier to manage, easier to locate a defective node or cable problem
 - ▣ Well-suited for transmitting signals over long distances on a LAN
 - ▣ Handles high-volume network traffic
 - ▣ Enables reliable communication
 - ▣ Equal access
- Demerits
 - ▣ Expensive
 - ▣ Requires more cable and network equipment at the start
 - ▣ Not used as widely as bus topology
 - Fewer equipment options
 - Fewer options for expansion to high-speed communication

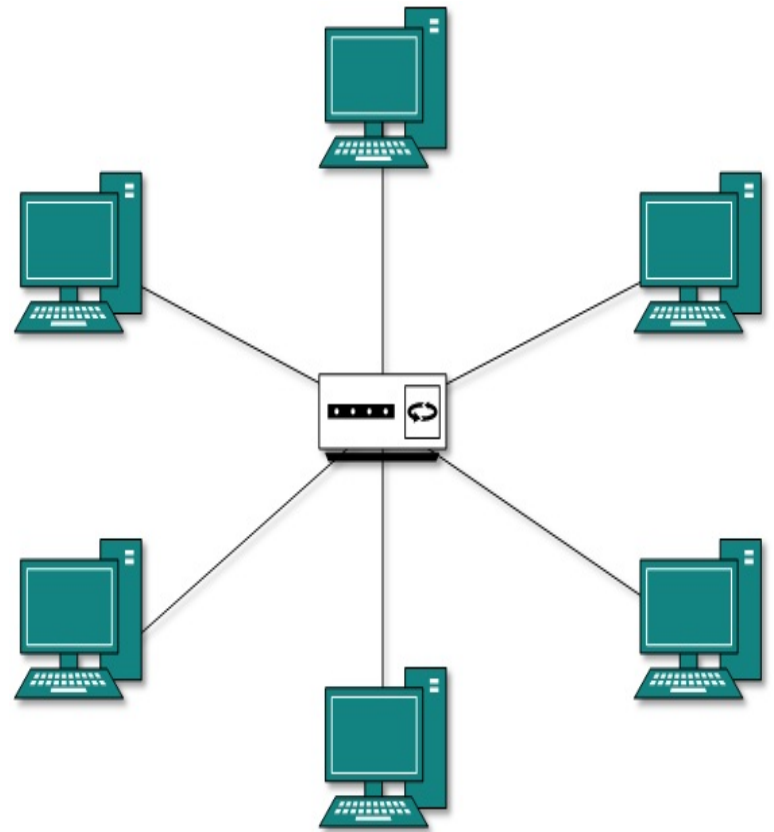
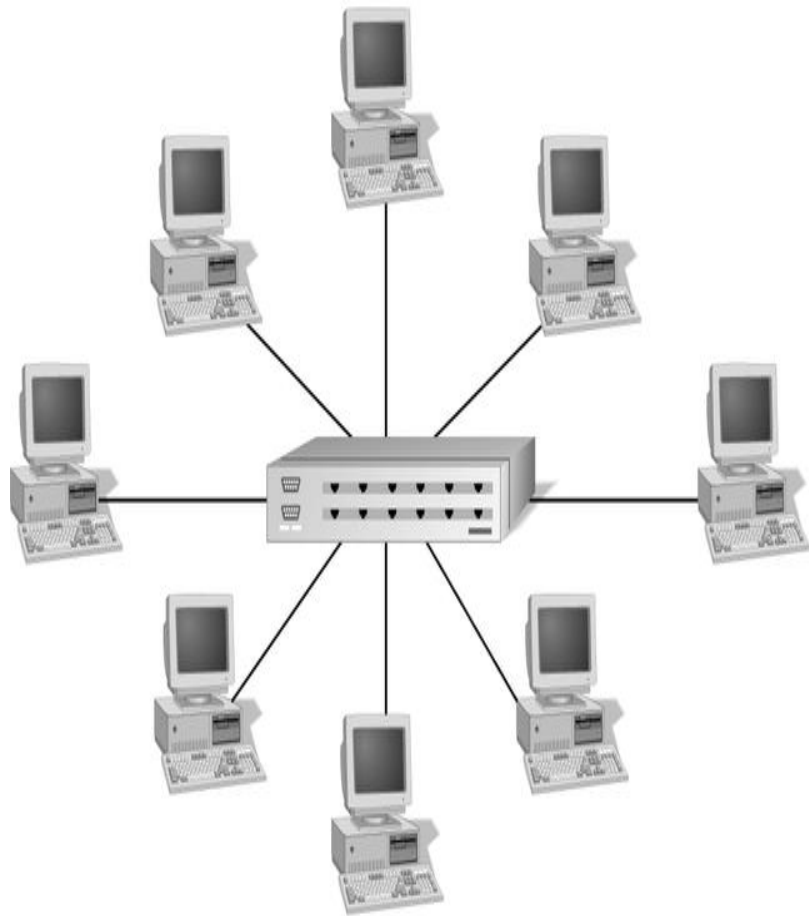
Star Topology

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- ❑ Any single cable connects only two devices
 - ▣ Cabling problems affect two nodes at most
- ❑ Requires more cabling than ring or bus networks
 - ▣ More fault-tolerant
- ❑ Easily moved, isolated, or interconnected with other networks
 - ▣ Scalable
- ❑ Every node on the network is connected through a central device is called switch/hub

Star Topology

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Merits and Demerits of Star Topology

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- Merits
 - ▣ Good option for modern networks
 - ▣ Low startup costs
 - ▣ Easy to manage
 - ▣ Scalable
 - ▣ Most popular topology in use;
 - ▣ wide variety of equipment available
- Demerits
 - ▣ Hub/switch is a single point of failure
 - ▣ Requires more cable than the bus

Mesh Topology

- Not common on LANs
- Most often used in WANs to interconnect LANS
- Each node is connected to every other node
- Allows communication to continue in the event of a break in any one connection
- Two types of mesh topology
 - Full Mesh
 - Partial Mesh

Merits and Demerits Mesh Topology

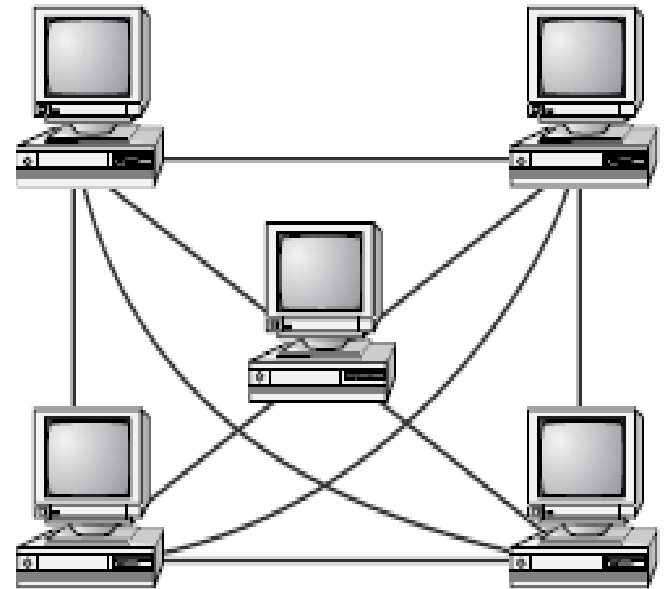
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Merits

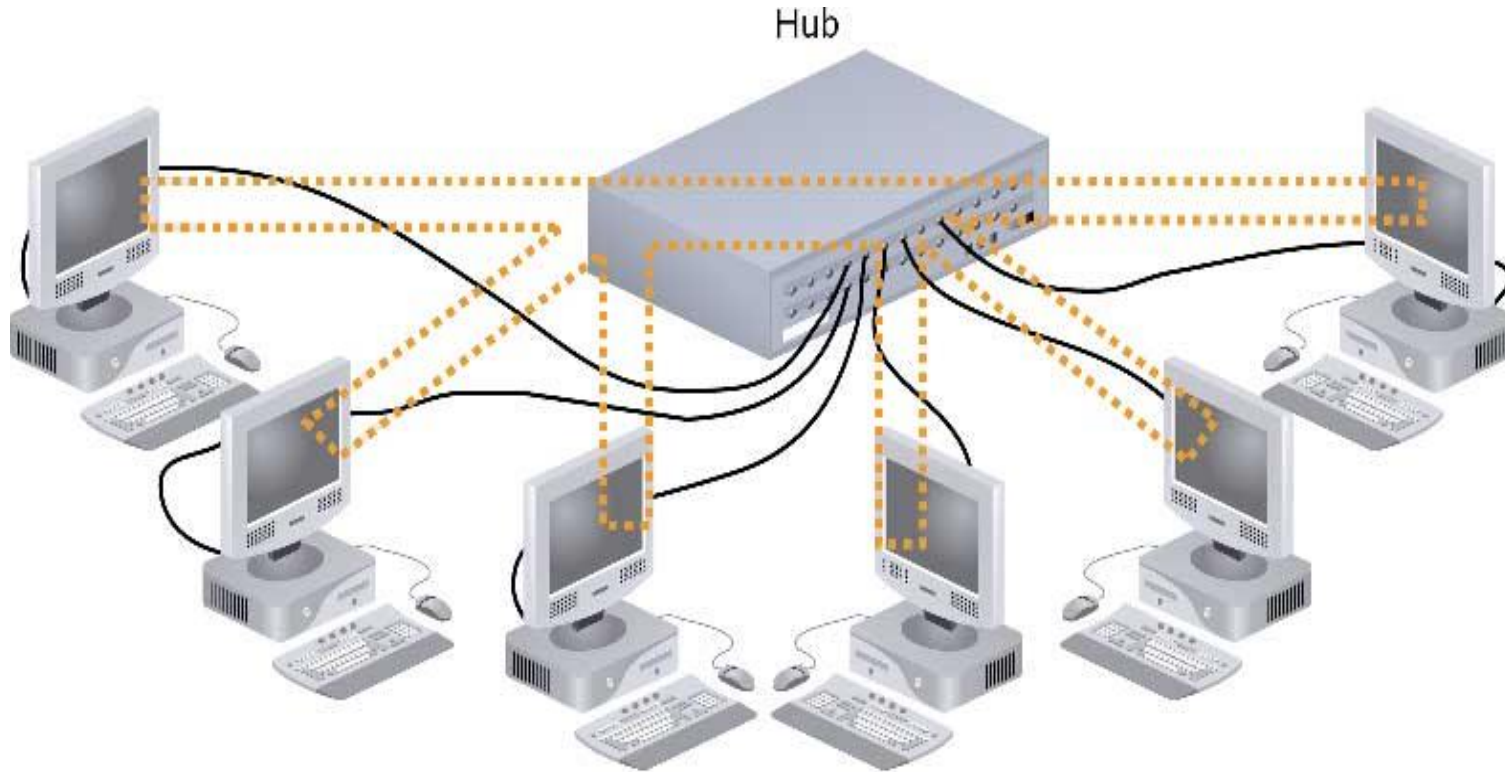
- ▣ Improves Fault Tolerance

Demerits

- The most Expensive
- Difficult to install
- Difficult to manage
- Difficult to troubleshoot

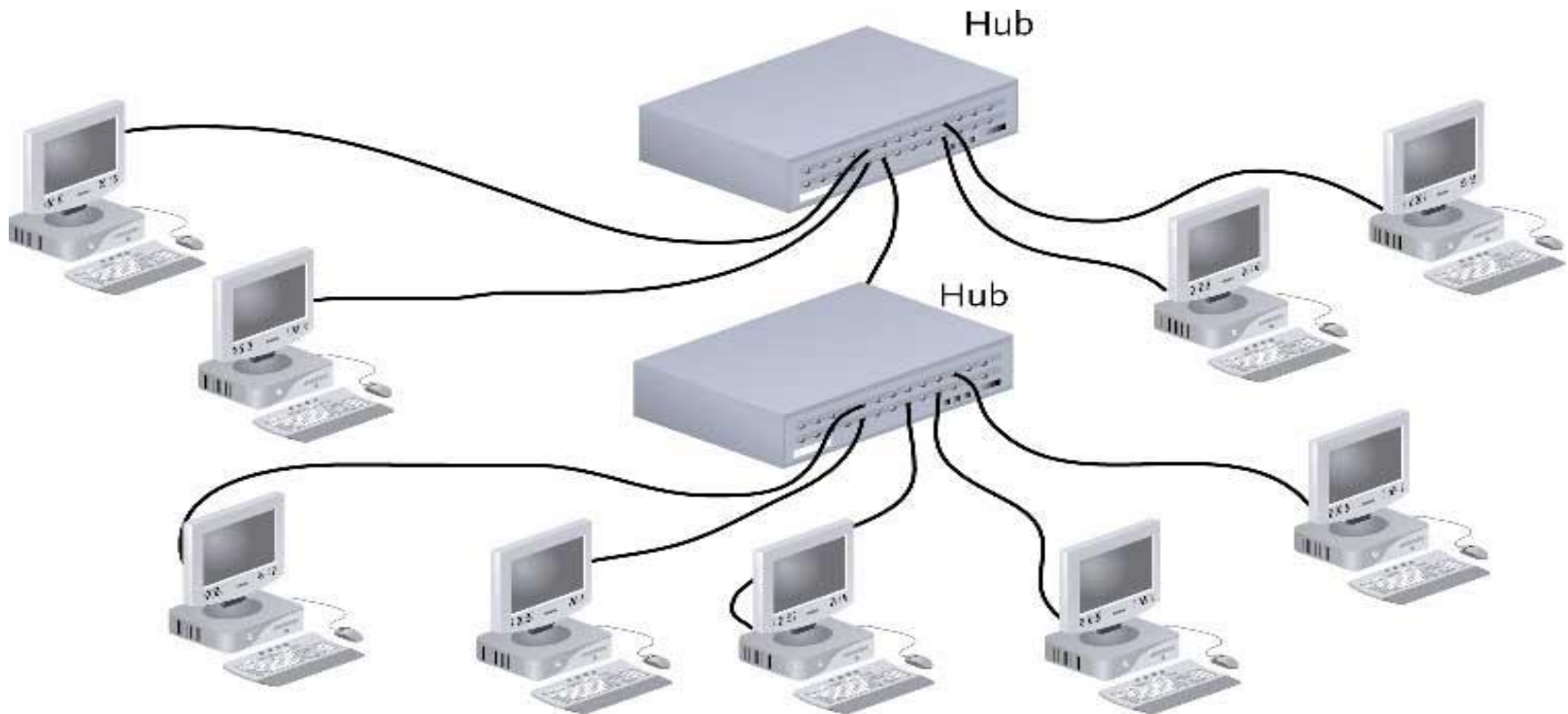


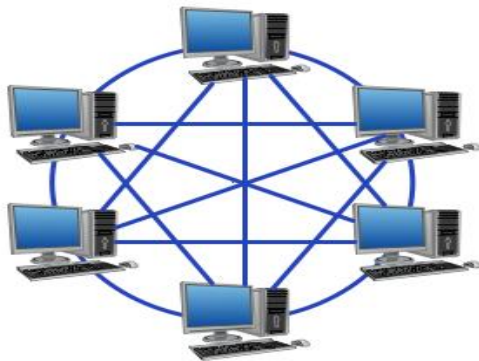
Hybrid Physical Topologies: Star-Ring Topology



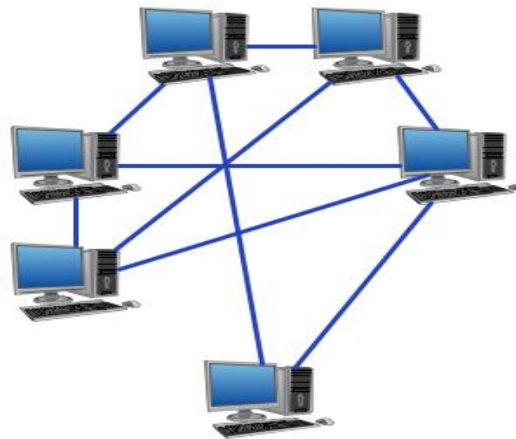
Star-Wired Ring

Star-Bus Topology





Fully Connected Network Topology



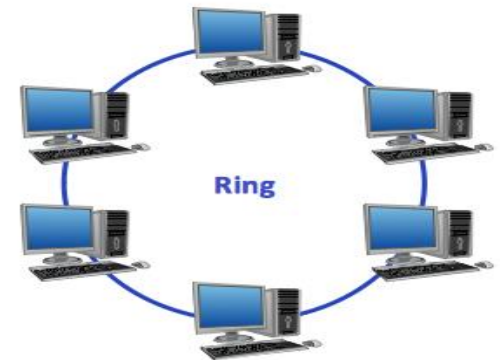
Mesh Network Topology



Star Network Topology



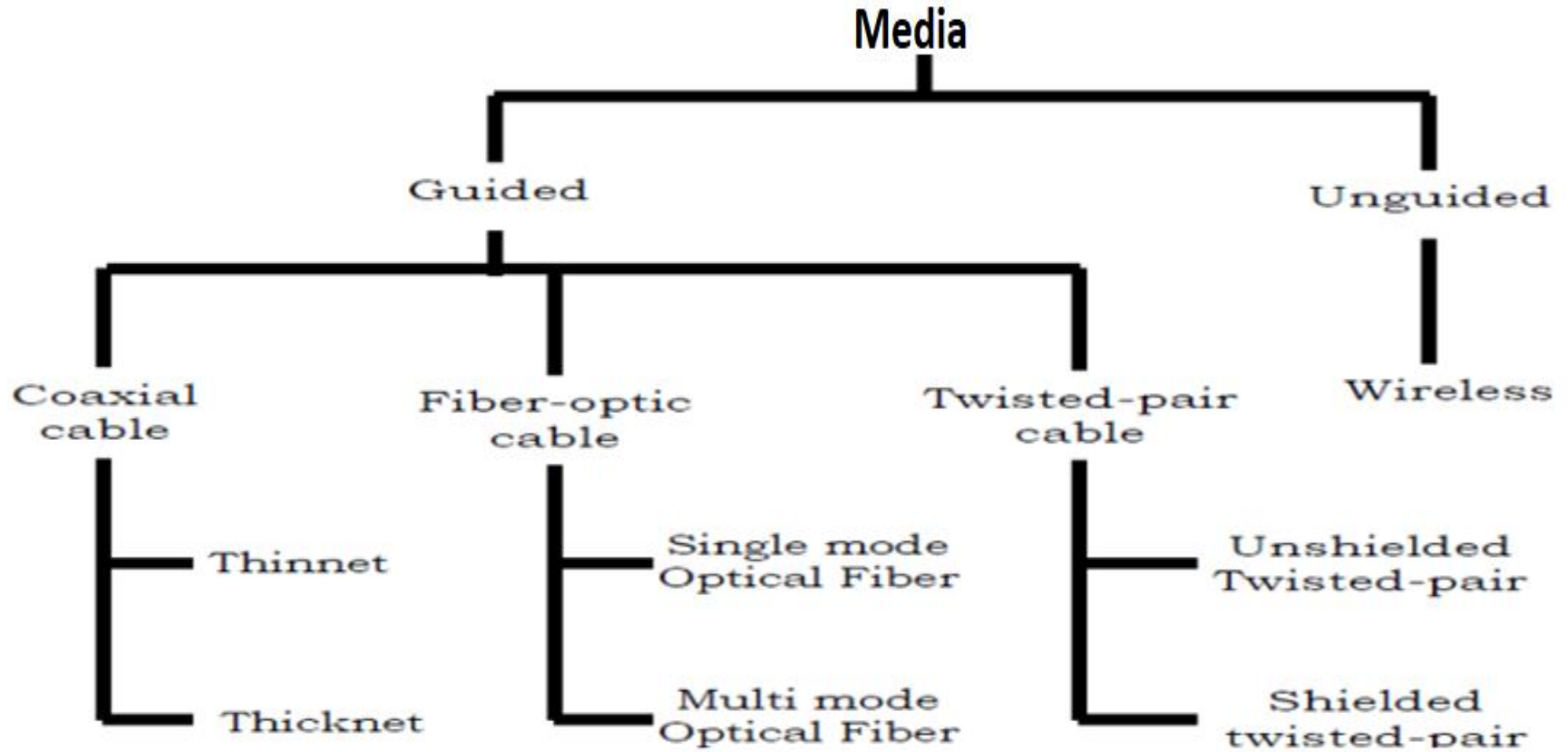
Common Bus Topology



Ring Network Topology



Transmission Media



Transmission Media

Two main categories:

- Guided — wires, cables
 - Twisted-Pair cables:
 - Unshielded Twisted-Pair (UTP) cables
 - Shielded Twisted-Pair (STP) cables
 - Coaxial cables
 - Fiber-optic cables
- Unguided — wireless transmission
 - radio,
 - Microwave
 - Infrared
 - Bluetooth

What is the Internet?

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- ▣ **It is a global system of interconnected computer networks that use the standard TCP/IP protocol to link several billion devices worldwide**
- ▣ **It is an international *network of networks* that consists of millions of private, public, academic, business, and government networks, linked by a broad array of electronic, wireless, and optical networking technologies.**
- ▣ **It is the mother of all networks**

Internet

- ❑ **The Internet is a worldwide system of interconnected computer networks. When you connect your computer to the Internet via your Internet Service Provider (ISP), you become part of the ISP's network, which is connected to other networks that make up the Internet**
- ❑ **the Internet is not a closely controlled by 'single' system, but an assemblage of independent networks united by the common use of TCP/IP protocol.**
- ❑ **It grew out of an experiment begun in the 1960's by the U.S. Department of Defense , ARPANET (The Advanced Research Projects Agency Network)**

INTERNET and World Wide Web

- The internet is the global network of networks, which interconnects thousands of computer systems and millions of people around the world. The networks that are interconnected to the internet are owned and operated by various organizations around the world.
- It is a “network of networks” that consists of smaller domestic, academic, business, and government networks, which together carry various information and services such as e-mail, online chat, file transfer and the interlinked Web pages and other documents of the World (WWW).

Intranets and Extranets

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□ Intranet

- **An intranet is a network that works like the Internet but is only available within a particular organization, not to the public.**
- **TCP/IP network located within a single organization for communications and processing**
- **An intranet may have web pages used to share company specific data within that company, such as internal telephone numbers or details of employee benefits.**

□ Extranet

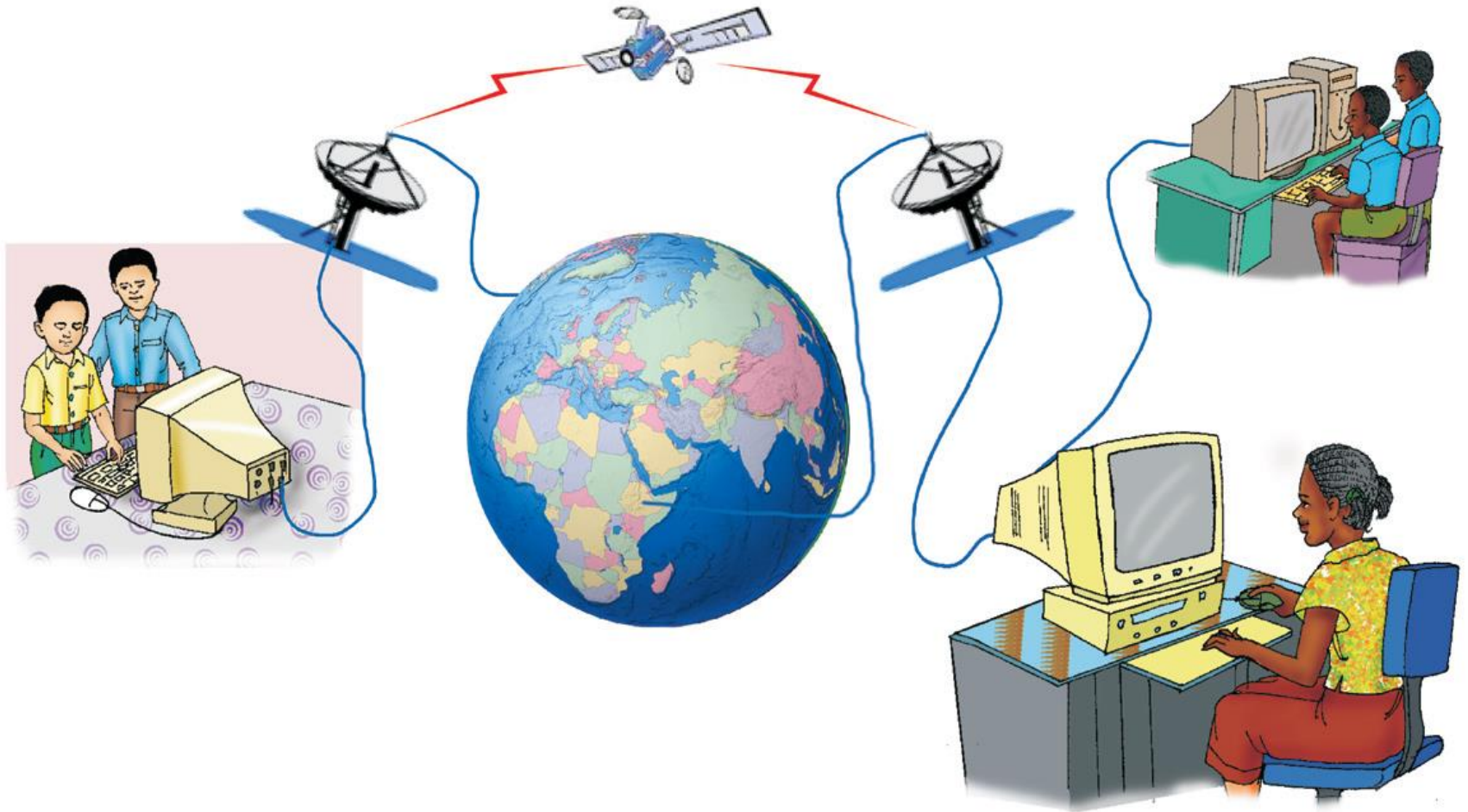
- **Formed when firms permit outsiders to access their internal TCP/IP networks**

Web Browsers

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- ❑ **Primary purpose to display Web pages**
- ❑ **Internet Explorer and Firefox are the two dominant web browser examples**
- ❑ **Other browsers include:**
 - ❑ **Netscape**
 - ❑ **Opera**
 - ❑ **Safari (for Apple)**
 - ❑ **Google Chrome**

Internet



Internet



To connect to the Internet, the following are needed:

- ✓ **Computer**
- ✓ **Telephone line/cable**
- ✓ **Modem**
- ✓ **Switch or router**
- ✓ **ISP (Internet Service Provider)**
- ✓ **Web browser, e.g., *Internet Explorer, Mozilla Firefox, Google Chrome, Safari, Opera, etc.***

INTERNET Connections

Dial-up Connection

- **This provides connection to Internet through a dial-up terminal connection.**
- **The computer, which provides Internet access is known as 'Host' and the computer that receives the access, is 'Client' or 'Terminal'.**
- **The client computer uses modem to access a "host" and acts as if it is a terminal directly connected to that host.**

■ Leased Connection

- ❑ **It is the secure, dedicated and most expensive, level of Internet connection.**
- ❑ **With leased connection, your computer is dedicatedly and directly connected to the Internet using high-speed transmission lines.**
- ❑ **It is on-line twenty-four hours a day, seven days a week.**
- ❑ **Leased Internet connections are limited to large corporations and universities who could afford the cost**

Internet Services

- Internet is best characterized by the services it provides in the form of text, graphics, sound, software and also people through a variety of services and tools for communication exchange.
 - **World Wide Web**
 - **Electronic Mail (e-mail)**
 - **Telnet**
 - **File Transfer Protocol (FTP)**
 - **Internet Telephony**
 - **Web TV/Radio**
 - **Internet Relay Chat**
 - **News Groups**

WWW (World Wide Web)

- ❑ **www is the most important service provided by Internet.**
- ❑ **Developed in 1989 by Tim Berners-Lee of the European Particle Physics Lab (CERN) in Switzerland**
- ❑ **Links within WWW documents can take you quickly to other related documents.**
- ❑ **Provides access to billions, possibly trillions, of Web pages**
- ❑ **WWW is a set of sites that you can go for information.**
- ❑ **The process of sharing common information of the world by the help of the Internet services. It includes education, health, games, chat, sport, news and others.**

WWW

- Document on the web contains multimedia formats: text, image, figures, animation, video, and sound and also contains hyperlinks (which appear as highlighted or underlined images or texts, or icons, or hotspots in images) to other documents stored anywhere on the web.
- It requires special software programs like Netscape, Internet **Explorer, AltaVista, Wikipedia or others.**
They are called Web Browsers.

http://www.aau.edu.et/index.php/home-newcs/index.html



http
Protocol
Identifier



www.aau.edu.et
Server's Name



index.php/home-
ewcs/index.html
Directory & File Name

Tim Berners-Lee



- Father of W .W .W
- The inventor of HTML.
- Invented W W W while working at CERN, the European Particle Physics Laboratory.

Email- Electronic Mail

- **email is the most frequently used application of the Internet which this is used for sending a message electronically over the internet, from the sender to the receiver.**
- **The message first goes to your Internet Service Provider's mail server, which in turn sends it to the recipient's mail server.**
- **To create, send, and receive e-mail messages, you need an e-mail program and an account on an Internet mail server with a domain name.**

File Transfer Protocol (FTP)

- **Using FTP programs, we can **upload** or **download** files. But to do this there should be an admission from the remote computer.**
- **There are two computers involved in an FTP transfer: a server and a client.**
- **The FTP server, running FTP server software, listens on the network for connection requests from other computers. The client computer, running FTP client software, initiates a connection to the server**

Internet Telephony (Voice over IP)

- **Voice over Internet Protocol (VoIP) is a methodology and group of technologies for the delivery of Voice communications and Multimedia sessions over Internet Protocol (IP) networks, such as the Internet.**
- **Other terms commonly associated with VoIP are *IP telephony, Internet telephony.***
- ***E.g. Skype, VIBER***

Telnet (Remote Login)

- **Telnet:- It is a program that allows you log in from your own computer to a remote computer directly through the Internet and you can work on that computer.**
- **The term "telnet" is a mashing together of "telephone" and "network"**
- **For example, if I travelled abroad and had use of machine with Internet access, I could use telnet to login to my account on cserver at AAU provided I have an account on the machine.**

Internet Relay Chat-IRC



- **Internet Relay Chat is one of the most popular and most interactive services on the Internet.**
- **Using an IRC client (program) you can exchange text messages interactively with other people all over the world**