

Introduction to Computer Systems

Computer Networks

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Lecture 8 Recap

- Computer Security

Lecture 9 Outline

- Computer Networks

Computer Networks

A **computer network** consists of communications media, devices, and software connecting two or more computer systems or devices.

The computers and devices on the networks are also sometimes called **network nodes**.

Organizations can use networks to share hardware, programs, and databases and to transmit and receive information, allowing for improved organizational effectiveness and efficiency. Networks enable geographically separated workgroups to share documents and opinions, which fosters teamwork, innovative ideas, and new business strategies. Effective use of networks can help a company grow into an agile, powerful, and creative organization, giving it a long term competitive advantage.

Advantages of Computer Networks

- The computers on the network can share hardware devices like printer, scanner etc.
- Data and software can be shared within the computer on the network.
- Files can be transferred from one computer to another computer.
- Computers in the network can communicate with each other.
- Networks enable remote access to resources and data, allowing users to work from anywhere with an internet connection.
- Networks enable real-time communication and collaboration between users, regardless of their location.
- Network administrators can centrally manage and monitor resources and user accounts
- Networks can be expanded easily by adding new devices and resources, making them ideal for growing organizations.
- Networks enable data backup and disaster recovery mechanisms, ensuring that data is not lost in the event of a disaster.

Disadvantages of Computer Networks

- Networks are vulnerable to security risks such as hacking, viruses, and malware, which can compromise data and systems.
- The cost of setting up a network can be high, particularly for large organizations or those that require specialized hardware or software.
- Networks require ongoing maintenance and support to ensure optimal performance, which can be time-consuming and costly.
- Networks can become congested, particularly during peak usage periods, leading to slower data transfer rates and reduced performance.
- Networks can compromise privacy by enabling unauthorized access to sensitive data, such as personal and financial information.
- As networks evolve and new technologies emerge, compatibility issues may arise between older devices and newer protocols and software.

Network Topology

Network topology is the shape or structure of a network, including the arrangement of the communication links and hardware devices on the network.

The three most common network topologies in use today are:

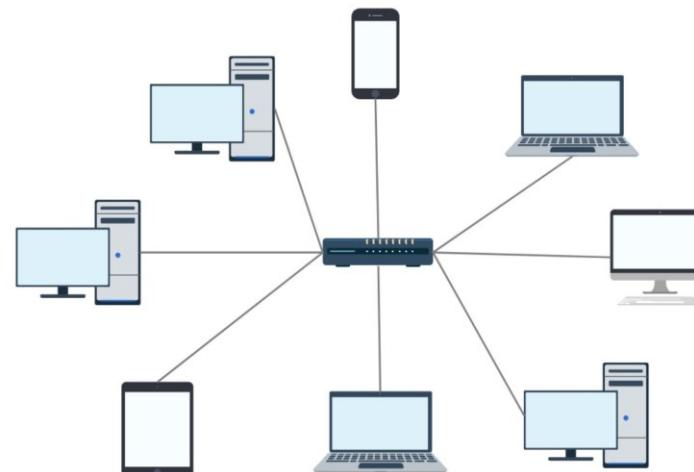
- **Star topology**
- **Bus Topology**
- **Mesh Topology**

Network Topology: Star

In a **star network**, all network devices connect to one another through a single central device called the **hub node**.

Many home networks employ the star topology. A failure in any link of the star network will isolate only the device connected to that link. However, should the hub fail, all devices on the entire network will be unable to communicate.

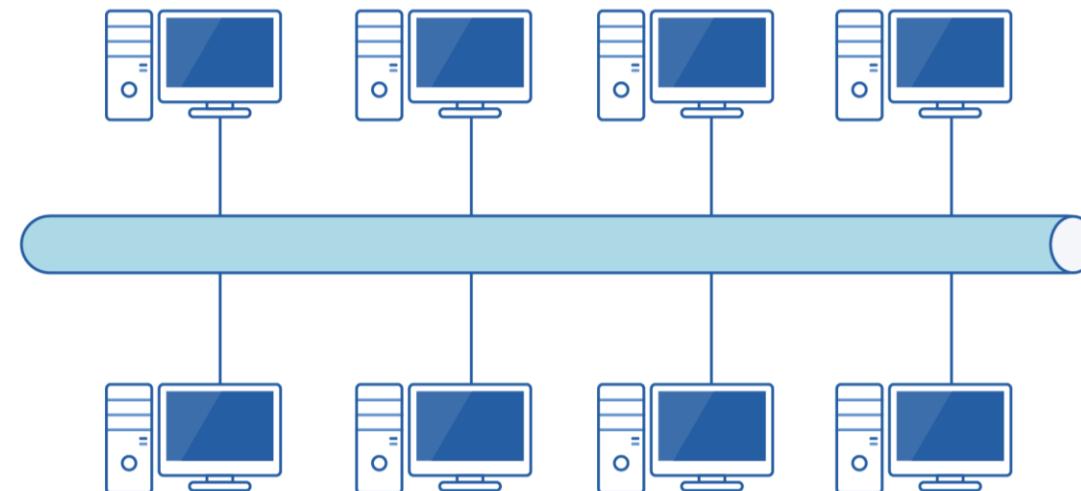
Example - local area network (LAN) in an office or a home, where all devices are connected to a central switch.



Network Topology: Bus

In a **bus network**, all network devices are connected to a common backbone that serves as a shared communications medium. To communicate with any other device on the network, a device sends a broadcast message onto the communications medium. All devices on the network can “see” the message, but only the intended recipient actually accepts and processes the message.

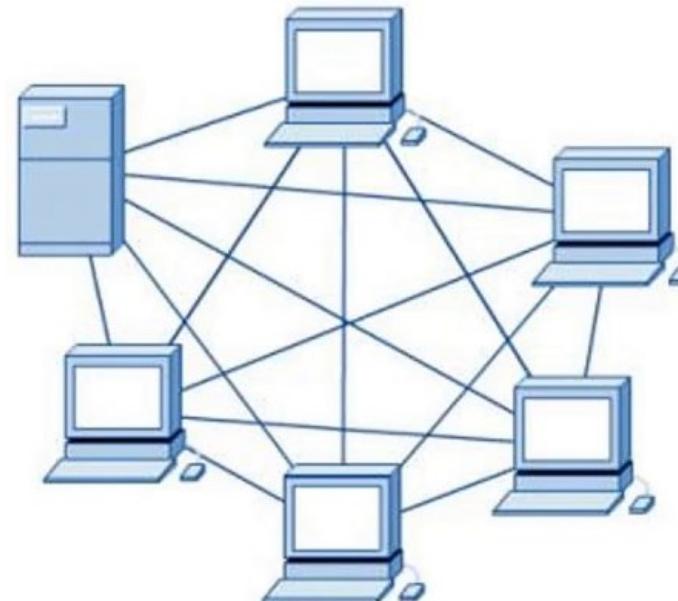
Example - an Ethernet cable network, which connects devices such as computers and printers in an office.



Network Topology: Mesh

Mesh networks use multiple access points to link a series of devices that speak to each other to form a network connection across a large area. Communications are routed among network nodes by allowing for continuous connections and by bypassing blocked paths by “hopping” from node to node until a connection can be established. Mesh networks are very robust: if one node fails, all the other nodes can still communicate with each other, directly or through one or more intermediate nodes.

Example – mesh Wi-Fi network in a large building, Google Wifi, Zigbee, Google Home



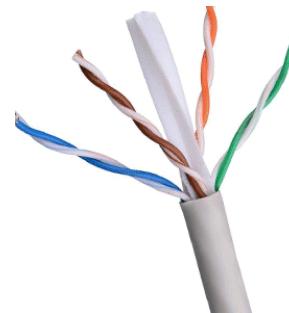
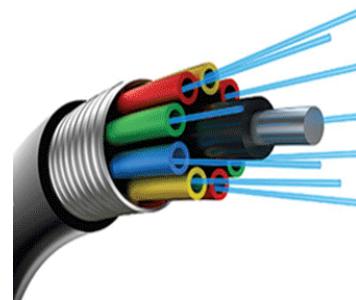
Communication Medium

Communication medium are any material substance that carries an electronic signal to support communications between a sending and a receiving device.

- **Guided/Wired**

communications signals are guided along a solid medium

Example - copper cables, fiber-optic cables, and coaxial cables.



Communication Media

- **Wireless Technologies**

Communications signal is broadcast over airwaves as a form of electromagnetic radiation.

- **Wireless Communication**

Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. Example - radio waves, microwaves, and infrared radiation.

- **Near field communication (NFC)**

very short-range wireless connectivity technology that enables two devices placed within a few inches of each other to exchange data. Examples – NFC terminals to pay for purchases

- **Bluetooth**

wireless communications specification that describes how cell phones, computers, printers, and other electronic devices can be interconnected over distances of 10 to 30 feet at a transmission rate of about 2 Mbps

- **Wi-Fi**

In a Wi-Fi network, the user's computer, smartphone, or cell phone has a wireless adapter that translates data into a radio signal and transmits it using an antenna.

Communication Hardware

Networks require various communications hardware devices to operate, including modems, fax modems, multiplexers, private branch exchanges, front-end processors, switches, bridges, routers, and gateways.

Device	Function
Modem	Translates data from a digital form (as it is stored in the computer) into an analog signal that can be transmitted over ordinary telephone lines
Fax modem	Combines a fax with a modem; facsimile devices, commonly called fax devices, allow businesses to transmit text, graphs, photographs, and other digital files via standard telephone lines
Multiplexer	Allows several communications signals to be transmitted over a single communications medium at the same time, thus saving expensive long-distance communications costs
PBX (private branch exchange)	Manages both voice and data transfer within a building and to outside lines; PBXs can be used to connect hundreds of internal phone lines to a few outside phone company lines
Front-end processor	Manages communications to and from a computer system serving many people
Switch	Uses the physical device address in each incoming message on the network to determine which output port it should forward the message to reach another device on the same network
Bridge	Connects one LAN to another LAN where both LANs use the same communications protocol
Router	Forwards data packets across two or more distinct networks toward their destinations through a process known as routing; often, an Internet service provider (ISP) installs a router in a subscriber's home that connects the ISP's network to the network within the home
Gateway	Serves as an entrance to another network, such as the Internet

Communication Software

- **network operating system (NOS):** Systems software that controls the computer systems and devices on a network and allows them to communicate with each other
- **network-management software:** Software that enables a manager on a networked desktop to monitor the use of individual computers and shared hardware (such as printers), scan for viruses, and ensure compliance with software licenses.
- **mobile device management (MDM) software:** Software that manages and troubleshoots mobile devices remotely, pushing out applications, data, patches, and settings while enforcing group policies for security.
- **software-defined networking (SDN):** An emerging approach to networking that allows network administrators to have programmable central control of the network via a controller without requiring physical access to all the network devices.

Network Types

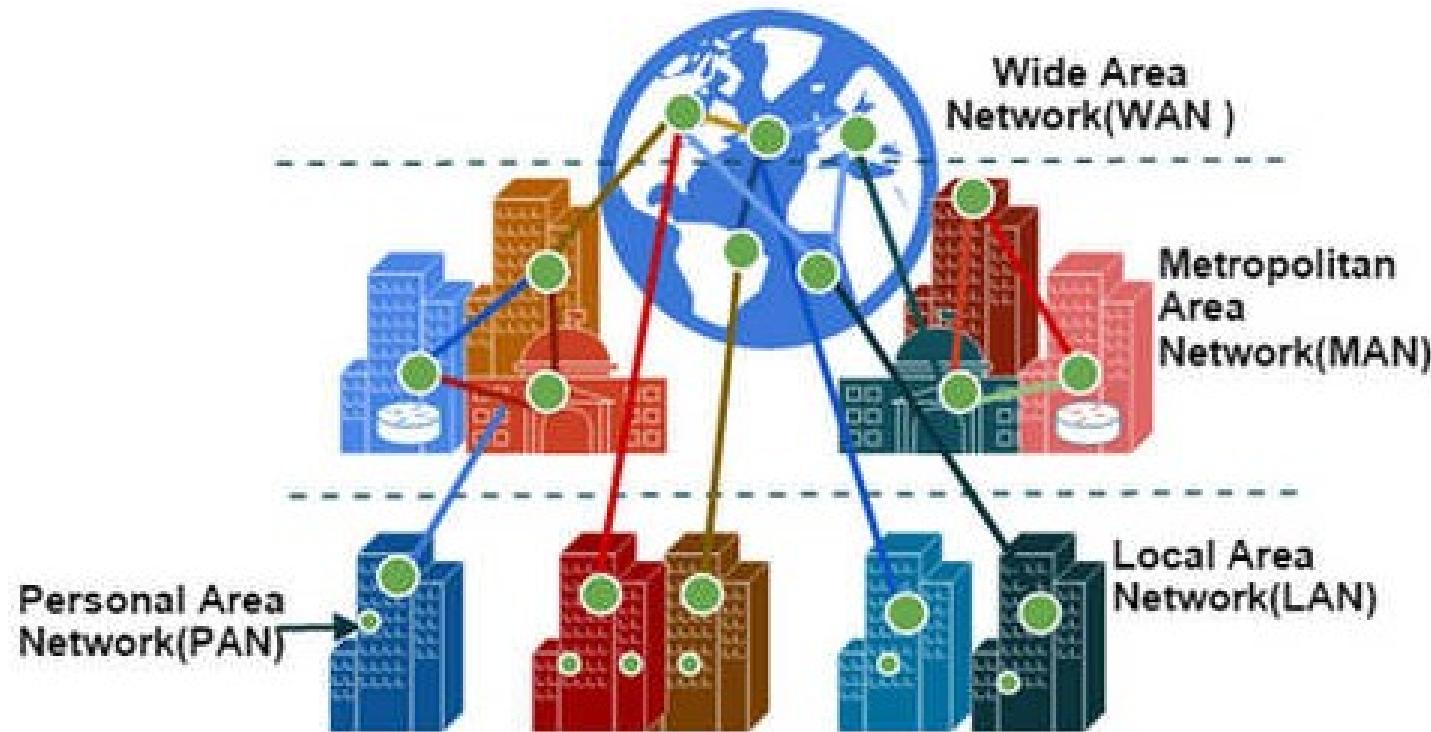
Personal Area Networks - A personal area network (PAN) is a wireless network that connects information technology devices close to one person.

Local Area Networks - A network that connects computer systems and devices within a small area, such as an office, home, or several floors in a building is a local area network (LAN).

Metropolitan Area Networks - A metropolitan area network (MAN) is a network that connects users and their computers in a geographical area that spans a campus or city.

Wide Area Networks - A wide area network (WAN) is a network that connects large geographic regions.

Network Types



Lecture 9 Post Lecture Activities

- What are the advantages and disadvantages of the Star, Bus, Mesh Network Topologies
- What are the differences between Network Types: PAN, LAN, MAN, WAN

Lecture 9 Next Week

- Internet & WWW
- Cloud Computing

Thank you