

CSE 100: Computer Skills

Lecture 8: Computer Networks

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NETWORK BASICS

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Network Definition

- Set of technologies that connects computers
- Allows communication and collaboration between users
- Benefits of network includes
 - Resource sharing
 - Communication
 - Remote Login

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The Uses of a Network

- Simultaneous access to data
 - Data files are shared
 - Access can be limited
 - Shared files stored on a server
 - Software can be shared
 - Site licenses
 - Network versions
 - Application servers

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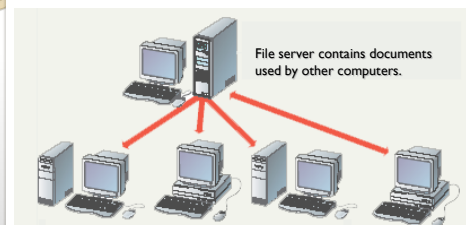
The Uses of a Network

- Shared peripheral device
 - Printers and faxes are common shares
 - Reduces the cost per user
 - Devices can be connected to the network
 - Print servers control network printing
 - Manage the print queue

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Sharing Data



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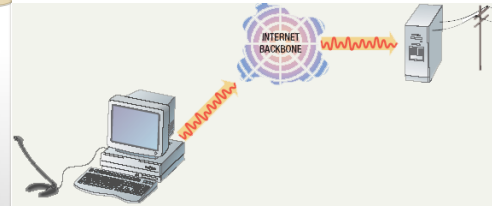
The Uses of a Network

- Personal communication
 - Email
 - Instantaneous communication
 - Conferencing
 - Tele conferencing
 - Videoconferencing
 - Audio-conferencing
 - Data-conferencing
 - Voice over IP
 - Phone communication over network wires

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Voice Over IP



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The Uses of a Network

- Easier data backup
 - Backup copies data to removable media
 - Server data backed up in one step

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An Example Network

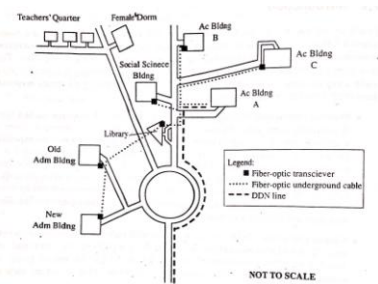


Figure 7.1: Layout of Shah Jalal University Network.

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Roles of Computer in a Network

- A computer when connected to a network has a role to play
- Possible roles of a computer are
 - Client
 - Server
 - Peer
- Roles of a computer depends on the software installed

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Types of Network

- Network can be of different Types. The common types include
 - Client-Server Network
 - Peer to Peer Network
 - Local Area Network
 - Wide Area Network
 - Hybrid Network
 - Campus Area Network
 - Metropolitan Area Network
 - Home Area Network
 - Personal Area Network

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How Networks Are Structured

- Server based network
 - Node is any network device
 - Servers control what the node accesses
 - Users gain access by logging in
 - Server is the most important computer

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Common Network Types

- Client-Server network
 - Nodes and servers share data roles
 - Nodes are called clients
 - Servers are used to control access
 - Database software
 - Access to data controlled by server
 - Server is the most important computer
 - Advantage of Client-Server network include
 - Strong Central Security
 - Central File Storage
 - Easy management of storage

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Common Network Types

- Peer to peer networks (P2PN)
 - All nodes are equal
 - Nodes access resources on other nodes
 - Each node controls its own resources
 - Most modern OS allow P2PN
 - Distributing computing is a form of P2PN
 - There is no central control
 - Ideal for small business
 - Setup is easy

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Common Network Types

- Local Area Network (LAN)
 - Contains printers, servers and computers
 - Systems are close to each other
 - Contained in one office or building
 - Organizations often have several LANS
 - Most commonly shared resources is disk storage
 - Twisted pairs or coaxial cable often used to connect computers

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Common Network Types

- Wide Area Networks (WAN)
 - Two or more LANs connected
 - Over a large geographic area
 - Typically use public or leased lines
 - Phone lines
 - Satellite
 - The Internet is a WAN
 - Less reliable and lower speed than LAN

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Hybrid Network Types

- Campus Area Networks (CAN)
 - A LAN in one large geographic area especially in a campus or spanning multiple buildings
 - Resources related to the same organization
 - Each department shares the LAN

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Hybrid Network Types

- Metropolitan Area Network (MAN)
 - Large network that connects different organizations
 - Shares regional resources
 - Typically spread over a city

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Hybrid Network Types

- Home Area Network (HAN)
 - Small scale network
 - Connects computers and entertainment appliances
 - Found mainly in the home

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Hybrid Network Types

- Personal Area Network (PAN)
 - Very small scale network
 - Range is less than 2 meters
 - Cell phones, PDAs, MP3 players
 - Bluetooth is an example of PAN

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NETWORK TOPOLOGIES

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Network Topologies

- Topology
 - Logical layout of wires and equipment
 - Choice affects
 - Network performance
 - Network size
 - Network collision detection
 - Several different types

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Network Topologies

- Packets
 - Pieces of data transmitted over a network
 - Packets are created by sending node
 - Data is reassembled by receiving node
 - Packet header
 - Sending and receiving address
 - Packet payload
 - Number and size of data
 - Actual data

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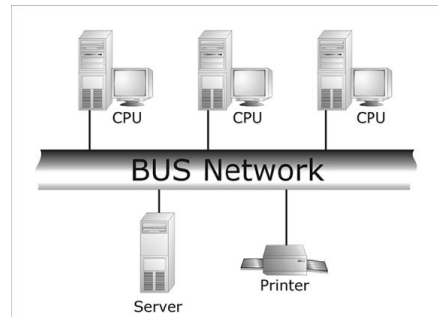
Network Topologies

- Linear Bus topology
 - One wire connects all nodes
 - Terminator ends the wires
- Advantages
 - Easy to setup
 - Small amount of wire
- Disadvantages
 - Slow
 - Easy to crash

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Bus Topology



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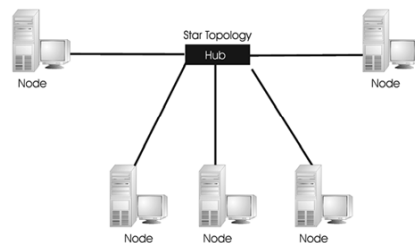
Network Topologies

- Star topology
 - All nodes connect to a hub
 - Packets sent to hub
 - Hub sends packet to destination
- Advantages
 - Easy to setup
 - One cable can not crash network
- Disadvantages
 - One hub crashing downs entire network
 - Uses lots of cable
- Most common topology

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Star Topology



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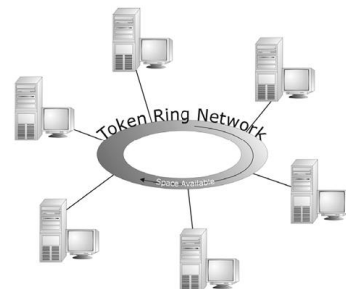
Network Topologies

- Ring topology
 - Nodes connected in a circle
 - Tokens used to transmit data
 - Nodes must wait for token to send
- Advantages
 - Time to send data is known
 - No data collisions
- Disadvantages
 - Slow
 - Lots of cable

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Ring Topology



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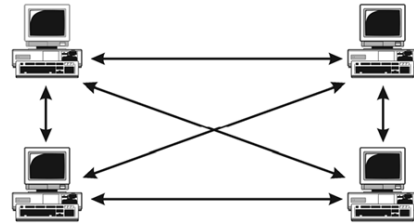
Network Topologies

- Mesh topology
 - All computers connected together
 - Internet is a mesh network
 - Advantage
 - Data will always be delivered
 - Disadvantages
 - Lots of cable
 - Hard to setup

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Mesh Topology



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◦ NETWORK MODEL

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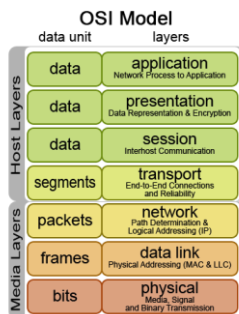
Network Model

- There are many models that model any network
- Most common is Open System Interconnect (OSI) model developed by International Standards Organization (ISO)
- OSI model defines
 - How devices communicate
 - How physical media is used
 - How bits are represented, etc

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OSI Model



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OSI Model

- **The physical layer (layer 1)** - Media, Signal and Binary Transmission. Examples include hubs, repeaters, and Ethernet cables. Data is transmitted by an electric voltage, radio frequencies, infrared or ordinary light.
- **Data Link layer (layer 2)** - This is the most complex layer in the OSI model, and it is sometimes divided into two parts: one for media access control (MAC) and one for logical link control.
- **Network layer (layer 3)** - Path Determination, IP, and Routing. Layer 3 formats data as packets. Directs the data to the correct physical path.

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OSI Model

- **Transport layer** (layer 4) - End-to-End Connections and Reliability. As the name implies, this layer moves data across network connections, usually using TCP. It also handles error recovery and re-transmissions.
- **Session layer** (layer 5) - Interhost Communication. This layer manages multiple types of communications and sends data to logical ports, including those using NFS and SQL.
- **The presentation layer** (layer 6) - Data Representation and Encryption, including format conversions. Think of this layer as the translator. Examples include ASCII, TIFF, JPEG, MIDI, and MPEG.

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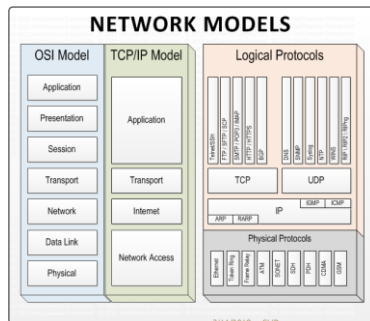
OSI Model

- **Application layer** (layer 7) - Network Process to Application. This end-user layer packages the data received from the Presentation Layer in the format needed by the application or end-user process that receives it. Examples include browsers, SMTP, HTTP, and FTP. This layer also creates what is to be sent back to the Presentation Layer.
- Having trouble remembering the layer order? Just keep the phrase "**All People Seem To Need Data Processing**" in mind.

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OSI Model and TCP/IP Model



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COMMUNICATION MEDIA AND NETWORK HARDWARE DEVICES

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Network Media

- Links that connect nodes
- Choice impacts
 - Speed
 - Security
 - Size

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Wire Based Media

- Twisted-pair cabling
 - Most common LAN cable
 - Called Cat5 or 100BaseT
 - Four pairs of copper cable twisted
 - May be shielded from interference
 - Speeds range from 1 Mbps to 1,000 Mbps
- Twisted-pair cables
 - Unshielded Twisted pair (UTP)
 - Shielded Twisted pair (STP)



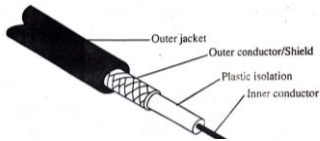
Figure 7.6: Unshielded (left) and shielded (right) twisted pair cable.

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Wire Based Media

- Coaxial cable
 - Similar to cable TV wire
 - One wire runs through cable
 - Shielded from interference
 - Speeds up to 10 Mbps
 - Nearly obsolete

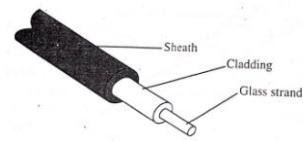


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Wire Based Media

- Fiber-optic cable
 - Data is transmitted with light pulses
 - Glass strand instead of cable
 - Immune to interference
 - Very secure
 - Hard to work with
 - Speeds up to 100 Gbps

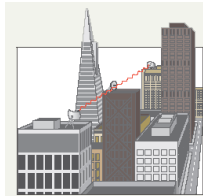


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Wireless Media

- Data transmitted through the air
- LANs use radio waves
- WANs use microwave signals
- Easy to setup
- Difficult to secure



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Comparisons of Media

Factor	UTP	Coax	Optical Fiber	Wireless
Cost	Cheap	Low	High	High
Installation	Easy	Easy	Hard	Hard
Capacity	Upto 100 Mbps	Upto 10 Mbps	Upto 100 Gbps	Upto 54 Mbps
Node	2	30 to 100	2	2
Distance	Upto 100m	Upto 2 Km	Upto 10 Km	Variable
Interference immunity	Low	High	Ideal	Low

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Network Hardware

- Network interface cards (NIC)
 - Network adapter
 - Connects node to the media
 - Unique Machine Access Code (MAC)



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Network Hardware

- Network linking devices
 - Connect nodes in the network
 - Cable runs from node to device
 - Crossover cable connects two computers
- Modem
 - Stands for Modulator-Demodulator
 - Connects computer via traditional telephone lines

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Network Hardware

- Hubs
 - Center of a star network
 - All nodes receive transmitted packets
 - Slow and insecure
 - Can be active or passive
 - Passive hubs mainly contains wiring
 - Active hubs amplifies the signal inside
 - Intelligent or smart hub can detect line faults, segment the network to smaller network to avoid collision

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Network Hardware

- Switches
 - Replacement for hubs
 - Intelligent Hub
 - Only intended node receives transmission
 - Fast and secure
 - A switch usually isolates the LANs it is connected to

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Network Hardware

- Bridge
 - Connects two or more LANs together
 - Packets sent to remote LAN cross
 - Other packets do not cross
 - Segments the network on MAC addresses

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Network Hardware

- Router
 - Connects two or more dissimilar networks together
 - Packets sent to remote LAN cross
 - Network is segmented by IP address
 - Connect internal networks to the Internet
 - Need configured before installation



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Network Cabling

- Cabling specifications
 - Bandwidth measures cable speed
 - Typically measured in Mbps
 - Maximum cable length
 - Connector describes the type of plug

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Network Cabling

- Ethernet
 - Very popular cabling technology
 - 10 Base T, 10Base2, 10Base5
 - Maximum bandwidth 10 Mbps
 - Maximum distances 100 to 500 meters



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Network Cabling

- Fast Ethernet
 - Newer version of Ethernet
 - Bandwidth is 100 Mbps
 - Uses Cat5 or greater cable
 - Sometimes called 100Base T
 - Requires a switch
- Gigabit Ethernet
 - High bandwidth version of Ethernet
 - 1 to 10 Gbps
 - Cat 5 or fiber optic cable
 - Video applications

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PRACTICAL NETWORKS

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Practical networks

- Practical networks not made on OSI model
- Ethernet
 - Ethernet is a way of making LANs in bus and star configuration
 - There are 5 versions known
 - 10Base5 Bus network, Use coaxial cables
 - 10Base2 Bus network, Use coaxial cables
 - 2BaseT
 - 10BaseT Star network, Use twisted pair cables
 - 100BaseT Star network, Use twisted pair cables

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Practical networks

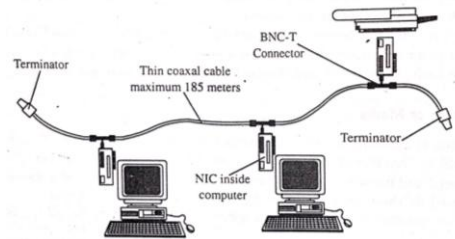


Figure 7.9: Ethernet 10Base2 network

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Practical networks

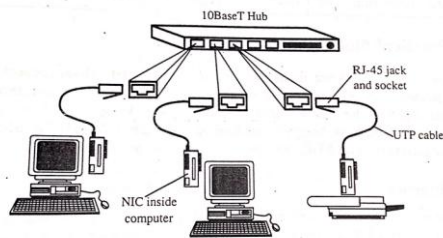


Figure 7.10: Ethernet 10BaseT network.

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NETWORK PROTOCOLS

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Network Protocols

- Language of the network
 - Rules of communication
 - Error resolution
 - Defines collision and collision recovery
 - Size of packet
 - Naming rules for computers

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Network Protocols

- TCP/IP
 - Transmission Control Protocol/Internet Protocol
 - Most popular protocol
 - Machines assigned a name of 4 numbers
 - IP address
 - 209.8.166.179 is the White House's web site
 - Dynamic Host Configuration Protocol
 - Simplifies assignment of IP addresses
 - Required for Internet access

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Network Protocols

- IPX/SPX
 - Internet Packet Exchange/Sequenced Packet Exchange
 - Older protocol
 - Associated with Novell Netware
 - Easy to install and suitable for internetworking
 - Lacks central control
 - Replaced by TCP/IP

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Network Protocols

- NetBEUI
 - Network BIOS Extended User Interface
 - Used by Windows to name computers
 - Transmission details handled by TCP/IP
 - Not suitable for internet
- AppleTalk
 - Apple computers talk in AppleTalk protocol suite
 - Restricted to apple computers
 - Not used now

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Homework Based on Lecture 8

- Questions from Chapter 7, Introduction to computers by Mohammed Alamgir
- Exercise 1, 2, 3, 5, 7, 8, 15, 17, 18, 19, 20, 21, 24, 27, 28, 29, 33, 34

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END

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