TOPIC 10: DATA COMMUNICATION& NETWORKING

INTRODUCTION TO COMPUTER NETWORKS

Definition of a computer Network

A computer network is defined as a collection of computers linked together using transmission media for the purpose of communication and resource sharing.
Some of the shared resources include internet connectivity, printers, fax machines, modems, storage devices, networked software programs etc.

Basic requirements for setting up a computer network

NETWORKING HARDWARE includes all computers, peripherals and Communications devices that enable two or more computers to exchange items such as data, instructions, and information with each other.
Examples include: a network interface card, modem, Hub/Switch, Router, repeater, network Bridge, Firewall etc.

A network interface card (NIC), is a device that enables the computer or device that does not have built-in networking capability to access a network. Examples include adapter card, PC Card, USB network adapter, flash card e.t.c

A modem is a device which Modulates a digital signal from computers into an analog one to send data out over the phone line. Then for an incoming signal it Demodulates, the analog signal into a digital one.

A **hub**, (also called a multi-station access unit (MAU)) is a device that provides a central point for cables in a network. Unlike the hubs, a **switch** does not broadcast the data to all the computers, it sends the data packets only to the destined computer.

A **Router** connects multiple networks and routs communications traffic to the appropriate network using the fastest available path. A router allows multiple computers to share a single high-speed Internet connection such as through a cable modem
A **repeater** is a device that accepts a signal from a transmission medium, amplifies it, and retransmits it over the medium. As a signal travels over a long distance, it undergoes a reduction in strength, an occurrence called **attenuation**.
A **network bridge** is device that connects two networks making each accessible to the

other. A bridge knows all of the addresses on each side of the bridge and sends information accordingly

A **firewall** is a networking device that is installed at the entrance to a LAN, particularly when connecting a private network to a public network, such as the internet. The firewall uses rules to filter inbound traffic into the private network, to protect the private network users and data from malevolent hackers. Unauthorized traffic is rejected, and authorized traffic passes as illustrated below.

A multiplexer is a device that combines two or more input signals from various devices into a single stream of data and then transmits it over a single transmission medium. By combining the separate data streams into one, a multiplexer increases the efficiency of communications and reduces the need for using multiple separate transmission media.

Networking / communications software

This consists of programs and applications that aid the setup and use of a network. It includes network operating.

A network operating system (NOS) is the system software that organizes and coordinates the activities on a network.

NOS software consists of programs that help users establish a connection to another computer or network, such as network drivers, and manage the transmission of data, instructions, and information.

Examples of NOSs include: Novell NetWare, Microsoft Windows server 2008, 2012, 2016, Sun Solaris, etc.

Network application software: These are programs that provide an interface for users to communicate over computer networks. A variety of examples of application software for communications include:

- E-mail client applications,
- FTP programs,
- Web browsers like Internet Explorer,
- Newsgroup/ message boards
- Chat apps,
- Instant messaging,
- Video conferencing applications e.g. Skype, and VoIP.

TYPES OF NETWORKS

Personal Area Network

A personal area network (PAN) is the interconnection of computer devices within the range of an individual person, typically within a range of 10 meters.

Local Area Network

A local area network (LAN) is a network that connects computers in a small geographic area such as a building like a computer laboratory, or an office. The nodes are connected to the LAN via cables. A wireless LAN (WLAN) is a LAN that does not use physical wires, but uses wireless media such as radio waves

Types of Local Area Networks

- Peer-to-peer Network.
- Client-Server Network

1. Peer-to Peer Network

This is a type of network where each computer can share the hardware, data, or information located on any other computer on the network. Each computer stores files on its own storage devices. Each computer on the network contains both the network operating system and application software.

Advantages of Peer-to Peer Network

- A peer-to-peer network is simple to setup i.e. does not require too much configuring
- It is not expensive to set up
- It does not require a dedicated server to control the network
- It is perfect for home and small business users.

Disadvantages of a Peer to Peer Network

- The system is not centralized, making administration difficult .
- Lack of security i.e. files can be accessed by any one on the network.

2. Client-Server Network

A client/server network has one or more computers acting as a server while the other computers (i.e., clients) on the network can request services from the server.

A client computer is a computer that can access the resources on a network. While **A server** is a computer that provides a centralized storage area for programs, data, and information.
A dedicated server is a server that performs a specific task. Examples of dedicated Servers include: file server, print server, database server, and a network server

Roles of Dedicated Servers

- A file server stores and manages files on a network
- A print server manages printers and print jobs.
- A database server stores and provides access to a database
- A network server (e.g., a DNS) manages network traffic.

Requirements of a server computer

- It needs a computer with very high processing speed
- It needs large amounts of RAM
- It needs a very big storage capacity
- It needs a very fast Network interface card
- It needs network operating system such as Novell Netware, Windows NT Server or Apple Share

Advantages of Client-Server Network

- All Resources are centralized and easier to access.
- Easy management and administration of the network.
- More data security since all network access is controlled through the server.
- The network is flexible, because changes and new technology can be easily included into system.
- Client /Server network is faster than P2P since data and resources are handled by a dedicated machine
- It is to Backup all data stored centrally on the server.
- Client Server network can support many computers as compared to a P2P network

Disadvantages of a Client /Server Network

- It is expensive to set up as compared to a P2P network.
- It requires an extra computer to serve as a dedicated server.
- Maintenance – large networks will require an administrator staff to ensure efficient operation
- Dependence – When the server goes down, operations will cease across the network
- Server can get overloaded since all the processing is controlled at one point.

A Campus Area Network (CAN) is a network that connects two or more LANs but is limited to a specific and contiguous geographical area such as a college campus, industrial complex, or a military base. It spans multiple LANs but smaller than a MAN

A metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus. A MAN usually interconnects two or more LANs using a high-capacity backbone technology, such as fiber-optical links or other digital media. A MAN covers a smaller geographic area than a WAN.

A wide Area Network (WAN) is a network that covers a large geographic area. An example of a WAN is a network that connects the district office computers of a company across the country or across several counties in the world. Computers are often connected to a WAN via public networks such as the telephone system or by dedicated lines or satellites.

A virtual private network (VPN) extends a private network across a public network, and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network. Applications running across the VPN may therefore benefit from the functionality, security, and management of the private network.

VPNs may allow employees to securely access a corporate intranet while located outside the office. They are used to securely connect geographically separated offices of an organization, creating one cohesive network.

Advantages of wireless networks:

Mobility - With a laptop computer or mobile device, access can be available throughout a school, at the mall, on an airplane, etc.

Fast setup - If your computer has a wireless adapter, locating a wireless network can be as simple as clicking "Connect to a Network" -in some cases, you will connect automatically to networks within range.

Cost - Setting up a wireless network can be much more cost effective than buying and installing cables.

Expandability - Adding new computers to a wireless network is as easy as turning the computer on (as long as you do not exceed the maximum number of devices).

Speed - The transmission speed of wireless networks is improving; however, faster options (such as gigabit Ethernet) are available via cables. If you are also moving large amounts of data around a private network, a cabled connection will enable that work to proceed much faster.

Disadvantages of wireless networks:

Security - Be careful. Be vigilant. Protect your sensitive data with backups, isolate private networks, provide strong encryption and passwords, and monitor network access traffic to and from your wireless network.

Interference - Because wireless networks use radio signals and similar techniques for transmission, they are susceptible to interference from lights and electronic devices.

Inconsistent connections - Wireless connections are not nearly as stable as those through a dedicated cable.

Network Protocol

This refers to a set of rules and procedures governing transmission between components in a computer network.

The role played by networking protocols as used in Networking

- Identifying each device in the communication path;
- Securing the attention of the other device;
- Verifying correct receipt of the transmitted message;
- Determining that a message requires retransmission if it is incomplete or has errors;
- Performing recovery when errors occur.

Common protocols as used as in networking

Simple Mail Transfer Protocol (SMTP) - an internet protocol for transferring of e-mails.
File Transfer Protocol (FTP): It allows files containing text, programs, graphics, numerical data, and so on to be downloaded off or uploaded onto a network.
Internet Protocol (IP) - does the packet forwarding and routing.
Transmission Control Protocol/Internet Protocol (TCP/IP) is a network standard that defines how messages (data) are routed from one end of a network to the other, ensuring the data arrives correctly.
Transmission Control Protocol (TCP) :responsible for delivery of data over the network.
Hypertext Transfer Protocol (HTTP): It allows Web browsers and servers to send and receive Web pages.
Simple Network Management Protocol (SNMP): It allows the management of networked nodes to be managed from a single point.

Telnet Protocol: It provides terminal emulation that allows a personal computer or workstation to act as a terminal, or access device, for a server.
Sequential Packet Exchange (IPX/SPX):works with the Novell's internet work' packet / sequential exchange; responsible for delivery of sequential data over the network

INTRANET, EXTRANET & INTERNET

Intranet refers to a connection of private computer networks within an organization**.**
Intranet refers to a connection of private computer networks within an organization.
An intranet has tools to facilitate communication between organization's employees or workgroups to improve the knowledge and data sharing capability.
Many schools and non-profit groups have deployed intranets. A simple intranet consists of an internal email system.
More complicated intranets include Web sites and databases containing company news, forms, and personnel information.

Advantages of Installing an Intranet

Sharing resources such as laser printers, fax machines, modems, scanners, etc. is simplified
Electronic Mail: Electronic mail on a LAN can enable students to communicate with teachers and peers at their own school.
Flexible Access: School networks allow students to access their files from computers throughout the school. Students can also work cooperatively through the network.

Disadvantages of Installing a School Network

- Expensive to Install. Although a network will generally save money over time, the initial costs of installation can be prohibitive.
- Requires Administrative Time. Proper maintenance of a network requires considerable time and expertise.
- Must Monitor Security Issues. Wireless networks are becoming increasingly common; however, security can be an issue with wireless networks

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Most extranets use the internet as the entry point for outsiders, a firewall configuration to limit access and a secure protocol for authenticating users

Advantages of extranet

- Exchange large volumes of data using Electronic Data Interchange (EDI)
- Share product catalogs exclusively with trade partners

- Collaborate with other companies on joint development efforts
- Jointly develop and use training programs with other companies
- Provide or access services provided by one company to a group of other companies, such as an online banking application managed by one company on behalf of affiliated banks.
- Share news of common interest exclusively

Disadvantages of extranet

- Extranets can be expensive to implement and maintain within an organization (e.g., hardware, software, employee training costs)
- Security of extranets can be a concern when hosting valuable or proprietary information.

The internet is a global connection of computer networks. The internet links together millions of computers, to exchange and share information all over the world.

Benefits of installing an intranet in a school

- Facilitates internal emails
- Provides access to company contacts information, procedure manual and other frequently updated documents
- Used for posting and updating employee forms
- Posting internal job listings
- Provides electronic catalogs for ordering supplies
- Facilitates collaborative computing
- Scheduling meeting and appointments.
- Posting financial statements and other types of corporate information
- Maintains shared calendars, projects timelines and other project documents
- Provides access to company databases and other systems
- For monitoring internal security.

TASK: COPY THE NOTES IN YOUR NOTES BOOK AND MAKE A SUMMARY.