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Certified Basic Network Support Professional Sample Material

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V-Skills

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1. INTRODUCTION TO NETWORKING CONCEPTS

A network is a collection of computers and other hardware components interconnected by communication channels that allow sharing of resources and information.

1.1 What is Networking

Networking is the practice of linking two or more computing devices together for the purpose of sharing data. Networks are built with a mix of computer hardware and computer software. A host device on a network can be computers, servers, laptops, Personal Digital Assistants (PDAs), or anything a person uses to access the network. Network devices are hubs, repeaters, bridges, switches, router and firewall.

1.2 Advantages & Disadvantages

Advantages of Networking

- ✓ Peripherals such as printers can be shared amongst many different users.
- ✓ Software can be shared amongst different users.
- ✓ Communication across the network is cheap and fast.

Disadvantages of Networking

- ✓ Cabling can be expensive to install and replace.
- ✓ A fault with the server may prevent the whole network from working.
- ✓ Security measures are needed to restrict access to the network.
- ✓ WANs are vulnerable to hackers and viruses.

1.3 Network Characteristics

The key characteristics often used to differentiate between types of networks are as follows

- ✓ **Geographic Distribution -** The main difference between the types of networks is the way in which they are geographically distributed. A LAN is restricted to a limited geographic coverage of a few kilometers, but WAN spans greater distances and may extend over several thousand kilometers. Therefore LANs typically provide communication facilities within a building or a campus, whereas WANs may nationwide or even worldwide.
- ✓ **Data rate -** Data transmission rates are much higher in LANs than in WAN. Transmission rates in LANs range from 0.2 megabit per second to 1 gigabit per second and for WANs ranges from 1200 bits per second to slightly over 1 Mbps.
- ✓ **Ownership -** A LAN is owned by a single organization because of its limited geographic coverage. A WAN is usually formed by interconnecting multiple LANs each of which may belong to a different organization. Therefore administrative and maintenance complexities and costs of LANs are usually much lower than for WANs.
- ✓ **Communication cost -** The overall communication cost of a LAN is much lower than that of a WAN due to lower error rates, simple routing algorithms and lower administrative and maintenance costs. Higher cost of WAN are due to leased lines or public communication systems, such as telephone lines, microwave links and satellite channels.

1.4 Network Models (Peer-to-Peer and Client-and-Server)

The term computer network model defines the category in which a computer network can be grouped into. Networks are divided into peer to peer and client-server.

Peer To Peer Networks

When nodes or workstations perform the same communication functions, they are referred to as peers, in this network model, both server and client operations are performed by the same computer. Each user administers his/her workstation and the resources in it. There are no dedicated servers and no hierarchy among the computers. All the computers are equal and therefore are known as peers. Each computer functions as both a client and a server, and there is no administrator responsible for the entire network. The user on each computer determines which data on that computer is shared on the network.

Security is also managed by the user of the devices. This model is not quite secure and is suited for a small computer networks (with 10 computers or less) where users do not want to share files. User's files are decentralized – they are not stored in a single location.

Client Server Networks

This network model offers centralized access to services and devices. One computer plays the role of a server. It is the most common type of network architecture today that provides centralized data storage, security, manning of applications and network administration. Most servers have operating system like Windows NT/2003 or later, Linux, Novel Netware etc.

1.5 Network Types (LAN,WAN,MAN,PAN)

Different types of networks are distinguished based on their size (the number of nodes), their data transfer speed, and their reach. Private networks are networks that belong to a single organization. There are usually of three categories

- ✓ LAN (local area network)
- ✓ MAN (metropolitan area network)
- ✓ WAN (wide area network)

There are two other types of networks as PANs (Personal Area Network), which are limited few feets, and CANs (Campus Area Networks), which are the same as MANs (with bandwidth limited between each of the network's LANs).

LAN

It's a group of computers which all belong to the same organization, and which are linked within a small geographic area using a network, and often the same technology (usually Ethernet). Data transfer speeds over a local area network can be up to 10 Mbps, 1 Gbps and 10 Gbps. LAN can reach to 100 or even 1000 users. LAN can be sub-divided as per the services that it provides and operating modes into, a "peer-to-peer" network (having no central computer and each computer has the same role) and a "client/server" network (with a central computer for services to users).

MAN

MANs (Metropolitan Area Networks) connect multiple geographically nearby LANs to one another (over an area of few kilometres) at high speeds. Thus, a MAN lets two remote nodes

communicate as if they were part of the same local area network. A MAN is made from switches or routers connected to one another with high-speed links (usually fiber optic cables or microwave).

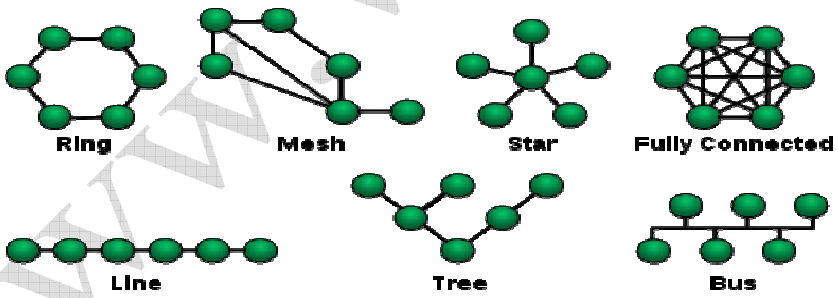
WAN

A WAN (Wide Area Network or extended network) connects multiple LANs to one another over vast geographic distances. The speed available on a WAN varies depending on the cost of the connections (which increases with distance) and may be low. WANs operate using routers, which can "choose" the most appropriate path for data to take to reach a network node. The most well-known WAN is the Internet.

1.6 Network Topologies (Bus, Star, Ring)

Network topology is the arrangement of the various elements (links, nodes, etc.) of a network. Essentially, it is the topological structure of a network, and may be depicted physically or logically. Physical topology refers to the placement of the network's various components, including device location and cable installation, while logical topology shows how data flows within a network, regardless of its physical design. Distances between nodes, physical interconnections, transmission rates, and/or signal types may differ between two networks, yet their topologies may be identical.

The shape of the cabling layout used to link devices is called the physical topology of the network. This refers to the layout of cabling, the locations of nodes, and the interconnections between the nodes and the cabling. The logical topology, in contrast, is the way that the signals act on the network media, or the way that the data passes through the network from one device to the next without regard to the physical interconnection of the devices. A network's logical topology is not necessarily the same as its physical topology. The classification of network topology can also be divided amongst various topologies like bus, star, ring or circular, mesh and tree



Ring

A network topology that is set up in a circular fashion in which data travels around the ring in one direction and each device on the right acts as a repeater to keep the signal strong as it travels. Each device incorporates a receiver for incoming signal and a transmitter to send the data on to the next device in the ring. The network is dependent on the ability of the signal to travel around the ring.

Mesh

The value of fully meshed networks is proportional to the exponent of the number of subscribers, assuming that communicating groups of any two endpoints, up to and including all the endpoints, is approximated by Reed's Law.

Fully connected - The number of connections in a full mesh = n(n - 1) / 2. The physical fully connected mesh topology is generally too costly and complex for practical networks, although the topology is used when there are only a small number of nodes to be interconnected.

Partially connected - The type of network topology in which some of the nodes of the network are connected to more than one other node in the network with a point-to-point link – this makes it possible to take advantage of some of the redundancy that is provided by a physical fully connected mesh topology without the expense and complexity required for a connection between every node in the network.

Star

Each network node is connected to a central hub or switch with a point-to-point connection. The switch is the server and the peripherals are the clients. All network traffic travels the network through the central node which acts as a signal repeater. This topology is the easiest topology to design and implement. It has simplicity of adding additional nodes. The disadvantage of the star topology is that the central node represents a single point of failure.

Line

Line topography is the connection of multiple devices in succession to each other. In this setup the end device terminates the line, and when a break occurs the devices past the break are cut out of the line. This form of topography allows for longer runs than it's loop equivalent.

Tree

The type of network topology in which a central 'root' node (the top level of the hierarchy) is connected to one or more other nodes that are one level lower in the hierarchy (i.e., the second level) with a point-to-point link between each of the second level nodes and similarly the second level nodes are connected next below third level but, the top level central 'root' node being the only node that has no other node above it in the hierarchy. The 'branching factor' or the number of nodes below a node is fixed. An example of this network is cable TV technology.

Bus

In local area networks where bus topology is used, each node is connected to a single cable. Each computer or server is connected to the single bus cable. A signal from the source travels in both directions to all machines connected on the bus cable until it finds the intended recipient. If the machine address does not match the intended address for the data, the machine ignores the data. Alternatively, if the data matches the machine address, the data is accepted. Since the bus topology consists of only one wire, it is rather inexpensive to implement when compared to other topologies. However, the low cost of implementing the technology is offset by the high cost of managing the network. Additionally, since only one cable is utilized, it can be the single point of failure. If the network cable is terminated on both ends and when without termination data transfer stop and when cable breaks, the entire network will be down.

1.7 Internet connection (DSL, Cable, Serial Link)

The need for speed has changed the options available to consumers and businesses. The connection speeds will change over time and also between Internet Service Providers (ISP). Various internet connection technologies have different characteristics and are discussed.

Dial-up Internet Access

It is called as dial-up access and is economical but slow. Users connect by a modem linked to PC by dialing a phone number (from ISP) but tying up phone line. It is an analog connection as data is sent over an analog, public-switched telephone network. The modem converts received analog data to digital and vice versa. Due to telephone lines usage, the quality of the connection is not always good and data rates are limited. The connection speeds range from 2400 bps to 56 Kbps.

ISDN - Integrated Services Digital Network

It is an international communications standard for sending voice, video, and data over digital telephone lines or normal telephone wires and speeds are from 64 Kbps to 128 Kbps.

B-ISDN - Broadband ISDN - Broadband ISDN is similar in function to ISDN but it transfers data over fiber optic telephone lines, not normal telephone wires. SONET is the physical transport backbone of B-ISDN. Broadband ISDN has not been widely implemented.

DSL – Digital Subscriber Line

DSL uses existing telephone line and gives internet simultaneously with telephone service without tying up phone line. Two main categories of DSL for home are called ADSL and SDSL. All types of DSL technologies are collectively called xDSL with speeds from 128 Kbps to 9 Mbps.

ADSL - Asymmetric Digital Subscriber Line - ADSL is the most commonly deployed types of DSL in North America. It supports data rates of from 1.5 to 9 Mbps when receiving data or downstream rate and from 16 to 640 Kbps when sending data or the upstream rate.

ADSL+2 - ADSL Extension - An extension to ADSL broadband technology with faster download speeds though similar as ADSL. Both use a special filter on a telephone line to split existing telephone lines (POTS) between regular telephone (voice) and ADSL+2.

Cable - Broadband Internet Connection

It uses a cable modem for Internet connection over cable TV lines. It works by using TV channel space for data transmission, with certain channels used for downstream transmission, and other channels for upstream transmission. As, the coaxial cable is used so, greater bandwidth is present. Cable speeds range from 512 Kbps to 20 Mbps.

Wireless Internet Connections

Wireless Internet, or wireless broadband is the newest Internet connection types. It uses radio frequency bands for transmission. It provides an always-on connection which can be accessed from anywhere but within a network coverage area hence, it is not present in some areas. It is usually more expensive and mainly available in metropolitan areas by cellular operators using 2Gor 3G.

T-1 Lines – Leased Line

T-1 lines are a leased line option connecting to the Internet backbone with a dedicated phone connection supporting data rates of 1.544Mbps. A T-1 line consists of 24 individual channels, each supporting 64Kbits per second and can be configured to carry voice or data traffic. One or some of individual channels can be taken, and called as fractional T-1access.

T-3 Lines – Dedicated Leased Line - T-3 lines are similar to T-1 with data rates of about 43 to 45 Mbps. It consists of 672 individual channels, each of which supports 64 Kbps.

OC3 - Optical Carrier

It is used to specify the speed of fiber optic networks as per the SONET standard. It is used as a fiber optic backbone for large networks with large voice, data, video, and traffic needs. Speeds are 155.52 Mbps, or roughly the speed of 100 T1 lines.

Internet over Satellite (IoS)

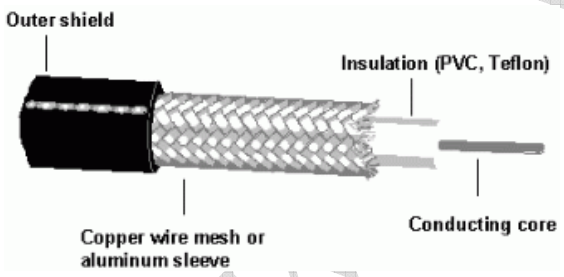
It provides access to Internet via a satellite that orbits the earth. A satellite is placed at a static point above the earth's surface, in a fixed position. IoS is slower due to distances between the earth and the satellite. Average connection speeds are between 492 up to 512 Kbps.

1.8 Network Media

Network media is the actual path over which data travels as it moves from one component to another. The network transmission medium carry signals between computers. There is a variety of media that meet the varying needs and sizes of networks and the common types are coaxial, twisted-pair, unshielded twisted-pair, shielded twisted-pair, fiber-optic and wireless

Coaxial Cable

It has a hollow outer cylindrical conductor that surrounds a single inner wire made of two conducting elements usually copper and surrounding it, is a layer of flexible insulation. Over this insulating material is a woven copper braid or metallic foil that acts both as the second wire in the circuit and as a shield for the inner conductor. This second layer, or shield, can help reduce the amount of outside interference. Covering this shield is the cable jacket.



Coaxial Cable

Thicknet and Thinnet

It supports 10 to 100 Mbps and is more costly than UTP but, can be cheaper for a physical bus topology as less cable will be needed. Coaxial cable can be cabled over longer distances than twisted-pair cable usually 500m compared to 100m for UTP. The largest diameter (1 cm) coaxial cable is referred as Thicknet but, it is too rigid to install easily due to its thickness. A connection device called vampire tap connect network devices to Thicknet by attachment unit interface (AUI). Similarly, coaxial cable with an outside diameter of only 0.35 cm is referred as Thinnet and used with networks with many twists and turns. Thinnet uses BNC (British Naval Connector or Bayonet Neill Concelman) connectors which are a male type mounted at each end of a cable.

Twisted-Pair Cable

Twisted-pair cable is a type of cabling that is used for telephone communications and Ethernet networks. A pair of wires forms a circuit that can transmit data. The pairs are twisted to provide

protection against crosstalk, the noise generated by adjacent pairs. Using cancellation with twisting the wires, self-shielding for wire pairs within the network media is provided. Two basic types of twisted-pair cable exist of unshielded twisted pair (UTP) and shielded twisted pair (STP).

Unshielded Twisted-Pair (UTP) Cable

It relies on cancellation effect by the twisted wire pairs to limit signal degradation due to electromagnetic interference (EMI) and radio frequency interference (RFI). The number of twists in the wire pairs varies to reduce crosstalk between the pairs. UTP cable has four pairs of either 22- or 24-gauge copper wire. UTP external diameter is 0.43 cm and is easy to install and less expensive than other types of media. It is installed by a Registered Jack 45 (RJ-45) connector. UTP cable is more prone to electrical noise and interference also, the distance between signal boosts is shorter for UTP than others. Commonly used types of UTP cabling are as follows

- ✓ Category 1—Used for telephone communications. Not suitable for transmitting data.
- ✓ Category 2—Capable of transmitting data at speeds up to 4 megabits per second (Mbps).
- ✓ Category 3—Used in 10BASE-T networks. Can transmit data at speeds up to 10 Mbps.
- ✓ Category 4—Used in Token Ring networks. Can transmit data at speeds up to 16 Mbps.
- ✓ Category 5—Can transmit data at speeds up to 100 Mbps.
- ✓ Category 5e —Used in networks running at speeds up to 1000 Mbps.
- ✓ Category 6—It has four pairs of copper wires and is the fastest standard for UTP.

Shielded Twisted-Pair (STP) Cable

Each of four pair of STP wires is wrapped in a metallic foil and then are wrapped in an overall metallic foil thus, reducing electrical noise within the cable (pair-to-pair coupling, or crosstalk) and from outside the cable (EMI and RFI). It is installed with STP data connector but, is more expensive and difficult to install. It's speed and throughput are from 10 to 100 Mbps with maximum cable length to 100 m.

Fiber Optic Cable

It is a flexible, transparent fiber made of glass (silica) or plastic, thicker than a human hair. It functions as a waveguide to transmit light between the two ends of the fiber. It enables transmission over longer distances and at higher data rates. Optical fibers have a transparent core surrounded by a transparent cladding material with a lower index of refraction. Light is kept in the core by total internal reflection. This causes the fiber to act as a waveguide. Fibers supporting many propagation paths are multi-mode fibers (MMF) and a single mode are called single-mode fibers (SMF). MMF has a wider core diameter, and is used for short-distance but SMF are used for links longer than 1 km. Each fiber can carry many independent channels, each using a different wavelength of light. Speed varies from 5Mbps to 50Gbps and newer are in Tbs.

Wireless

It avoids using cables by using radio communication. It is used by two-way radios, GPS units, cellular telephones, personal digital assistants (PDAs), wireless networking, wireless computer mice or keyboards or headsets, satellite television and cordless telephones. IEEE 802.x (Wi-fi) standards are used for wireless computer network and are of different speeds and coverage area as 802.11 a/b/g/n.

Self Assessment Questions

Q.1 What does STP refer to ?
A. Single Twisted-Pair
B. Shielded Twisted-Pair
C. Simple Twisted-Pair
D. None

Q.2 What does UTP refer to ?
A. Unshielded Twisted-Pair
B. Untwisted Twisted-Pair
C. Unique Twisted-Pair
D. None

Q.3 What is the highest category of UTP cables ?
A. 7
B. 6
C. 5
D. 4

Q.4 Does EMI hamper data transmission ?
A. True
B. False
C. Depends on environment
D. None

Q.5 Does ring topology refer to layout of physical devices in a circular manner ?
A. True
B. False
C. Can not say
D. None

Answers : 1-B, 2-A,3-B,4-A,5-B