

COMPUTER NETWORKS AND NETWORKS SECURITY

Question 1

- (a) Describe briefly, the following terms: (1Mark Each)
- (i) Switch (PCC-May 2007)
 - (ii) Data Centre (PCC-May 2007)
 - (iii) Repeaters (PCC-Nov 2007)
 - (iv) DNS Server (PCC-May 2008)
 - (v) MODEM (PCC-Nov 2008)
 - (vi) VPDN (PCC-June 2009)
 - (vii) Layer 3 or Network Layer (PCC-Nov 2009)
- (b) Explain each of the following: (1 Mark Each)
- (i) Multiplexer (PCC-May 2008)
 - (ii) E-mail (PCC-Nov 2009)

Answer

- (a) (i) Switch: It is hardware device used to direct messages across a network. Switches create temporary point to point links between two nodes on a network and send all data along that link.
- (ii) Data Centre: It is a centralized depository for the storage, management and discrimination of data and information. It can be defined as highly secure, fault-resistant facilities, hosting customer equipment that connects to telecommunications networks.
- (iii) Repeaters: Repeaters are devices that solve the snag of signal degradation which results as data is transmitted along the cables. It boosts or amplifies the signals before passing it through to the next section of cable.
- (iv) DNS Server: Domain Name Server is an Internet-wide distributed database system that documents and distributes network specific information such as the associated IP address for a host name, and vice-versa. The host storing this database is a domain name server.

Information Technology

- (v) MODEM: It stands for Modulator/Demodulator and is an encoding as well as decoding device used in data transmission that converts a digital computer signal into an analog telephone signal (i.e. it modulates the signal) and converts an analog telephone signal into a digital computer signal (i.e. it demodulates the signal) in a data communication system.
- (vi) VPDN: VPDN (Virtual Private Dial-Up Network) is a user to LAN connection used by a company that has employees who need to connect to the private network from various remote locations.
- (vii) Layer 3 or Network Layer: Network Layer corresponds to the layer 3 of the OSI model and enables a choice of the physical route of transmission of a message packet by
 - ◆ creating a virtual circuit for upper layers to make them independent of data transmission and switching.
 - ◆ establishing, maintaining, and terminating connections between the nodes.
 - ◆ ensuring proper routing of data.
- (b) (i) Multiplexer: It is a device that enables several devices to share one communication line. The Multiplexer scans each device to collect and transmit data on a single line to the CPU, and also communicates transmission from the CPU to the appropriate terminal linked to the multiplexer. The devices are polled and periodically asked whether there is any data to transmit.
- (ii) E-mail: E-mail is a method of composing, sending, storing and receiving messages over electronic communication systems. The term e-mail applies both to the Internet e-mail system based on the Simple Mail Transfer Protocol (SMTP) and to intranet systems allowing users within one company to e-mail each other.

Question 2

Describe the ways a computer network can help business. (7 Marks)(PCC-June 2009)

Answer

A computer network can help the business in following ways:

- (i) File Sharing: File sharing is the most common function provided by networks and consists of grouping all data files together on a server or servers. When all data files in an organization are concentrated in one place, it is much easier for staff to share documents and other data.
- (ii) Print Sharing: When printers are made available over the network, multiple users can print to the same printer. This facility can reduce the number of printers the organization must purchase, maintain and supply.
- (iii) E-Mail: Internal or "group" email enables the staff of an office to communicate with each other quickly and effectively. Group email applications also provide capabilities for contact management, scheduling and task assignment.

Computer Networks and Networks Security

- (iv) **Fax Sharing:** Through the use of a shared modem(s) connected directly to the network server, fax sharing permits users to fax documents directly from their computers without ever having to print them out on paper.
- (v) **Remote Access:** Staff often require access to their email, documents or other data from locations outside the office. A highly desirable network function, remote access allows users to dial in to an organization's network via telephone and access all the network resources that they can access when they're in the office.
- (vi) **Shared Databases:** Shared databases are an important subset of file sharing. If the organization maintains an extensive database, a network is the only effective way to make the database available to multiple users at the same time.
- (vii) **Fault Tolerance:** This is the process of making sure that there are several lines of defense against accidental data loss. Tape backups, servers attached to an uninterruptible power supply and redundant hardware are examples of such defense lines.
- (viii) **Internet Access and Security:** When computers are connected via a network, they can share a common, network connection to the Internet. This facilitates email, document transfer and access to the resources available on the World Wide Web.
- (ix) **Communication and collaboration:** A network allows employees to share files, view other people's work, and exchange ideas more efficiently.
- (x) **Organization:** A variety of network scheduling software is available that makes it possible to arrange meetings without constantly checking everyone's schedules.

Question 3

- (i) Star Network Topology

(5 marks)(PCC-Nov 2008)

Answer

- (i) Star Network Topology

The geometrical arrangement of computer resources, remote devices and communication facilities is known as Network Structure or Network Topology. Star Network topology is characterized by communication channels emanating from centralized computer system as shown in figure given below:

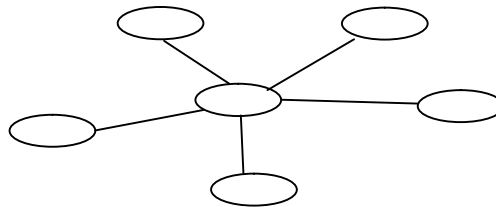


Figure: Star Network Topology

The processing nodes in a star network interconnect directly with a central system. Each terminal, small computer, or large main frame can communicate only with the central site and not with other nodes in the network. If it is desired to transmit information from one

Information Technology

node to another, it can be done only by sending the details to the central node, which in turn sends them to the destination.

Advantages:

- It is easy to add new and remove nodes.
- A node failure does not bring down the entire network.
- It is easier to diagnose network problems through a central hub.

Disadvantages:

- If the central hub fails, the whole network ceases to function.
- It costs more to cable a star configuration than other topologies.

Question 4

Describe the Ring Network. Discuss its advantages and disadvantages.

(5 Marks) (PCC-Nov 2009)

Answer

Ring Network: This is one of the structures for local area networks. In this topology, the network cable passes from one node to another until all nodes are connected in the form of a loop or ring. There is a direct point-to-point link between two neighboring nodes. These links are unidirectional which ensures that transmission by a node traverses the whole ring and comes back to the node, which made the transmission. Ring Network topology is particularly appropriate for organizations that require a centralized database or a centralized processing facility.

Advantages:

- (i) Ring networks offer high performance for a small number of workstations.
- (ii) These can span longer distances compared to other types of networks.
- (iii) Ring networks are easily extendable.

Disadvantages:

- (i) It is relatively expensive and difficult to install.
- (ii) Failure of one computer on the network can affect the whole network.
- (iii) It is difficult to trouble shoot a ring network. Adding or removing computers can disrupt the network.

Question 5

Discuss various Data transmission modes.

(4 Marks)(PCC-May 2007)

Answer

There are three Data transmission modes:

- (i) Simplex: A simplex communication mode permits data to flow in only one direction. A terminal connected to such a line is either a send-only or a receive only device. Simplex

mode is seldom used because a return path is generally needed to send acknowledgements, control or error signals.

- (ii) Half duplex: In this mode, data can be transmitted back and forth between two stations, but data can only go in one of the two directions at any given point of time.
- (iii) Full duplex: A full duplex connection can simultaneously transmit and receive data between two stations. It is most commonly used communication mode. A full duplex line is faster, since it avoids the delay that occurs in a half-duplex mode each time the direction of transmission is changed.

Question 6

Briefly explain various types of communication services used to transmit data in a network.

(5 Marks)(PCC-May 2008)

Answer

Communication Services: An organisation that wishes to transmit data uses one of the common carrier services to carry the messages from station to station. Some of the common types of communication services used to transmit data in a network are:

1. Narrow Band Service: It is used where data volume is relatively low. The transmission rates usually range from 45 to 300 bits per second. Examples of this service are telephone companies, typewriters exchange service (TWX) and Telex service.
2. Voice Band Service: Voice band services use ordinary telephone lines to send data messages. Transmission rates vary from 300 to 4,800 bits per second, and higher.
3. Wide Band Service: Wide band services provide data transmission rates from several thousands to several million bits per second. These services are limited to high-volume users. Such services generally use coaxial cable or microwave communication.

Communication Services may be either leased or dial up. A leased communication channel, which gives the user exclusive use of the channel, is used where there are continuing data transmission needs. The dial up variety requires the person to dial the computer. This alternative is appropriate when there are periodic data to be transmitted.

Question 7

Briefly explain various functions of Communication Software.

(5 Marks)(PCC-Nov 2008)

Answer

Various Functions of Communication Software: Communication software manages the flow of data across a network. It performs the following functions:

- (i) Access control: Linking and disconnecting different devices; automatically dialing and answering telephones; restricting access to authorized users and establishing parameters such as speed, mode, and direction of transmission.

Information Technology

- (ii) Network management: Polling devices to see whether they are ready to send or receive data; queuing input and output; determining system priorities; routing messages and logging network activity, use, and errors.
- (iii) Data and file transmission: Controlling the transfer of data, files, and messages among various devices.
- (iv) Error detection and control: Ensuring that the data sent is indeed the data received.
- (v) Data security: Protecting data during transmission from unauthorized access.

Question 8

Explain the OSI Model of communication

(5 Marks) (PCC-June 2009)

Answer

OSI or the Open System Interconnection Model of Communication has been outlined by International Organization for Standardization (ISO) to facilitate communication among the various hardware and software platforms which are heterogeneous in nature. It consists of following seven layers of functions:

- (i) Physical Layer: This first layer is a hardware layer which specifies mechanical features as well as electromagnetic features of the connection between the devices and the transmission.
- (ii) Data Link Layer: This is the second layer and is also a hardware layer which specifies channel access control method and ensures reliable transfer of data through the transmission medium.
- (iii) Network Layer: This is the third layer and makes a choice of the physical route of transmission.
- (iv) Transport Layer: This is the fourth layer and ensures reliable transfer of data between user processes, assembles and disassembles message packets, provides error recovery and flow control. At this layer, multiplexing and encryption take place.
- (v) Session Layer: This is the fifth layer and establishes, maintains and terminates sessions (dialogues) between user processes. Identification and authentication are undertaken at this layer level.
- (vi) Presentation Layer: This is the sixth layer which controls on screen display of data, transforms data to a standard application interface. Encryption, data compression can also be undertaken at this layer.
- (vii) Application Layer: This is the seventh layer which provides services for file transfer, file sharing, etc. Database concurrency and deadlock situation controls are undertaken at this layer.

Question 9

Write short notes on the following:

- (i) TCP/IP

(5 Marks) (PCC-Nov 2007)

Answer

TCP/IP: The protocols used on the Internet are called TCP/IP (Transmission Control Protocol/Internet Protocol). A TCP/IP protocol has two parts which create packet switching network:

- (a) TCP deals with exchange of sequential data.
- (b) IP handles packet forwarding as is used on the Internet.

TCP/IP has following four layers.

- (i) The Application Layer, which provides service directly to the user.
- (ii) The Transport Layer, which provides end-to end communication between applications and verifies correct packet arrival.
- (iii) The Internet Layer, which provides packet routing for error checking, addressing and integrity.
- (iv) The Network Interface Layer, which provides an interface to the network hardware and device drivers. This can also be called the data link layer.

Some reference books also include a fifth layer namely Physical Layer as part of TCP / IP which transmits the data from one system to another system in the form of 0^s and 1^s.

The TCP protocol breaks file or message in small packets. Each packet is then given a header, which contains the destination address. The packets are then sent over the Internet. The IP protocol guides the packets so that they arrive at the destination. Once there, the TCP protocol reassembles the packets into the original message.

Question 10

Describe the factors which have contributed to the growth of Local Area Network.

(6 Marks)(PCC-Nov 2007)

Answer

Growth of LAN

The following factors have contributed to the growth of LAN.

- (i) Security: Security for programs and data can be achieved using servers that are locked through both software and physical means such as diskless nodes.
- (ii) Expanded PC Usage: Once a LAN has been set up, it actually costs less to automate all processes as existing PCs can be easily converted into nodes by adding network interface card.
- (iii) Distributed Processing: LAN with inter-user communication and information exchange helps to develop distributed processing system.
- (iv) Electronic mail and Message Broadcasting: E-mail allows users to communicate more easily among themselves through a mail-box on the server.

Information Technology

- (v) **Organisational Benefit:** The information flow becomes a lot smoother with various departments, having the ability to access or request for information and data pertinent to them. Besides these, it leads to reduction in costs of Hardware, Software, and also in time, and cost of training on manpower to use the system.
- (vi) **Data Management Benefit:** Since data is located centrally on the server, it becomes much easy to manage it, as well as back it up.
- (vii) **Software cost and upgradation:** Network version software cost is less compared to single version software. Software upgrade is easy as package is stored centrally on the server

Question 11

Describe the various characteristic of client / server technology. (5 Marks)(PCC-May 2007)

Answer

Characteristics of C/S Technology:

- (i) It consists of client process and a server process that can be distinguished from each other.
- (ii) The client portion and the server portion can operate on separate platforms.
- (iii) Either the client or the server platform can be upgraded without having to upgrade the other platform.
- (iv) The server is able to service multiple clients concurrently.
- (v) The system includes some sort of networking capability.
- (vi) A significant portion of application logic resides at the client end.
- (vii) Action is usually initiated at the client end and not the server end.
- (viii) User friendly GUI resides at the client end.
- (ix) SQL capability is available.
- (x) Database server provides data protection and security.

Question 12

Describe in brief the various components of Client Server Architecture.

(4 Marks)(PCC-June 2009)

Answer

The various components of Client-Server Architecture are as follows:

- (i) **Client:** Clients, which are typically PCs, are the “users” of the services offered by the servers. There are basically three types of clients:
 - ◆ **Non-Graphical User Interface (GUI) Clients:** These require a minimum amount of human interaction e.g. ATMs, cell phones, fax machines, and robots.

- ◆ GUI-Clients: These are human interaction models usually involving object/action models like the pull-down menus in Windows 3-X.
 - ◆ Object-Oriented User Interface (OOUI) Clients: These take GUI-Clients even further with expanded visual formats, multiple workplaces, and object interaction rather than application interaction. Windows 95 is a common OOUI Client.
- (ii) Server: Servers await request from the client and regulate access to shared resources and perform action based on client request. File servers make it possible to share files across a network by maintaining a shared library of documents, data, and images. Database servers, transaction servers and web servers are some of the servers used in client server architecture.
- (iii) Middleware: The network system implemented within the client/server technology is termed as Middleware. It is all the distributed software needed to allow clients and servers to interact. General middleware allows for communication, directory services, queuing, distributed file sharing, and printing.
- (iv) Fat-client or Fat-server: Fat-client allows more of the processing to take place on the client, like with a file server or database server. Fat-servers place more emphasis on the server and try to minimize the processing done by clients. Transactions, GroupWare, and web servers are examples of Fat Servers. Fat Clients are also referred to as “2-Tier” systems and Fat-servers as “3-Tier” systems.

Question 13

Explain the various types of Internet servers.

(7 Marks)(PCC-Nov 2008)

Answer

Types of Internet Servers:

- (i) File server: It manages requests from clients for files stored on the server's local disk. A central file server permits groups and users to share and access data in multiple ways.
- (ii) Mail server: A mail server is the most efficient way to receive and store electronic mail messages for a community of users. A central mail server runs 24 hours a day. The mail server can also provide a global email directory for all community and organization's users, as well as email gateway and relay services for all other mail servers.
- (iii) DNS server: Domain Name Service is an Internet-wide distributed database system that documents and distributes network-specific information, such as the associated IP address for a host name, and vice versa.
- (iv) Gopher server: Gopher is an Internet application that uses multiple Gopher servers to locate images, applications, and files stored on various servers on the Internet. Gopher offers menu choices to prompt users for information that interests them, and then establishes the necessary network connections to obtain the resource.
- (v) Web server: The World Wide Web (WWW) is a very popular source of information on the Internet. Web browsers present information to the user in hypertext format. When the user selects a word or phrase that a Web page's author has established as a hypertext

Information Technology

link, the Web browser queries another Web server or file to move to another Web page related to the link.

- (vi) FTP server: File Transfer Protocol (FTP) is an Internet-wide standard for distribution of files from one computer to another. The computer that stores files and makes them available to others is a server.
- (vii) News server: Usenet News is a world wide discussion system consisting of thousands of newsgroups organized into hierarchies by subject.
- (viii) Chat server: Some organizations choose to run a server that will allow multiple users to have real-time discussions, called chats on the Internet. Most chat servers allow the creation of private chat rooms where participants can meet for private discussions.
- (ix) Caching server: A caching server is employed when the number of accesses to the Internet is to be restricted. A caching server sits between the client computer and the server that would normally fulfill a client's request. Once the client's request is sent, it is intercepted by the caching server. The caching server maintains a library of files that have been requested in the recent past by users on the network. If the caching server has the requested information in its cache, the server returns the information without going out to the Internet.
- (x) Proxy server: A proxy server is designed to restrict access to information on the Internet. If, for example, the organization does not want its users to have access to pornographic materials, a proxy server can be configured to refuse to pass the request to the intended Internet server.

Question 14

Describe 'Caching Server' and 'Proxy Server'. How are they different from each other?

(5 marks)(PCC-Nov 2009)

Answer

Caching Server: A caching server is used to restrict number of one's own access to the Internet. Basically, a caching server sits between the client computer and the server that would normally fulfill a client's request. The caching server intercepts the request sent and maintains a library of files that have been requested in the recent past by users on the Internet. If the request is found in the library, the server returns the desired information without going out to the Internet. Thus, a caching server does not restrict information flow. Instead, it makes a copy of requested information, so that frequent requests can be served locally, rather than from the original Internet source. It provides a good means to reduce overall traffic to and from the Internet. It is also possible to connect the caching servers in a hierarchy so that if the requested information is not available locally, it can be passed to the nearby caching servers for possible availability.

Proxy Server: A proxy server is designed to restrict access to information on the Internet. A proxy server can be configured to refuse to pass the request to the intended Internet server. Such a server operates on a list of rules given to it by a System Administrator. Some proxy

software use list of specific forbidden sites, the others examine the content of a page pertaining to the request.

Question 15

Explain value added services being offered by a Data Centre. (5 Marks)(PCC-Nov 2007)

Answer

The following value added services are offered by a data centre.

- (i) Data monitoring: This is done via a database agent, which enables the high availability of the database through comprehensive automated management.
- (ii) Web monitoring: It assesses and monitors website performance, availability, integrity and responsiveness from a site visitor's perspective. It also reports on HTTP and FTP service status.
- (iii) Backup and Restore: It provides centralized integrated management solution for enterprise data storage using specialized backup agents for data base, operating system, open files and application.
- (iv) Intrusion detection system: It helps in detecting inappropriate, incorrect or anomalous activity. It provides automated network based security assessment and policy compliance evaluation.
- (v) Storage on demand: It provides the backend infrastructure so as to give a robust and cost effective storage strategy. It provides infrastructure to access information at any time with security, reliability and availability needed to meet the requirements of a company.

Question 16

Describe various features of Data Centers. (5 Marks)(PCC-Nov 2008)

Answer

Data Center is a centralized repository for the storage, management and dissemination of data and information. Data centers can be defined as highly secure with fault-resistant facilities and hosting computer equipment that connects to telecommunication networks.

Features of Data Centers

- (i) Size: Data centers are characterized foremost by the size of their operations and require a minimum area of around 5,000 to 30,000 square meters. A financially viable data center could comprise of a hundred to several thousand servers.
- (ii) Data Security: It should ensure maximum data security and 100 per cent availability. Data centers have to be protected against intruders by controlling access to the facility and by video surveillance. They should be able to withstand natural disasters and calamities, like fire and power failures. Recovery sites must be well maintained.
- (iii) Availability of Data: The goal of a data center is to maximize the availability of data, and to minimize potential downtime. To do this, redundancy has to be built into all the

Information Technology

mission critical infrastructure of the data center, such as connectivity, electrical supply, security and surveillance, air conditioning and fire suppression.

- (iv) Electrical and power systems: A data center should provide the highest power availability with uninterrupted power systems (UPS).
- (v) Security: Physical security and systems security are critical to operations. Thus, it should provide both types of security measures to ensure the security of equipments and data placed at the data center.

Question 17

What are the challenges faced by the management of a data center.

(3 Marks) (PCC-June 2009)

Answer

Challenges faced by the management of a data center are as follows:

- (i) Maintaining a skilled staff and high infrastructure needed for daily data center operations: A company needs to have staff which is expert at network management and has software/operating system skills and hardware skills. A company has to employ a large number of such people.
- (ii) Maximizing uptime and performance: While establishing sufficient redundancy and maintaining watertight security, data centers have to maintain maximum uptime and system performance.
- (iii) Technology Selection: The other challenges that enterprise data centers face is technology selection, which is crucial to the operations of the facility keeping business objectives in mind.
- (iv) Resource balancing: The enterprise chief technical officer today needs to strike a working balance between reduced operational budgets, increased demands on existing infrastructure, maximizing availability, ensuring round-the-clock monitoring and management, and the periodic upgrades that today's technology demands.

Question 18

Explain briefly various Disaster Recovery (DR) plans for eliminating Down Time.

(5 Marks)(PCC-May 2008)

Answer

Disaster Recovery (DR) Plans: Data centres need to be equipped with the appropriate disaster recovery system that minimizes downtime for its customers. The following different types of disaster recovery plans are used:

1. Cold site: An alternative facility that is devoid of any resources or equipment, except air conditioning and raised flooring. Equipment and resources must be installed in such a facility to duplicate the critical business functions of an organisation. Cold sites may have variations depending on their communication facilities.

Computer Networks and Networks Security

2. Warm site: An alternate processing site that is only partially equipped, as compared to a hot site, which is fully equipped. It may have shared or dedicated server.
3. Hot site: An alternative facility that has the equipment and resources to recover business functions that are affected by a disaster. Hot sites may vary in the type of facilities offered such as data processing, communication, or other critical business functions which need duplication. The location and size of the hot site must be proportional to the equipment and resources needed.

Question 19

What are the Network Threats and Vulnerabilities?

(4 Marks)(PCC-May 2008)

Answer

The threats to the security of system assets can be broadly divided into nine categories:

- (i) Fire,
- (ii) Water,
- (iii) Energy variations like voltage fluctuation, circuit breakage, etc.,
- (iv) Pollution,
- (v) Intrusions and eavesdropping, which can be eliminated / minimised by physical access controls, prevention of electromagnetic emission and providing the facilities with their proper locations / sites,
- (vi) Viruses and worms, which can be avoided by using licensed copies of software files, cutting the use of shareware, downloading files or software only from reliable websites, implementing read-only access to software, installing anti-virus software,
- (vii) Misuse of software, data and services, which can be avoided by preparing employees' code of conduct,
- (viii) Structural damages and
- (ix) Hackers, the expected loss from whose activities can be mitigated only by robust logical access controls.