31.05.2022

CDOE, DAVV shall be offering following program in ODL mode from the forthcoming session after the approval of DEB-UGC:

1. MBA (Finance/Marketing/HR)
2. MBA (Energy management)
3. MA (Sociology)
4. MA (Economics)
5. MCA

It is proposed that out of total subject being taught in above mentioned two-year PG programs, a maximum of 40 % SLMs be outsourced, and remaining be prepared in-house.

For outsourced SLMs, norms of the University shall be followed.

Submitted for kind approval.

Director, CDOE

Approved

31.5.22

CDOE shall be offering MCA program in ODL mode from the forthcoming session after the approval of DEB-UGC. It is proposed that following experts for the content creation, SLM writing and editing may be approved for the subjects of MCA first year. These experts shall be paid honorarium as per the University norms.

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Submitted for kind approval.

Director, CDOE

Hon'ble Rector/VC

The Director, CDOE

Sharma 30.6.2022

Approved

30.6.22

DEVI AHILYA VISHWAVIDYALAYA, INDORE

(Formerly University of Indore), NAAC A^{+} Grade
State University of Madhya Pradesh

Self-Learning Material

DIRECTORATE OF DISTANCE EDUCATION

Khandwa Road, Indore

DIRECTORATE OF DISTANCE EDUCATION

M.C.A. (ODL), 2 Year Degree Program

Self-Learning Material

(Sample Copy)

Subject

Computer Networks

Unit- I

Fundamentals of Computer Networks

2022

UNIT- I

Fundamentals of Computer Networks

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1.1 LEARNING OUTCOMES

After a study of this e-content module the learners will be able to:

- Know about the Evolution of Computer Networking.
- Know about the Uses of Computer Networking.
- Understand the Properties of Computer Networking.
- Understand the Basic Equipment's Requirement for Networking.
- Explore the Types of Networking.

1.2 INTRODUCTION

Hello students in this lecture I will be discussing about the topic of Computer Networking. How networking of computer works, how data is shared among the connected computer using networking system. A computer network or a data network is a technology which primarily used between two devices to communicate and transfer data with each other, moreover it's also used communicate with other devices like printer and fax etc. In computer networks, networked computing devices pass data to each other along data connections. The connections between two devices / NODES are done by a cable media or wireless media. The best known example of network till date is the internet.

Network computer devices that originate, route and terminate the data are called network nodes. Nodes can include hosts such as personal computers, phones, servers as well as networking hardware. Two such devices are said to be networked together when one device is able to exchange information with the other device, whether or not they have a direct connection to each other.

Computer networks support applications such as access to the World Wide Web, shared use of application and storage servers, printers, fax machines, and use of email and instant messaging applications. Computer networks differ in the physical media used to transmit their signals, the communications

protocol to organize network traffic, the network's size, network topology and organizational intent.

1.3 EVOLUTION OF NETWORKING

Now let us know how evolution of networking took place in history of computer networking:

- In the late 1950s, early networks of communicating computers included the military radar system Semi-Automatic Ground Environment (SAGE).
- Then in 1960, the commercial airline reservation system semi-automatic business research environment (SABRE) went online with two connected mainframe computers.
- In 1962, J.C.R. Licklider developed a working group he called the "Intergalactic Computer Network", a precursor to the ARPANET, at the Advanced Research Projects Agency (ARPA).
- And1964, researchers at Dartmouth developed the Dartmouth Time Sharing System for distributed users of large computer systems. The same year, atMassachusetts Institute of Technology (MIT), a research group supported by General Electric and Bell Labs used a computer to route and manage telephone connections.
- Throughout the 1960s, Leonard Kleinrock, Paul Baran, and Donald Davies independently developed network systems that used packets to transfer information between computers over a network.
- In year 1965, Thomas Marill and Lawrence G. Roberts created the first wide area network (WAN). This was an immediate precursor to the ARPANET, of which Roberts became program manager. And in this year the first widely used telephone switch that implemented true computer control was introduced by Western Electric.
- In 1969, the University of California at Los Angeles, the Stanford Research Institute, the University of California at Santa Barbara, and the

University of Utah were connected as the beginning of the ARPANET network using 50 Kbit/s circuits.

- Then in late 1972, commercial services using X.25 were deployed, and later used as an underlying infrastructure for expanding TCP/IP networks.
- In 1973, Robert Metcalfe wrote a formal memo at Xerox PARC describing Ethernet, a networking system that was based on the Aloha network, developed in the 1960s by Norman Abramson and colleagues at the University of Hawaii. In July 1976, Robert Metcalfe and David Boggs published their paper titled as "Ethernet: Distributed Packet Switching for Local Computer Networks" and collaborated on several patents received in 1977 and 1978. In 1979, Robert Metcalfe pursued making Ethernet an open standard.
- In 1976, John Murphy of Datapoint Corporation created ARCNET, a token-passing network first used to share storage devices.
- In 1995, the transmission speed capacity for Ethernet was increased from 10 Mbit/s to 100 Mbit/s. By 1998, Ethernet supported transmission speeds up to a Gigabit. The ability of Ethernet to scale easily (such as quickly adapting to support new fiber optic cable speeds) is a contributing factor to its continued use today. So this is how the evolution of computer networking took place and still continued today.

1.4 USES OF COMPUTER NETWORKING

Next comes the uses of computer networking:

- **Facilitate Communication**

The primary purpose of computer networking is to facilitate communication. A network allows a user to instantly connect with another user, or network, and send and receive data. It allows remote users to connect with one another via videoconferencing, virtual meetings and digital emails.

Computer networks provide access to online libraries, journals, electronic newspapers, chat rooms, social networking websites and email clients and

most importantly World Wide Web. Users can benefit from making online bookings for theaters, restaurants, hotels, trains and airplanes. They can shop and carry out banking transactions from the comfort of their homes.

Computer networks allow users to access interactive entertainment channels, such as video on demand, interactive films, interactive and live television, multiperson real-time games and virtual-reality models.

- **Resource Sharing**

Computer networks allow users to share files and resources. They are popularly used in organizations to cut costs and streamline resource sharing. A single printer attached to a small local area network (LAN) can effectively service the printing requests of all computer users on the same network. Users can similarly share other network hardware devices, such as modems, fax machines, hard drives and removable storage devices.

Networks allow users to share software applications, programs and files. They can share documents (such as invoices, spreadsheets and memos), word processing software, videos, photographs, audio files, project tracking software and other similar programs. Users can also access, retrieve and save data on the hard drive of the main network server.

- **Centralized Support and Administration**

Computer networking centralizes support, administration and network support tasks. Technical personnel manage all the nodes of the network, provide assistance, and troubleshoot network hardware and software errors. Network administrators ensure data integrity and devise systems to maintain the reliability of information through the network. They are responsible for providing high-end antivirus, anti-spyware and firewall software to the network users. Unlike a stand-alone system, a networked computer is fully managed and administered by a centralized server, which accepts all user requests and services them as required.

Today, computer networks are the core of modern communication. All modern aspects of the public switched telephone network (PSTN) are computer-controlled. Telephony increasingly runs over the Internet Protocol, although not necessarily the public Internet. The scope of communication has increased significantly in the past decade. This boom in communications would not have been possible without the progressively advancing computer network. Computer networks, and the technologies that make communication between networked computers possible, continue to drive computer hardware, software, and peripherals industries. The expansion of related industries is mirrored by growth in the numbers and types of people using networks, from the researchers to the home user.

PROPERTIES OF COMPUTER NETWORKING

Next we will learn the properties of computer networking.

Computer networking may be considered a branch of electrical engineering, telecommunications, computer sciences, information technology or computer engineering, since it relies upon the theoretical and practical application of the related disciplines.

A computer network has the following properties:

Facilitates interpersonal communications

People can communicate efficiently and easily via email, instant messaging, chat rooms, telephone, video telephone calls, and video conferencing.

Allows sharing of files, data, and other types of information

Authorized users may access information stored on other computers on the network. Providing access to information on shared storage devices is an important feature of many networks.

Allows sharing of network and computing resources

Users may access and use resources provided by devices on the network, such as printing a document on a shared network printer, uses computing resources

across a network to accomplish tasks.

May be insecure

A computer network may be used by computer Crackers to deploy computer viruses or computer worms on devices connected to the network, or to prevent these devices from accessing the network (denial of service).

May interfere with other technologies

Interference with other technologies strongly disturbs certain forms of radio communication, e.g., amateur radio. It may also interfere with access technologies such as ADSL and VDSL.

May be difficult to set up

A complex computer network may be difficult to set up. It may be costly to set up an effective computer network in a large organization.

1.6 BASIC EQUIPMENTS REQUIREMENT FOR NETWORKING

Now we will understand what all basic equipments required for networking of two or more computers.

For a basic network connection, few items are needed

- 2 or more hosts / computers or network capable devices.
- Media for connection as cable or wireless
- Network devices to connect more than 2 devices or not directly connecting devices like router.

Network devices can be connected directly which is called peer to peer connection or can be connected in a group of devices.

There are certain protocols and rules to connect and process, which is mandatory to achieve best result. To transfer data and information we need a set of rules which can be understood by all network devices. These rules are called protocols andto process the information and making it transferable on network, a process is used called OSI model.

1.7 THREE BASIC NETWORKING TYPES

Next we will study the three basic networking types

LAN - Local area network: LAN is a set or group of computer / devices. A networked office building, school, or home usually contains a single LAN, though sometimes one building will contain a few small LANs (perhaps one per room), and occasionally a LAN will span a group of nearby buildings.

WAN-Wide Area Network: Wan is a network where a PC or group of PCs connects to other network or internet .Residences typically employ one LAN and connect to the Internet WAN via an Internet Service Provider (ISP) using a broadband connection. The ISP provides a WAN IP address to the modem, and all of the computers on the home network use LAN (so-called private) IP addresses. Home network use IP addresses. All computers on the home LAN can communicate directly with each other but must go through a central gateway, typically a broadband router, to reach the ISP.

MAN- Metropolitan Area Network: MAN is a computer network in which two or more computers or communicating devices or networks which are geographically separated but in same metropolitan city and are connected to each other are said to be connected on MAN. Metropolitan limits are determined by local municipal corporations; the larger the city, the bigger the MAN, the smaller a metro city, smaller the MAN.

1.8 THE OSI MODEL

The OSI, or Open System Interconnection, model defines a networking framework to implement protocols in seven layers. Control is passed from one layer to the next, starting at the application layer in one station, and proceeding to the bottom layer, over the channel to the next station and back up the hierarchy. The OSI model doesn't do any functions in the networking process; it is a conceptual framework so we can better understand complex interactions that are happening. The OSI model takes the task of internetworking and divides that up into what is referred to as a vertical stack that consists of the following layers:

1st one is Physical layer

This layer conveys the bit stream - electrical impulses, light or radio signal through the network at the electrical and mechanical level. It provides the hardware means of sending and receiving data on a carrier, including defining cables, cards and physical aspects. Fast Ethernet, RS232, and ATM are protocols with physical layer components.

2nd is Data Link

At this layer, data packets are encoded and decoded into bits. It furnishes transmission protocol knowledge and management and handles errors in the physical layer, flow control and frame synchronization. The data link layer is divided into two sub layers: The Media Access Control (MAC) layer and the Logical Link Control (LLC) layer. The MAC sub layer controls how a computer on the network gains access to the data and permission to transmit it. The LLC layer controls frame synchronization, flow control and error checking.

- Layer 2 Data Link examples include PPP, FDDI, ATM, IEEE 802.5/ 802.2, IEEE 802.3/802.2, HDLC, Frame Relay,

Then comes the 3rd layer Network

This layer provides switching and routing technologies, creating logical paths, known as virtual circuits, for transmitting data from node to node. Routing and forwarding are functions of this layer, as well as addressing, internetworking, error handling, congestion control and packet sequencing.

- Layer 3 Network examples include AppleTalk DDP, IP and IPX.

4th is Transport layer

This layer provides transparent transfer of data between the systems, or hosts, and is responsible for end-to-end error recovery and flow control. It ensures complete data transfer.

- Layer 4 Transport examples include SPX, TCP, and UDP.

Then comes the fifth Session layer

This layer establishes, manages and terminates connections between applications. The session layer sets up, coordinates, and terminates conversations, exchanges, and dialogues between the applications at each end. It deals with session and connection coordination.

- Layer 5 Session examples include NFS, NetBIOS names, RPC, SQL.

After session layer there is Presentation Layer;

This layer provides independence from differences in data representation (e.g., encryption) by translating from application to network format, and vice versa. The presentation layer works to transform data into the form that the application layer can accept. This layer formats and encrypts data to be sent across a network, providing freedom from compatibility problems. It is sometimes called the syntax layer.

- Layer 6 Presentation examples include encryption, ASCII, EBCDIC, TIFF, GIF, PICT, JPEG, MPEG, MIDI.

And the last one is Application Layer

This layer supports application and end-user processes. Communication partners are identified, quality of service is identified, user authentication and privacy are considered, and any constraints on data syntax are identified. Everything at this layer is application-specific. This layer provides application services for file transfers, e-mail, and other network software services. Telnet and FTP (File Transfer Protocol) are applications that exist entirely in the application level. Tiered application architectures are part of this layer.

- Layer 7 Application examples include WWW browsers, NFS, SNMP, Telnet, HTTP, and FTP

1.9 COMMUNICATION PROTOCOLS

A communications protocol is a set of rules for exchanging information over network links. In a protocol stack, each protocol leverages the services of the protocol below it. An important example of a protocol stack is HTTP running

over TCP over IP over IEEE 802.11. (TCP and IP are members of the Internet Protocol Suite. IEEE 802.11 is a member of the Ethernet protocol suite.) This stack is used between the wireless router and the home user's personal computer when the user is surfing the web.

Whilst the use of protocol layering is today ubiquitous across the field of computer networking, it has been historically criticized by many researchers for two principle reasons. Firstly, abstracting the protocol stack in this way may cause a higher layer to duplicate functionality of a lower layer, a prime example being error recovery on both a per-link basis and an end-to-end basis. Secondly, it is common that a protocol implementation at one layer may require data, state or addressing information that is only present at another layer, thus defeating the point of separating the layers in the first place. For example, TCP uses the ECN field in the IPv4 header as an indication of congestion; IP is a network layer protocol whereas TCP is a transport layer protocol.

Communication protocols have various characteristics. They may be connection-oriented or connectionless, they may use circuit mode or packet switching, and they may use hierarchical addressing or flat addressing.

1.10 SUMMARY:

Users and network administrators typically have different views of their networks. Users can share printers and some servers from a workgroup, which usually means they are in the same geographic location and are on the same LAN, whereas a Network Administrator is responsible to keep that network up and running. A community of interest has less of a connection of being in a local area, and should be thought of as a set of arbitrarily located users who share a set of servers, and possibly also communicate via peer-to-peer technologies.

Network administrators can see networks from both physical and logical perspectives. The physical perspective involves geographic locations,

physical cabling, and the network elements (e.g., routers, bridges and application layer gateways) that interconnect the physical media.So today we have studied about computer networking, all about how does it emerged and what all benefits we have using computer networking. Thank you.

1.11 GLOSSARY

Network: A group of interconnected computers.

Nodes: A point in a network where lines cross or branch.

Email: The sending of electronic messages from one computer user to another.

Encode: Convert into a coded form.

Decode: Convert a coded message into understandable language.

Protocol: The accepted code of behavior in a situation

Framework: A supporting structure.

1.12 FAQs

Q1. What are the uses of Computer Networking?

Ans. Uses of Computer Networking:

a) Facilitate Communication

b) Resource Sharing

c) Centralized Support and Administration

Q2. How many types of Networking exist?

Ans. There are three basic types of Networking

a) LAN (Local Area Network)

b) WAN (Wide Area Network)

c) MAN (Metropolitan Area Network)

Q3. Explain in brief the advantages / disadvantages of Computer Networking?

Ans. Advantages of Computer Networking:

a) Facilitates interpersonal communications.

b) Allows sharing of files, data, and other types of information

c) Allows sharing of network and computing resources

Disadvantages of Computer Networking:

a. May be insecure

b. May interfere with other technologies

c. May be difficult to set up

Q4. What are the basic equipments required for Networking?

Ans. For a basic network connection, few items are needed

- Two or more hosts / computers or network capable devices.
- Media for connection as cable or wireless
- Network devices to connect more than 2 devices like switch , hub and expansion devices like routers.
- An ISP (internet service provider)provided device (Modem) to connect to the internet

Q5. Explain in brief about the OSI Model?

Ans. The OSI, or Open System Interconnection, model defines a networking framework to implement protocols in seven layers. The OSI model takes the task of internetworking and divides that up into what is referred to as a vertical stack that consists of the following layers:

a) Physical Layer
b) Data Link
c) Layer Network
d) Transport Layer
e) Session Layer
f) Presentation Layer
g) Application Layer

Control is passed from one layer to the next, starting at the application layer in one station, and proceeding to the bottom layer, over the channel to the next station and back up the hierarchy. The OSI model doesn't do any functions in the networking process; It is a conceptual framework so we can better understand complex interactions that are happening.

1.13 SELF ASSESSMENT TEST

Q1. In the late 1950s, early networks of communicating computers included.....

a. ARPANET
b. Semi-Automatic Business Research Environment (SABRE)
c. Semi-Automatic Ground Environment (SAGE)

Q2. Full Form of OSI.....

a. Open System Internode
b. Open System Interconnection
c. Operating System Internet

Q3. Which one is a type of Networking?

a. WAN
b. Ethernet
c. Data Link

Q4. What would you call a set of rules for exchanging information over network links?

a. Communication Protocols
b. Nodes
c. Internet

Q5. When two or more computers or communicating devices or networks are geographically separated but are in the same metropolitan city and are connected to each other then they are said to use which type of network?

a. LAN
b. MAN
c. WAN