ITT565 INTRODUCTION:

NETWORK OPERATION SYSTEM AND ADMINISTRATION

Network Operating System Concepts

- Definition of Network Operating System
  - Computer Network Models
  - The Roles of a System Administrator

Definition of Network Operating System (NOS)

- Network operating system (NOS) is the *software* that allows multiple computers to communicate, share files and hardware devices with one another (ComputerHope, 2020).
- It is an operating system that manages network resources that includes special functions for connecting computers and devices into a local area network (LAN).
- The NOS manages multiple requests (inputs) concurrently and provides the security necessary in a multiuser environment.

What is network resources?

- Shared resources, also known as network resources, refer to computer data, information, or hardware devices that can be easily accessed from a remote computer through a local area network (LAN) or enterprise intranet.
- Successful shared resource access allows users to operate as if the shared resource were on their own computer.
- The most frequently used shared network environment objects are files, data, multimedia and hardware resources like printers, fax machines and scanners.

https://www.techopedia.com/definition/24796/shared-resources

Examples of NOS

- NetWare, Unix, Windows 2000, or Mac OS X require an existing operating system in order to function (e.g., Windows 3.11 for Workgroups requires DOS; LAN Server requires OS/2; LANtastic requires DOS).
- In addition to file and print services, a NOS may also offer directory services and a messaging system (email), as well as network management and multiprotocol routing capabilities. (Indiana University Knowledge Base, 2020).

Networking concepts

10.2 A recap of networking concepts

Here is a summary of what we assume understood at the beginning of this chapter:

- Computers communicate by sending electrical or optical signals over wires or fibers.
- Short cables can only 'hold' one bit at a time. A bit floods a cable or fiber like signaling Morse code with a torch, and has a physical size normally equal to the fundamental wavelength of the binary signal. The signal spreads through the medium in all directions at anything up to the speed of light in the medium.
- Each computer has a hardware interface at layer 1 of the OSI model.
- Each interface has a Media Access Control (MAC) address at layer 2, e.g. an Ethernet address such as 00:90:27:A2:47:7B.
- All hosts connected to the same cable see all the signals passing through it, but messages are framed using a protocol that incorporates a MAC address, and only the host with the correct MAC address normally bothers to read a message with its address. (A computer that listens to all traffic is said to be in promiscuous mode.)
- MAC addresses are 'flat'; they have no structure, so the only way to find a host with a given MAC address is to either direct the message over a dedicated path, or send a message to every computer and wait for the right one to respond. This is impractical in large networks, so we need another layer of addressing: layer 3.
- A message sent to *one* computer from another is called a *unicast*.
- A message sent from one computer to all computers on a Local Area Network (LAN) is called a *broadcast*.
- When multiple cables are joined together as part of an Internetwork, they must be joined by a *router*. If the cables are part of the same logical IP network, they are joined by a *switch* (or a bridge, which is an old name for a primitive switch).

Ref:
Mark Burgess (2004), Principles of Network and System Administration

Computer Network Models

- A computer network consists software and hardware that is used to send and receive data from one device to another.
- The role of hardware and software:
  - hardware is to prove the physical equipment that are required in order to send and receive data
  - software defines the set of instructions that uses the hardware equipment's for data transmission.
- A simple transmission of data consists several steps at various layers of computer network.
- Computer network models discusses:
  - how the data is transferred and received at a computer level in detail

https://beginnersbook.com/2019/04/computer-network-models/

Layers of a computer network models

- The main purpose of having several layers in a computer network model is to divide a process of sending and receiving data into small tasks.
- These layers are connected with each other,
- Each layer provide certain data to its immediate higher and immediate lower layer and receives certain data from the same.
- Dividing a model is layers makes the structure quite simple that makes it easy to identify the issue if it occurs.

https://beginnersbook.com/2019/04/computer-network-models/

Three main components of a computer network model.

- Sender, receiver and carrier.
  - At sender Side:
    Higher layer: Higher layer serves the middle layer, directs the message (or data) to middle layer
    Middle layer: Middle layer picks up the data from higher layer and transfer it to the lower layer
    lower layer: The data is transmitted to the lower layer of the receiver side.
  - At receiver Side:
    lower layer: Receives the data from the lower layer of sender side and transfer it to middle layer.
    Middle layer: Middle layer picks up the data from lower layer and transfer to higher layer.
    Higher layer: Higher layer transfers the data to the receiver.

- Model has different set and design of layers.
- The most important computer network models are:
  1. OSI Model
  2. TCP/IP Model

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2.6.1 The OSI model

The International Standards Organization (ISO) has defined a model for describing communications across a network, called the OSI model, for *Open Systems Interconnect (reference model)*. This model is a generalized abstraction of how network communication can be and is implemented. The model does not fit every network technology perfectly, but it is widely used to discuss and refer to the layers of technology involved in networking, thus we begin by recapping this model. The OSI model describes seven layers of abstraction.

Layer	Name	Example
7	Application layer	Program protocol commands
6	Presentation layer	XDR or user routines
5	Session layer	RPC / sockets
4	Transport layer	TCP or UDP
3	Network layer	IP Internet protocol
2	Data link layer	Ethernet protocol
1	Physical layer	Cables, interfaces

Ref:
Mark Burgess (2004), Principles of Network and System Administration

OSI model

1. OSI Model stands for Open System interconnection model.
- 2. OSI Model defines how data is transferred from one computer to another computer.
3. In a very basic scenario two computers connected with a LAN and connectors transfer data using the NIC. This forms a computer network, however if both the system uses different operating systems, for example one system runs on windows and other one runs on MacOS then how can data be transferred between these two different systems, here comes the role of a OSI model which is a seven layered model that defines how a data can be transferred between different systems.

OSI model

4. OSI model was introduced by International Organization for standardization (ISO) in 1984.
5. There are seven layers in a OSI model:

- Layer 7 → Application layer
- Layer 6 → Presentation Layer
- Layer 5 → Session layer
- Layer 4 → Transport layer
- Layer 3 → Network Layer
- Layer 2 → Data Link layer
- Layer 1 → Physical layer

Summary of OSI layers

- Layer 7 → Application layer→ protocols e.g. https, FTP, SMTP, DHCP etc
- Layer 6 → Presentation Layer→ Translation, encryption, compression→ e.g. encryption, ASCII, PNG, MIDI
- Layer 5 → Session layer → authentication, authorization, session management→e.g Syn/Ack
- Layer 4 → Transport layer (data is in segments) → segmentation, flow control , flow control, error control, Connection oriented transmission, Connectionless transmission→ e.g TCP, UDP, port numbers
- Layer 3 → Network Layer (data is in packets)→ logical address, routing, path determination (e.g. IP, routes
- Layer 2 → Data Link layer (data is in frames) e.g MAC, switches
- Layer 1 → Physical layer (data is in bits (1001011)) e.g cable: RJ45

Computer Network TCP/IP model

- **TCP/IP Reference Model is a four-layered suite of communication protocols. It was developed by the DoD (Department of Defense) in the 1960s. It is named after the two main protocols that are used in the model, namely, TCP (Transmission Control Protocol) and IP (Internet Protocol).**
- **TCP/IP is a set of standardized rules that allow computers to communicate on a network such as the internet.**
- **IP is the part that obtains the address to which data is sent.**
- **TCP is responsible for data delivery once that IP address has been found.**

https://www.tutorialspoint.com/ipv4/ipv4_tcpip_model.htm
https://www.avast.com/c-what-is-tcp-ip

Computer Network TCP/IP model

- **IP provides a mechanism to uniquely identify hosts by an IP addressing scheme. IP uses best effort delivery, i.e. it does not guarantee that packets would be delivered to the destined host, but it will do its best to reach the destination. Internet Protocol version 4 uses 32-bit logical address.**
- **Think of it this way: The IP address is like the phone number assigned to your smartphone. TCP is all the technology that makes the phone ring, and that enables you to talk to someone on another phone.**
- **They are different from one another, but they are also meaningless without one another.**

https://www.tutorialspoint.com/ipv4/ipv4_tcpip_model.htm
https://www.avast.com/c-what-is-tcp-ip

OSI MODEL versus TCP/IP

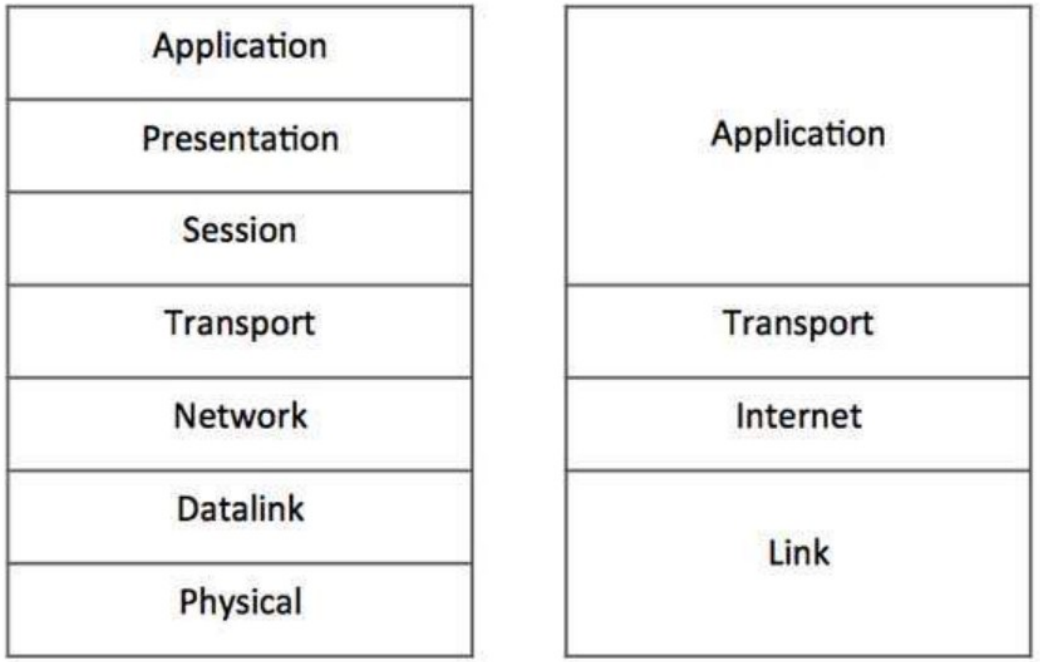

Figure − Comparative depiction of OSI and TCP/IP Reference Models

https://www.tutorialspoint.com/ipv4/ipv4_tcpip_model.htm

TCP/IP Model Layers

- **Application Layer**
- **The Application Layer provides the user with the interface to communication. This could be your web browser, e-mail client (Outlook, Eudora or Thunderbird), or a file transfer client.**
- **The Application Layer is where your web browser, a telnet, ftp, e-mail or other client application runs. Basically, any application that rides on top of TCP and/or UDP that uses a pair of virtual network sockets and a pair of IP addresses.**
- **The Application Layer sends to, and receives data from, the Transport Layer.**

https://upsir26.blogspot.com/search/label/Networking?m=0

TCP/IP Model Layers

- **Transport Layer**
- **The Transport Layer provides the means for the transport of data segments across the Internet Layer. The Transport Layer is concerned with end-to-end (host-to-host) communication.**
- **Transmission Control Protocol provides reliable, connection-oriented transport of data between two endpoints (sockets) on two computers that use Internet Protocol to communicate.**
- **User Datagram Protocol provides unreliable, connectionless transport of data between two endpoints (sockets) on two computers that use Internet Protocol to communicate.**
- **The Transport Layer sends data to the Internet layer when transmitting and sends data to the Application Layer when receiving.**

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TCP/IP Model Layers

- Internet Layer
- The Internet Layer provides connectionless communication across one or more networks, a global logical addressing scheme and packetization of data. The Internet Layer is concerned with network to network communication.
- The Internet Layer is responsible for packetization, addressing and routing of data on the network. Internet Protocol provides the packetization, logical addressing and routing functions that forward packets from one computer to another.
- The Internet Layer communicates with the Transport Layer when receiving and sends data to the Network Access Layer when transmitting.

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TCP/IP Model Layers

- **Network Access Layer**
- **The Network Access Layer provides access to the physical network.**
- **This is your network interface card. Ethernet, FDDI, Token Ring, ATM, OC, HSSI, or even Wi-Fi are all examples of network interfaces. The purpose of a network interface is to allow your computer to access the wire, wireless or fiber optic network infrastructure and send data to other computers.**
- **The Network Access Layer transmits data on the physical network when sending and transmits data to the Internet Layer when receiving.**

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- All Internet-based applications and their data, whether it is a web browser downloading a web page, Microsoft Outlook sending an e-mail, a file, an instant message, a Skype video or voice call;
- the data is chopped into data segments and encapsulated in Transport Layer Protocol Data Units or PDU's (TCP or UDP segments).
- The Transport Layer PDU's are then encapsulated in Internet Layer's Internet Protocol packets.
- The Internet Protocol packets are then chopped into frames at the Network Access layer and transmitted across the physical media (copper wires, fiber optic cables or the air) to the next station in the network.

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The Roles of a System Administrator

1. Account Provisioning → add account for new users , remove for in active staff and handles all issues relating to account.
2. Adding and removing hardware
3. Performing backups
4. Installing and upgrading software
5. Monitoring the system
6. Troubleshooting
7. Maintaining local documentation
8. Monitoring security → implement security policy, periodically check security is not violated, evaluate network trap and audit the security system

The End