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| **Assignment 1**  **SYSC 5201**  **Introduction to Computer Communications** |
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**Q-1:- Describe layering architecture and explain its advantages and disadvantages.**

**Ans:-**

**Layering Architecture:-**

In the layering architecture, the overall process of the network is divided into small tasks to overcome the complexity of the system. The process involved in the layering architecture is shared among various layers so that each layer can perform their own duty which in-turn increases flexibility, scalability and maintainability. Each single layer uses services from the below layer and provides service to the upper layer. Any changes made in any individual layer don’t affect any other layer of the layering architecture.

Need for layering architecture:-

a. Layering Architecture reduces the complexity in computer networks.

b. It is very much flexible as a change made in any layer doesn’t affect other layers in the layering architecture.

**Advantages of Layering Architecture:-**

a. The components are test independently in layering architecture.

b. Flexibility, maintainability, and scalability are increased in layering architecture.

c. Layering architecture allows access to different part of the applications simultaneously with minimal interference or reliance on other parties.

d. Private information is hidden from other layers in layering architecture.

**Disadvantages of Layering Architecture:-**

a. There must be some problem in the performance of the layering architecture due to size of the number of layers.

b. Layers are dependent on each other in layering architecture i.e. when you want to make changes in one layer then you have to make changes in every layers. It is impossible to define layers independently without taking support from any layers.

c. It is not used worldwide and it is used only in limited fields.

d. Error detection and debugging is quite difficult in Layering Architecture.

**Q-2:- What are the key functionalities of different layers of the OSI model? Be specific and**

**answer the question for all the layers.**

**Ans**:-

The various layers of OSI model are as follows:-

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| Layer 7  Application Layer |
| Layer 6  Presentation Layer |
| Layer 5 Session Layer |
| Layer 4  Transport Layer |
| Layer 3  Network Layer |
| Layer 2  Datalink Layer |
| Layer 1  Physical Layer |

The key functionalities of different layers of OSI model are stated below:

**1**. **Physical Layer (Layer 1)**:- The physical layer is the lowermost layer of the OSI (Open Systems Interconnection) model. It is also known as layer 1 and it acts as an electrical and mechanical interface between the two network medium. This network medium consists of wires, cables, plugs, sockets, and other physical aspects by which network signals are transmitted or conducted. The basic functions of the physical layer are as follows:-

a. Use for sending and receiving of data from one computer to another computer across a physical medium. This physical medium can be a cable of any type like Twisted Pair Cables, Co-axial Cables, Optical Fiber, etc. The data is transmitted as audio tones, electrical signals, light pulses, etc. which are in the form of bits i.e. 0 and 1.

b. Upper layers data i.e. incoming messages in the OSI model are converted into 0’s and 1’s for transmission over various mediums. Similarly the bits are converted into electronic signals for the outgoing messages in the physical layer.

c. Interface between the computer and the network medium (coax, twisted pair, etc.) is managed by the network layer.

CSMA/CD, DSL, Fast Ethernet, RS232, and ATM are the basically the protocols used in physical layer components.

**2. Data link Layer (Layer 2):-** It is also known layer 2 of the OSI (Open Systems Interconnection) model. As the name suggests, the data link layer (layer 2) is used for data transmission within a network. The Data Link Layer in the OSI model is above the Physical layer and below the Network layer. The hardware and the software protocols are connected by using the Data Link Layer. The basic functionalities of Data Link Layer are as follows:-

a. Responsible for sending error-free data frames from one node to another node across the physical layer of the OSI model. It cannot send frames across routers.

b. The Data Link Layer provides access to the upper layers to use the mediums of the Data Link Layer to send data across it using framings technique.

This layer is divided into 2 sub-layers:-

1. Media Access Control sub-layer:- It refers to the sub-layer that determines how devices or computers on the network gain access to the media. Many networks present uses a shared or common medium so it is quite to follow a particular set of protocols to avoid the conflicts in the network. For example:- Ethernet uses CSMA/CD method of MAC (Media Access Control)

2. Logical link control sub-layer:- This layer is responsible for transmission of data between devices in a network. It controls packet synchronization, flow control and error checking.

**3. Network Layer (Layer 3):-** The manner in which the data should be sent between 2 devices is handled or determined in this layer. It is used for point to point transfer of data, error-detection and correction and routing. The network routes where data packets are sent from source to the destination host are defined across network boundaries in this layer. Fragmentation and reassembly process takes place in this layer where data packets are fragmented into segments and then reassembled back to the destination. The examples of network layer are DDP, IT, IPX, etc.

**4. Transport Layer (Layer 4):-** As the name suggests, the transport layer is used for transfer of data from one end to another end in a network. In the transport layer, the data received from the upper layers is divided or split into segments or units before sending it to the lower layers. The packets sent over the network in the Transport layer move accurately without any errors in it and as soon as the packets are received over the network, an acknowledgement is sent by the recipient. The examples of Transport Layer are TCP, UDP, etc.

**5. Session Layer: -** It is below the presentation layer of the OSI model. The connection between 2 hosts in a network is triggered by Session layer in the OSI model. Once the work is done and the communication is no longer needed, the session layer terminate or disconnect the session. The session layer performs 3 functions in the OSI model :-

a. Setting up or starting a session.

b. Managing or controlling a session.

c. Closing a session.

The examples of Session Layer are RPC, SQL, etc.

**6. Presentation Layer: -** The data conversion takes place in the presentation layer of the OSI model. The need of conversion is required because the host presents at the sender and receiver may be using different data presentation schemes. The message gets transmitted from the sender end in a language or syntax that the receiving computer present at the receiving end can understand. The converted data format is then passed to the layer above the presentation layer i.e. Application layer. The primary job of the presentation is to convert the data formants in a way so that other layers can understand.

The examples of presentation layer are ASCII, encryption, JPEG, etc.

**7. Application Layer: -** It is topmost layer of the OSI model. In the application layer, the user uses various applications like TELNET and FTP to interact with the network. The communications between applications is managed by application layer. The examples of Application layer protocols that enable different functions in the application layer are HTTP, FTP, TELNET, SNMP, etc.

**Q-3**:- **Describe the following terminologies in the OSI model:**

**a. PDU and SDU**

**b. SAP**

**c. Protocol**

**d. Service**

**e. Segmentation and Reassembly**

**f. Multiplexing**

**g. Connectionless and Connection oriented**

**Ans:-**

**a. PDU and SDU:-**

**Protocol Data Unit**:-

In OSI model, PDU (Protocol Data Unit) is used to share or exchange information to any particular protocol. Protocols basically mean the rules and regulations which is used when devices communicate or interact with each other. PDU basically is a unit of data in the protocol which comprises of user data and protocol information. The communication between 2 peer layers in interconnected systems is exchanged through PDU.

Service Data Unit:-

Service Data unit contains a piece of information which is used to pass or share the information from the given layer to the layer above it. The transportation of SDU takes place by merging PCI and SDU and the combination of both in-turn makes a PDU of that layer.

**b. SAP:-**

The services between the two adjacent layers in the network layer can be accessed through service access points. It is the point in the network layer at which an entity of one layer provides services to the entity to the layer above it. For example: Layer m provides service to the layer m+1 entity only through SAP.

**c. Protocols:-**

A Protocol is a set of rules and regulations. It used when devices interact or communicate over each other in a network. In OSI model, the whole model is divided into layers with each layer having some specific purposes or functions. All of these tasks are disciplined by protocols.

**d. Services:-**

Services basically mean the functionality provided by a different layer in the OSI model. In OSI model, every layer present provides some services to the layer above it. The services provided by one layer to any other layer helps a given layer to provide services or communicate with any other layer in the computer systems.

**e. Segmentation and Reassembly**:-

In **Segmentation**, the whole packet is divided into smaller segments or units before sending it at the receiver end. Each segment or units obtained from the packet or message have a sequence number it is used in the transport layer where application data is break down into smaller pieces of data of similar size. This process is bit similar to the fragmentation process of the network layer as the network fragments the data into small packets before sending it forward.

In **Reassembly**, the segments or units are received at the receiving with their sequence numbers end and organized or reassembling them in the proper way before sending it forward to the intended destination.

**f. Multiplexing:-**

Multiplexing basically means combination of a multiple channels over a single channel. The data transmitted over a shared medium can be various analog and digital signals. In short, multiplexing is used to convert various multiple signals into a single signal. Multiplexing can be implemented in any of the OSI layers. The advantages of Multiplexing are as follows:-

1. Reduction in cost as we are using only one line.

2. A single point of failure created in multiplexing as we are using only wire to transmit the signal but same is not in the case when we are using multiple wires to transmit the signals.

**g. Connectionless Services**:-

In connectionless services, no connection is required between sender and a receiver or when creating any end to end connection in the network. The data is send from the one end. The sender sends the message in the form of packets to the destination and there is a chance that packets can travel in different direction as there is no established connection from one end to another end or between a sender and a receiver. The receiving of data in the Connectionless services is not that much guaranteed as compared to the connection-oriented services. The examples of connectionless protocols are UDP (User Datagram Protocol), Ethernet, IPX(Internetwork Packet Exchange),etc.

**Connection Oriented Services:-**

In connection oriented services, a connection is established between the sender and the receiver or between 2 end points before sending any data between them. It is trust-worthy network service as the receiving of data is guaranteed between 2 end nodes. The example of Connection Oriented Protocol is TCP. The phases involved in connection oriented services are as follows:-

a. Establishment of Connection.

b. Data Transfer.

c. Connection Termination.

a. Establishment of Connection: - In the establishment of connection, a connection is set-up between the source and destination.

b. Data Transfer: - In the phase, data is transmitted over the path where the connection is established.

c. Connection Termination: - In the last phase, an established connection is terminated when it is longer in use.

**Q-4:- Can a connection-oriented, reliable message transfer service be provided across a connectionless packet network?**

**Ans**:-

Yes, it could be possible to provide reliable message transfer service across a connectionless network. For instance, a protocol called TCP (Transmission control Protocol) provides connection oriented reliable transfer service over Internet Protocol (IP) which is done over a connectionless transfer service. In order to achieve the connection, TCP have layers which establish reliable service. The transport layer can establish a logical connection across the connectionless packet network by setting up state information (such as - packet sequence number) at the end systems. During making a connection in between, the message is broken into separate segments, and each segment is assigned a reference number before transmitting it over the network. Using these reference numbers, the systems transport-layer entities acknowledges received packets, determine and resend missed or lost packets, eliminate duplicate packets, and rearrange out-of-order packets. At the end the original message is reassembled in a form of packets that gets arrived at the receiving end. This is how TCP provide a reliable connection over connectionless network.

**Q-5:- Explain how the telephone network might modify the way calls are handled to provide the following services:**

** Call Display: the number and/or name of the calling party is listed on a screen before**

**the call is answered.**

** Call Waiting: a special sound is heard when the called party is on the line and another**

**user is trying to reach the called party.**

** Call Answer: if the called party is busy or after the phone rings a prescribed number of**

**times, the network gives the caller the option of leaving a voice message.**

** Three-Way-Calling: allows a user to talk with two other people at the same time.**

**Ans**:-

**Call Display: the number and/or name of the calling party is listed on a screen before the call is answered**.

The system verifies and sends user information like display of number, name, etc. of the called party on every device when a call is made over the network. The invitation for the connection of call or connection set-up between the caller and the called party takes place simultaneously with the above process

**Call Waiting: a special sound is heard when the called party is on the line and another user is trying to reach the called party.**

In this case, the calling person receive a special sound from the system called beep sound every few seconds which alert him/her that there is an incoming call from any other user. In this case, the called party can continue on line with the 1st call without answering the 2nd call (The number is busy will be heard by the user who is calling) or the called party can answer the 2nd call by putting in hold (The subscriber have put your call on hold sound will be heard to user who is on hold) the 1st call.

**Call Answer: if the called party is busy or after the phone rings a prescribed number of times, the network gives the caller the option of leaving a voice message.**

If the call is not received or not answered by the user after calling him/her many times, the system automatically transfers the call into the answering machine which is associated with any particular number. In the answering machine, the called party can leave their voice message describing the reason of their call, their name and number.

**Three-Way-Calling: allows a user to talk with two other people at the same time.**

In three way-calling, the caller establish a conference calling. Conference calling basically means talking with multiple people at the same time over the network. In this process, the system can set-up a connection including multiple users over the network without disconnecting the 1st pair. When you are in call with the 1st caller, the caller or the called party (from the 1st pair) can call other users too without disconnecting 1st pair call. This process is not possible in all telephone networks or in all mobile phones. Few networks or mobiles phones lack this feature and they are still in the process of upgrading that.

**Q-6:- Suppose that network addresses are scarce, so addresses are assigned so that they are not globally unique; in particular suppose that the same block of addresses may be assigned to different organizations. How can the organizations make use of these addresses? Can users from two such organizations communicate with each other?**

**Ans:-**

Yes they can communicate with each other using proper gateway. In general, a good approach is to enable a communications between users in different organizations and it can be done where each organization has a special gateway to communicate outside the organization. Internal users within the organization contact the gateway to establish calls to other organizations and then gateways have special procedures to establish connections with each other. This enables to establish connections between their internal users and users in other networks.