ICP-2011 – Computer Networks
Assignment – Review Questions

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Answers

1. **Pure Time Division Multiplexing (TDM)** – The time slots are allocated on a constant basis. This means that user 1 always gets time slot 1, user 2 always gets time slot 2, and so no. Provided bandwidth is not used efficiently. There is guaranteed transmission path.

   Statistical Time Division Multiplexing (STDM) – Allocates bandwidth to each user on the basis of demands and needs. A user uses time slots only when they are actually transmitting data. When a user is not sending data, no time slots are allocated to it, and other users that are sending data can use these time slots. Time slots are allocated statistically.

   raw data rate of the user $= B \cdot \frac{1}{T}$ [b]
   raw data rate of the entire TDM channel $= B \cdot N \cdot \frac{1}{T}$ [b]

   user A transmission bandwidth $= 10 \cdot 2 = 20$ [Mb/s]
   user C transmission bandwidth $= \frac{10}{2} = 5$ [Mb/s]

2. TODO: Image with matrix is somehow damaged because column parity digits are not visible.

   Parity checking-based error correction technique fails when even number of errors occur.

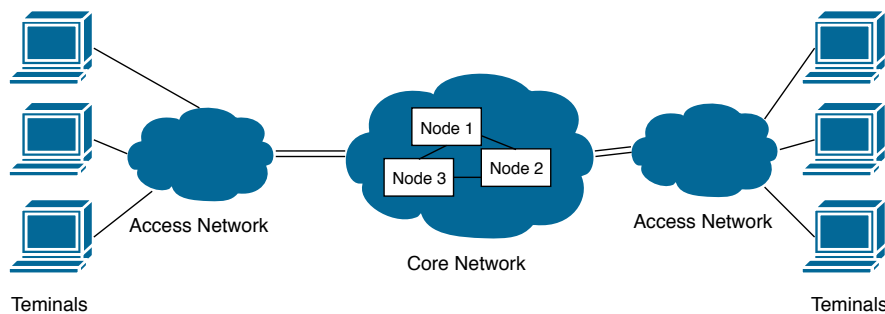3. Data network architecture diagram:

   Figure 1: Data Network Architecture

   Communication protocol – Set of rules and procedures describing exchange the information within networks. Protocols enables devices to communicate by using set of rules.

   Communication architecture – Describes special functions that the computer hardware and software must perform to allow application programs to communicate with the outside world. Communication architecture is based on communication protocol.

4. OSI reference model layers:

   1 Physical Layer

   vi) Mechanical, electrical and functional interface.

   2 Data Link Layer

   i) Error correction and re-transmission.
   iv) Responsibility for carrying frames between adjacent nodes.
   vii) Flow control.
   viv) Three packet switching technologies including X.25, Frame Relay and ATM.

   3 Network Layer

   iii) Route determination.
   viv) Three packet switching technologies including X.25, Frame Relay and ATM.

4 Transport Layer

    i) Error correction and re-transmission.

    vii) Flow control.

    viii) Reliable process-to-process message delivery.

5 Session Layer

    ii) Establishing and monitoring an entire communication connection between users.

6 Presentation Layer

7 Application Layer

    v) Communicates directly with user's application program.

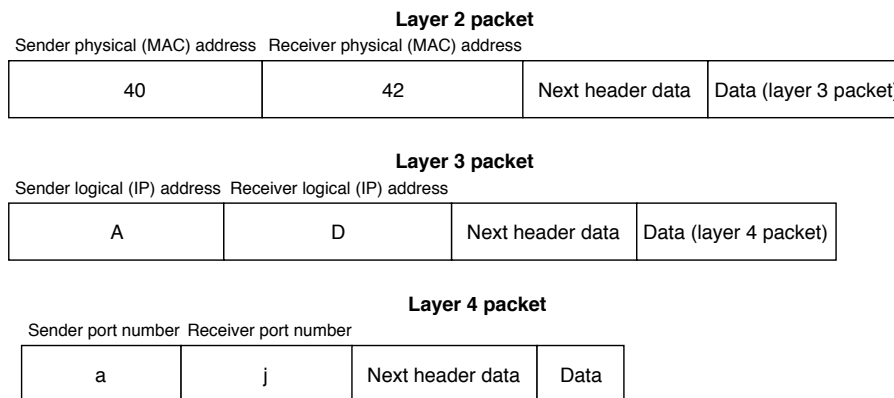5. Diagram shows content of packets when computer A sends data to computer D:

Layer 2 packet

Sender physical (MAC) address	Receiver physical (MAC) address		
40	42	Next header data	Data (layer 3 packet)

Layer 3 packet

Sender logical (IP) address	Receiver logical (IP) address		
A	D	Next header data	Data (layer 4 packet)

Layer 4 packet

Sender port number	Receiver port number		
a	j	Next header data	Data

Figure 2: Computer A sends data to computer D

Diagram shows content of packets when computer D sends data to computer A:

Layer 2 packet

Sender physical (MAC) address	Receiver physical (MAC) address		
80	82	Next header data	Data (layer 3 packet)

Layer 3 packet

Sender logical (IP) address	Receiver logical (IP) address		
D	A	Next header data	Data (layer 4 packet)

Layer 4 packet

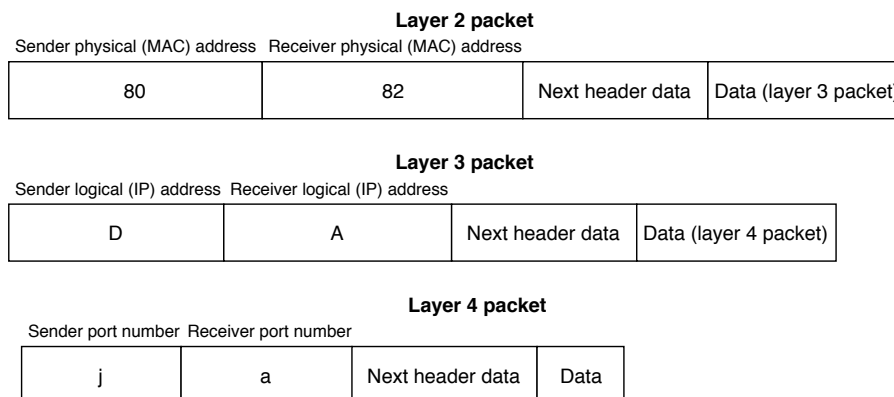| Sender port number	Receiver port number		
j	a	Next header data	Data

Figure 3: Computer D sends data to computer A

Data which sends computer A are encapsulated to layer 4 packet which in addition contains port numbers and other header information. Whole layer 4 packet is then encapsulated to layer 3 packet which in addition contains logical (IP) addresses and other header information. Finally is whole layer 3 packet encapsulated to layer 2 packet which in addition contains physical (MAC) addresses and other header information. This layer 2 packet is forwarded to layer 1.

If the physical destination address of a frame is corrupted during the transmission, the frame will be dropped and computer A can be informed about that either when receives this information from device

that has received this corruption or computer A could waiting for some acknowledgment information which has not received.

Error control mechanisms are still required at layer 4 because sending data are basically divided on multiple packets and some of these packets may be dropped, lost or it could be lost their original order and such errors could be detected only at layer 4 of receiving side.

6. TCP in conjunction with IP can ensure the proper message delivery to the destination because TCP operates at layer 4 and ensures the reliability of user's message delivery, re-transmit data lost by the lower layers and IP operates at layer 3 and is responsible for routing and delivering individual packets.

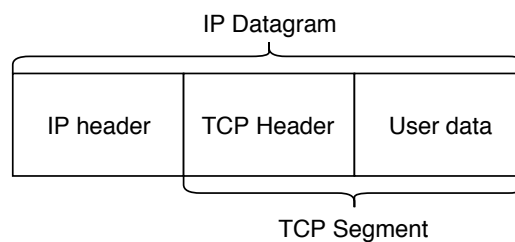Diagram shows relationship between a TCP segment and an IP datagram:

Figure 4: Relationship between a TCP segment and an IP datagram
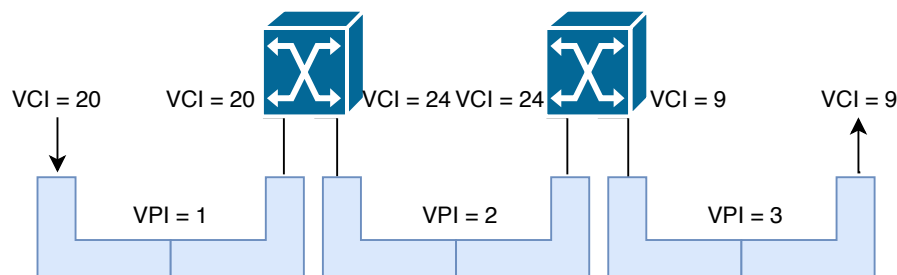
7. Diagram of ATM switches:

Figure 5: ATM switches using both VCI and VPI numbers

8. **TCP and UDP main differences** – TCP allows better error checking, more functionality and stability. UDP, however, lacks extensive error checking but is considered to be much faster than TCP. TCP, unlike UDP, establishes a virtual connection before transmission, guarantees the delivery of data over networks and if data is not received correctly, the sending computer will be notified and re-sends the information. TCP is connection oriented protocol and UDP is connection-less protocol.

9. **Packet switching** – Information is divided into a number of specially formatted packets, each of which includes some addresses such as logical, physical and port addresses. These packets are routed by a series of intermediate nodes of the network to the destination. At the destination, received packets are reassembled to form the original stream of data.

Connection oriented packet switching – End-to-end virtual connection to the destination is established using single request packet that contains the source and destination addresses. The subsequent packets of the same message just need to carry the marking information, which defines the already established virtual connection. There is no need to look at addressing information to calculate a path for each packet, the intermediate nodes only read the marking information to route the packet to its destination.

Connection-less packet switching – Each packet of a message is an independent unit that contains the source and destination addresses. Each packet is independently routed at each intermediate nodes it crosses.

10. Routing table in a connection-less packet switched network **can not** have two entries with the same destination address because this routing table must unambiguously maps destination addresses to output ports.

    Switching table in a connection oriented packet switched network

    i) **can** have two entries with the same input VPI,

    ii) **can** have two entries with the same incoming VCI and

    iii) **can not** have two entries with the same incoming VPI and VCI pair.