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(Under the Department of Science & Technology Govt. of Bihar, Patna)
Department of Information Technology
Solution, Mid Semester Examination, November - 2018

Subject: Computer Networks (05-1513)

Semester: V

Time Allowed: 2 Hr.

Max. Marks: 20

Instructions: Attempt any four questions. First question is compulsory for all.

Write your assumptions clearly if any. Be brief and to the points in writing answers. This question paper consists of 5 questions and 1 page only. Try to write all parts of a question consecutively.

Q1. a) List the functions & features of TCP?

Ans: TCP Functions/Services:

1. Process-to-process Communication
2. Stream Delivery
3. Full-Duplex Communication
4. Multiplexing & Demultiplexing
5. Connection Oriented Service
6. Reliable Service

TCP Features:

1. Number System (Byte Number, Sequence Number & Acknowledgment Number)
2. Flow Control
3. Error Control
4. Congestion Control

b) Filter out Application, Transport, Network & Data Link layer protocols from the given list.

i. TCP	ii. ARP	iii. DHCP	iv. RIP	v. DNS	vi. SMTP	vii. ETHERNET	viii. HTTPS	ix. UDP	x. IP
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Ans: Application Layer: DHCP, DNS, SMTP, HTTPS

Transport Layer: TCP, UDP

Network Layer: ARP, RIP, IP

Data Link Layer: ETHERNET

c) Define the type of the following destination address:

i. 4A:30:10:21:10:1A	ii. 47:20:1B:2E:08:EE	iii. FF:F0:F1:F2:F3:F4	iv. FF:FF:FF:FF:FF:FF
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Ans: i. Unicast

ii. Multicast

iii. Unicast

iv. Broadcast

d) What is Loopback address, which class it belongs to?

Ans: Address belonging to local system for local access only, 127.0.0.1. It belongs to class A.

e) Unstuff the following frame payload in which E is escape byte, F is flag byte & D is data byte.

E E D E F D D E F E D D D

Ans: EDFDDFEEDDD

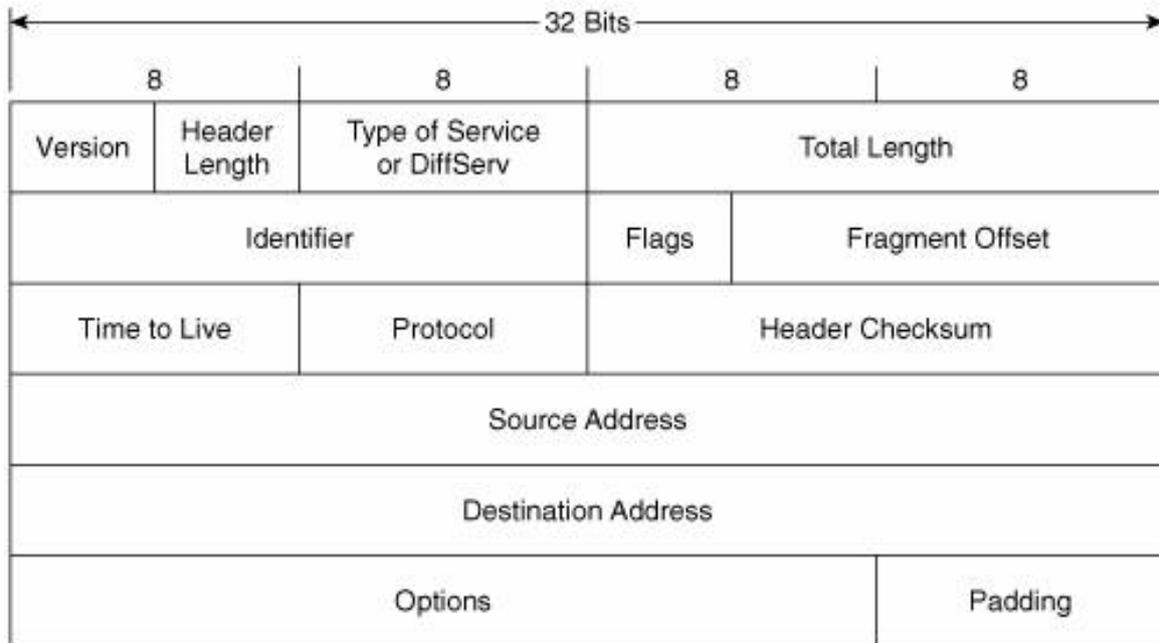
[1*5=5]

Q2. a) What is the ratio of useful data to the entire packet for the smallest Ethernet frame?

Ans: $46/64 = 71.875\%$

b) Describe IPV4 header briefly and write the private ranges of Class A, B & C addresses.

Ans:



IP header includes many relevant information including Version Number, which, in this context, is 4. Other details are as follows:

- **Version:** Version no. of Internet Protocol used (e.g. IPv4).
- **IHL:** Internet Header Length; Length of entire IP header.
- **DSCP:** Differentiated Services Code Point; this is Type of Service.
- **ECN:** Explicit Congestion Notification; It carries information about the congestion seen in the route.
- **Total Length:** Length of entire IP Packet (including IP header and IP Payload).
- **Identification:** If IP packet is fragmented during the transmission, all the fragments contain same identification number. to identify original IP packet they belong to.
- **Flags:** As required by the network resources, if IP Packet is too large to handle, these ‘flags’ tells if they can be fragmented or not. In this 3-bit flag, the MSB is always set to ‘0’.
- **Fragment Offset:** This offset tells the exact position of the fragment in the original IP Packet.
- **Time to Live:** To avoid looping in the network, every packet is sent with some TTL value set, which tells the network how many routers (hops) this packet can cross. At each hop, its value is decremented by one and when the value reaches zero, the packet is discarded.
- **Protocol:** Tells the Network layer at the destination host, to which Protocol this packet belongs to, i.e. the next level Protocol. For example, protocol number of ICMP is 1, TCP is 6 and UDP is 17.
- **Header Checksum:** This field is used to keep checksum value of entire header which is then used to check if the packet is received error-free.
- **Source Address:** 32-bit address of the Sender (or source) of the packet.
- **Destination Address:** 32-bit address of the Receiver (or destination) of the packet.
- **Options:** This is optional field, which is used if the value of IHL is greater than 5. These options may contain values for options such as Security, Record Route, Time Stamp, etc.

Private Address Range of Class A:

10.0.0.0 to 10.255.255.255, 127.0.0.0 to 127.255.255.255

Private Address Range of Class B:

172.16.0.0 to 172.31.255.255, 169.254.0.0 to 169.255.255

Private Address Range of Class C:

192.168.0.0 to 192.168.255.255

c) A pure ALOHA network transmits 400-bit frames on a shared channel of 400kbps. What is the throughput if the system (all stations together) produces

a) 2000 frames per second	b) 1000 frames per second
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Ans: Frame Transmission Time = 400 bits/400 kbps = 1ms

a) 2000 Frames per second i.e. 2 Frames per millisecond, $G = 2$

$$S = G * \text{pow}(e, -2G) = 2 * \text{pow}(e, -4) = 0.0366 \text{ i.e. } 3.66 \%$$

$$\text{Throughput} = 0.0366 * 2000 = 73 \text{ frames}$$

Out of 2000 frames only 73 frames will probably survive.

b) 1000 Frames per second i.e. 1 Frame per millisecond, $G = 1$

$$S = G * \text{pow}(e, -2G) = 1 * \text{pow}(e, -2) = 0.135 \text{ i.e. } 13.5 \%$$

$$\text{Throughput} = 0.135 * 1000 = 135 \text{ frames}$$

Out of 1000 frames only 135 frames will probably survive.

[1+3+1=5]

Q3. a) Mention atleast five the differences between switch & router.

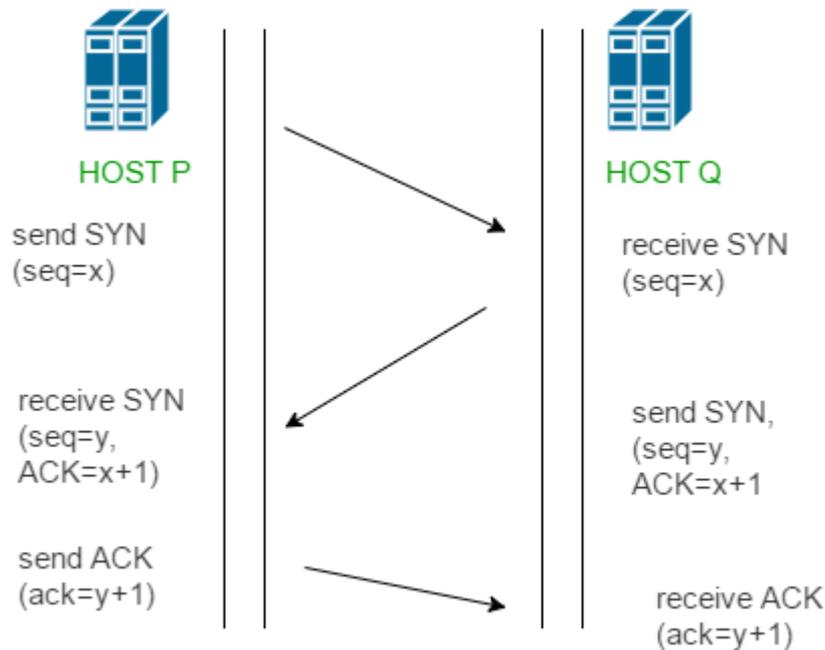
Ans: Any five

	Routers	Switches
Mode of transmission of data	It Transmits data in the form of packets.	It Transmits data in the form of frames.
Address used for data transmission.	It makes use of IP address for data transmission.	It makes use of MAC address for data transmission.
Layer of OSI Model	It makes use of layer 3 of OSI model. Layer 3 is the network layer.	It makes use of layer 2 of OSI model. Layer 2 is the Data Link Layer.
Table	It makes use of the Routing Table for routes to get to the destination IP.	It makes use of CAM (Content addressable Memory) table for MAC address.
Broadcast domain	Routers break the broadcast domain and it does not propagate broadcast domain.	Switches allow the broadcast domain and contain per port collision domain.
Function	Router in networking is used to connect two different Networks	It is used to connect End devices such as computers, printers, scanners etc.
Used for	It is used for both WAN/LAN networks.	It is only used for the LAN networks.
Mode of Transmission	By default, Router is in full duplex mode. However, we can change them manually into half-duplex.	Switches are used in half as well as full duplex mode. However, we can also make them in auto-negotiation.
NAT (Network Address	In Routers, we can perform Network Address Translation as	In Switches, we can neither perform Network Address

Translation) and PAT (Port Address Translation).	well as Port Address Translation	Translation nor Port Address Translation.
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b) Explain TCP connection establishment & Termination phase & clearly mention header information regarding it.

Ans:



Connection Establishment using Three-way Handshake

Step 1. Host P (Client) sends a TCP segment with SYN = 1, ACK = 0, ISN (Initial Sequence Number) i.e. $x = 2000$ (Assumed).

The Active Open device (Host P) sends a segment with the SYN flag set to 1, ACK flag set to 0 and an Initial Sequence Number 2000 (For Example), which marks the beginning of the sequence numbers for data that Host P will transmit. SYN is short for SYNchronize. SYN flag announces an attempt to open a connection. The first byte transmitted to Host Q will have the sequence number ISN+1.

Step 2. Host Q (Server) receives Host A's TCP segment and returns a TCP segment with SYN = 1, ACK = 1, ISN i.e. $y = 5000$ (Host Q's Assumed Initial Sequence Number), Acknowledgment Number = 2001 ($2000 + 1$, the next sequence number Host Q expecting from Host P).

Step 3. Host P sends a TCP segment to Host Q that acknowledges receipt of Host Q's ISN, With flags set as SYN = 0, ACK = 1, Sequence number = 2001, Acknowledgment number = 5001 ($5000 + 1$, the next sequence number Host P expecting from Host Q)

This handshaking technique is referred to as the Three-way handshake or SYN, SYN-ACK, ACK.

After the three-way handshake, the connection is open and the participant computers start sending data using the sequence and acknowledge numbers.

c) If an IPV4 datagram, the M bits is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and last bytes of the payload respectively are?

Ans: Last Fragment, 2400 & 2759

[1+3+1=5]

Q4. a) Clearly specifying size of each field, draw the Ethernet frame and briefly describe each field.

Ans:

PREAMBLE	S F D	DESTINATION ADDRESS	SOURCE ADDRESS	LENGTH	DATA	CRC
7 Bytes	1 Byte	6 Bytes	6 Bytes	2 Bytes	46 - 1500 Bytes	4 Bytes

- **PREAMBLE** – Ethernet frame starts with 7-Bytes Preamble. This is pattern of alternative 0's and 1's which indicates starting of the frame and allow sender and receiver to establish bit synchronization. Initially, PRE (Preamble) was introduced to allow for the loss of few bits due to signal delays. But today's high-speed Ethernet don't need Preamble to protect the frame bits. PRE (Preamble) indicates the receiver that frame is coming and allow the receiver to lock onto the data stream before the actual frame begins.
- **Start of frame delimiter (SFD)** – This is a 1-Byte field which is always set to 10101011. SFD indicates that upcoming bits are starting of frame, which is destination address. Sometimes SFD is considered the part of PRE, this is the reason Preamble is described as 8 Bytes in many places.
- **Destination Address** – This is 6-Byte field which contains the MAC address of machine for which data is destined.
- **Source Address** – This is a 6-Byte field which contains the MAC address of source machine. As Source Address is always an individual address (Unicast), the least significant bit of first byte is always 0.
- **Length** – Length is a 2-Byte field, which indicates the length of entire Ethernet frame. This 16-bit field can hold the length value between 0 to 65534, but length can not be larger than 1500 because of some own limitations of Ethernet.
- **Data** – This is the place where actual data is inserted, also known as **Payload**. Both IP header and data will be inserted here, if Internet Protocol is used over Ethernet. The maximum data present may be as long as 1500 Bytes. In case data length is less than minimum length i.e. 46 bytes, then padding 0's is added to meet the minimum possible length.
- **Cyclic Redundancy Check (CRC)** – CRC is 4 Byte field. This field contains 32-bits hash code of data, which is generated over Destination Address, Source Address, Length and Data field. If the checksum computed by destination is not same as sent checksum value, data received is corrupted.

Size of frame of Ethernet IEEE 802.3 varies 64 bytes to 1518 bytes including data length (46 to 1500 bytes).

b) Answer the question considering the content of a packet given below.

i) Write the Source & Destination IP Address (Write in proper decimal form)

Ans: Source Address: **7F 00 00 02** i.e. **127.0.0.2**

Destination Address: **7F 80 00 22** i.e. **127.128.0.34**

ii) Which application layer protocol's data is being carried out

Ans: Source Port Number: **AB 42** i.e. **43842**

Destination Port Number: **00 50** i.e. **80**

As we know 80 is the port number used for web service, so the application layer protocol HTTP.

iii) What is the length of actual data

Ans: From IP header we can find out, IP header length is $5 * 4 = 20$ Bytes, Total Length is **00 2E** i.e. 46 Bytes. Hence the actual payload of IP packet is $46 - 20 = 26$ Bytes. This 26 Bytes includes TCP header and actual Data. From TCP header we can see that the header size is $5 * 4 = 20$ Bytes, so the actual data is $46 - 20 = 26$ Bytes (**4D 49 54 49 41 4E**)

iv) How long this packet is going to live before reaching destination

Ans: TTL Value is **40** i.e. 64. It is going to live 60 jumps/hops/network jumps.

v) What will happen to this packet if it reaches a link with a smaller MTU than this packet size? Answer with justification in maximum 3 sentences.

Ans: From the header information about Flag + Fragmentation offset (**40 00**) (Binary form: 0100 0000 0000 0000), we can see that the 1st three bits are **010** and we know that it is used for making fragmentation decision. Here D (2nd Bit) = 1 & M (3rd Bit) = 0. So the packet can't be fragmented and hence **discarded** from network.

**45 00 00 2E B5 73 40 00 40 06 85 BC 7F 00 00 02 7F 80 00 22 AB 42 00 50 59 64
A6 1C 02 B3 D3 6C 50 18 01 18 01 56 FF BA 00 00 4D 49 54 49 41 4E**

[2 + 3 [1 + 4 * 0.5] = 5]

Q5. a) How is the preamble field different from the SFD field?

Ans: The preamble is a 56-bit field that provides an alert and timing pulse. It is added to the frame at the physical layer and is not formally part of the frame. SFD is a one-byte field that serves as a start of frame. SFD is not serving as the synchronization but preamble does this between source and receiver.

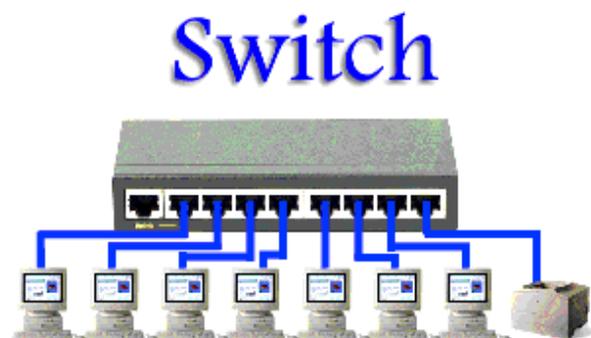
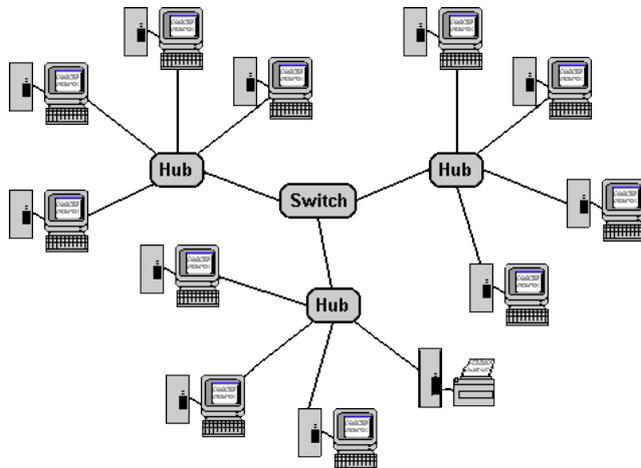
b) Suppose that the stop-and-wait protocol is used on a link with a bit rate of 512 kilobits per second and 20 milliseconds propagation delay. What is the minimum frame size in bytes to achieve a link utilization of at least 50% & 80%.

Ans: Transmission speed (T) = 512 kbps, Propagation delay (P) = 20 ms (One Way)
Efficiency = (L/ T)/((L/T) + 2 * P) = x/(x+2*20*10⁻³), Here L is size of frame.

- a) For 50% Efficiency
x = 2/50 i.e. L/T = 2/50 => L = 21Kbits
- b) For 80% Efficiency
x = 3.2/20 i.e. L/T = 3.2/20 => L = 82KBits

c) You are supposed to design & setup a small home network using Hub(s)/Switch(s) to play a multiuser game with friends over network. Describe the steps that you will take. Also mention why Router is not preferred/required here.

Ans:



We can accept any of these two designs. Since the game is to be played in a home network then it is not necessary to have more than one network and hence router is not required. The steps here will include: a) Choosing right cable, which is Straight through cable here since connectivity is done between dissimilar devices. b) Connecting these cables to right port (RJ45). c) Assign proper IP address to form a network. Generally, class C private addresses are used. d) Checking the connectivity by pinging other systems.

Switch here will make network work at faster speed than hubs, since there is no collision in case switches (switch separates collision domains).

[1+2+2=5]