

**Crack  
1<sup>st</sup>  
in 1 Attempt  
GATE & PSUs**



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**COMPUTER SCIENCE & IT**

**WORKBOOK**

**Computer Network + DBMS + Operating System**

# 1

## Introduction

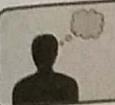


### Multiple Choice Questions

- Q.1 In physical layer data is represented in the form of  
(a) Packets      (b) Bits  
(c) Frames      (d) Segments
- Q.2 Which of the following transmission media supports 100 Mbps or higher transmission?  
(a) Category 5 UTP cable  
(b) Analog POTS lines  
(c) RG-62 Coaxial cables  
(d) High-power, single frequency radio
- Q.3 The Internet is a collection of redundant high-speed wide area links. Which network topology does the internet use?  
(a) Star      (b) Ring  
(c) Mesh      (d) Bus
- Q.4 A 10 Base 2 Ethernet network uses what type of cable?  
(a) Thinnet coaxial      (b) Twisted-Pair cable  
(c) Thicknet -coaxial      (d) None of these
- Q.5 Which OSI layer corresponds to TCP-UDP layer?  
(a) Physical      (b) Data link  
(c) Network      (d) Transport
- Q.6 At which layer, the trailer usually contains bits used for error detection?  
(a) Network      (b) Session  
(c) Transport      (d) Data link
- Q.7 Which of the following layer is responsible for the source-to-destination delivery of a packet possible across multiple networks.

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- (a) Network      (b) Session  
(c) Transport      (d) Data link
- Q.8 What are the advantages of star topology  
(a) Less number of cables are required  
(b) More number of cables are required  
(c) It is a distributed topology  
(d) Security is high
- Q.9 Which of the following is not a service primitive?  
(a) Connect      (b) Listen  
(c) Send      (d) Sound
- Q.10 What is the primary purpose of a VLAN?  
(a) Demonstrating the proper layout for a network  
(b) Simulating a network  
(c) To create a virtual private network  
(d) Segmenting a network inside a switch or device
- [ISRO-2009]
- Q.11 Which one of the following is not a client-server application?  
(a) Internet chat      (b) Web browsing  
(c) E-mail      (d) Ping
- [GATE-2010]
- Q.12 Why does the Data Link Layer append a trailer to frames?  
(a) This is due to the router configuration.  
(b) The Data Link Layer runs always in reverse mode.  
(c) The Data Link Layer only appends a header, but never a trailer.  
(d) This way the checksum for error correction can be done "on the fly".

**Try Yourself**

- T1.** Which layer does IP belong to?  
 (a) Physical Layer    (b) Data Link Layer  
 (c) Network Layer    (d) Transport Layer  
 [Ans: (c)]
- T2.** Which is not a layer in the ISO-OSI model?  
 (a) Security Layer    (b) Physical Layer  
 (c) Data Link Layer    (d) Network Layer  
 [Ans: (a)]
- T3.** Which of the following statements is true?  
 I. In a well designed system, the higher layer does not have to worry about the implementation details of lower layers  
 II. A layer offers a service to the next higher layer  
 III. Two entities of the same layer handle a protocol  
 Select the correct option:  
 (a) Only I               (b) I and II  
 (c) I, II and III        (d) II and III  
 [Ans: (c)]
- T4.** Which of the following is true?  
 (a) Packet encapsulate frame  
 (b) Datagram encapsulate packet  
 (c) Frame encapsulate packet  
 (d) None of the above      [Ans: (c)]
- T5.** What is the technique of merging inputs of many links onto one link called?  
 (a) Digitalizing          (b) Multiplexing  
 (c) Transmitting         (d) Tunneling  
 [Ans: (b)]
- T6.** Matching between List-I and List-II.  
**List-I**  
 A. Data link layer  
 B. Network layer  
 C. Transport layer  
**List-II**  
 1. Ensure reliable transport of data over a physical point to point link  
 2. Encodes/decodes data for physical transmission

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3. Allow end to end communication between 2 processes  
 4. Routes data from one network node to the next

**Codes:**

A	B	C
(a) 1	4	3
(b) 2	4	1
(c) 2	3	1
(d) 1	3	2

[Ans: (a)]

- T7.** How many 8 bit characters can be transmitted per second over a 9600 baud serial communication link using asynchronous mode of transmission with time one start bit, 8 data bits, one parity bit and 2 stop bits?

[Ans: (960)]

- T8.** Protocols are

- (a) Agreements on how communication components and DTE's are to communicate
- (b) Logical communication channels used for transferring data
- (c) Physical communication channels used for transferring data
- (d) None of the above

[Ans: (a)]

- T9.** Match List-I with List-II and select the correct answer using the codes given below the lists:

**List-I**

- A. Session layer
- B. Transport layer
- C. Application layer
- D. MDI (Medium Dependent Interface)

**List-II**

- 1. Connects DCE into physical channel
- 2. Provides end to end connectivity
- 3. Provides organised means to exchange data between users
- 4. Supports an end user process and perform required file transfer

**Codes:**

A	B	C	D
(a) 3	4	2	1
(b) 3	2	4	1
(c) 2	4	1	3
(d) 4	3	2	1

[Ans: (b)]



# 2

## IP Addressing



### Multiple Choice Questions

- Q.1** Two computers C<sub>1</sub> and C<sub>2</sub> are configured as follows. C<sub>1</sub> has IP address 203.197.2.53 and subnet mask 255.255.128.0. C<sub>2</sub> has IP address 203.197.75.201 and subnet mask 255.255.192.0. Which one of the following statements is true?
- C<sub>1</sub> and C<sub>2</sub> both assume they are on the same network
  - C<sub>2</sub> assumes C<sub>1</sub> is on same network, but C<sub>1</sub> assumes C<sub>2</sub> is on a different network
  - C<sub>1</sub> assumes C<sub>2</sub> is on same network, but C<sub>2</sub> assumes C<sub>1</sub> is on a different network
  - C<sub>1</sub> and C<sub>2</sub> both assume they are on different networks

[GATE-2006]

#### Common Data For Q.2 & Q.3

A class B network address 130.50.0.0 is submitted as follows. The last 10 bits of the host id are allotted for host number and the remaining 6 bits are reserved for subnet number.

- Q.2** How many subnets and number of hosts in each subnet are possible with the above addressing scheme?
- 62, 1022
  - 30, 510
  - 14, 254
  - None of these

- Q.3** What are the first hosts addresses of 1<sup>st</sup> and 4<sup>th</sup> subnets?
- 130.50.4.1 and 130.50.16.1
  - 130.50.1.1 and 130.50.4.1
  - 130.50.0.0 and 130.50.3.0
  - None of these

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- Q.4** Suppose an organization is assigned a block of 2048 contiguous addresses starting at address 128.211.168.0. The following figure shows the binary values of address in the range

Dotted Decimal	32-bit Binary Equivalent
Lowest 128.211.168.0	10000000 11010011 10101000 00000000
Highest 128.211.175.255	10000000 11010011 10101111 11111111

Which of the following represents the CIDR (Classless Inter-Domain Routing)

- 128.211.168.0/11
- 128.211.168.0/21
- 128.211.175.255/11
- None of these

- Q.5** Suppose a subnetwork X has a subnet mask 255.255.255.192 and a host address on C is 130.127.48.130. Which of the following is on the same subnet with y?

- 130.127.48.120
- 130.127.48.187
- Both (a) and (b)
- None of these

- Q.6** Consider the following IP address corresponding subnet mask:

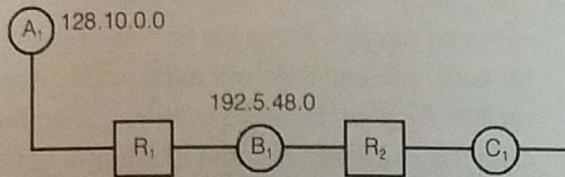
IP address = 172.60.50.2

Subnet mask = 255.255.224.0

Find the range of assignable IP address on the subnet on which the host belongs

- 172.60.32.0 - 172.60.63.255
- 172.60.32.1 - 172.60.63.254
- 172.60.32.1 - 172.60.64.255
- 172.60.32.0 - 172.60.127.254

Q.7 Consider the following figure



Where  $A_1$ ,  $B_1$ ,  $C_1$  are three networks and  $R_1$  and  $R_2$  are routers. Then network  $B$  belongs to which of the following class.

- (a) Class A                  (b) Class B
- (c) Class C                  (d) Class D

Q.8 A host is connected to a Department network which is part of a University network. The university network is part of the Internet. The largest network in which the Ethernet address of the host is unique is

- (a) The Subnet to which the host belongs
- (b) The Department network
- (c) The University network
- (d) The Internet

[GATE IT-2004]

Q.9 An organization has a class C network and wants to form, subnet for four departments with hosts as follows:

- |       |       |
|-------|-------|
| A. 72 | B. 35 |
| C. 20 | D. 18 |

What are the possible arrangements of subnets?

- (a) For A-255.255.255.128;  
For B-255.255.255.192;  
For C&D-255.255.255.224
- (b) For A-255.255.255.224;  
For B-255.255.255.192;  
For C & D -255.255.255.128
- (c) For A-255.255.255.192;  
For B - 255.255.255.128;  
For C & D - 255.255.255.224
- (d) For A-255.255.255.224;  
B& C& D - 255.255.255.224

Q.10 A subnetted Class B network has the following broadcast address: 144.16.95.255. Its subnet mask

- (a) is necessarily 255.255.224.0
- (b) is necessarily 255.255.240.0
- (c) is necessarily 255.255.248.0
- (d) could be an one of 255.255.224.0, 255.255.240.0, 255.255.248.0

[GATE IT-2006]

Q.11 An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be

- (a) 255.255.0.0                  (b) 255.255.64.0
- (c) 255.255.128.0              (d) 255.255.252.0

[GATE-2005]

Q.12 The address of a class B host is to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

- (a) 62 subnets and 262142 hosts
- (b) 64 subnets and 262142 hosts
- (c) 62 subnets and 1022 hosts
- (d) 64 subnets and 1024 hosts

[GATE-2007]

Q.13 The routine table of a router is shown below:

Destination	Subnet Mask	Interface
132.81.0.0	255.255.0.0	eth0
132.81.64.0	255.255.224.0	eth1
132.81.68.0	255.255.255.0	eth2
132.81.68.64	255.255.255.224	eth3

A packet bearing a destination address 132.81.68.132 arrives at the router. On which interface will it can not be forwarded?

- (a) Eth0                          (b) Eth1
- (c) Eth2                          (d) Eth3

[DRDO-2008]

Q.14 Which of the following statements is/are TRUE about IP address.

P: IP address 128.128.255.255 is used for broadcasting on class B network

Q: IP address 127.127.255.255 is used for loopback testing.

- (a) P only                          (b) Q only
- (c) both P and Q                  (d) Neither P nor Q

[DRDO-2008]

Q.15 Which of the following is a MAC address?

- (a) 192.166.200.50
- (b) 00056A:01A5CCA7FF60
- (c) 568.Airport Road
- (d) 01:A5:BB:A7:FF:60

[GATE-2003]

Q.16 The subnet mask for a particular network is 255.255.31.0 which of the following pairs of IP addresses could belong to this network?

- (a) 172.57.88.62 and 172.56.87.23
- (b) 10.35.28.2 and 10.35.29.4
- (c) 191.203.31.87 and 191.234.31.88
- (d) 128.8.129.43 and 128.8.161.55

[ISRO-2009]

Q.17 Convert IP address whose hexadecimal representation in C22F1582 to dotted

- (a) 194.47.21.130
- (b) 194.47.15.130
- (c) 194.47.21.82
- (d) None of these

Q.18 Suppose computers A and B have IP addresses 10.105.1.113 and 10.105.1.91 respectively and they both use the same netmask N. Which of the values of N given below should not be used if A and B should belong to the same network?

- (a) 255.255.255.0
- (b) 255.255.255.128
- (c) 255.255.255.192
- (d) 255.255.255.224

[GATE-2010]

Q.19 Which of the following is a class C IP address?

- (a) 168.192.1.1
- (b) 172.192.11.1
- (c) 192.168.11.1
- (d) 11.192.168.1



### Numerical Data Type Questions

Q.20 A host in a subnet has the IP address 130.83.126.10. How many hosts can be addressed in this subnet?

Q.21 If a class B network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

[GATE-2008]

### Linked Data Questions (Q.22 & Q.23)

Q.22 The Internet host is roughly doubling in size every 18 months. Although no one really knows for sure, one estimate put the number of hosts on it at 7 million in January 1996. Using these data the expected number of internet hosts in the January 2008 is (in billion)

Q.23 In order to connect these numbers of hosts the minimum number of networks required in class A is \_\_\_\_\_.



### Try Yourself

T1. Match the following

#### List-I (Packets)

	Source IP	Destination IP
--	-----------	----------------

A. Data 250.255.255.255 40.40.40.40

	Source IP	Destination IP
--	-----------	----------------

B. Data 22.21.23.24 255.255.255.255

	Source IP	Destination IP
--	-----------	----------------

C. Data 24.23.22.21 24.22.23.24

#### List-II

1. Unicast packet within network
2. This packet never exists
3. Limited broadcasting

#### Codes:

	A	B	C
(a)	1	2	3
(b)	2	3	1
(c)	3	1	2
(d)	2	1	3

[Ans: (b)]

T2. The direct broadcast address of the IP address 205.18.136.187 with subnet Mask 255.255.255.240 is

- (a) 205.18.136.187
- (b) 205.18.255.255
- (c) 205.18.136.255
- (d) 205.18.136.191

[Ans: (d)]

T3. Consider the following routing table at an IP router:



# 3

## Data Link Layer



### Multiple Choice Questions

- Q.1 The IEEE 802 project provides the Data link layer into two sublayers. Which sublayer of the Data link layer communicates directly with the network interface card?
- (a) Logical link control sublayer
  - (b) Logical access control sublayer
  - (c) Medium access control sublayer
  - (d) Data access control sublayer
- Q.2 Which of the following is a product of LLC sublayer?
- (a) 802.3 frame
  - (b) 802.5 frame
  - (c) PDU (Protocol Data Unit)
  - (d) Preamble
- Q.3 A signal has a bandwidth of 20 Hz. The highest frequency is 60 Hz. What is the lowest frequency?
- (a) 40 Hz
  - (b) 50 Hz
  - (c) 60 Hz
  - (d) 80 Hz
- Q.4 Which error detection method consists of a parity bit for each data unit as well as an entire data unit of parity bits?
- (a) Simply parity check
  - (b) Two-dimensional parity check
  - (c) CRC
  - (d) Checksum

#### Common Data For Q.5 & Q.6

A 3000 km long trunk is used to transmit frames using a Go-Back -N protocol. The propagation speed is

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- 6  $\mu$ sec/km and truck data rate is 1.544 Mbps. We ignore the transmission time taken to receive the bits in the acknowledgment. Frame size is 64 bytes.
- Q.5 If Go-Back-N protocol is used, what is the maximum window size at the sender's side?
- (a) 32
  - (b) 63
  - (c) 109
  - (d) 219
- Q.6 What is the maximum number of bits of the sequence number?
- (a) 5
  - (b) 6
  - (c) 7
  - (d) 8
- Common Data For Q.7 & Q.8**
- Two peer processes A(sender) and B(receiver) use stop-and-wait ARQ to send packets over a single link with capacity C. All packets have the same length of 100 bits. The round-trip time (which is the time until A receives an acknowledgment for a sent packet) is equal to 2 seconds. Assume that no packets or ACK's are dropped and that all packets and ACK's arrive error-free. Furthermore, assume that the capacity C is equal to 100,000 bits per second.
- Q.7 Find the average (transmission) rate (in bits per seconds) with which process A sends data to process B?
- (a) 34.47 bps
  - (b) 49.97 bps
  - (c) 51.45 bps
  - (d) 67.75 bps
- Q.8 What is the link utilization?
- (a) 0.0005
  - (b) 0.0002
  - (c) 0.0001
  - (d) 0.0050
- Q.9 Calculate the number of sequence bits, where packet size is 53 bytes, the RTT is 60 ms and bottle neck bandwidth is 155 Mbps

- (a) 10 bits                          (b) 12 bits  
 (c) 14 bits                           (d) 15 bits

**Q.10 Assertion (A):** Selective repeat protocol requires more sequence numbers than Go-back-N protocol.

**Reason (R):** Selective repeat protocol uses cumulative acknowledgments.

- (a) Both (A) and (R) are true and (R) is the correct reason for (A).  
 (b) Both (A) and (R) are true and (R) is not the correct reason for (A)  
 (c) Both (A) and (R) are false  
 (d) (A) is true but (R) is false

**Q.11** The minimum and maximum size of the payload in Ethernet frame is  
 (a) 0-1526                              (b) 46-1526  
 (c) 46-1500                            (d) 72-1500

**Q.12 Assertion (A):** Data link protocols almost always put the CRC in a trailer rather than in a header.

**Reason (R):** The CRC is computed during transmission and appended to the output stream as soon as the last bit goes out.

- (a) Both [A] and [R] are true and [R] is the correct reason for [A]  
 (b) Both [A] and [R] are true but [R] is not the correct reason for [A]  
 (c) Both [A] and [R] are false  
 (d) [A] is true but [R] is false

**Q.13** If N is the maximum sequence number, then the window size is SR and GBN protocols are respectively  
 (a)  $N/2, N-1$                               (b)  $N, N+1$   
 (c)  $(N+1)/2, N$                               (d)  $N-1, N/2$

**Q.14** A satellite channel of capacity of  $b$  bits/sec, the frame size 1 bits and round trip propagation time of  $R$  sec uses stop and wait protocol, what is the channel utilization  $U$ ?

- (a)  $U = \frac{1}{1+2R}$                               (b)  $U = \frac{b}{b+2R}$   
 (c)  $U = \frac{1/b}{1/b+R}$                               (d)  $U = \frac{b}{1+2R}$

#### Linked Answer For Q.15 & Q.16

**Q.15** Host A is sending data to host B over a full duplex link. A and B are using the sliding window protocol for flow control. The sender and receiver window sizes are 5 packets each. Data packets (sent only from A to B) are all 1000 bytes long and the transmission time for such a packet is 50  $\mu$ sec. Acknowledgment packets (sent only from B to A) are very small and require negligible transmission time. The propagation delay over the link is 200  $\mu$ sec. What is the total time required in this communication?

- (a) 250  $\mu$ sec                              (b) 200  $\mu$ sec  
 (c) 275  $\mu$ sec                                (d) 450  $\mu$ sec

**Q.16** What is the maximum achievable throughput in this communication?

- (a)  $7.96 \times 10^6$  Bps                      (b)  $11.11 \times 10^6$  Bps  
 (c)  $12.33 \times 10^6$  Bps                      (d)  $15.00 \times 10^6$  Bps

#### Common Data For Q.17 & Q.18

Given the generator function  $G(x)$  and the message function  $M(x)$  as follows:

$$G(x) = x^4 + x + 1$$

$$M(x) = x^7 + x^6 + x^4 + x^2 + x$$

**Q.17** Calculate the transmission function  $T(x)$

- (a)  $x^{11} + x^7 + x^5 + x^4 + x^3 + x$   
 (b)  $x^{11} + x^{10} + x^8 + x^6 + x^5 + x^2 + x$   
 (c)  $x^{10} + x^7 + x^6 + x^2 + x$   
 (d)  $x^{11} + x^{10} + x^8 + x^6 + x^5$

**Q.18** Consider the transmission is damaged such that the receiver receives

$$R(x) = x^{11} + x^9 + x^8 + x^7 + x^3 + x^2 + x + 1$$

Then how many bits differ?

- (a) 5    (b) 6  
 (c) 7    (d) 8

**Q.19** The distance between two stations M and N is  $L$  kilometers. All frames are  $K$  bits long. The propagation delay per kilometer is  $t$  seconds. Let  $R$  bits/second be the channel capacity. Assuming that processing delay is negligible, the minimum number of bits for the sequence number field in a frame for maximum utilization when the sliding window protocol is used, is

(a)  $\left\lceil \log_2 \frac{2LtR + 2K}{K} \right\rceil$  (b)  $\left\lceil \log_2 \frac{2LtR}{K} \right\rceil$

(c)  $\left\lceil \log_2 \frac{2LtR + K}{K} \right\rceil$  (d)  $\left\lceil \log_2 \frac{2LtR + K}{2K} \right\rceil$

[GATE-2007]

**Q.20** The binary exponential back off algorithm is defined by IEEE 802 as follows:

The delay is an integral multiple of slot times to delay before the  $n^{\text{th}}$  transmission attempt is chosen as a uniformly distributed random integer  $r$  in the range  $0 \leq r \leq 2^k$ , where the value of  $k$  will be lies on which of the following?

- (a)  $\max(n, 10)$
- (b)  $\min(n, 10)$
- (c)  $2^n - 1$
- (d)  $2^n$

**Q.21** In a data link protocol, the frame delimiter flag is given by 0111. Assuming that bit stuffing is employed, the transmitter sends the data sequence 01110110 as

- (a) 01101011
- (b) 011010110
- (c) 011101100
- (d) 0110101100

[GATE IT-2004]

**Q.22** In sliding window protocols in the data link layer, the frames to the left of the receiver window are frames

- (a) received but not acknowledged
- (b) received and acknowledged
- (c) not received
- (d) not sent

[DRDO-2009]

**Q.23** For a band limited signal, the Nyquist theorem specifies the maximum sampling rate to be

- (a) twice the lowest frequency of the signal
- (b) twice the highest frequency of the signal
- (c) twice the bandwidth of the signal
- (d) none of the above

[DRDO-2009]

**Q.24** In Go-Back-N protocol, if the maximum window size is 63, what is the range of the sequence number?

- |             |             |
|-------------|-------------|
| (a) 0 to 63 | (b) 0 to 64 |
| (c) 1 to 63 | (d) 1 to 64 |

[DRDO-2009]

**Q.25** Let 01111 be the frame delimiter flag in a data link protocol. What is the transmitted bit sequence for the data 011110111011110 using the bit stuffing method?

- (a) 011110111011110
- (b) 011101101110111010
- (c) 0111011011100111010
- (d) 011100110111001110010

[DRDO-2008]

**Q.26** A frame 1101011001 is to be transmitted using the cyclic redundancy check (CRC) with the generating polynomial  $x^3 + x + 1$  to protect it from errors. What is the transmitted frame?

- (a) 1101011001010
- (b) 1111010110010
- (c) 1110110110101
- (d) 1110111010111

[DRDO-2008]

**Q.27** The distance between two microwave towers, with link capacity 100 Mbps, is 24 km and the speed of the signal is  $3 \times 10^8$  m/sec. If the frame size is 16 Kb in the stop-and-wait protocol, what is the approximate link utilization?

Assume that the acknowledgment packets are negligible in size and there are no errors during communication.

- (a) 33%
- (b) 50%
- (c) 66%
- (d) 75%

[DRDO-2008]

**Q.28** Two ground stations are connected by a 10 Mbps satellite link. The altitude of the satellite is 36,000 km and the speed of the signal is  $3 \times 10^8$  m/sec. What should be the packet size for channel utilization of 50% using go-back-N sliding window protocol. Window size is 100. Assume that the acknowledgment packets are negligible in size and there are no errors during communications.

- (a) 1.5 Kbytes
- (b) 3 Kbytes
- (c) 4.5 Kbytes
- (d) 6 Kbytes

[DRDO-2008]

Q.29 Match the following:

- |             |                    |
|-------------|--------------------|
| I. Gateway  | P. Physical layer  |
| II. Switch  | Q. Data link layer |
| III. Router | R. Network layer   |
| IV. Hub     | S. Transport layer |
- (a) I-S, II-P, III-R, IV-Q  
 (b) I-S, II-R, III-Q, IV-P  
 (c) I-R, II-Q, III-S, IV-P  
 (d) I-S, II-Q, III-R, IV-P

[DRDO-2008]

Q.30 Sliding Window Protocol with Selective reject/repeat gives better performance than other Protocols when

- (a) buffer is sufficient and bandwidth is limited
- (b) buffer is moderate and bandwidth is sufficient
- (c) buffer is moderate and bandwidth is limited
- (d) buffer is sufficient and bandwidth is sufficient

Q.31 Silly Window Syndrome (SWS) occurs during?

- (a) Packet scheduling at routers
- (b) Intserv and DiffServ
- (c) Congestion control
- (d) Flow control



### Numerical Data Type Questions

Q.32 A selective repeat ARQ is using 7 bits to represent the sequence numbers. What is the maximum size of the window?

Q.33 Calculate the link utilization (in %) for stop and wait flow control mechanisms, if the frame size is 5000 bits, bit rate is 9000 bps and distance between device is 2000 km. Speed of propagation over the transmission media is 200,000 Km per second.

Q.34 Station A uses 32 bytes packets to transmit message to station B using a sliding window protocol. The round trip delay between A and B is 80 milliseconds and the bottleneck bandwidth on the path between A and B is 128 Kbps. What is the optimal window size that A should use?

[GATE-2006]

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Q.35 If a binary signal is sent over a 3-kHz channel whose signal to noise ratio is 20 dB. What is maximum achievable data rate (in Kbits/sec)?

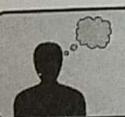
Q.36 A channel has a bit rate of 4 kbps and one-way propagation delay of 20 ms. The channel uses stop and wait protocol. The transmission time of the acknowledgment frame is negligible. To get a link utilization of at least 50%, the minimum frame size should be \_\_\_\_ bits.

[GATE IT-2005]

Q.37 An error correcting code has the following code words: 00000000, 00001111, 01010101, 10101010, 11110000. What is the maximum number of bit errors that can be corrected?

[GATE IT-2007]

Q.38 What is the channel capacity of printer (in bps) with a 400 Hz bandwidth and a signal-to-noise ratio is 7 dB?



### Try Yourself

T1. Consider a network connecting two systems located 8000 kilometers apart. The bandwidth of the network is  $500 \times 10^6$  bits per second. The propagation speed of the media is  $4 \times 10^8$  meters per second. It is needed to design a Go-Back-N sliding window protocol for this network. The average packet size is  $10^7$  bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then, the minimum size in bits of the sequence number field has to be \_\_\_\_\_.

[GATE-2015, Ans: (8)]

T2. Bandwidth of a link is 1000 Mbps and round trip time is given as 250  $\mu$ sec. If frame size is 500 bits, calculate the link utilization (in percentage) of channel when STOP and WAIT ARQ is used.

[Ans: (0.2)]

- T3. Station A needs to send a message consisting of 10 packets to station B using a sliding window of size 4. All packets are ready and can be transferred immediately. Selective repeat and GBN are used at 2 different times and every 5th packet get lost for both protocols. (ACK's from B never gets lost). Let  $x$  and  $y$  be the number of transmissions that A has to make in selective repeat and GBN respectively to ensure safe delivery to B. Then  $x+y = ?$

[Ans: (31)]

- T4. The message 11001001 is to be transmitted using CRC polynomial  $x^3+1$  to protect it from errors. The message that should be transmitted is:
- 11001001000
  - 11001001011
  - 11001010
  - 110010010011

[Ans: (b)]

- T5. Let  $G(x)$  be the generator polynomial used for CRC checking. What is the condition that should be satisfied by  $G(x)$  to detect odd number of bits of error?
- $G(x)$  contains more than two terms
  - $G(x)$  does not divide  $1+x^k$ , for any  $k$  not exceeding the frame length
  - $1+x$  is a factor of  $G(x)$
  - $G(x)$  has an odd number of terms

[Ans: (c)]

- T6. A bit stuffing based framing protocol uses an 8 bit delimiter pattern of 01111110. If the output bit string after stuffing is 01111100101, then the input bit string
- 0111110100
  - 0111110101
  - 0111111101
  - 0111111111

[Ans: (b)]

- T7. Consider a  $128 \times 10^3$  bits/second satellite communication link with one way propagation delay of 150 milliseconds. Selective retransmission (repeat) protocol is used on this link to send data with a frame size of 1 kilobyte. Neglect the transmission time of acknowledgement. The minimum number of bits required for the sequence number field to achieve 100% utilization is\_\_\_\_\_.

[GATE-2016, Ans: (4)]

- T8. A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames. Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps ( $1 \text{ Kbps} = 1000 \text{ bits/second}$ ). Size of an acknowledgment is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds. Assuming no frame is lost, the sender throughput is \_\_\_\_\_ bytes/second.

[GATE-2016, Ans: (2500)]

# 4

## MAC-Sublayer



### Multiple Choice Questions

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- Q.1** A bridge has access to the \_\_\_\_\_ address of a station on the same network.  
 (a) Physics (MAC)  
 (b) Network  
 (c) Service access point  
 (d) All of the above
- Q.2** A System with redundant bridges might have a problem with \_\_\_\_\_ in the system.  
 (a) Loops                         (b) Filters  
 (c) Spanning trees              (d) All the above
- Q.3** Suppose that 'N' Ethernet stations, all trying to send at the same time, require  $N/2$  slot times to sort out who transmits next. Assuming the average packet size is 5 slot times, express the utilization of Ethernet as a function of N.  
 (a)  $5/(N+10)$                   (b)  $10/(10+N)$   
 (c)  $10/N$                          (d)  $10/(5+N)$
- Q.4** A channel with latency of 50 ms and bandwidth of 45 Mbps can hold  
 (a) 280 KB of data              (b)  $2.25 \times 10^6$  bits  
 (c)  $1.11 \times 10^{-9}$  bits        (d)  $0.9 \times 10^9$  bits
- Q.5** In Ethernet CSMA/CD, what is the special bit sequence transmitted by media access management collision handling?  
 (a) Jamming signal              (b) Preamble  
 (c) Postamble                     (d) All of the above
- Q.6** In a network system if packet size is 2 kB, propagation time is 30 milliseconds and channel capacity is  $10^6$  bits/sec. What will be transmission time?

- (a) 16.0 millisecond   (b) 17.3 millisecond  
 (c) 16.0 microsecond   (d) 21 microsecond

- Q.7** What is the signal to noise ratio is needed to put a T<sub>1</sub> carrier on a 50 kHz line? (T<sub>1</sub> standard is 1.544 Mbps)  
 (a) 53 dB                         (b) 46.6 dB  
 (c) 93 dB                         (d) 100 dB

- Q.8** There are n stations in a slotted LAN. Each station attempts to transmit with a probability p in each time slot. What is the probability that ONLY one station transmits in a given time slot ?  
 (a)  $np(1-p)^{n-1}$                  (b)  $(1-p)^{n-1}$   
 (c)  $p(1-p)^{n-1}$                  (d)  $1-(1-p)^{n-1}$

[GATE-2007]

- Q.9** A network with CSMA/CD protocol in the MAC layer in the MAC layer is running a 1 Gbps over a 1 km cable with no repeaters. The signals speed in the cable is  $2 \times 10^8$  m/sec. The minimum frame size for this network should be  
 (a) 10000 bits                   (b) 10000 bytes  
 (c) 5000 bits                    (d) 5000 bytes

[GATE IT-2005]

- Q.10** Match the following:

- |             |                 |
|-------------|-----------------|
| I. 802.3    | P. Wireless LAN |
| II. 802.11  | Q. Bluetooth    |
| III. 802.15 | R. Ethernet     |
| IV. 802.16  | S. Wireless MAN |
- (a) I-R, II-P, III-Q, IV-S  
 (b) I-S, II-R, III-Q, IV-P  
 (c) I-R, II-Q, III-S, IV-P  
 (d) I-S, II-Q, III-R, IV-P

[DRDO-2008]

- Q.11 In a hub based LAN system, collision is detected by  
 (a) hub  
 (b) transmitting node  
 (c) hub and transmitting node  
 (d) receiving node

[DRDO-2009]

- Q.12 For a band limited signal, the Nyquist theorem specifies the maximum sampling rate to be  
 (a) twice the lowest frequency of the signal.  
 (b) twice the highest frequency of the signal.  
 (c) twice the bandwidth of the signal.  
 (d) None of the above

[DRDO-2009]

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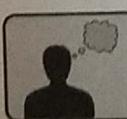
Q.18 Consider a simplified time slotted MAC protocol, where each host always has data to send and transmits with probability  $p = 0.2$  in every slot. There is no backoff and one frame can be transmitted in one slot. If more than one host transmits in the same slot, then the transmissions are unsuccessfully due to collision.

What is the maximum number of hosts which this protocol can support, if each host has to be provided a minimum throughput of 0.16 frames per time slot?

[GATE IT-2004]

- Q.19 In a TDM medium access control bus LAN, each station is assigned one time slot per cycle for transmission. Assume that the length of each time slot is the time to transmit 100 bits plus the end-to-end propagation delay. Assume a propagation speed of  $2 \times 10^8$  m/sec. The length of the LAN is 1 km with a bandwidth of 10 Mbps. The maximum number of stations that can be allowed in the LAN so that the throughput of each station can be 2/3 Mbps is \_\_\_\_\_.  
 [GATE IT-2005]

- Q.20 The round trip propagation delay for a 100 Mbps Ethernet having 48-bit jamming signal is 64 ms. What is the minimum frame size (in bytes)?  
 [DRDO-2008]



### Try Yourself

- T1. Consider two machines, A and B, connected by a 100 Mbps ethernet with three store and forward relay switches in path between them. Suppose that no other machines are using the ethernet, that each of the link introduces a propagation delay of 12  $\mu$ s, and that switch begins transmitting a packet immediately after receiving the last bit of the packet. What is the total transfer time for a 1500 bytes packet, as measured from transmission of the first bit from A to the receipt of last bit at B?

[Ans: (528)]

T2. In P-persistent CSMA network there are 5 systems in a slot. The probability of station not transmitting the data is 0.6. Only two stations should transmit the data to avoid collision. What is the probability that channel is collision free?

[Ans: (0.3456)]

T3. Determine the maximum length of the cable (in km) for transmitting data at a rate of 100 Mbps in Ethernet LAN with frame size of 1000 bits. Assume signal speed as  $2 \times 10^5$  km/sec.

[Ans: (1)]

T4. A 4 Mbps token ring has a token holding time value of 10 ms. What is the longest frame that can be sent on this ring? (in bits)

[Ans: (40000)]

T5. What is the minimum frame size in (bits) CSMA/CD, if 100 base 5 cable is used? (Assume velocity of data =  $2 \times 10^8$  m/s)

[Ans: (500)]

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T6. A network has a data transmission bandwidth of  $20 \times 10^6$  bits per second. It uses CSMA/CD in the MAC layer. The maximum signal propagation time from one node to another node is 40 microseconds. The minimum size of a frame in the network is \_\_\_\_\_ bytes.

[GATE-2016, Ans: (200)]

T7. In an Ethernet local area network, which one of the following statements is TRUE?

- (a) A station stops to sense the channel once it starts transmitting a frame.
- (b) The purpose of the jamming signal is to pad the frames that are smaller than the minimum frame size.
- (c) A station continues to transmit the packet even after the collision is detected.
- (d) The exponential backoff mechanism reduces the probability of collision on retransmissions.

[GATE-2016, Ans: (d)]





## Multiple Choice Questions

## Common Data For Q.1 &amp; Q.2

Suppose a router receives an IP packet containing 600 data bytes and has to forward the packet to a network with maximum transmission unit of 200 bytes. Assume that IP header is 20 bytes long.

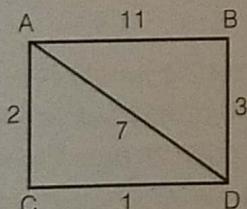
**Q.1** Calculate the numbers of fragments

- (a) 1
- (b) 2
- (c) 3
- (d) 4

**Q.2** Identify the fragmentation off-sets

- (a) 0, 20, 40, 60
- (b) 0, 22, 44, 66
- (c) 0, 30, 60, 90
- (d) 0, 32, 64, 96

**Q.3** Consider the following network.



Using distance vector routing, the distance to B that A will store initially in its routing table is \_\_\_\_\_ and once the routes have been converged, the distance to B that A will store in its routing table is \_\_\_\_\_?

- (a) 6 and 6 respectively
- (b) 6 and 11 respectively
- (c) 11 and 6 respectively
- (d) 11 and 11 respectively

**Q.4** Suppose a program transmits 64 short UDP packets to a certain host. Which of the following statements is not true, assuming that none of the packets get dropped?

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- (a) If the packets are transmitted over a circuit-switched network, then the packets are guaranteed to arrive in order.
- (b) If the packets are transmitted over a local area packet-switched network with fixed routing tables, then the packets are guaranteed to arrive in order.
- (c) If the packets are transmitted over a wide area packet-switched network with dynamic routing then packets are guaranteed to arrive in order.
- (d) Regardless of the routers or underlying network there is a nonzero probability that the packets will arrive in order.

**Q.5** Which one of the following statements is FALSE?

- (a) Packet switching leads to better utilization of bandwidth resources than circuit switching.
- (b) Packet switching results in less variation in delay than circuit switching.
- (c) Packet switching requires more per-packet processing than circuit switching.
- (d) Packet switching can lead to reordering unlike in circuit switching.

[GATE IT-2004]

**Q.6** A router has two full-duplex Ethernet interfaces each operating at 100 Mbps. Ethernet frames are at least 84 bytes long (including the Preamble and the Inter-Packet-Gap). The maximum packet processing time at the router for wirespeed forwarding to be possible is (in micro seconds)

- (a) 0.01
- (b) 3.36
- (c) 6.72
- (d) 8

[GATE IT-2006]



- (a) TCP, but not UDP
- (b) TCP and UDP
- (c) UDP, but not TCP
- (d) Neither TCP nor UDP

**Linked Answer For Q.14 & Q.15**

**Q.14** Suppose an  $x$ -bit message was send over a  $k$ -hop path in a circuit switched network. The circuit setup time is ' $s$ ' seconds; the propagation delay is  $d$  seconds per hop. The packet size is  $p$  bits, and the data rate is  $b$  bps. At what time, the message arrives at the receiver side?

- (a)  $t = s(k - 1) + \frac{x}{b}$
- (b)  $t = s + kd + b$
- (c)  $t = s + \frac{x}{b} + kd$
- (d)  $t = \frac{x}{b}$

**Q.15** Suppose, the message was sent in a lightly loaded packet switched network with the above said properties and  $s > (k-1)p/b$  we can conclude that,

- (a) Circuit switching is faster than packet switching.
- (b) Packet switching is faster than circuit switching.
- (c) Both packet and circuits switching are transmitting at the same rate
- (d) None of the above

**Q.16** One of the header fields in an IP datagram is the Time-to-Live (TTL) field. Which of the following statements best explain the need for this field?

- (a) It can be used to prioritize packets
- (b) It can be used to reduce delays
- (c) It can be used to optimize throughput
- (d) it can be used to prevent packet looping

[GATE-2010]

**Q.17** Which network forwards packet according to host destination adders?

- (a) Circuit switened, networks
- (b) Both datagram and virtual circuit networks
- (c) Datagram networks
- (d) Virtual circuit networks

**Q.18** Which of the following is a list of packet switching characteristics?

- (a) Bandwidth divided, translation tables for routing, destination address
- (b) Bandwidth shared, queues at router, different path possible
- (c) Bandwidth divided, store and forward, good for bursty data
- (d) Bandwidth shared, low transmission delay, routes may change

**Q.19** Resource reservation is a feature of

- (a) Both packet switching and circuit switching
- (b) Circuit switching
- (c) Packet switching
- (d) None of these

**Q.20** What information is used by a process running on one host to identify a process on another host?

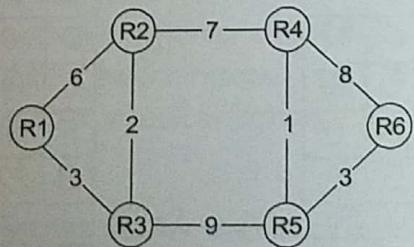
- (a) IP address
- (b) Process ID
- (c) Process descriptions
- (d) Port number

**Q.21** Which of following protocols may be used to obtain IP address given a physical address

- (a) RARP
- (b) BOOTP
- (c) DHCP
- (d) All of these

**Linked Answer For Q.22 & Q.23**

Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram.



**Q.22** All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

- (a) 4                                 (b) 3  
 (c) 2                                 (d) 1

Q.23 Suppose the weights of all unused links in the previous question are changed to 2 and the distance vector algorithm is used again until all routing tables stabilize. How many links will now remain unused?

- (a) 0                                     (b) 1  
 (c) 2                                     (d) 3



### Numerical Data Type Questions

Q.24 In a token ring network the transmission speed is  $10^7$  bps and the propagation speed is 200 meters/ $\mu$ s. The 1-bit delay in the network is equivalent to \_\_\_\_\_ meters of cable.

Q.25 A computer on 6 Mbps network is regulated by token bucket. The token bucket is filled at the rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long (in sec) can the computer at the fill 6 Mbps.

Q.26 The number of layers in X.25 network is \_\_\_\_.  
 [JNUEE-2008]



### Try Yourself

- T1. Which of the following are Dynamic Algorithms?  
 I. Distance Vector Routing  
 II. Flooding Algorithm  
 III. Link State Routing  
 IV. Path Vector Algorithm  
 (a) Only II, III and IV (b) Only I, II and IV  
 (c) Only I, II and III (d) Only I, III and IV  
 [Ans: (d)]

- T2. Which of the following is NOT true?  
 (a) BGP is an Intra Domain Protocol  
 (b) RIP is a Path Vector Routing Algorithm  
 (c) OSPF is a Distance Vector Routing Algorithm  
 (d) All of the above  
 [Ans: (d)]

- T3. Consider a network having 6 nodes A, B, C, D, E and F. The measured delay between A to B, A to D and A to C are 4, 5 and 6 respectively. Which of the following is routing table of A using distance vector routing? The vector tables of B, D, C are given as follows

$$(A, B, C, D, E, F)$$

Vector table of B = (2, 0, 4, 4, 3, 2)

Vector table of C = (5, 4, 0, 2, 7, 4)

Vector table of D = (5, 1, 3, 0, 3, 6)

- (a) 

	A	B	C	D	E	F
Via	0	4	6	5	7	6
-	B	C	D	B	B	B
- (b) 

	A	B	C	D	E	F
Via	0	6	6	4	5	7
-	B	C	D	B	B	B
- (c) 

	A	B	C	D	E	F
Via	0	4	6	6	5	7
-	B	C	D	B	B	B
- (d) None of these

[Ans: (a)]

- T4. Pick the true statements from the following.  
 (i) Circuit switching is a store and forward technique  
 (ii) Packet switching is faster compared to circuit switching.  
 (iii) Packet switching wastes less resources compared to circuit switching  
 (iv) Packet switching is not a store and forward technique.  
 (a) only (ii)                             (b) (ii) and (iii)  
 (c) only (i) and (iv)                     (d) All of these  
 [Ans: (b)]

- T5. Consider a route in a store and forward network going through 9 intermediate nodes. The packet contains 1100 bits and are transmitted at 64 Kbps. Assume propagation delay over the links are negligible. As a packet travels along the route, it encounters an average of 5 packets when it arrives at each node. How long does it take for the packet to get to the receiver if the nodes transmit on a "first come first served" basis (in ms)?  
 [Ans: (945.3)]

- T6. Which of the following assertions is False about the IP?
- IP is possible for a computer to have multiple IP addresses
  - IP packets from the same source to the same destination can take different routes in the network
  - IP ensures that a packet is discarded if it is unable to reach its destination within a given number of hops
  - The packet source cannot see the route of an outgoing packets the route is determined only by the routing tables in the routers on the way

[Ans: (d)]

- T7. An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose MTU (maximum transmission unit) is 100 bytes. Assume that the size of the IP header is 20 bytes. The number of fragments that the IP datagram will be divided into for transmission is \_\_\_\_\_.

[GATE-2016, Ans: (13)]



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Q.1 A tim

- th
- z
- t
- f

Q.2 Err  
data  
(a)  
(b)  
(c)  
(d)

Q.3 Su  
to  
ar  
ad  
se  
(a)  
(c)

Q.4 S  
o  
fo  
S



## Multiple Choice Questions

**Q.1** A time-exceeded message is generated if \_\_\_\_\_

- (a) the round trip time between hosts is close to zero
- (b) the time-to-live field has a zero value
- (c) fragments of a message do not arrive within a set time
- (d) both (b) and (c)

**Q.2** Errors in the header or option fields of an IP datagram require a \_\_\_\_\_ error message.

- (a) parameter problem
- (b) source quench
- (c) router solicitation
- (d) redirection

**Q.3** Suppose Host A sends over a TCP connection to Host B one segment sequence number 38 and 4 bytes of data. What will be acknowledgments number for the subsequent segment?

- (a) 38
- (b) 39
- (c) 42
- (d) 54

**Q.4** Suppose Host A is sending Host B a large file over a TCP connection. Then which of the following statements is/are true?

**S1:** The number of unacknowledged bytes that A sends cannot exceed the size of the receiver buffer

**S2:** If the sequence number for a segment of this connection is m, then the sequence number of the subsequent segment will be necessarily  $(m+1)$

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- (a) Only S1
- (b) Only S2
- (c) Both S1 & S2
- (d) None of the above

**Q.5** Which of the following protocol in TCP/IP network is responsible for error reporting mechanism.

- (a) TFTP
- (b) IGMP
- (c) RIP
- (d) ICMP

**Q.6** Which of the following assertions is FALSE about the Internet Protocol (IP)?

- (a) It is possible for a computer to have multiple IP addresses
- (b) IP packets from the same source to the same destination can take different routes in the network
- (c) IP ensures that a packet is discarded if it is unable to reach its destination within a given number of hops
- (d) The packet source cannot set the route of an outgoing packets; the route is determined only by the routing tables in the routers on the way

[GATE-2003]

**Q.7** Which one of the following statements is False?

- (a) TCP guarantees a minimum communication rate
- (b) TCP ensures in-order delivery
- (c) TCP reacts to congestion by reducing sender window size
- (d) TCP employs retransmission to compensate for packet loss

[GATE IT-2004]

**Q.8** In a communication network, a packet of length L bits takes link L1 with a probability of  $p_1$  or link L2 with a probability of  $p_2$ . Link L1 and L2

have bit error probability of  $b_1$  and  $b_2$  respectively. The probability that the packet will be received without error via either L1 or L2 is

- (a)  $(1 - b_1)^L p_1 + (1 - b_2)^L p_2$
- (b)  $[1 - (b_1 + b_2)^L] p_1 p_2$
- (c)  $[1 - (b_1^L)(1 - b_2^L)] p_1 p_2$
- (d)  $1 - (b_1^L p_1 + b_2^L p_2)$

[GATE IT-2005]

- Q.9** A program on machine X attempts to open a UDP connection to port 5376 on a machine Y, and a TCP connection to port 8632 machine Z. However, there are no application listening at the corresponding ports on Y and Z. An ICMP Port unreachable error will be generated by
- (a) Y but not Z
  - (b) Z but not Y
  - (c) Neither Y nor Z
  - (d) Both y and Z

[GATE IT-2006]

- Q.10** Which two control signals are used for handshaking between computer and modem for their existence?
- (a) Request to send and Clear to send
  - (b) Ring indicator and Data carrier detect
  - (c) Data set ready and Data terminal ready
  - (d) Data carrier detect and Data terminal ready

[DRDO-2009]

- Q.11** Maximum payload which can be carried by an IP V4 datagram is
- (a) 65495 bytes
  - (b) 65515 bytes
  - (c) 65475 bytes
  - (d) 65535 bytes

- Q.12** Which field does not belong to the IPv4 Datagram Format?
- (a) Version
  - (b) Total Length
  - (c) Time to Live
  - (d) Payload Length

- Q.13** If station A sends out a RARP\_REQUEST, what is station A trying to learn?
- (a) its own physical address
  - (b) its own logical address
  - (c) physical address of another station
  - (d) logical address of another station

- Q.14** What is not an IP routing protocol?
- (a) BGP
  - (b) EGP
  - (c) OSPF
  - (d) LLC

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- Q.15** What to do with a packet for a Station which is not on the local network?

- (a) Send packet to gateway specified in the routing table.
- (b) Discard packet.
- (c) Use ARP to get physical address of the Station and send packet directly.
- (d) Send packet to all stations using broadcast.

- Q.16** What is not an advantage of IPv6?

- (a) longer addresses
- (b) mobility is supported
- (c) increased security
- (d) better checksum algorithms

- Q.17** Which IP protocol is used to implement "ping"?

- |          |          |
|----------|----------|
| (a) IGMP | (b) ICMP |
| (c) CGMP | (d) BGP  |

### Numerical Data Type Questions

- Q.18** A TCP message consisting of 2100 bytes is passed to IP for delivery across two networks. The first network can carry a maximum payload of 1200 bytes per frame and the second network can carry a maximum payload of 400 bytes per frame, excluding network overhead. Assume that IP overhead per packet is 20 bytes. What is the total IP overhead in the second network for this transmission (in bytes)?

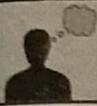
[GATE IT-2004]

#### Linked Answer for Q.19 & Q.20

- Q.19** The Internet host is roughly doubling in size every 18 months. Although no one really knows for sure, one estimate put the number of hosts on it at 7 million in January 1996. Using these data the expected number of internet hosts in the January 2008 is (in billion)

- Q.20** In order to connect these numbers of hosts the minimum number of networks required in class A is \_\_\_\_\_.

- Q.21** How long (in bytes) is the IP header in minimum?



### Try Yourself

T1. Match the following TCP timers with their functionality.

List-I

- A. RTO timer
- B. Keep alive timer
- C. Persistent timer
- D. Time WAIT timer

List-II

1. It runs for twice the maximum packet life time to make sure all packets are died off when connection is closed.
2. It is designed to prevent dead lock.
3. After this timer goes off the system will check if other side system is still there.
4. If ACK failed to arrive before the timer goes off, then segment is retransmitted.

Codes:

A	B	C	D
(a) 1	2	3	4
(b) 4	3	2	1
(c) 1	4	3	2
(d) 1	3	4	2

[Ans: (b)]

T2. Two hosts are connected via a packet switch with  $10^7$  bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in microseconds is \_\_\_\_\_.

[GATE-2015, Ans: (1575)]

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T3. Which of the following is NOT true with respect to a transparent bridge and a router?

- (a) Both bridge and router selectively forward data packets
- (b) A bridge uses IP addresses while a router MAC addresses
- (c) A bridge builds up its routing table by inspecting incoming packets
- (d) A router can connect between a LAN and a WAN

[Ans: (b)]

T4. For which of the following reasons does IP use the TTL in IP datagram header?

- (a) Ensure packets reach destination within that time
- (b) Discard packets that reach later than that time
- (c) Prevent packets from looping indefinitely
- (d) Limit the time for which a packet gets queued in intermediate routers

[Ans: (c)]

T5. Which of the following explains best about TTL?

- (a) Used for prioritizing packets
- (b) Used to reduce delays
- (c) Used to optimize throughput
- (d) Used to prevent packet looping

[Ans: (d)]

T6. For a host machine that uses the token bucket algorithm for congestion control, the token bucket has a capacity of 1 megabyte and the maximum output rate is 20 megabytes per second. Tokens arrive at a rate to sustain output at a rate of 10 megabytes per second. The token bucket is currently full and the machine needs to send 12 mega bytes of data. The minimum time required to transmit the data is \_\_\_\_\_ seconds.

[GATE-2016, Ans: (1.1)]



# 7

## Transport Layer



### Multiple Choice Questions

#### Linked Answer For Q.1 & Q.2

- Q.1 The TCP round trip time is currently 35 msec, and it takes a segment at this moment to be acknowledged in 32 ms after which the new RTT value is to be calculated. Then the next acknowledgment comes in after 40 ms. If  $\alpha = 0.9$  then finally what will be the new estimated RTT?
- (a) 34.7 ms      (b) 35.5 ms  
(c) 35.23 ms      (d) 38.4 ms
- Q.2 What will be the retransmission after time-out in basic algorithm?
- (a) 70.46 ms      (b) 86.14 ms  
(c) 70.10 ms      (d) 76.8 ms
- Q.3 Which of the following statements is/are true?  
**S1:** TCP is connection-oriented, and packets follow the same route from sender to receiver  
**S2:** SMTP packets follow the same route from sender to receiver.
- (a) Only S1 is true  
(b) Only S2 is true  
(c) Both S1 and S2 are true  
(d) Both S1 and S2 are false
- Q.4 **Assertion (A):** TCP cannot be used for multicasting and broadcasting applications.  
**Reason (R):** Congestion window in TCP dictates the traffic flow.
- (a) Both (A) and (R) are true and (R) is the correct reason for (A)
- Q.5 If the TCP round trip time, (RTT) is currently 30 msec and the following acknowledgments come in after 26.32 and 24 ms respectively. What is new RTT estimate use  $\alpha = 0.9$ ?
- (a) 29.6 ms      (b) 29.84 ms  
(c) 29.0688 ms      (d) 29.856 ms
- Q.6 Which one of the following will definitely result in data gram fragmentation?
- (a) Transmitting over a message-switched network  
(b) Transmitting over a circuit-switched network  
(c) Transmitting over a packet-switched network  
(d) Transmitting datagrams longer than the physical layer's maximum transmission unit
- Q.7 Which of the following functionalities must be implemented by a transport protocol over an layer above the network protocol?
- (a) Recovery from packet losses  
(b) Detection of duplicate packets  
(c) Packet delivery in the correct order  
(d) End to end connectivity
- [GATE-2003]
- Q.8 Which one of the following uses UDP as the transport protocol?
- (a) HTTP      (b) Telnet  
(c) DNS      (d) SMTP
- [GATE-2007]

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Q.9 Match the following:

- |         |                      |
|---------|----------------------|
| P. SMTP | 1. Application layer |
| Q. BGP  | 2. Transport layer   |
| R. TCP  | 3. Data link layer   |
| S. PPP  | 4. Network layer     |
|         | 5. Physical layer    |
- (a) P-2, Q-1, R-3, S-5  
 (b) P-1, Q-4, R-2, S-3  
 (c) P-1, Q-4, R-2, S-5  
 (d) P - 2, Q - 4, R - 1, S - 3

[GATE-2007]

Q.10 What is the maximum size of data that the application layer can pass on the TCP layer below?

- (a) Any size  
 (b)  $2^{16}$  bytes -size of TCP header  
 (c)  $2^{16}$  bytes  
 (d) 1500 bytes

[GATE-2008]

Q.11 In the slow start phase of the TCP congestion control algorithm, the size of the congestion window

- (a) Does not increase  
 (b) Increase linearly  
 (c) Increases quadratically  
 (d) Increases exponentially

[GATE-2008]

Q.12 A client process P needs to make a TCP connection to a server process S. Consider the following situation: the server process S executes a socket(), a bind() and a listen() system call in that order, following which it is preempted. Subsequently, the client process P executes a socket() system call followed by connect() system call to connect to the server process S. The server process has not executed any accept() system call. Which one of the following events could take place?

- (a) Connect() system call returns successfully  
 (b) Connect() system call will wait  
 (c) Connect() system call returns an error  
 (d) Connect() system call results in a core dump

[GATE-2008]

Q.13 A sender is employing public key cryptography to send a secret message to a receiver. Which one of the following statements is TRUE?

- (a) Sender encrypts using receiver's public key  
 (b) Sender encrypts using his own public key  
 (c) Receiver decrypts using sender's public key  
 (d) Receiver decrypts using his own public key

[GATE IT-2004]

Q.14 On a TCP connection, current congestion window size is congestion window = 4 kB. The window size advertised by the receiver is Advertise Window = 6 kB. The last byte sent by the sender is last byte Sent = 10240 and the last byte acknowledged by the receiver is 8192. The current window size at the sender is

- (a) 2048 bytes      (b) 4096 bytes  
 (c) 6144 bytes      (d) 8192 bytes

[GATE IT-2005]

Q.15 Consider a TCP connection in a state where there are no outstanding ACKs. The sender sends two segments back to back. The sequence numbers of the first and second segments are 230 and 290 respectively. The first segment was lost, but the second segment was received and Y be the ACK number sent by the receiver. X be the size of the first segment.

The Values of X and Y (in that order) are

- (a) 60 and 290      (b) 230 and 291  
 (c) 60 and 231      (d) 60 and 230

[GATE IT-2007]

Q.16 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. TELNET  
 B. FTP  
 C. NNTP  
 D. DNS

List-II

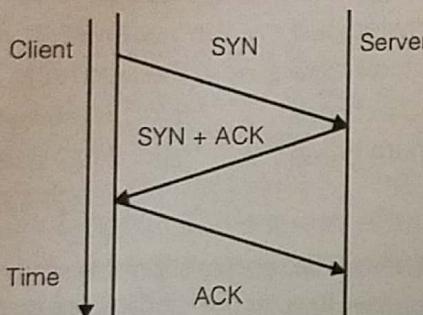
1. Mapping host names on to their network address  
 2. Move data efficiency from one machine to another

3. Allows user on one machine to log into a distant machine and work there
4. Moving new articles around
5. The protocol used for fetching pages on the World Wide Web

**Codes :**

A	B	C	D
(a) 2	1	4	5
(b) 3	2	1	4
(c) 3	2	4	1
(d) 1	2	3	4

**Q.17** The three way handshake for TCP connection establishment is shown below



Which of the following statements are TRUE?

- S1:** Loss of SYN + ACK from the server will not establish a connection.
- S2:** Loss of ACK from the client cannot establish the connection.
- S3:** The server moves LISTEN → SYN\_RECV → SYN\_SENT → ESTABLISHED in the state machine on no packet loss.
- S4:** The server moves LISTEN → SYN\_RECV → ESTABLISHED in the state machine on no packet loss.
- (a) S2 and S3 only    (b) S1 and S4 only  
 (c) S1 and S3 only    (d) S2 and S4 only

[GATE IT-2008]

**Q.18** Which of the following is false about DNS?

- (a) DNS is a client server application  
 (b) DNS uses the services of UDP for the messages of <512 BN, Otherwise TCP  
 (c) DNS tree can have only 64 levels  
 (d) DNS organizes the name space in a hierarchical structure

**Q.19** Error control is needed at the transport layer because of potential error occurring

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- (a) from transmission line losses
- (b) in routers
- (c) due to out of sequence delivery
- (d) from packet losses

[DRDO-2009]

**Q.20** Find the match between the elements of List-I and List-II as given below:

**List-I**

- A. NNTP
- B. SSH
- C. Daemon
- D. Tomcat

**List-II**

1. Web server
2. Background process for system administration
3. Protocol to read and post news
4. Allow to connect securely to remote machine
5. Mail sever

**Codes:**

A	B	C	D
(a) 5	2	4	3
(b) 3	4	2	1
(c) 5	4	2	1
(d) 3	2	4	5

[DRDO-2009]

**Q.21** Telnet has

- (a) separate data and control connection
- (b) common connection for data and control
- (c) default port number is 25
- (d) None of these

**Q.22** HTTP is

- (a) statefull protocol    (b) stateless protocol
- (c) default port no. 80    (d) Both (b) and (c)

**Q.23** SMTP is

- (a) default port is 30    (b) textbase protocol
- (c) push protocol    (d) Both (b) and (c)

**Q.24** HTTP has

- (a) persistent connection
- (b) nonpersistent connection
- (c) Both (a) and (b)
- (d) None of these



## Numerical Data Type Questions

Q.25 TCP operates over a 40 Gbps link. If TCP uses the full bandwidth continuously, how long (in ms) would it take the sequence numbers to wraparound completely?

Q.26 Suppose that the maximum transmit window size for a TCP connection is 12000 bytes. Each packet consists of 2000 bytes. At some point of time, the connection is in slow-start phase with a current transmit window of 4000 bytes. Subsequently the transmitter receives two acknowledgment. Assume that no packets are lost and there are no time-outs. What is the maximum possible value of the current transmit window? (in bytes) [GATE IT-2004]

Q.27 A computer on a 6 Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 2 Mbps. It is initially filled to a full capacity of 8 Mb. How long (in sec) can the computer transmit at the full 6 Mbps?

[DRDO-2008]

Q.28 If TCP uses 32 bits in TCP header for sequence number field, what is the TCP sequence number wraparound time (in minutes) for 45 Mbps line?

Q.29 A resource record of DNS has Time to live field which gives the indication of how stable the record is. Such information which is highly stable is assigned to \_\_\_\_\_.



### Try Yourself

T1. Assume that the bandwidth for a TCP connection is 1048560 bits/sec. Let  $a$  be the value of RTT in milliseconds (rounded off to the nearest integer) after which the TCP window scale option is needed. Let  $b$  be the maximum possible window size with window scale option. Then the values of  $a$  and  $b$  are  
 (a) 63 milliseconds  $65535 \times 2^{14}$   
 (b) 63 milliseconds  $65535 \times 2^{16}$   
 (c) 500 milliseconds  $65535 \times 2^{14}$   
 (d) 500 milliseconds  $65535 \times 2^{16}$

[GATE-2015, Ans: (c)]

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T2. Let the window size be  $W$  at the beginning of RTT. Assuming there are no losses in the RTT time. What are the respective window sizes for SLOW START and CONGESTION AVOIDANCE after completion of RTT?

(a)  $2W - 1, \frac{2W+1}{2}$  (b)  $W + 1, \frac{2W}{2}$

(c)  $W + 1, W - 1$  (d)  $2W, W + 1$

[Ans: (d)]

T3. The initial congestion window size over a TCP is 1. If slow start algorithm is used and the size of congestion window incremented by 1 whenever an ACK is received i.e. after first round trip time congestion window size is 2 segments. Assume connection never leaves slow start. Find the number of RTT's to send 3999 segments.

[Ans: (12)]

T4. The round trip delay between X and Y is given as 60 ms and bottleneck bandwidth of link between X and Y is 512 KBps. What is the optimal window size (in packets) if the packet size is 64 bytes and channel is full duplex.

[Ans: (240)]

T5. Assume the TCP round trip time RTT is currently 30 ms and the following ACK's come in after 26, 32 and 24 ms respectively. What is the new RTT estimate (in ms) using Jacobson's algorithm ( $\alpha = 0.9$ )? (where  $\alpha$  is smoothing factor)

[Ans: (29.25)]

T6. Which of the following transport layer protocols is used to support electronic mail?  
 (a) SMTP (b) IP  
 (c) TCP (d) UDP

[Ans: (c)]

T7. Which one of the following socket API functions converts an unconnected active TCP socket into a passive socket?  
 (a) Connect (b) Bind  
 (c) Listen (d) Accept

[Ans: (c)]



## 8

## Network Security



## Multiple Choice Questions

## Common Data For Q.1 to Q.3

The Diffie-Hellman key exchange is being used to establish a session key between the sender and the receiver with the values of  $n = 23$ ,  $g = 7$ .

- Q.1** If the sender's secret key is  $x = 3$ , then it transmits the message  $(23, 7, \underline{\hspace{2cm}})$ , fill in the blank.  
 (a) 4 (b) 17  
 (c) 21 (d) 28
- Q.2** Receiver's secret key  $y = 6$ , and if it responds with the message  $(\underline{\hspace{2cm}},)$ , fill the blank.  
 (a) 4 (b) 17  
 (c) 21 (d) 28
- Q.3** What is the session key between the sender and the receiver?  
 (a) 4 (b) 7  
 (c) 11 (d) 18

## Common Data For Q.4 &amp; Q.5

RSA algorithm is used with prime numbers 7 and 11 to generate public keys and private keys.

- Q.4** If the 'e' values is chosen as 7, then calculate 'd' value  
 (a) 60 (b) 55  
 (c) 40 (d) 43
- Q.5** Encrypt the plain text 9 using above data  
 (a) 37 (b) 43  
 (c) 47 (d) 53

## Common Data For Q.6 to Q.8

The Diffie-Hallmen key exchange is being used to establish a session key between the sender and the receiver with the values of  $g = 7$ ,  $n = 23$ .

- Q.6** If the sender's secret key is  $x = 3$ , then it transmits the message  $(32, 7, \underline{\hspace{2cm}})$ , fill in the blank  
 (a) 14 (b) 17  
 (c) 21 (d) 23
- Q.7** Receiver's secret key  $y = 5$ , and if it responds with the message  $(\underline{\hspace{2cm}},)$ , fill the blank.  
 (a) 14 (b) 17  
 (c) 21 (d) 23
- Q.8** What is the session key between the sender and the receiver?  
 (a) 14 (b) 17  
 (c) 21 (d) 23

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## Numerical Data Type Questions

## Common Data For Q.9 to Q.11

The Diffie-Hallmen key exchange is being used to establish a session key between the sender and the receiver with the values of  $n = 47$ ,  $g = 3$ .

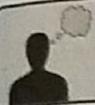
- Q.9** If the sender's secret key is  $x = 8$ , then it transmits the message  $(47, 3, \underline{\hspace{2cm}})$ , fill in the blank.
- Q.10** Receiver's secret key  $y = 10$ , and if it responds with the message  $(\underline{\hspace{2cm}},)$ , fill the blank.
- Q.11** What is the session key between the sender and the receiver?

**T2.** Ram and Sita for generating and Sita chooses value if  $G =$

**T3.** Two gate as the RSA alg. They encr character. T 13 respect integers h algorithm. I text for cor "IIT". Ass characters plain text c is convert RSA (ASC 2, 3,..., re

**T4.** Using pub signature and send one of the for the op

- (a) Encr priv Dec pub  
 (b) Encr priv Dec priv  
 (c) Encr priv Dec priv



## Try Yourself

- T1. Consider a secured environment making use of symmetric key Cryptography. Every host connects every other host. Calculate the number of unique keys required (Symmetric Keys) if there are 5 hosts in the network.

[Ans: (10)]

- T2. Ram and Sita uses the Diffie-Hellman protocol for generating session key. Ram chooses  $y = 3$  and Sita chooses  $x = 5$ . Identify session key value if  $G = 7$  and  $N = 23$

[Ans: (14)]

- T3. Two gate aspirants talking to each other use the RSA algorithm to encrypt their messages. They encrypt the message character by character. The value of  $p$ ,  $q$  and  $d$  are 5, 17 and 13 respectively, where  $p$ ,  $q$  and  $d$  are their integers having usual meaning in the RSA algorithm. Identify the sum of integers in cipher text for corresponding characters in plain text: "IIT". Assume that corresponding cipher characters are placed in their corresponding plain text character places. Also each character is converted to ASCII value before applying RSA (ASCII value of A, B, C,... and so on are 1, 2, 3,..., respectively).

[Ans: (119)]

- T4. Using public key cryptography, X adds a digital signature  $\sigma$  to message M, encrypts  $\langle M, \sigma \rangle$ , and sends it to Y, where it is decrypted. Which one of the following sequence of keys is used for the operation?

(a) Encryption: X's private key followed by Y's private key  
Decryption: X's public key followed by Y's public key

(b) Encryption: X's private key followed by Y's private key  
Decryption: X's public key followed by Y's private key

(c) Encryption: X's public key followed by Y's private key  
Decryption: Y's public key followed by X's private key

(d) Encryption: X's private key followed by Y's public key  
Decryption: Y's private key followed by X's public key

[Ans: (d)]

- T5. Which of the following are used to generate a message digest by the network security protocols?

P : RSA                    Q : RSA-1

R : DES                    S : MD5

- (a) P and R                (b) Q and R  
(c) Q and S                (d) R and S

[Ans: (c)]

- T6. An IP machine Q has a path to another IP machine H via three IP routers R1, R2 and R3

Q — R1 — R2 — R3 — H

H acts as an HTTP server, and Q connects to H via HTTP and downloads file. Session layer encryption is used, with DES as the shared key encryption protocol.

Consider the following 4 pieces of information:

1. The URL of the file downloaded by Q
2. The TCP port numbers at Q and H
3. The IP addresses of Q and H
4. The link layer addresses of Q and H

Which of 1, 2, 3, 4 can an intruder learn through sniffing at R2 alone?

- (a) 1 and 2                (b) 1 only  
(c) 2 and 3                (d) 3 and 4

[Ans: (c)]

- T7. Consider that B wants to send a message  $m$  that is digitally signed to A. Let the pair of private and public keys for A and B be denoted by  $K_x^-$  and  $K_x^+$  for  $x = A, B$ , respectively. Let  $K_x(m)$  represent the operation of encrypting  $m$  with a key  $K_x$  and  $H(m)$  represent the message digest. Which one of the following indicates the CORRECT way of sending the message  $m$  along with the digital signature to A?

- (a)  $\{m, K_B^+(H(m))\}$     (b)  $\{m, K_B^-(H(m))\}$   
(c)  $\{m, K_A^-(H(m))\}$     (d)  $\{m, K_A^+(m)\}$

[GATE-2016, Ans: (b)]

