COMPUTER SCIENCE & INFORMATION TECHNOLOGY

GATE | PSUs

COMPUTER NETWORKS

Volume - I : Study Material with Classroom Practice Questions

Computer Networks

(Classroom Practice Booklet Solutions)

1. Concept Of Layering

01. Ans: (b)

Sol: Data Link Layer is responsible for decoding bit stream into frames.

02. Ans: (c)

Sol: Network Layer has the functionality of determining which route through the subnet to use.

03. Ans: (c)

Sol: Given: At each layer, n bits of information is added/appended.

= nh

Total message = original message+overhead

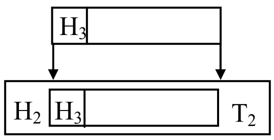
m + nh

$$\% \text{ of overhead } = \frac{nh}{m+nh} \times 100$$

04. Ans: (b)

Sol: packet ⇒ 3 ⇒ NPDU ⇒

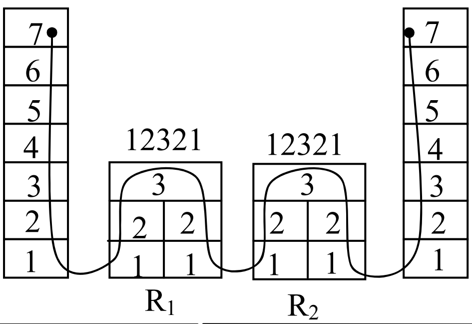
Frame ⇒ 2 ⇒ DPDU ⇒



05. Ans: (b)

Sol: Network Layer – 4 times

Data Link Layer – 6 times



Layer visited

Layer 7 – 2 times

Layer 6 – 2 times

Layer 5 – 2 times

Layer 4 – 2 times

Layer 3 – 4 times → Network Layer

Layer 2 – 6 times → Data Link Layer

Layer 1 – 6 times

06. Ans: (c)

Sol: Transport Layer is responsible for the End to End delivery of the entire message.

07. Ans: (a)

Sol: Data link layer ensures reliable transport of data over a Physical point to point link.

Network layer routes data from one network node to next.

Transport layer allows end to end communication between two processes.

08. Ans: (c)

Sol: Fragment: Network layer (fragmentation)

Segment: Transport layer (segmentation)

There is a restriction on the message length in the subnet, so breaking the lengthy message starts at transport layer.

2. LAN Technologies

01. Ans: (c)

Sol: When the transmission delay is high and propagation delay is low the number of collisions decreases. When the collisions decreases throughput increases.

02. Ans: (a)

Sol: Ethernet uses Manchester encoding in which is bit has two signal segments, so 10Mbps = 10×M×2 signal segments per seconds = 20 mega baud.

03. Ans: (c)

Sol: B = 1 Gbps

d = 1 km

v = 200000 km/sec; L = ?

$$\frac{L}{B} = 2 * \frac{d}{v}$$

$$L = 2 \times \frac{1}{200000} \times 10^9$$

= 10000 bits or 1250 bytes

04. Ans: 200

Sol: L = ?

B = 20 Mbps

T_p = 40 micro sec

$T_x = L/B$

= 100 ms

$T_x = 2T_p$

$$\frac{L}{B} = 2\,T_p$$

$L_{min} = 2T_p \times B$

$= 2 \times 40 \times 10^{-6} \times 20 \times 10^6$

= 2(40) (20) bits = 1600 bits

= 200 Bytes

05. Ans: (b)

Sol: Collision number for A is 1, and for B it is 2.

Possible numbers for 'A' from backoff algorithm is (0,1),

for B they are (0, 1, 2, 3)

Going by the Combinations,

A will have 5 chances and

B has 1 chance out of 8.

Rest of the two is Undecided.

n = 1, A = (0,1) , B = (0,1)

A	B	Remark
0	0	Collision
0	1	A = ¼
1	0	B = 1/4
1	1	Collision

n = 2, A = (0,1) , B = (0,1,2,3)

A	B	Remark
0	0	Collision
0	1	A
0	2	A
0	3	A
1	0	B
1	1	Collision
1	2	A
1	3	A

$$\therefore\; A = \frac{5}{8} = 0.625,\quad B = \frac{1}{8} = 0.125$$

Hence Probability for 'A' in 5/8 = 0.625.

06. Ans: (c)

Sol: Frame Transmission time = $1000/10 \times 10^6$

= 100μs

At time t = 0 both A & B transmit

At time t = 12.5μs a detects collision

At time t = 25 μs

Last bit of B's aborted transmission arise at A.

At t = 37.5μs first bit of A's retransmissions arrives at B.

At 37.5μs A's packet is completely arrives B.

100 + 37.5 = 137.5

07. Ans: 0.4404

Sol: All k-stations

For a stations $P(1 - P)^k$

For some stations among k-station

$= k.P(1–P)^{k–1}$

S_1	S_2	S_3	S_4
P	**1 – P**	**1 – P**	**1 – P**

For S_1 (0.1) (0.8) (0.7) (0.6) = 0.0336

For S_2 (0.9) (0.2) (0.7) (0.6) = 0.0756

For S_3 (0.9) (0.8) (0.3) (0.6) = 0.1296

For S_4 (0.9) (0.8) (0.7) (0.4) = 0.2016

0.4404

Probability for any one station among S_1, S_2, S_3, S_4 to send a frame without collision = 0.4404.

08. Ans: (b)

Sol: B = 10 Mbps

Slot time = 51.2 μsec

L = 512 bytes

Number of slots = 1.716

Transmission time = $\frac{L}{B}$

$= \frac{512 \times 8 (bits)}{10 \times 10^6}$

$= 4.096 \times 10^{-4}$

Contention width = no. of slots × slot time

$= 1.716 \times 51.2 = 87.85$ μsec

$= 87.85 \times 10^{-6}$ seconds

$$\eta = \frac{\frac{L}{B}}{\text{contention width} + \frac{L}{B}}$$

$$\eta = \frac{4.096\times10^{-4}}{4.096\times10^{-4} + 87.85\times10^{-6}} = 82.3\%$$

3. Data Link Layer

01. Ans: (c)

Sol:

```
1011)  01011011000 (01000011
         1011
       ------------
              1100
              1011
       ------------
                1110
                1011
       ------------
                  101
                 \___/
                  CRC
```

02. Ans: (a)

1	2	3	4	5	6	7	8	9	10	11
$\underline{1}$	$\underline{0}$	$\underline{1}$	$\underline{1}$	$\underline{0}$	$\underline{1}$	$\underline{0}$	$\underline{1}$	$\underline{1}$	$\underline{1}$	$\underline{1}$
2^0	2^1		2^2				2^3			

3=1+2 5=1+4	$1 \Rightarrow 10011$	Even parity 1
6=2+4	$2 \Rightarrow 11011$	0
7=1+2+4 9=1+8	$4 \Rightarrow 010$	1
10=2+8 11=1+2+8	$8 \Rightarrow 111$	1

Hamming code = $\underline{10}1\underline{1}010\underline{1}111$

03. Ans: 4.7

L = 1000 bits

d = 100×10^3 m

V = 2×10^8 m/sec

B = 20 Mbps = 20×10^6 bps

$$T_X = \frac{L}{B} = \frac{1000\,\text{bits}}{20\times10^6\,\text{bps}} = 5\times10^{-5}\text{ sec}$$

$$T_P = \frac{d}{v} = \frac{100\times10^3\,\text{m}}{2\times10^8\,\text{m/sec}} = 5\times10^{-4}\text{ sec}$$

$$a = \frac{T_P}{T_X} = \frac{5\times10^{-4}}{5\times10^{-5}} = 10$$

$$\text{Efficiency }(\eta) = \frac{1}{1+2a}$$

$$= \frac{1}{1+2\times10} = \frac{1}{21} = 0.047 = 4.7\%$$

04. Ans: 160 bits

Sol: B = 4 Kbps

Propagation delay = 20 msec

η = 50%

RTT = 2 × Propagation

= 40 msec

L = BR N = 50 then L = BR

= $4 \times 10^3 \times 40 \times 10^{-3}$

= 160 bits

05. Ans: 10.8

Sol: B = 1.5 Mbps

RTT (Round Trip Time) = 45ms

L = 1 KB

$$\text{Link utilization} = \frac{L}{L+BR}$$

$$\frac{1024\times 8}{(1024\times 8)+1.5\times 10^{6}\times 45\times 10^{-3}}$$

$$=\frac{8192}{8192+67500}=\frac{8192}{75692}=0.108=10.8\%$$

06. Ans: (c)

Sol: Propagation delay = 100 μsec

d = 20 KM

L = 1 Kb = 1024 ×8 bits

B =?

RTT = Transmission delay

RTT = 2 × Propagation delay

RTT = 200 μsec

Transmission delay = L/B

$$B=\frac{1024\times 8}{200\times 10^{-6}}=40\text{ Mbps}$$

07. Ans: 2500

Sol: B = 80 kbps

L = 1000 bytes

T_p = 100 ms

T_x = L/B = 100 ms

Tax = ack size/ bandwidth = 100 ms

Efficiency = tx/(tx +2tp+tax) = $\frac{100}{400}=0.25$

Throughput = efficiency * bandwidth

= 0.25 *10^4 bytes

= 2500 bytes

08. Ans: (c)

Sol: L = 1000 bits frame BER = 4×10^{-5}

d = 100 km = 100×10^3 m

B = 20 Mbps = 20×10^6 bps

v = 2×10^8 m/sec

$$T_X=\frac{L}{B}=\frac{1000}{20\times 10^{6}}=0.5\times 10^{-4}$$

$$T_P=\frac{d}{v}=\frac{100\times 1000}{2\times 10^{8}}=0.5\times 10^{-3}$$

GBN

w = 10

$$=\frac{w(1-LP)}{(1+2a)[1+LP(w-1)]}$$

$$=\frac{10\times 0.96}{21\times[1+0.04\times 9]}$$

$$=\frac{9.6}{28.56}$$

= 0.336

= 33.6% ≅ 34%

SR

w = 10

$T_P = 0.5\times 10^{-3}$

$T_X = 0.5\times 10^{-4}$

$$a=\frac{T_P}{T_X}=\frac{0.5\times 10^{-3}}{0.5\times 10^{-4}}=\frac{1}{0.1}=10$$

a = 10

So, 1 + 2a = 1 + 2 (10) = 21

Here (w) < (1 + 2a) so smaller window

$$\text{Efficiency}=\frac{w(1-LP)}{1+2a}$$

$$=\frac{10(1-LP)}{21}$$

$$=\frac{10\times 0.96}{21}=\frac{9.6}{21}=0.457$$

≅ 46%

09. Ans: (d)

Sol: 512 bytes x 8 bits/B = 4096 bits per frame

4096/64000bps= 64 msec to send one frame

Round trip delay = 540 msec

Window size 1: send 4096 bits per 540msec

4096bits/540msec = 7.585 × 103 bps throughput

Window size 7: 7585 x 7 = 53096 bps

Window size 9 and greater:

7585 x 9 = 68265 bps but the maximum capacity is 64 kbps so for window sizes greater than 9 the maximum throughput is 64 kbps

11. Ans: (d)

Sol: B = 1 Mbps

Latency delay (or)

Propagation delay = 1.25 sec

L = 1 KB

(1) RTT = 2 × 1.25
$= 2.5$ sec

(2) 1 sec = 1×10^6 bits
2.5 sec =?

(3) $\varpi_p = \frac{\omega \text{bits}}{(\text{pkt size})}$

$= \frac{2.5\times10^6}{1024\times8} = 305$

(4) sequence no. = ω_p = 305

$\therefore 2^k = 305$

$\therefore$ k = 9 bits for GBN

for SR

$W_p = 610$

so k = 10 bits

12. Ans: (c)

Sol: d = 3000 km

B = 1.536 Mbps

L = 64 bytes

Propagation speed = 6 μsec/km

Propagation delay for 3000 km

$\Rightarrow 3000 \times 6$ μsec

(1) RTT = 2 × 18000 μsec

$= 36000 \times 10^6$

= 36 msec

(2) 1 sec $\rightarrow 1.536 \times 10^6$ bits
36 ms?

(3) $\omega_p = \frac{\omega \text{bits}}{(\text{pktsize})}$

$= \frac{1.536\times10^6\times36\times10^{-3}}{64\times8}$

= 108

(4) Sequence num ω_p = 108

(5) $2^k = \omega_p \Rightarrow 2^k = 108$

$\Rightarrow 2^k = 2^7$

$\Rightarrow k = 7$

10. Ans: 16

Sol: w = 3

Total 9 packets

Every fifth packet lost

					w = 3					w = 3					w = 3			
Packets	1	2	3	4	5	6	7	5	6	7	8	9	7	8	9	-	-	9
Attempts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			16

Total 16 attempts

13. Ans: 2%

Sol: Calculation for 100 frames = 3960 × 100

= 396000

Overhead

100 × 10 = 4000

NAK 40

Retransfers = <u>4000</u>

8040

Total = 8040 + 396000

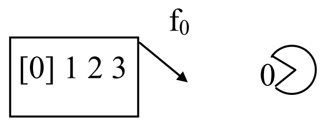
% of Bandwith that is wasted = [8040/(8040+396000)] * 100 = 1.99 ≅ 2%

14. Ans: (b)

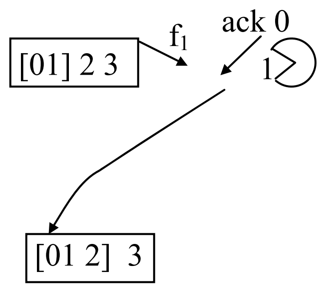
Sol: Instantaneously all 4 frames arrive at router.

<u>Time line</u> **<u>Remark</u>**

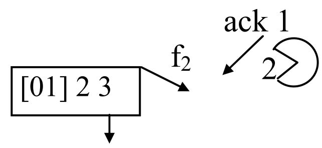
t = 0 frame '0' is sent out



t = 1
→ f_0 is arrived @ B
→ ack is sent out
→ receiver slide down for next frame
→ f_1 is sent out



t = 2
→ f_1 is arrived @ B
→ ack is sent out
→ receiver slide down for next frame
→ f_2 is sent out
→ previous ack is arrived, next round
Frame is instantly joined in window



outstanding frames are there in the window = 2, Now onwards

15. Ans: 4

Sol: 5 step problem

1. Calculate RTT = $2(T_p)$
2. Calculate BR, window size in bits
3. Calculate W = window in packets = BR/L
4. For selective repeat, ASN is set to 2W
5. Sequence number, k

Bandwidth (B) = 128×10^3 bps

Propagation delay (T_P) = 150 msec

Packet size(L) = 1 kilobyte

Transmission delay (T_t) = $\frac{L}{B}$

$$T_t = \frac{1\times8\times10^3 \text{ bits}}{128\times10^3 \text{ bps}}$$

$$\Rightarrow T_t = \frac{1}{16}\text{sec}$$

$$T_t = 64 \text{ msec}$$

W_S = sender window size

$$\eta = \frac{W_S\times T_t}{T_t+2T_p}$$

$$1 = \frac{W_S\times64}{64+2\times150}$$

$$\frac{364}{64} = W_S$$

$W_s = 5.6875$

$W_S + W_R$ = Available sequence numbers for SR $W_S = W_R$

ASN = $2\times W_S$

ASN = 2×5.6875

ASN = 11.375

No. of bits in the sequence number

$= \lceil\log_2 ASN\rceil$

$= \lceil\log_2^{11.375}\rceil$

= 4

16. Ans: (d)

Sol: Given:

B = 10^6 bps

Distance = 10000 km

$T_P = 2\times10^8$ m/s

L = 50000 B

$$p = T_x = \frac{L}{B} = \frac{50000\times8}{100\times10^4}$$

$$= \frac{4}{10}\times\frac{10^3}{10^3} = \frac{4000}{10} = 400 \text{ msec}$$

$$q = \frac{d}{v} = \frac{10000\times10^3}{2\times10^8}$$

$$= \frac{1}{20} = \frac{1}{20}\times\frac{10^3}{10^3} = \frac{1000}{20}\text{ms} = 50 \text{ ms}$$

17. Ans: 89.33

Sol: B = 1 Mbps

T_p = 0.75 ms

T_{proc} = 0.25 ms

Payload = 1980 B

Ack = 20 B

OH = 20 B

L = Payload + OH = 1980 + 20 = 2000 Bytes

$$T_x = \frac{L}{B} = \frac{2000\times8}{1\times10^6} = 16 \text{ ms}$$

$$T_{ax} = \frac{20\times8}{1\times10^6} = 160\ \mu\text{sec}$$

= 0.16 msec

Total time = $T_x+T_p+T_{proc}+T_{ax}+T_p+T_{aproc}$

= 16ms + 0.75ms + 0.25ms+ 0.16ms+0.75ms

= 17.91 ms

$$\eta = \frac{T_x}{\text{Total Time}}$$

$$= \frac{16}{17.91} = 89.33\%$$

4. Switching(Circuit, Packet)

01. Ans: (a)

Sol: Given data

Circuit setup time = 'S' sec

Bandwidth = bit rate = 'b' bps

Path = 'K'-hop

Propagation delay = 'd' sec per hop

Connection release = not given

Packet size = 'p' bits

Message size = 'x' bits

K = 3

K – hop path (hop means jump)

$$T_P = \frac{d}{v} = \frac{m}{m/s} = sec$$

Total delay = I + II + III

I. Circuit setup time = S

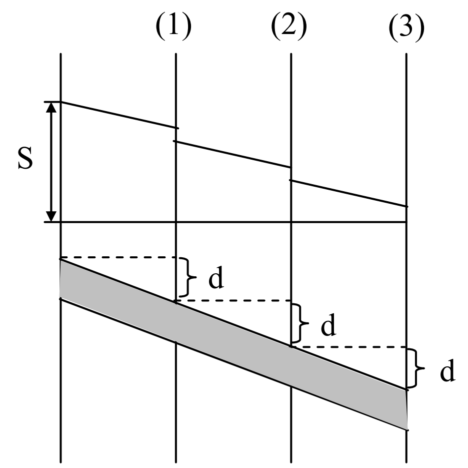
II. $T_X = \frac{L}{B} = \frac{\text{message size}}{\text{bit rate}} = \frac{x}{b}$

III. T_P=one hop → propagation time='d' sec

For k hop → propagation time ?

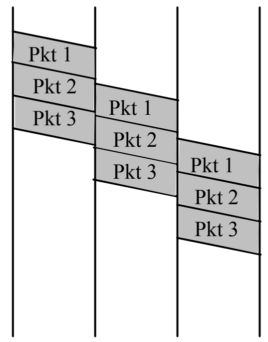
= k × d

∴ Total delay = S + x/b + k.d



02. Ans: (d)

Sol:



- The last packet is getting retransmitted at k – 1 hops so the delay is $(k-1)\frac{p}{b}$.
- There is no set of time (NO S)
- Transmission delay is x/b
$$= \frac{p_1 + p_2 + .. + p_n}{b}$$
- Message
For k hop → propagation time?
= k × d
- Total time = $x/b + k.d + (k-1)\frac{p}{b}$

5. Network Layer

01. Ans: (b)

Sol:

1100 0010. 0010 1111. 0001 0101. 1000 0010

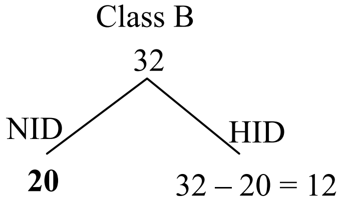
C 2 2 F 1 5 8 2

C 2	2 F	1 5	8 2
12×16^1	2×16^1	1×16^1	8×16^1
$+2\times16^0$	$+15\times16^0$	$+5\times16^0$	$+2\times16^0$
= 194	= 47	= 21	= 130

∴ 194.47.21.130

02. Ans (c)

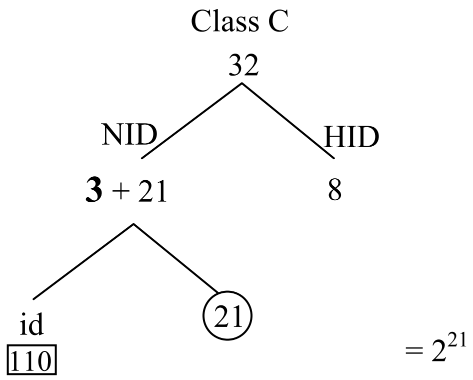
Sol: In given problem network part is of 20 bits.



Among 20 NID bits we are not going to use 2 bits which are fixed for class B prefix so number of network possible are $2^{20-2} = 2^{18}$ and number of hosts possible are $2^{12} - 2$.

03. Ans: (c)

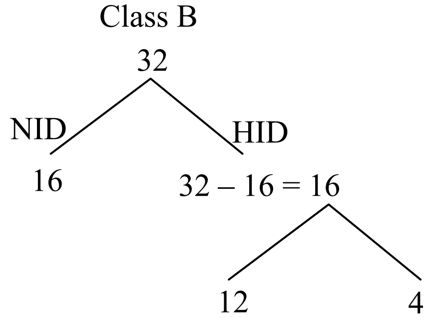
Sol:



$= 2^{21}$

From NID, 3 bits are reserved for prefix of class C address therefore number of network all allowed under class C address are $2^{24-3} = 2^{21}$.

04. Ans : (b)



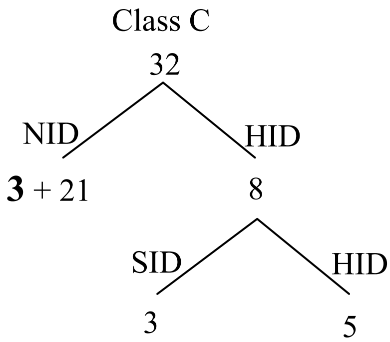
255. 255. 255. 240

1111 1111. 1111 1111. 1111 1111. 1111 0000

Host per subnet = $2^4 - 2$

05. Ans: (c)

Sol:



$2^x = 7$

∴ x = 3

$2^3 = 8$ subnets can be formed

$2^5 - 2 = 30$ host per subnet

1111 1111. 1111 1111. 1111 1111. 1110 0000

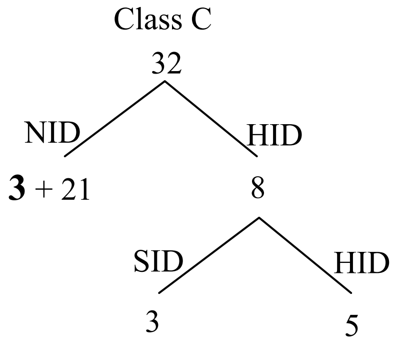
255. 255. 255. 224

(or)

Given 25 host per subnet

$2^x = 25$

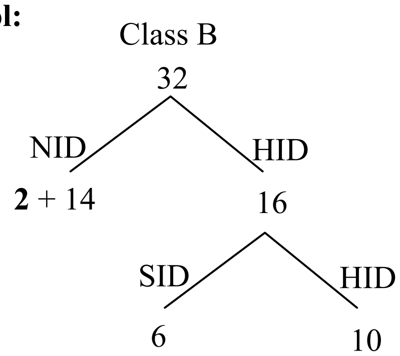
x = 5 host per subnet



Subnet mask → /27

06. Ans: (d)

Sol:



64 departments = 2^6

1111 1111. 1111 1111. 1111 1100. 0000 0000

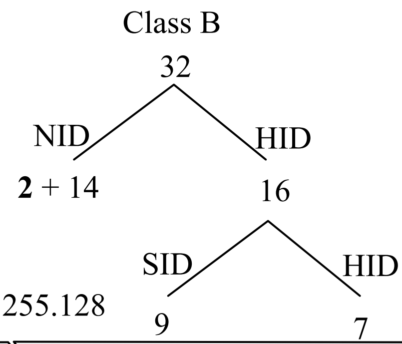
255. 255. 252. 0

07. Ans : 255.255.255.128

Sol: 100 LAN's

$2^x = 100$ hosts

$\therefore x = 7$

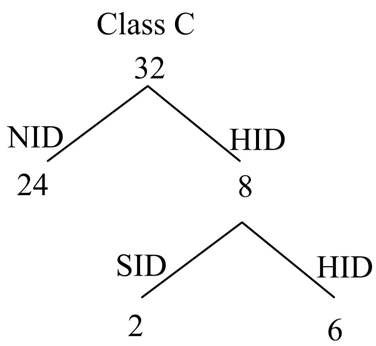


/25 ⇒ 255.255.255.128

08.

Sol: SM = 255.255.255.192

192 = 1100 0000



Class C network has 24-bits NID and 8 bit HID

(a) 2 bits are borrowed from HID

(b) no. of subnets = $2^2 = 4$

(c) no. of system per subnet = $2^6 - 2$

$= 64 - 2 = 62$

09. Ans: 158

Sol: /27 clearly indicates that first 3 bits (128, 64, 32) in the last octet are borrowed for subnet, 5 bits for Host ID. and mask is 255.255.25.224. If you perform AND operation between IP (200.10.11.144) and Subnet mask (255.255.255.224) then we get 200.10.11.128. So subnet ID is 128 and network ID is 200.10.11.

We have 5 bits for host ID. We cannot have all 1's in host ID, therefore we will have 11110 (last 5 bits) for the last IP address. Therefore in last octet we will have 10011110, it is 158

10. Ans : 24

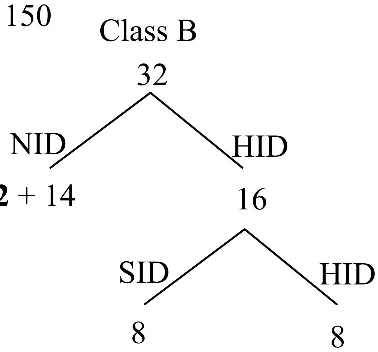
Subnet mask → / 24

⇒ 255.255.255.128

Given LANS = 150

$2^x = 150$

x = 8



16+8 = 24

11. Ans: (a)

Sol: (b) 245.248.128.0/21 and 245.248.128.0/22 → same 128 can not be given to two subnets

(c) 245.248.132.0/22 and 245.248.132.0/21 same 132 can not be given to two subnets

(d) 245.248.1360./24 and 245.248.132.0/21 same /24 will not be required

12. Ans: (c)

Sol:

128.56.24.0/24	0001 10	00
128.56.25.0/24	0001 10	01
128.56.26.0/24	0001 10	10
128.56.27.0/24	0001 10	11
8 + 8 +	Change after 6 bit	Change 00
	0001 10	00

8 + 8 + 6 ⇒ 22 128.56.24.0/22

13. Ans: 26

Sol: For each hop TTL is reduced by 1 (minimum) and there are 6 hops here hence 32 – 6 = 26.

14. Ans: 800 bytes

Sol: Offset 100 means there are 100 fragments before this, 8 bytes for each fragment 800 bytes.

15. Ans: (c)

Sol: For last fragment always M = 0. If HLEN is 10 then header length is 40 bytes (We use scale factor of 4 in HLEN).Therefore total data in fragment is 400 – 40 = 360 bytes.

Since offset is 300 total bytes ahead of this fragment is 8×300 = 2400 bytes (we use scale factor of 8 in offset). Therefore it is last fragment, starting byte is 2400 and ending byte is 2759

(Actually 2400 + 360 = 2760 bytes but byte number starts with zero, so it is from 2400 to 2759)

16. Ans: (c)

Sol: For the first network the maximum allowed payload size =1200 bytes per frame and for the second network the maximum allowed payload size= 400 bytes per frame.

Per packet IP overhead is given as 20 bytes.

So first we will calculate the total number of packets formed.

Note: If first network consider:

For first network 2100 bytes will be divided into 2 packets of size 1200 and 900 bytes.

So IP overhead of 1st network

= (2* 20=40 bytes)

But given is second network.

For second network 2100 bytes will be divided into 6 packets 5 of 400 bytes and 1 of 100 bytes.

So, IP overhead of the 2nd network

= (6* 20 = 120 bytes)

Thus, the maximum IP overhead for the 2nd network = 120 bytes

06. Routing Algorithms

01. Ans: (c)

Sol: Going via B gives (11, 6, 14, 18, 12, 8).
Going via D gives (19, 15, 9, 3, 9, 10).
Going via E gives (12, 11, 8, 14, 5, 9).
Taking the minimum for each destination except C gives (11, 6, 0, 3, 5, 8).
The outgoing lines are (B, B, -, D, E, B).

02. Ans: (c)

Sol: RIP uses distance vector routing
RIP packets are sent using UDP
OSPF doesn't use UDP or TCP and sends directly via IP
OSPF operation is based on LSR

03. Ans: (a)

Sol: Perform AND operation Given IP address and net mask, and compare results with network number if it matches with network number, then forward packet through that interface. If not matched with any entry then use default route.

Ex: for (i)

128 .96 .171.92
AND 255.255.254.0
= 128 .96 .170 .0

Hence packet must be transferred through Interface 0. Sometimes result matches with multiple network number, if so use interface that has longest length subnet mask.

So similarly for
i : a
ii : c
iii : e
iv: d

04. (i) Ans: (a)

Sol: 128.96.39.10 is one of the IP address in the same subnet, it uses interface 0
255.255.255.128. → 512 Subnet
→ 126 Host
128.96.40.151 it uses R_4 as the next because this IP address is under default subnet number.

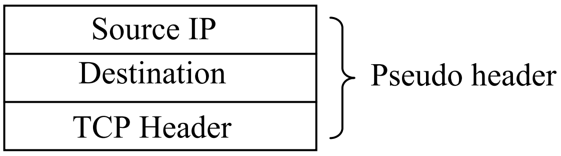
04. (ii) Ans: (d)

Sol: 128.96.40.12 uses R_2 as the next hop because it falls under 128.96.40.0
192.4.153.0 → Uses R_3 as the next hop because it falls under 192.4.153.0

7. TCP, UDP and Congestion Control

01. Ans: (c)

Sol: TCP pseudo Header Format



02. Ans: (b)

Sol: Each socket is binded with a port

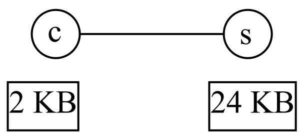
03. Ans: (d)

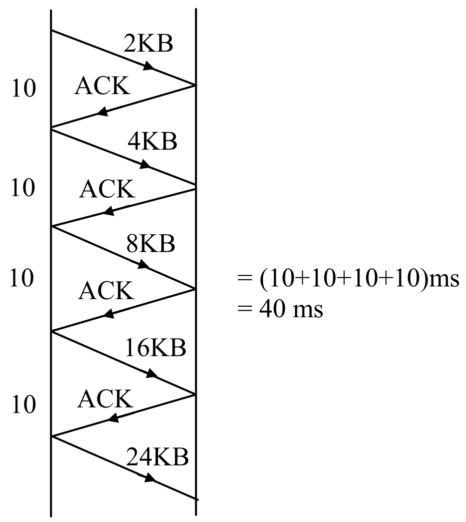
04. Ans: (b)

Sol: RTT = 10 msec

Scap = 24 KB

Lcap = 2 KB

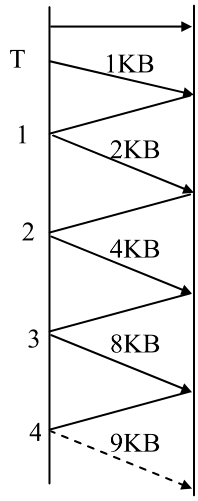




After 40 ms a full window is transmitted

05. Ans: (c)

Sol:



When timeout occurs thresh hold $= \frac{1}{2}(18) = 9$

Minimum (Congestion Window, Receiver Window)

1. Minimum (1, –)
2. Minimum (2, –)
3. Minimum (4, –)
4. Minimum (8, –)

~~16~~

9

Since it is crossing threshold, instead of 16 KB it sent 9 KB

06. Ans : 8738.14

Sol: Transport data unit

Total numbers available = 2^8 = 256 and they should be consumed in 30 sec.

Data rate per connection $= \dfrac{128 \times 8 \times 256}{30}$

07. Ans: (b)

Sol: Given ⇒ M = max burst = 6 Mbps

ρ = const rate

= token arrive rate 1 Mbps

C = 8 Mbps

S = ?

$$S = \frac{C}{M-\rho} = \frac{8\text{Mbits}}{(6-1)\text{Mbits/sec}}$$

$$= \frac{8}{5}\text{sec}$$

= 1.6 sec

08. Ans: (c)

Sol: Given L = 1000 byte

M = 50 million bytes/sec

ρ = 10 million byte/sec

C = 1×10^6 bytes

S = ?

$$S = \frac{C}{M-\rho} = \frac{1\times10^6}{50\times10^6 - 10\times10^6} = \frac{1}{40}$$

= 25 msec

09. Ans : 1.1

Sol: C= 1 MB

M = 20 MB parsec

Arrive rate = 10 MB per sec

Actual file size = 12×10^6 bytes

S = ?

$$S = \frac{C}{M-\rho} = \frac{1}{20-10}$$

$$= \frac{1}{10\text{sec}} = 0.1\text{sec}$$

The computer runs with bursty rate for the duration of '5' sec. the amount of data outlet = equation (1)

$$= \frac{20\text{MB}}{5} \times 0.1\text{sec}$$

= 2 MB data is outlet ………….. step (1)

Current file size = 12 MB = already outlet data with 'M' rate

= 12 MB – 2 MB

Remaining data = 10 MB

This remaining data 10 MB goes as with constant rate ρ.

ρ ⇒ 10 MB → 1 sec

Remaining data 10 MB → ?

$\frac{10\text{MB}}{10\text{MB}} \times 1 = 1\text{sec}$ ………………… step (2)

Total time taken = S1 + S2

= 0.1 + 1

= 1.1 sec

10. Ans: (d)

Sol: Data in 1st segment is from byte number 230 to byte number 289, that is 60 bytes As 1st is lost so, TCP will send ACK for the next in-order segment receiver is expecting. So it will be for 230.

11. Ans: (b)

SYNTAX:

int connect(int *sockfd*, **const struct sockaddr ****addr*,
socklen_t *addrlen*);

The **connect**() system call connects the socket referred to by the file descriptor *sockfd* to the address specified by *addr*. The *addrlen* argument specifies the size of *addr*. The format of the address in *addr* is determined by the address space of the socket *sockfd*;

If the socket *sockfd* is of type **SOCK_DGRAM**, then *addr* is the address to which datagrams are sent by default, and the only address from which datagrams are received. If the socket is of type **SOCK_STREAM** or **SOCK_SEQPACKET**, this call attempts to make a connection to the socket that is bound to the address specified by *addr*.

Generally, connection-based protocol sockets may successfully **connect**() only once; *connectionless protocol sockets may use **connect()** multiple times to change their association. Connectionless sockets may dissolve the association by connecting to an address with the sa_family member of sockaddr set to **AF_UNSPEC** (supported on Linux since kernel 2.2).*

So A process can successfully call connect function again for an already connected UDP socket for the above reason. Hence statement II is correct.
Statement I is wrong as the UDP is a connection less service and basically used for query and response purpose and there is no meaning of concurrent service (simultaneous)

12. Ans: 29.256

Sol: RTT = 30 msec

$\propto = 0.9$

NRTT = 26

Basic algorithm = $\propto$(IRTT)+(1-$\propto$) (NRRT)

$= 0.9 \times 30 + (1-0.9)(26)$

$= 29.6$ msec

2^{nd} round = 29.84 msec

3^{rd} round = 29.256 msec

08.Application Layer Protocols

01. Ans: (b)

Sol: Refer page 100 for the concept of base 64 encoding

02. Ans: (c)

Sol: The concept to be followed.

Step 1: The client(browser) initiates a DNS query for remote server. It may be that they already have this server in their DNS cache, in which case the client may simply send a TCP SYN directly to the application server.

Step 2: The client will next send a connection request to the application server. This will be a TCP SYN packet, the first in the TCP three-way handshake.

Step 3: Next, after the TCP connection has been established, the client will request data from the server. In the web-based application, the client performs an HTTP GET.

09. Basics Of Wi-Fi

01. Ans: (b)

Sol: RTS and CTS mechanism is used for collision avoidance, not collision detection.

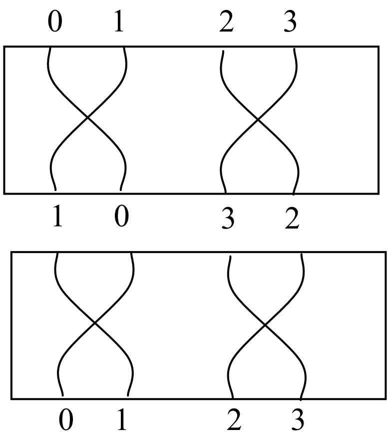
10. Network Security

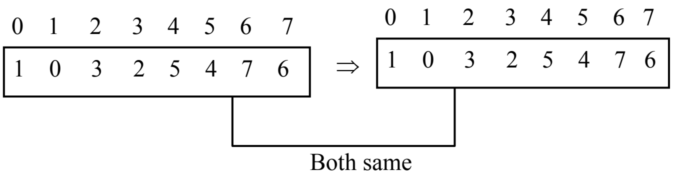
Chapter – 1

(a) Private key

01.

Sol: Symmetric in nature

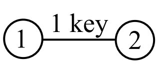




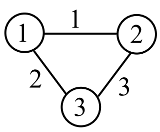
Both are in symmetric nature. Hence IP = IP^{-1}

02. Ans: (c)

Sol: 2 nodes

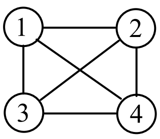


3 nodes



3 keys ⇒ 1 + 2

4 nodes



1+2+3 = 6 keys

n nodes ⇒ 1+2….+(n-1) = $\frac{n(n-1)}{2}$ keys

(b) Cipher Modes

03. Ans: (b)

Sol: Bit error causes its impact on two blocks only (i, i+1).

04. Ans: (c) as per concept

05. Ans: (b) as per concept

06. Ans: (c) as per concept

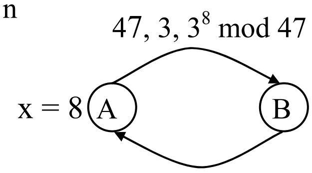
07. Ans: (c) as per concept

(c) Key Management

08. Ans: (d)

Sol: Given n = 47, g = 3, x = 8

n, g, g^x mod n



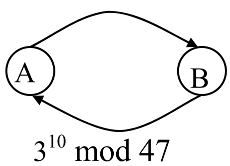
3^8 mod 47= 28

∴(47, 3, <u>28</u>)

09. Ans: (b)

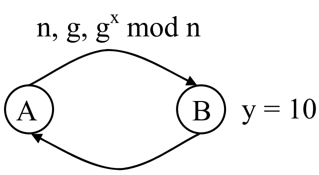
Sol: Given y = 10, n = 47, g = 3.

3^{10} mod 47 = 17



10. Ans: (a)

Sol:



3^{10} mod 47 = 17

Session key = 17^8 mod 47 = 4

11. Ans: (a) & (d)

Sol: Property for good candidate

Choose 'n' in such a way that $n, \left(\frac{n-1}{2}\right)$ both should be prime.

(a) $7, \frac{7-1}{2} = 3 \Rightarrow (7, 3)$

(b) 33 is not prime

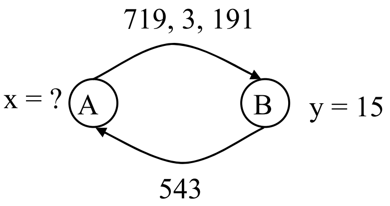
(c) $37, \frac{37-1}{2} = 18 \Rightarrow (37, 18)$

(d) $47, \frac{47-1}{2} = \frac{46}{2} = 23 \Rightarrow (47, 23)$

$\therefore$ Option (a) & (d) is correct

12. Ans: (c)

Sol:



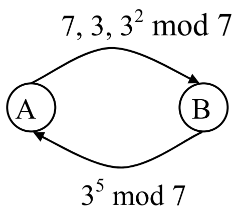
3^{15} % 719 = 543

Session key = 191^{15} % 719 = 40

191^{15} mod 719	1	1	1	1
e = 15	1	531	326	403
d = 1	191	42	432	**40**

13. Ans: (b)

Sol: n = 7, g = 3, x = 2, y = 5



2^5 % 7 = 32%7 = 4

Chapter – 2

14.

Sol: a =1, b =2

(a) p = 7 q = 11

n = p × q

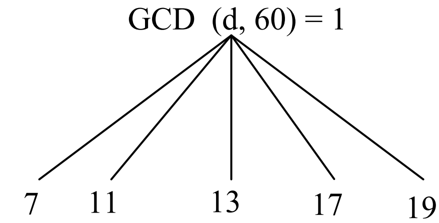
= 7 × 11 = 77

z = (p –1) (q – 1)

= (7 – 1) (11 – 1)

= 6 × 10 = 60

GCD (d, z) = 1



Five legal values for d is **7, 11, 13, 17, 19**

(b) p = 13, q = 31, d = 7. Find e

P = 13, q = 31,

n = p × q

z = (p – 1) (q – 1)

= 12 × 30 = 360

d = 7 GCD (d, z) = 1

(e × d) mod z = 1 k_u = {e, n}

(e × d) = 1 mod Z k_r = {d, n}

Encryption p^e mod n = c

Decryption c^d mod n = p

(e × d) = 1 mod 360

(e × 360) = 1 mod 360

(multiple of 360 + 1) % 360 = 1

i = 1 360 × 1 = 360 +1 = 361% 360 = 1

$e \times 7 = 361$; $e = \frac{361}{7}$ = fraction

i = 2 360 × 2 = 720 + 1 = 721% 360 = 1

$\Rightarrow e \times 7 = 721$

$e = \frac{721}{7} = 103$

(c) p = 5; q = 11; d = 27

p = 5

q = 11

n = 11 × 5 = 55

z = 4 × 10 = 40

(e × d) = 1 mod z

(e × 27) % 40 = 1

Multiple of 4 + 1

i = 1 40 × 1 ⇒ (40 + 1) % 40 = 1

e × 27 = 41, e = fraction

i = 2 40 × 2 ⇒ (80 +1) % 40 = 1

e × 27 = 81, e = 3

Encrypted "abcdefghij"

P	P^e mod n P^3 mod 55
a = 1	1^3 mod 55 = 1
b = 2	8 mod 55 = 8
c = 3	27 mod 55 = 27
d = 4	64 mod 55 = 9
e = 5	125 mod 55 = 15
f = 6	216 mod 55 = 51
g = 7	343 mod 55 = 13
h = 8	512 mod 55 = 17
i = 9	729 mod 55 = 14
j = 10	1000 mod 55 = 10

15. Ans: (c)

Sol: e = 5, p = 7, q = 17

Z = 6 × 16 = 96

(e × d) = 1 mod z = e = 5

(e × d) = multiple of 96 + 1

i = 1 96 × 1 + 1 = 97% 96 = 1

e × d = 97;d = 97/5 = fraction

i = 2 96 × 2 = 192 + 1 = 193

e × d = 193 fraction

i = 3 96 × 3 = 288 + 1 = 289

e × d = 289 fraction

i = 4 96 × 4 = 384 384 + 1 = 385

e × d = 385 $d = \frac{385}{5} = 77$

16. Ans: (d)

Sol: A = 1, B = 2, C = 3, D = 4, E = 5, F = 6

M = 'F'

= 6

Given p = 7, q = 17

n = 7 × 17 = 119

$C = M^e \bmod n$

$= 6^5 \bmod 119 = 41$

17. Ans: (d)

Sol: p = 397, q = 401, e = 343, d =?

z = 396 × 400 = 158400

So, d = 12007

$$Q = \frac{\phi(n)}{e}$$

T = A – B * Q

A = B

B = T

R = ϕ(n) % e

ϕ(n) =

Extended Euclidean Algorithm

Q	A	ϕ(n)	B	e
–	0	15800	1	343
46	1	343	–461	277
1	–461	277	462	66
4	462	66	–2309	13
5	–2309	13	12007	①

18. Ans: (a)

Sol: encrypted p = 1314

p^e mod n

e = 343

n = 401 × 397

n = 159, 197

1314^{343} mod 159197

256	128	64	32	16	8	4	2	1
1	0	1	0	1	0	1	1	1

1314^{343} mod 159197

1314^{343}	1	0	1	0	1	0	1	1	1
d=1	1	134,626	59017	138690	97772	24844	175679	118532	84228
	1314	X	19399	X	429	X	158670	56382	**33677**

Chapter – 3

19. Ans: (d)

Sol: Definition of Digital sign and PKC.