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Computer Science & Information Technology

COMPUTER NETWORKS

Text Book:
Theory with worked out Examples and Practice Questions

Computer Networks

(Solutions for Text Book Practice Questions)

Chapter 1 Concept of Layering

01. Ans: (b)

Sol: Data link layer has error, flow, access control, framing as functionalities. Bit synchronization is part of physical layer.

02. Ans: (c)

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

= nh

Total message = original message+overhead

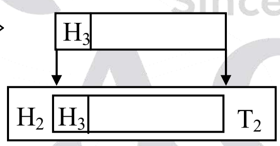
= m + nh

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

03. Ans: (b)

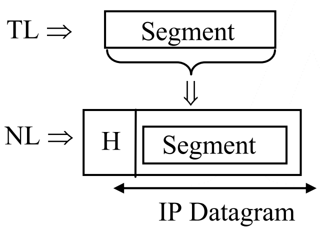
Sol: Packet ⇒ 3 ⇒ NPDU ⇒

Frame ⇒ 2 ⇒ DPDU ⇒



04. Ans: (a)

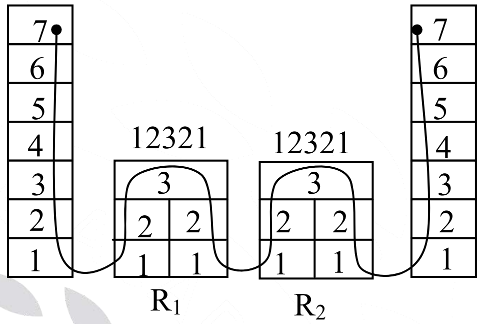
Sol:



05. Ans: (c)

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: (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.

07. 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.

08. Ans: (b) & (d)

Sol: The PDUs of Physical layer are bits. Segments are the PDUs of Transport Layer.

09. Ans: (a), (c) & (d)

Sol: FTP is a out band protocol as it uses a control connection and a data connection in parallel. Control connection is used to send information such as user identification, password, commands to 'put' and 'get' files. Data connection is used to send the file. Because of this control connection (separate) FTP is "out-of-band".

Chapter 2 Network Performance Parameters

01. Ans: (a)

Sol: Given data

$B = 4$ Mbps

$d = 100$km

$L = 2$MB

$T_P = ?$

As the question have given fiber link, the speed of propagation is $2*10^8$ m/s

$$\therefore T_p = \frac{d}{v} = \frac{100\times10^3}{2\times10^8} = 0.5\text{ms}$$

02. Ans: 4.9 Mbps

Sol: Given data

$L = 1$Mb

$B = 1$Gbps

$R = 200$ms

Throughput = ?

$$T_x = \frac{L}{B} = \frac{10^6}{10^9} = 1\text{ms}$$

$$\therefore \text{Throughput} = \frac{\text{Total data size}}{\text{Total time}} = \frac{10^6}{(1+200)\times10^{-3}}$$

$$= \frac{1000}{201}\text{Mbps} = 4.9\text{Mbps}$$

03. Ans: 101ms (or) 0.101 sec

Sol: Given data

$L = 1000$ kb

$B = 1$Gbps

$R = 100$ ms

Total Time =?

$$T_x = \frac{L}{B} = \frac{10^6}{10^9} = 1\text{ms}$$

$\therefore$ Total Time $= T_X + 2T_P = 1\text{ms} + 100$ ms

$= 101$ ms (or) 0.101 sec.

04. Ans: 8 ms

Sol: Given data

$L = 1KB$

$B = 1Mbps$

$T_P = 20$ ms

$T_X = ?$

$$T_x = \frac{L}{B} = \frac{8\times10^3}{10^6}$$

$= 8ms$

05. Ans: 13.88 μs

Sol: Given data

d = 2500 meters

$v = 1.8 \times 10^8 m/s$

$T_P = ?$

$$T_P = \frac{d}{v} = \frac{25\times10^2}{1.8\times10^8} = \frac{250}{18}\ \mu s$$

$= 13.88\ \mu s$

06. Ans: 250KB

Sol: Given data

B = 25 Mbps

T_P =40ms

$B \times D = ?$

$T_P = 40ms \Rightarrow RTT = 80ms$

As the link is duplex link

$B \times D = B \times R = 25 \times 10^6 \times 80 \times 10^{-3} = 250$ KB

07. Ans: 21%

Sol: Given data

L = 2KB

T_P= 30ms

B = 1Mbps

η= ?

$$T_X = \frac{L}{B} = \frac{8\times10^3\times2}{10^6}$$

= 16ms

$$\therefore \text{Throughput} = \frac{8\times2\times10^3}{(16+60)\times10^{-3}}$$

$$= \frac{16}{76}\times10^6 \text{ bps} = 0.21 \text{ Mbps}$$

we know that, $\eta = \frac{T}{B} \Rightarrow \eta = \frac{0.21}{1}$

= 21%

08. Ans: (d)

Sol: Given:

$B = 10^6$ bps

Distance = 10000 km

$T_P = 2 \times 10^8$ m/s

L = 50000 B

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

$$= \frac{400}{10^3}\times\frac{10^3}{10^3} = 400ms$$

$$= \frac{10^4\times10^3}{2\times10^5\times10^3}$$

$$= \frac{10^5\times10^2}{2\times10^5\times10^3}$$

$$= \frac{100}{2} ms$$

= 50ms

Chapter 3

LAN Technologies

01. Ans: (a)

Sol: In Manchester encoding, we use two signal changes to represent a bit .Therefore always baud rate is twice the bit rate. Hence bit rate is half the baud rate.

02. Ans: (a)

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

03. Ans: 10000

Sol: B = 1 Gbps

d = 1 km

v = 200000 km/sec; L = ?

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

$$= 2 \times \frac{10^3}{2 \times 10^3 \times 10^5} \times 10^9$$

= 10,000bits or 1250 bytes.

04. Ans: (d)

Sol: B = 100 Mbps

d = 1 km

L = 1250 bytes

v = ?

In CSMA/CD,

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

$$\Rightarrow v = \frac{2dB}{2}$$

$$\Rightarrow v = \frac{2 \times 10^3 \times 10^2 \times 10^6}{10^4} = \frac{2 \times 10^4}{10^4}$$

$= 2 \times 10^7$

$= 2 \times 10^4$ km/sec

= 20,000km/sec.

05. Ans: 200

Sol: L = ?

B = 20 Mbps

T_p = 40 micro sec

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

$L = 2 \times T_P \times B$

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

= 1600bits (or) 200 bytes.

06. 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 = 1/4
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

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

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

07. (a) Ans: 137.5 (b) Ans: 125

Sol: (a)

Frame Transmission time = $1000/10\times10^6$

= 100μs

At time t = 0 both A & B transmit

At time t = 12.5μs a detects collision

At time t = 25 μs

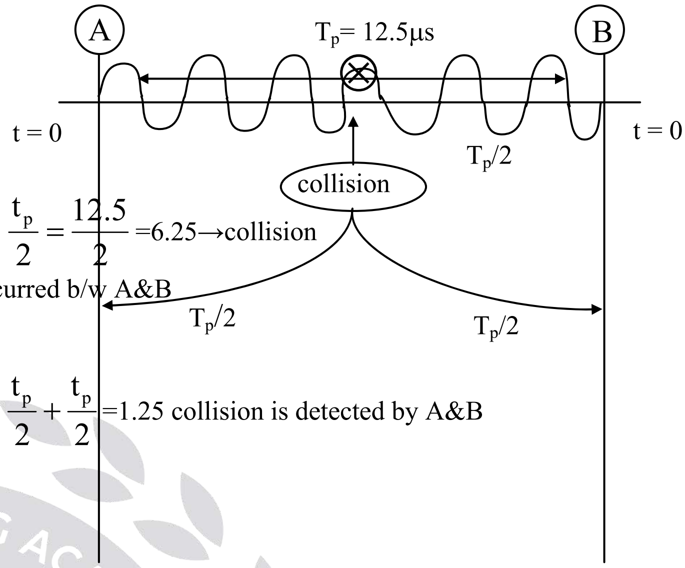
Last bit of B's aborted transmission arise at A.

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

(b) $T_x = \frac{1000}{10\times10^6} = 100\mu s$



at $t = \frac{t_p}{2} = \frac{12.5}{2}$ =6.25→collision is occurred b/w A&B

at $t = \frac{t_p}{2} + \frac{t_p}{2}$ =1.25 collision is detected by A&B

Since, the question have mentioned "without purging," no need of considering T_{purge} time

$\therefore$ At t = $T_{CD} + T_x + T_P$

= (12.5+100+12.5)μs

= 125μs

A's packet completely delivered to B.

08. 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.

09. Ans: 81 to 85

Sol: B = 10 Mbps

Slot time = 51.2 μsec, L = 512 bytes

Number of slots = 1.716

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

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

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

Contention width = no. of slots × slot time

$$= 1.716 \times 51.2 = 87.85 \ \mu\text{sec}$$

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

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

$$\eta = \frac{4.096 \times 10^{-4}}{4.096 \times 10^{-4} + 87.85 \times 10^{-6}} = 82.3\%$$

10. Ans: (c)

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

11. Ans: (a), (c) & (d)

Sol: Option (a) is FALSE, as in Ethernet, the station is need not to stop to sense the channel prior to frame transmission.

Option (b) is TRUE; a signal is jammed to inform all the other devices or stations about collision that has occurred so that further data transmission is stopped.

Option (c) is FALSE; once collision is detected, a station should stop its packet transmission.

Option d is FALSE; the Binary Exponential Back Off algorithm reduces the probability of collision on retransmissions.

12. Ans: (a) & (c)

Sol: WAN uses technologies such as MPLS, ATM, X.25 Frame relay for data connection over greater distances. LAN uses technologies such as Ethernet and token ring to connect to other networks.

Chapter 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)

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

Total delay = I + II + III

I. Circuit setup time = S

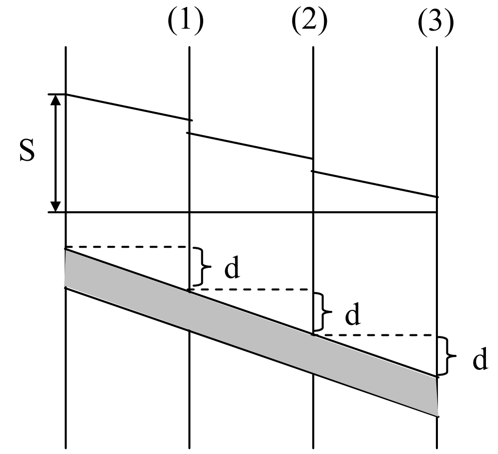
$$\text{II. } T_X = \frac{L}{B} = \frac{\text{message size}}{\text{bit rate}} = \frac{x}{b}$$

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

For k hop → propagation time ?

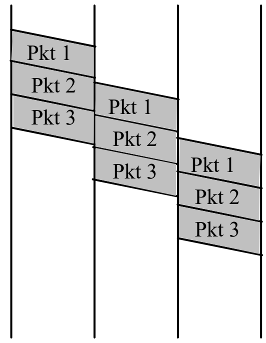
= k × d

∴ 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 (NOS)
- 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 + $(k-1)\frac{p}{b}$

03. Ans: (a) & (c)

Sol: In datagram (Connectionless Packet Switching) switching, packets may be delivered out of order. But, both Circuit Switching and Virtual Circuit Switching (Connection oriented Packet Switching) ensured in order delivery.

04. Ans: (a) & (b)

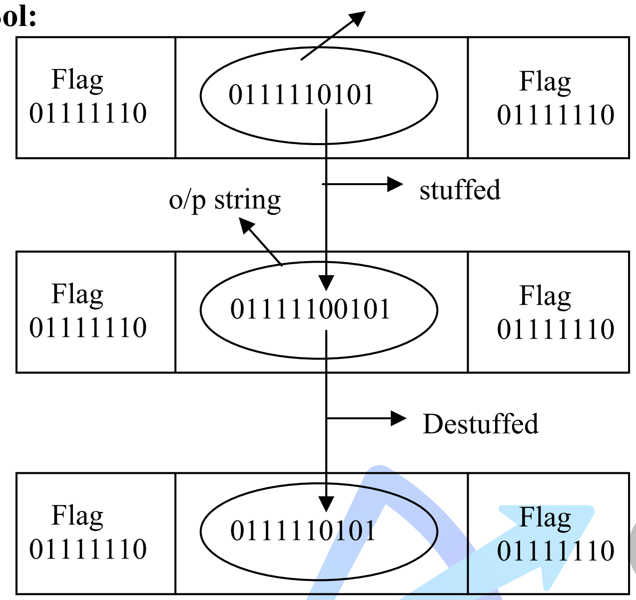
Sol: In Circuit Switching (Connection Oriented Switching), bandwidth is fixed as connection is established prior to Data transfer.

Chapter 5

Data Link Layer

01. Ans: (b)

Sol:



02. Ans: (c)

Sol:

```
1011) 01011011000 (01000011
      0000
      01011
      1011
      00000
      0000
      00001
      0000
      00011
      0000
      00110
      0000
      01100
      1011
      01110
      1011
      0101
```

03. Ans: (a)

Sol:

1	2	3	4	5	6	7	8	9	10	11
1	0	1	1	0	1	0	1	1	1	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 = 10110101111

04. Ans: 4.76

Sol: L = 1000 bits

$d = 100 \times 10^3$ m

$V = 2 \times 10^8$ m/sec

$B = 20$ Mbps $= 20 \times 10^6$ bps

$$T_X = \frac{L}{B} = \frac{1000\,\text{bits}}{20 \times 10^6\,\text{bps}} = 50\mu\,\text{sec}$$

$$T_P = \frac{d}{v} = \frac{100 \times 10^3\,\text{m}}{2 \times 10^8\,\text{m/sec}} = 500\mu\,\text{sec}$$

$$a = \frac{T_P}{T_X} = \frac{500}{50} = 10$$

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

$$= \frac{1}{1+2\times 10} = \frac{1}{21} = 0.047 = 4.7\%$$

05. Ans: 47.6

Sol: Given data

$$\left.\begin{matrix} L = 1000\text{ bits} \\ B = 20\text{Mbps} \end{matrix}\right\} T_X = \frac{L}{B} = \frac{1000}{20\times10^6} = 50\mu s$$

$$\left.\begin{matrix} d = 100\text{km} \\ v = 2\times10^8 \text{m/s} \end{matrix}\right\} T_P = \frac{d}{v} = \frac{10^2\times10^3}{2\times10^2\times10^6} = 500\mu s$$

$$\therefore a = \frac{T_P}{T_X} = \frac{500\,\mu s}{50\,\mu s} = 10$$

w = 10

Case(1): If w ≥1+2a then η = 100%

⇒10≥1+2(10) ⇒ 10≥21 False

Case (2):

$$\eta = \frac{w}{1+2a} = \frac{10}{21} = 0.476\,(\text{or})\,47.6\%$$

06. Ans: 160

Sol: B = 4 Kbps

Propagation delay = 20 msec

η = 50%

RTT = 2 × Propagation delay

= 40 msec

if N = 50 then L = BR

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

= 160 bits

07. Ans: 10.8

Sol: B = 1.5 Mbps

RTT (Round Trip Time) = 45ms

BR = $1.5\times10^6\times45\times10^{-3}$ bits

= $15 \times 45 \times 10^2$ bits

= 67500 bits

L = 8192 bits

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

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

08. Ans: 2500

Sol: B = 80 kbps

L = 1000 bytes

T_p = 100 ms

T_x = L/B = 100 ms

T_{ax} = ack size/ bandwidth = 100 ms

Efficiency= $T_x/(T_x + 2T_p + T_{ax}) = \frac{100}{400} = 0.25$

Throughput = efficiency * bandwidth

= 0.25 *10^4 bytes

= 2500 bytes

09. 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 μsec

= 0.16 msec

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

$= 16\text{ ms} + 0.75\text{ ms} + 0.25\text{ ms} + 0.16\text{ ms} + 0.75\text{ ms}$

$= 17.91\text{ ms}$

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

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

10. Ans: (d)

Sol: 512 bytes × 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 × 7 = 53096 bps

Window size 9 and greater:

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

11. Ans: 21

Sol: Given data

$$\left.\begin{array}{l} L = 1000\text{ bits} \\ B = 20\text{Mbps} \end{array}\right\} T_x = \frac{L}{B} = \frac{10^3}{20\times10^6} = 50\mu s$$

$$\left.\begin{array}{l} d = 100\text{km} \\ v = 2\times10^8 m/s \end{array}\right\} T_P = \frac{d}{v} = \frac{10\times10^3}{2\times10^8} = 500\mu s$$

$$a = \frac{T_p}{T_x} = 10$$

as the question has given that η =100%

$\Rightarrow w = 1 + 2a \Rightarrow w = 1 + 2(10) = 21$

12. 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: (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) $w_p = \frac{\text{w bits}}{(\text{pkt size})}$

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

(4) sequence no. = w_p = 305

$\therefore\ 2^k = 305$

$\therefore$ k = 9 bits for GBN

for SR

W_p = 610

so k = 10 bits

14. Ans: (c)

Sol: d = 3000 km

B = 1.536 Mbps

L = 64 bytes

Propagation delay = 6 μsec/km

$\therefore$ Propagation delay for 3000 km

⇒ 3000 × 6 μsec

(1) RTT = 2 × 18000 μsec

= 36000 × 10^6

= 36 msec

(2) 1 sec → 1.536 × 10^6 bits

36 ms → ?

(3) $w_p = \frac{\text{w bits}}{(\text{pktsize})}$

$= \frac{1.536\times10^6\times36\times10^{-3}}{64\times8} = 108$

(4) Sequence number w_p = 108

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

$\Rightarrow 2^k = 2^7$

⇒ k = 7

15. Ans: 4

Sol: Given data

$\left.\begin{array}{l}B = 128\times10^3\,\text{bps}\\ L = 1\text{KB}\end{array}\right\} T_x = \frac{L}{B} = \frac{8\times10^3}{128\times10^3} = 62.5\text{ms}$

$\left.\begin{array}{l}T_P = 150\text{ms}\\ \eta = 100\%\end{array}\right| a = \frac{T_P}{T_x} = \frac{150\text{m}}{62.5\text{ms}} = 2.4$

In SR protocol, if η=100% then w = 1+2a

⇒ w = 1+2 (2.4) ⇒ w = 5.8 ≈ 6

$\Rightarrow \frac{2^n}{2} = 6 \Rightarrow 2^n = 12 \approx 2^4 \Rightarrow \boxed{n = 4}$

16. Ans: (a), (c)

Sol: Given data

W = 5

L=1000 Bytes

$\left.\begin{array}{l}T_x = 50\mu s\\ T_P = 200\mu s\end{array}\right\} a = \frac{T_P}{T_x} = \frac{200\mu s}{50\mu s} = 4$

(a) Total time = $T_x + 2T_p$ = (50 + 2×200) μs

= 450 μs → True

(b) Throughput

$= \frac{WL}{T_x + 2T_P} = \frac{5\times1000}{450\times10^{-6}}\text{Bytes/s}$

$= \frac{5000}{450}\times10^6\,\text{Bytes/sec}$

= 11.11×10^6Bytes/sec → False

(c) efficiency

Case(1): if $W \geq 1 + 2a$ then $\eta = 100\%$

$\Rightarrow 5 \geq 1 + 2\,(4) \Rightarrow 5 \geq 9$ false

Case(2): if $W < 1 + 2a$ then

$$\eta = \frac{W}{1+2a} = \frac{5}{9} = 55.55\% \approx 56\% \text{ True}$$

(d) As the answer is in micro seconds, but in option (d) it is given in milliseconds So, it is false.

17. Ans: (b) & (d)

Sol:

```
1011) 0 1 0 1 1 0 1 1 0 0 0 (01000011
      0 0 0 0
      -------
      Ø 1 0 1 1
        1 0 1 1
        -------
        Ø 0 0 0 0
          0 0 0 0
          -------
          Ø 0 0 0 1
            0 0 0 0
            -------
            Ø 0 0 1 1
              0 0 0 0
              -------
              Ø 0 1 1 0
                0 0 0 0
                -------
                Ø 1 1 0 0
                  1 0 1 1
                  -------
                  Ø 1 1 1 0
                    1 0 1 1
                    -------
                    Ø 1 0 1
```

Option (b) is true & option (c) is false

∴ The message that should be transmitted is $\underbrace{01011011}_{\text{msg}}\ \underbrace{101}_{\text{CRC}}$, which has the length of 11 bits. Hence option (a) is false and option (d) is true.

Chapter 6 Network Layer (IPv4/IPv6)

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: (b)

Sol:

0001 0111. 0010 1010. 1000 0100. 1100 1000

1 7 2 A 8 4 C 8

1 7	2 A	8 4	C 8
1×16^1	2×16^1	8×16^1	12×16^1
$+ 7\times16^0$	$+10\times16^0$	$+4\times16^0$	$+8\times16^0$
= 23	= 42	= 132	= 200

∴ 23.42.132.200

03. Ans (c)

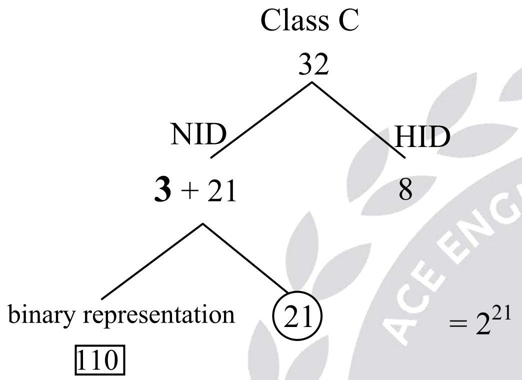
Sol: In given problem network part is of 20 bits.

```
        Class B
          32
        /    \
     NID      HID
     20       32 – 20 = 12
```

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

04. Ans: (c)

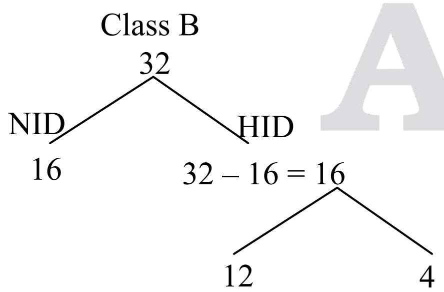
Sol:



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

05. Ans : (b)

Sol:



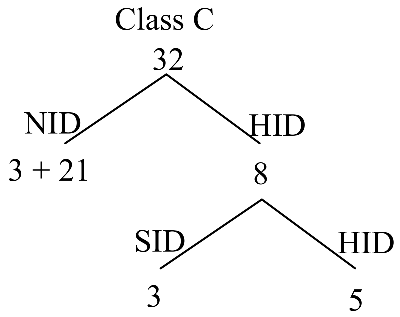
255. 255. 255. 240

1111 1111. 1111 1111. 1111 1111. 1111 0000

Hosts per subnet = $2^4 - 2$

06. Ans: (c)

Sol:



$2^x = 7$

$\therefore x = 3$

$2^3 = 8$ subnets can be formed

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

1111 1111. 1111 1111. 1111 1111. 1110 0000

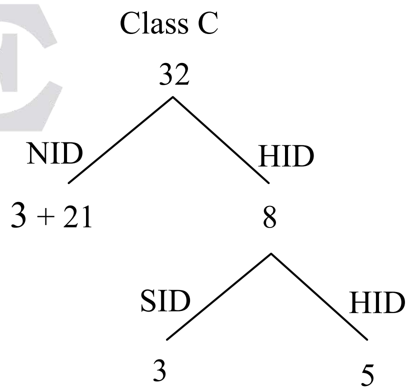
255. 255. 255. 224

(or)

Given 25 hosts per subnet

$2^x = 25$

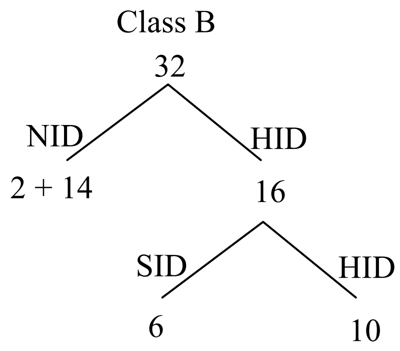
x = 5 hosts per subnet



Subnet mask → /27

07. Ans: (d)

Sol:



64 departments = 2^6

1111 1111. 111 1111. 1111 1100. 0000 0000

255. 255. 252. 0

08. Ans: 255. 255. 255. 128

Sol: As we need to create two hosts, we need to have 7-bit host ID

Given class is B, so

DMA = 255. 255. 0.0

$\Rightarrow \underbrace{255.255.}_{NID}\underbrace{11111111.}_{SID}\underbrace{10000000}_{HID}$

$\Rightarrow$ 255. 255. 255. 128

09. Ans: 24

Sol: class B DMA = $\underbrace{255.255.}_{NID}\ \underbrace{0.0}_{HID}$

Given LANs = 150

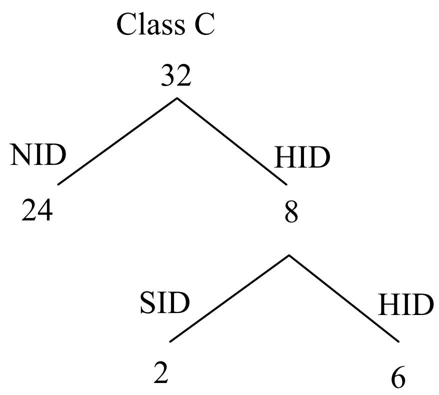
$\Rightarrow$No. of extra is to be added= $\log_2^n = \log_2^{150} \Rightarrow \log_2^{2^8} = 8$

$\Rightarrow \underbrace{255.255.}_{NID}\underbrace{11111111.}_{SID}\underbrace{00000000}_{HID} = /24$

10.

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 systems per subnet = $2^6 - 2$

= 64 – 2 = 62

11. Ans: 158

Sol: Given network 200.10.11.144/27

to find out LA, we need to set (32–n) no. of right most bits to 1

$\therefore$ 200.10.11.144/27

$\Rightarrow 200.10.11.100\underbrace{10000}/27$

$\Rightarrow$ 200.10.11.10011111/27

$\Rightarrow$200.10.11.159/27→broadcast(not assignable)

So, the assignable last address is

$\Rightarrow$200.10.11.158/27

↑ 4^{th} octet

12. Ans: (a)

Sol: (b) 245.248.<u>128</u>.0/21 and 45.248.<u>128</u>.0/22 → same 128 can not be given to two subnets

(c) 245.248.<u>132</u>.0/22 and 45.248.<u>132</u>.0/21 same 132 can not be given to two subnets

(d) 245.248.136.0./<u>24</u> and 45.248.132.0/21 same /24 will not be required

13. 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

14. 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: 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.

15. Ans: 1

Sol: Perform AND operation between IP and /12, /14, /16, /15 mask. If result matches with "prefix" given in the table then that should be the interface packet is forwarded. If it matches with multiple masks then use longest length mask.

Ex: Here it matches with /12 & /15, so use /15.

16. Ans: 26

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

17. Ans: 800 bytes

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

18. 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)

19. Ans: (a), (b)

Sol: Advantages of Supernetting are

(i) Control and reduce network traffic

(ii) Helpful to solve the problem of lacking IP addresses

(iii) Minimizes the routing table

20. Ans: (b) & (d)

Sol: As M bit is 1, it is not the last fragment.

HLEN = 10

→ Header length=10 × 4 bytes = 40 bytes.

Total Length = 200 bytes

→ Header length + Data length = 200

→ Data length = 200 – 40 = 160 bytes.

Offset = 100

→ the 1^{st} byte value in this fragment

= 100 × 8 = 800.

Last byte value in this fragment = 959 (as data length is 160 bytes).

Chapter 7 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: (a)

Sol: RIP is based hop count, hence uses distance vector. OSPF is based on cost, and hence uses link state.

03. 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

04. Ans: 51

05. Ans: (a) & (c)

Sol: In DVR, Convergence process is slower as it uses periodic updates. Link State Routing algorithm results more overhead as it needs to execute Dijkstra's algorithm at every router of the in order to construct Shortest Path Tree.

06. Ans: (a) & (c)

Sol: The standard requirements to achieve successful routing are:

1. Correctness 2. Simplicity 3. Fairness 4. Optimality 5. Robustness 6. Stability 7. Efficiency

Chapter 8 TCP/UDP & Sockets, Congestion Control

01. Ans: (c)

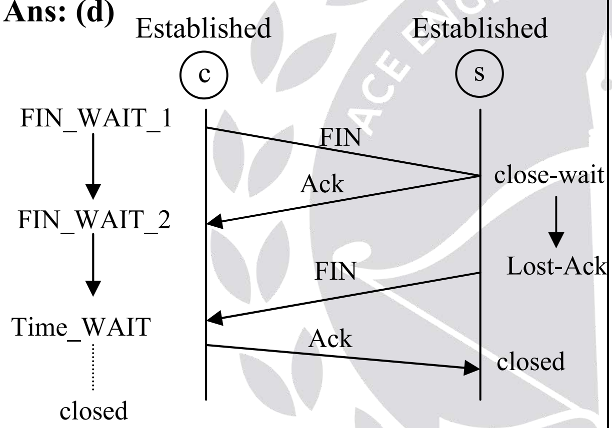
Sol: TCP pseudo Header Format

Source IP	Pseudo header
Destination	Pseudo header
TCP Header	

02. Ans: (b)

Sol: Each socket is binded with a port

03. Ans: (d)

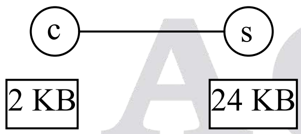


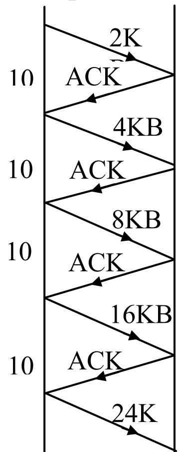
04. Ans: (b)

Sol: RTT = 10 msec

Scap = 24 KB

Ccap = 2 KB



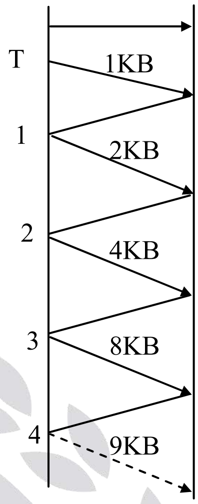


= (10+10+10+10)ms
= 40 ms

After 40 ms a full window is transmitted

05. Ans: (c)

Sol:



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

Minimum (Congestion Window, Receiver Window)

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

closed ~~16~~ 9

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

06. Ans: 10

Sol: 1sec → 200×10^6 bits

$$1\text{sec} \rightarrow \frac{200\times10^6}{8}\text{ Bytes}$$

$$1\text{sec}\rightarrow \frac{200\times10^6}{8}\text{ seq no.s}$$

$$\frac{8}{200\times10^6}\text{sec} \leftarrow 1\text{seq no.}$$

$$\frac{8\times2^{28}}{200\times10^6}\text{sec.} \leftarrow 2^{28}\text{seq no.}$$

$10.76\text{secs} \leftarrow 2^{28}$ seq no.

07. Ans: 34

Sol: Given, Bandwidth = 10^9 bps

Session start with sequence number = 1234

Wraparound time calculation = ?

In TCP sequence number of each byte = 32 bits

So, 2^{32} bytes are to be transmitted in a warp around time.

$\frac{10^9}{8}$ bytes .... 1 sec

2^{32} bytes .... ?

$$= \frac{2^{32}}{\frac{10^9}{8}} = \frac{2^{32}}{125\times10^6} = \frac{4294967296}{125\times10^6} = 34.35 \text{ sec}$$

Approximate
$10^9 \simeq 2^{30}$
$\frac{10^9}{8} \simeq 2^{27}$
2^{27} .... 1 sec
2^{32} .... ?
$\frac{2^{32}}{2^{27}} = 2^5 = 32$ sec

08. Ans: (b)

Sol: Given ⇒ M = max burst = 6 Mbps

ρ = constant rate

= token arrive rate 1 Mbps

C = 8 Mbps

S = ?

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

$$= \frac{8}{5}\text{sec} = 1.6 \text{ sec}$$

09. Ans: (c)

Sol: Given L = 1000 bytes

M = 50 million bytes/sec

ρ = 10 million bytes/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

10. Ans : 1.1

Sol: Given

Maximum burst rate, M = 20 MBPS

Token arrival rate, P = 10 MBPS

Constant rate(bucket o/p), P = 10 MBPS

Bucket capacity, C = 1 MB

Time for 1 MB, $S = \frac{C}{(M-P)}$

$$= \frac{1}{(20-10)}$$

= 0.1 sec ……… eq (1)

For the total message of 12 MB

So with the bursty rate (20Mbps), the transmission of data during 0.1 sec is

= 20MBps * 0.1 sec = 2MB

The remaining message = 12MB – 2MB

= 10MB

So time taken required to transmit the remaining data of 10MB with token arrival rate of 10 MBPS is

data/data rate=10MB/10MBps = 1sec…(2)

Total time is = equation (1) + equation (2)

= 0.1 + 1s = 1.1sec

11. 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.

12. Ans: 29.256

Sol: I_{RTT} = 30 msec, $\propto = 0.9$

$N_{RTT} = 26$

$EMT = \alpha (I_{RTT})+(1–\alpha) (N_{RTT})$

$= 0.9 \times 30 + (1 – 0.9) (26)$

= 29.6 msec

<u>for second round</u>

$E_{RTT} = \alpha * I_{RTT} + (1–\alpha) N_{RTT}$

= (0.9) (29.6) + (0.1) (32)

= 26.64 + 3.3 = 29.84 ms

<u>for third round</u>

$E_{RTT} = \alpha * I_{RTT} + (1–\alpha) N_{RTT}$

= (0.9) (29.84) + (0.1) (24)

= 26.856 + 2.4 = 29.256 ms

13. Ans: (a), (b) & (d)

Sol: Header Checksum is part of IPv4 Datagram Header as it calculates the checksum for only Header. But, TCP calculates the checksum for both header and data.

14. Ans: (a) & (c)

Sol: UDP is message oriented, unreliable connectionless datagram protocol. It is efficient for Broadcasting & Multicasting. As UDP's Header is very small compared to TCP's Header, it has less overhead than TCP. TCP is Byte Oriented Protocol, but, UDP is message oriented protocol.

Chapter 9 Application Layer Protocols

01. Ans: (b)

Sol: Refer page 119 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.

03. Ans: (c)

Sol: In DNS we need quick response than reliability hence it uses UDP.

04. Ans: (d)

05. Ans: (a) & (b)

Sol: POP & IMAP are called as pull protocols, but not DNS.

DNS Services:

i. Host name to IP address translation

ii. Host aliasing

iii. Mail sever aliasing

iv. Load distribution

06. Ans: (a) & (c)

Sol: USER & PASS are commands of FTP. HTTP commands are HEAD, GET, POST, PUT, DELETE, TRACE, OPTIONS. etc.