GATE | PSUs

COMPUTER SCIENCE & INFORMATION TECHNOLOGY

Computer Networks

Text Book : Theory with worked out Examples and Practice Questions

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Computer Networks

(Solutions For Text Book Practice Questions)

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

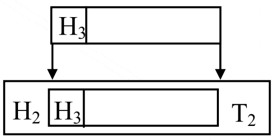
$$= m + nh$$

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

03. Ans: (b)

Sol: packet ⇒ 3 ⇒ NPDU ⇒

Frame ⇒ 2 ⇒ DPDU ⇒

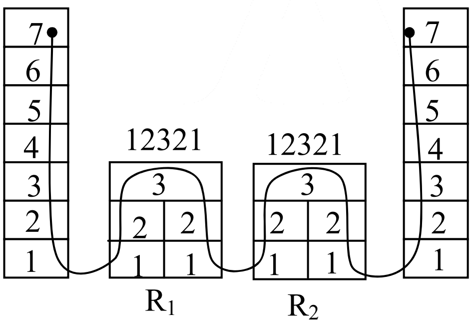


04. Ans: (a)

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.

2. LAN Technologies

01. Ans: (d)

Sol: Given:

$B = 10^6$ bps

Distance = 10000 km

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

L = 50000 B

$$p = T_x = \frac{L}{B} = \frac{50000 \times 8}{100 \times 10^4}$$

$$= \frac{4}{10} \times \frac{10^3}{10^3}$$

$$= \frac{4000}{10}$$

= 400 msec

$$q = \frac{d}{v} = \frac{10000 \times 10^3}{2 \times 10^8}$$

$$= \frac{1}{20} = \frac{1}{20} \times \frac{10^3}{10^3}$$

$$= \frac{1000}{20} \text{ ms}$$

= 50 ms

02. 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.

03. 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.

04. Ans: 10000

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

05. Ans: (d)

Sol: Condition for minimum frame size is transmission delay = 2 × propagation delay.

L/B = 2 × d/v.

L = 1250 × 8 bits,

$B = 10^8$ bits, d = 1 KM.

If we substitute values you get

v = 20,000 km/sec

06. 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

07. 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.

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

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

$= 100\mu s$

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

09. 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) = <u>0.2016</u>

<u>0.4404</u>

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

10. Ans: 81 to 85

Sol: B = 10 Mbps

Slot time = 51.2 μsec, L = 512 bytes

Number of slots = 1.716

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

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

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

Contention width = no. of slots × slot time

= 1.716 × 51.2 = 87.85 μsec

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

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

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

11. 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.

3. Basics of Wi-Fi

01. Ans: (b)

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

02. Ans: (d)

03. Ans:(c)

Sol: In wireless LANs it is difficult to detect the collision rather than to avoid it. So the access method for wireless LANs as define by IEEE 802.11 is based on collision avoidance i.e CSMA/CA.

04. Ans: (c)

Sol: IEEE 802.11 uses CSMA/CA protocol
CSMA/CA uses RTS-CTS Mechanism to avoid- collision.
RTS-Request to send,
CTS-Clear to send.

05. Ans: (d)

Sol: Network allocation vector (NAV) Restrict the stations to sense the medium, when medium is busy.
Like counter, decreases at constant rate.
If zero means medium is idle if non zero means medium is busy.

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)

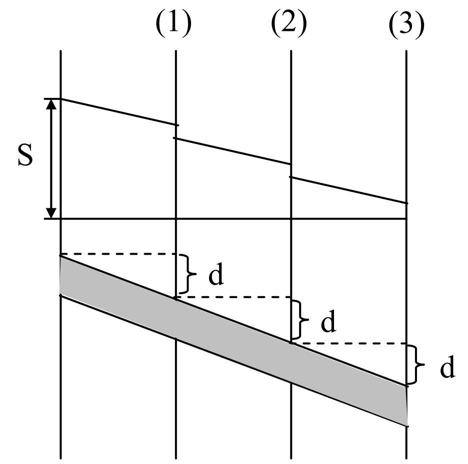
$$T_P = \frac{d}{v} = \frac{m}{m/s} = \text{sec}$$

Total delay = I + II + III
I. Circuit setup time = S

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

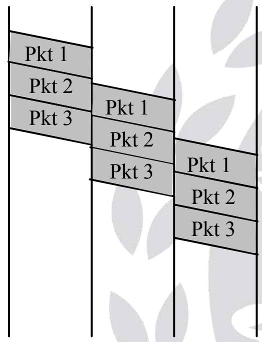
III. T_P=one hop → propagation time='d' sec
For k hop → propagation time ?
= k × d

∴ 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?

  $= k \times d$

- Total time = $x/b + k.d + (k-1)\frac{p}{b}$

5. Data Link Layer

01. Ans: (b)

Sol: Stuffed bit is 4th bit from the last.

02. Ans: (c)

Sol:

```
1011)  01011011000 (01000011
        1011
        ------
           1100
           1011
           ------
             1110
             1011
             ------
              101
              CRC
```

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	1 ⇒ 10011	Even parity 1
5=1+4		
6=2+4	2 ⇒ 11011	0
7=1+2+4	4 ⇒ 010	1
9=1+8		
10=2+8	8 ⇒ 111	1
11=1+2+8		

Hamming code = 10110101111

04. Ans: 4.76

L = 1000 bits

d = 100 × 10^3 m

V = 2 × 10^8 m/sec

B = 20 Mbps = 20 × 10^6 bps

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

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

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

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

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

05. Ans: 47.6

06. Ans: 160

Sol: B = 4 Kbps

Propagation delay = 20 msec

η = 50%

RTT = 2 × Propagation delay

= 40 msec

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

L = 1 KB

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

$$= \frac{1024\times8}{(1024\times8)+1.5\times10^6\times45\times10^{-3}}$$

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

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

$$T_x = \frac{L}{B}$$

$$= \frac{2000\times 8}{1\times 10^6} = 16 \text{ ms}$$

$$T_{ax} = \frac{20\times 8}{1\times 10^6}$$

= 160 μsec

= 0.16 msec

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

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

= 17.91 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

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

$$= \frac{2.5\times 10^6}{1024\times 8} = 305$$

(4) sequence no. = w_p = 305

∴ 2^k = 305

∴ 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 speed = 6 μsec/km

Propagation delay for 3000 km

⇒ 3000 × 6 μsec

(1) RTT = 2 × 18000 μsec

$= 36000 \times 10^{6}$

= 36 msec

(2) 1 sec → 1.536×10^{6} bits

36 ms → ?

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

$$= \frac{1.536 \times 10^{6} \times 36 \times 10^{-3}}{64 \times 8} = 108$$

(4) Sequence number $w_p = 108$

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

$\Rightarrow 2^k = 2^7$

$\Rightarrow k = 7$

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

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 $(T_t) = \dfrac{L}{B}$

$$T_t = \frac{1 \times 8 \times 10^3 \text{ bits}}{128 \times 10^3 \text{ bps}}$$

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

T_t = 64 msec

W_S = sender window size

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

$$1 = \frac{W_S \times 64}{64 + 2 \times 150}$$

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

Ws = 5.6875

$W_S + W_R$ = Available sequence numbers for SR

$W_S = W_R$

ASN = 2 × W_S

ASN = 2 × 5.6875

ASN = 11.375

No. of bits in the sequence number

$= \lceil \log_2 \text{ASN} \rceil$

$= \lceil \log_2 11.375 \rceil = 4$

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

$\therefore$ 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

$\therefore$ 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:

Class C
32
NID — HID
3 + 21   8
id (110) — (21)

$= 2^{21}$

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)

Class B
32
NID — HID
16   32 – 16 = 16
12 — 4

255.	255.	255.	240
1111 1111.	1111 1111.	1111 1111.	1111 0000

Hosts per subnet = $2^4 - 2$

06. Ans: (c)

Sol:

Class C

32

NID — HID

3 + 21 — 8

SID — HID

3 — 5

$2^x = 7$

$\therefore x = 3$

$2^3 = 8$ 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

Class C

32

NID — HID

3 + 21 — 8

SID — HID

3 — 5

Subnet mask → /27

07. Ans: (d)

Sol:

Class B

32

NID — HID

2 + 14 — 16

SID — HID

6 — 10

64 departments = 2^6

1111 1111. 1111 1111. 1111 1100. 0000 0000

255. 255. 252. 0

08. Ans : 255.255.255.128

Sol: 100 LAN's

$2^x = 100$ hosts

$\therefore x = 7$

Class B

32

NID — HID

2 + 14 — 16

SID — HID

9 — 7

/25 ⇒ 255.255.255.128

09. Ans : 24

Subnet mask → / 24

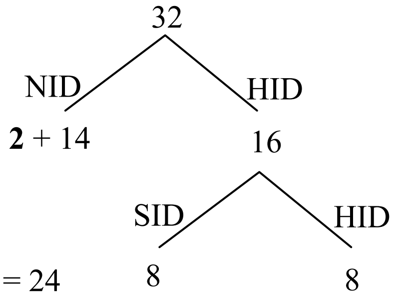
⇒ 255.255.255.128

Given LANs = 150

$2^x = 150$

x = 8

Class B



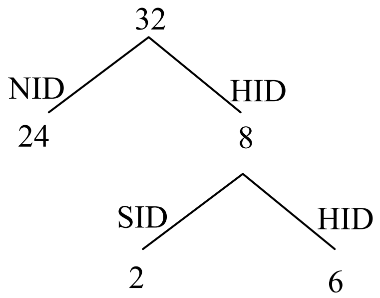
16+8 = 24

10.

Sol: SM = 255.255.255.192

192 = 1100 0000

Class C



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: /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

12. 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) 245.248.136.0./24 and 245.248.132.0/21 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)

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

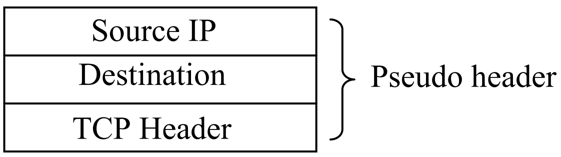
OSPF operation is based on LSR

04. Ans: 51

8. TCP/UDP & Sockets, Congestion Control

01. Ans: (c)

Sol: TCP pseudo Header Format



02. Ans: (b)

Sol: Each socket is binded with a port

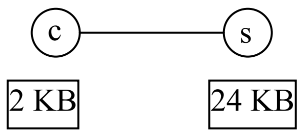
03. Ans: (d)

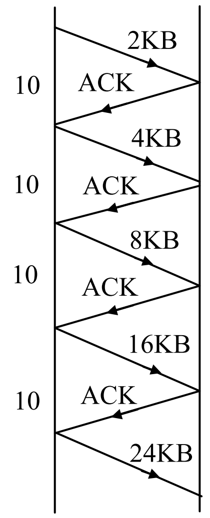
04. Ans: (b)

Sol: RTT = 10 msec

Scap = 24 KB

Lcap = 2 KB



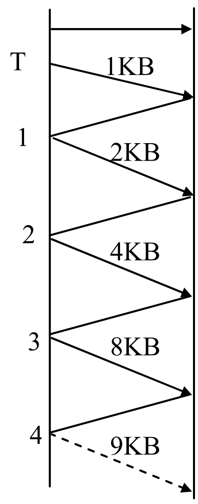


= (10+10+10+10)ms
= 40 ms

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: 10

Sol: 1 sec …….. 200×10^6

$$\Rightarrow \frac{200\times10^6}{8}$$

$= 25 \times 10$ sequence

$$= \frac{2^{28}}{25\times10^6} = \frac{2^{28}}{25\times2^{20}} = \frac{2^8}{25} = \frac{250}{25} = 10\text{sec}$$

---

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 $\Rightarrow$ 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: RTT = 30 msec, $\propto = 0.9$

NRTT = 26

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

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

= 29.6 msec

2^{nd} round = 29.84 msec

3^{rd} round = 29.256 msec

9. Application Layer Protocols

01. Ans: (b)

Sol: Refer page 90 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)

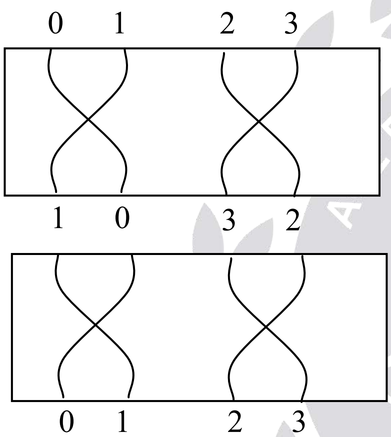
Sol: In DNS we need quick response than reliability hence it uses UDP.

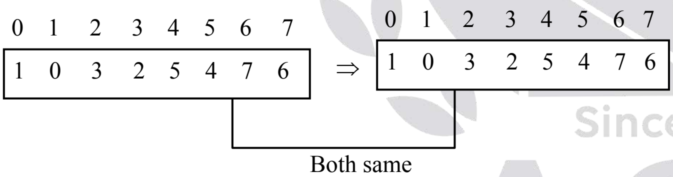
04. Ans: (d)

10. Network Security

01.

Sol: Symmetric in nature

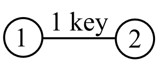




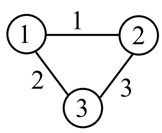
Both are in symmetric nature. Hence IP = IP^{-1}

02. Ans: (c)

Sol: 2 nodes

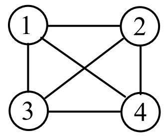


3 nodes



3 keys ⇒ 1 + 2

4 nodes



1+2+3 = 6 keys

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

03. 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) $47, \frac{47-1}{2} = \frac{46}{2} = 23 \Rightarrow (47, 23)$

∴ Option (a) & (d) is correct

04. Ans: (b)

Sol: p = 7, a = 3 primitive root

$X_A = 2$, $X_B = 5$

Public key $y_A = a^{XA} \bmod p = 3^2 \bmod 7 = 2$

Public key $y_B = a^{XB} \bmod p = 3^5 \bmod 7 = 5$

Shared key $K_{AB} = (y_A)^{XB} \bmod p = 2^5 \bmod 7 = 4$

05. Ans: (b)

Sol: (I) $\left.\begin{array}{l} M' = M^e \bmod n \\ M = (M')^d \bmod n \end{array}\right\}$ Encryption and Decryption

(II) Is false

(III) Is true ed = 1 mod $\phi(n)$

d is the inverse of e

e is public key

d is private key

(IV) Is false

06. Ans: (d)

Sol: RSA Algorithm:

Step: (I) p = 3, q = 11

Step: (II) n = p × q = 3 × 11 = 33

z = (p –1) (q – 1)

= (3 – 1) (11 – 1)

= (2 ×10)

= 20

z = 20

Step: (III) Given e = 3: Public key

Step: (IV) (d × e) mod z = 1

(d × 3) mod 20 = 1

21 mod 20 = 1

(d × 3) = 21

$d = \frac{21}{3} = 7$

private key = 7

07. Ans: 11

Sol: p = 13, q = 17

$K_u = \{e, u\} = \{35\}$

$K_r = d = ?$

RSA steps

1. p = 13 q = 17

2. n = 13 × 17

$\phi(n) = (p – 1) (q – 1)$

= 12 × 16

= 192

d = ?

e = 35

So (e × d) mod $\phi(n)$ = 1

(35 × d) mod 192 = 1

d = 11

08. Ans: (d)

Sol: Definition of Digital sign and PKC230

09. Ans: (b)

Sol: A birthday attack is a type of cryptographic attack that exploits the mathematics behind the birthday problem in probability Theory. The attack depends on the higher likelihood of collisions found between random attack attempts and a fixed degree of permutations.

1: Sender can launch the attack

Digital signatures can be susceptible to a birthday attack. A message *m* is typically signed by first computing *f(m)*, where *f* is a cryptographic hash function, and then using some secret key to sign *f(m)*. Suppose Alice(sender) wants to trick Bob (receiver) into signing a fraudulent contract. Alice prepares a fair contract m and a fraudulent one m'. She then finds a number of positions where m can be changed without changing the meaning, such as inserting commas, empty lines, one versus two spaces after a sentence, replacing synonyms, etc. By combining these changes, she can create a huge number of variations on m which are all fair contracts.

In a similar manner, Alice also creates a huge number of variations on the fraudulent contract m'. She then applies the hash function to all these variations until she finds a version of the fair contract and a version of the fraudulent contract which have the same hash value, $f(m) = f(m')$. She presents the fair version to Bob for signing. After Bob has signed, Alice takes the signature and attaches it to the fraudulent contract. This signature then "proves" that Bob signed the fraudulent contract. This way the sender launches the Birthday attack.