**CMP2205 Assignment**

**Due: 26th March**

1. Consider a system with a t-layer protocol hierarchy. In this case assume that applications generate length m byte messages. Also, an H-byte header is added at each layer.
   1. Determine the fraction of the band width utilized by the message.
   2. Determine the fraction of wasted bandwidth by headers.
2. Cordier a 3MHz bandwidth channel with a capacity of 20Mbps and assuming white thermal noise, what signal to noise ratio id dB is required to achieve this capacity?
3. Differentiate between TCP and UDP and clearly indicate the practical scenarios when each protocol is useful.
4. Consider three networks, all packet switched, each with p nodes. Of the 3 networks, network 1 has a star topology with a central switch, network 3 has a (bidirectional) ring, and network 3 is fully interconnected (i.e. it has a direct connection from every node to every other node). What are the best, average, and worst-case transmission paths in hops?
5. A digital signaling system is required to operate at 9600 bps.
6. If a symbol encodes a 4-bit word, what is the minimum required channel band width?
7. What is the minimum bandwidth for 8-bit words?

Answers

cse123A Computer Networks Fall 99 Final

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Thursday, December 16, 3pm to 5pm CENTER 212

ANSWER KEY

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Name:(please print)

ucsd id No.

Answer all questions. Exam is closed book.

Write your answers in the space indicated and provided for with each

question.

Write legibly. Avoid Overwriting. Write with pen only. Do not write

on the reverse side.

Keep rough work separate and do not submit it. Rough work not

evaluated. For rough work separate blank sheets are provided.

Q. No. marks Q.No. marks Q.No. marks Q.No. marks

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1 5 10 1 20 1 30 2

2 3 11 4 21 2 31 10

3 9 12 6 22 2 32 4

4 5 13 2 23 1 33 2

5 3 14 2 24 1+2 34 3

6a 1 15 2 25 1

6b 2 16 2 26 3

7 15 17 2 27 3

8 1 18 1 28 1

9 2 19 2 29 1

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Total (out of 109) :

PAGE 1

(there are 17 pages - PAGE 1 to PAGE 17)

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Question 1:

A large population of Aloha users manage to generate 50 requests/sec,

including both originals and retransmissions. Time is slotted in units of

40 msec. What is the expected number of transmission attempts needed?

Answer:

G, the average number of transmissions per slot, is 2.

Expected number of transmission attempts is e\*\*G (page 250 in

text book) which calculates to 7.4

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Question 2:

If delays are recorded as 8-bit numbers in a 50-router network, and delay

vectors are exchanged twice a second, how much bandwidth per (full duplex)

line is taken by the distributed routing algorithm? Assume each router

has three lines to other routers.

Answer:

The routing table is 50 x 8 = 400 bits. This information is sent twice a

second on each link each way. So 800 bps are consumed on each link in each

direction.

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Question 3:

A datagram subnet allows routers to drop packets whenever they need to.

The probability of a router discarding a packet is p. Consider the case of

a source host connected to source router, which is connected to the

destination router, and then to the destination host. If either of the

routers discards a packet, the source host eventually times out and tries

again. If both host-router and router-router lines are counted as hops,

what is the mean number of

(a) hops a packet makes per transmission?

(b) transmissions a packet makes?

(c) hops required per received packet?

Answer: (a) Each packet may make 1, 2 or 3 hops. For 1 hop, the first

router drops it and the probability is p. For 2 hops, it goes through

first router but not the second and the probability is (1-p)p. For 3 hops,

it goes through both routers and the probability is (1-p)(1-p). Mean hops

per transmission is given by

1 x p + 2 x (1-p)p + 3 x (1-p)(1-p) which simplifies to p\*\*2 - 3p +3

(b) The probability of successful transmission all the way is (1-p)\*\*2

Let us denote it by w. The average number of transmissions per packet is

given by

w + 2w(1-w) + 3w(1-w)\*\*2 + + nw(1-w)\*\*(n-1) + ....

which reduces to 1/w, that is, 1/(1-p)\*\*2

(c) mean hops per packet = mean hops per transmission x mean number

of transmissions which is ( pxp - 3p + 3 ) / ((1-p) x (1-p))

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Question 4:

z bits of data are to be transmitted over a k-hop path in a packet-switched

network as a series of packets, each containing p data bits and h header

bits. Assume z>>p+h. The line speed is b bits per sec and the propagation

delay is negligible. What value of p minimizes the total transmission time

for the data?

Answer: The total number of packets needed is z/p. The total of data+header

works out to (p+h)z/p bits. The source takes (p+h)z/(pb) sec to transmit

this. The forwarding of the last packet by intermediate routers on the way

takes up (k-1)(p+h)/b sec. Adding up the two gives the time to clear the

full pipe (that is, from start at source of the first bit of first packet

to move out till the receipt of the last bit of the last packet at the

destination).

Total time = (p+h)z/(pb) + (p+h)(k-1)/b. Minimize with respect to p by

differentiating with respect to p, setting to zero and solving for p,

we get p = sqrt((hz/(k-1))

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Question 5:

Three packet-switching networks each contain N nodes. The first is star

topology with a central router, the second is a bidirectional ring, and the

third is fully interconnected (every node is connected to every other).

What are the best, average and worst case tranmission paths in hops for

each of the above networks?

Answer: star - 2, 2, 2 hops (best, average, worst)

ring - 1, N/4, N/2

full - 1, 1, 1

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Question 6:

(a). The following data fragment occurs in the middle of a data stream

using character stuffing for frames. DLE STX A DLE B DLE ETX What is the

output after stuffing?

Answer: DLE STX A DLE DLE B DLE ETX

7 5

(b). What is the remainder obtained by dividing x + x + 1

3

by x + 1 ?

2

Answer: x + x + 1

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Question 7:

For the network described in the table, give the routing table for each of

the nodes A, B, C, D, E, F. Shortest path (Dijkstra's)routing is used.

Link table of the network:

Router A A B C C D

Router C D E E F E

cost 3 8 2 1 6 2

Answer: Fill in the following table. Each entry is (hop, total distance)

If hop itself is destination mark it as \*.

To: A B C D E F

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From

A - C,6 \*,3 C,6 C,4 C,9

B E,6 - E,3 E,4 \*,2 E,9

C \*,3 E,3 - E,3 \*,1 \*,6

D E,6 E,4 E,3 - \*,2 E,9

E C,4 \*,2 \*,1 \*,2 - C,7

F C,9 C,9 \*,6 C,9 C,7 -

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Question 8:

Give an example of a 4-bit error that will not be detected by two dimensional

parity. You may use the following as a hint.

0 1 0 1 0 0 1 |1

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1 1 0 1 0 0 1 |0

|

1 0 1 1 1 1 0 |1

|

0 0 0 1 1 1 0 |1

|

0 1 1 0 1 0 0 |1

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1 0 1 1 1 1 1 |0

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1 1 1 1 0 1 1 |0 <----- column parity bits

Answer: invert any 4 bits which lie on the corners of a rectangle.

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Question 9:

A network with four routers A, B, C, D uses Distance Vector Routing. The

distance table for the router A is < 0 1 4 100>. Router A receives from B

the vector < 1 0 1 1 >. Show the updated distance table for router A.

Answer: < 0 1 2 2 >

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Question 10:

To provide more reliability than what single parity bit can give, an error

detecting code uses one parity bit for the odd numbered bits of a message

and a second parity bit for the even numbered bits of the message. What is

the Hamming distance of this code?

Answer: 2

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Question 11:

Identify the class of each of the following IP addresses.

(a) 128.36.199.3 (b) 21.12.240.17 (c) 183.194.76.253 (d) 200.3.6.2

Answer: (a) class B (b) class A (c) class B (d) class C

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Question 12:

Frames of 1000 bits are sent over a 1 Mbps satellite channel - propagation

delay of 270 msec. Acks are always piggybacked. Headers are very short.

Three bit sequence numbers are used. What is the maximum achievable

channel utilization in frames per sec for (a) stop-and-wait protocol

(b) protocol with go-back-n and (c) protocol with selective-repeat ?

Answer:

At 1Mbps, 1000 bits take 1 msec (neglect headers). The round trip time for

a frame is 1+270++270+1 = 542 msec. (till ack is received by the sender).

(a) channel utilization is 1 frame in 542 msec = 1.85 frames per sec

(b) pipeline 7 frames (3 bit seq number) with roundtrip of 548 msec giving

channel utilization 7/548 = 12.77 frames per sec

(c) pipeline 4 frames ( window size is sequence-size /2 ) in 545 msec

giving channel utilization 4/545 = 7.34 frames per sec

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Question 13:

In wired LANs, all stations can monitor the medium and detect collisions,

but not so in a wireless LAN. What are the two problems this gives rise to

in wireless LANs called?

Answer:

i) hidden Station (ii) exposed station.

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Question 14:

In binary exponential backoff scheme to deal with collisions, after k

consecutive collisions, how long does a colliding station wait before

attempting transmission?

Answer: for a random time chosen from the interval [ 0, T x 2\*\*k ], where

T is the worst case round trip propagation time for the channel.

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Question 15:

In MACA (Multiple Access, Collision Avoidance) in wireless LANs, what

happens if two stations send an RTS (Request to send) at the same time?

Answer: If the RTSs do not collide, the two senders will both receive CTS

and go ahead. If the RTSs collide, they will not get CTS and will have to

try again using some randomised backoff.

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Question 16:

What is does a station, say, A do when it hears an RTS in MACA?

Answer:

If the RTS is for it, it sends a CTS. Otherwise, it pauses for time

sufficient for a CTS to go to the sender (from some one else).

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Question 17:

In datagram service, routing table is looked up for every incoming datagram

to a router. In virtual circuit service, packets are forwarded using the

VCI - virtual circuit index - by routers. Do we need routing tables for

virtual circuit service?

Answer:

Yes - for establishing connection (virtual circuit) from source to

destination.

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Question 18:

Why are large networks (communication subnet of routers) organized

hierarchically?

Answer:

To keep size of routing tables small/manageable and to reduce the time to

compute routing tables.

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Question 19:

State one advantage and one disadvantage of source-routing.

Answer:

Advantage - smaller routing tables in routers;

routers need not exchange information and compute routing tables.

Disadvantage - increased size of packets (to carry route information);

static (non-adaptive) routing.

[any one for each of Advantage/Disadvantage will do].

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Question 20:

In link-state routing, how many lsps (link-state-packets) does a router

create for broadcasing to other routers?

Answer: one for each link that the router has.

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Question 21:

When is it a good idea to use hop count as a criterion for routing?

Answer: In a homogeneous network (like link-characteristics) with

uniformly distributed load.

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Question 22:

Tokens are added every 0.5 secs to a token bucket of capacity 500 bytes.

Each token is 100 bytes in size. (a) If a packet of size 400 bytes arrives

from the host when the bucket has tokens worth 200 bytes, and there are no

other packets queued for service, what is the least and most waiting the

packet will face before transmission?

Answer:

The packet needs 2 more tokens - (400-200)/100. If it arrives just when a

token is about to arrive, it waits 0.5 sec - the least. Most waiting is

1.0 sec.

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Question 23:

Why is multicasting more efficient than multiple unicasts?

Answer:

(atmost) only one copy of a packet is sent on a link.

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Question 24:

In a wireless LAN, (i) sender P who may send to Q can not hear R who may

also send to P. What is R called? (ii) Q sends to P and though R can send

to S without collision, it defers. Why? What is R called?

Answer:

(i) R is a Hidden Station (from P)

Note: The question should read "R who may send to Q" and not

"R who may send to P" - this is a typo. Every one gets 1

mark.

(ii) R hears Q (but does not know it 'll not interfere for P) and defers.

R is an exposed station (exposed to Q)

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Question 25:

What is the name of the protocol that translates network-layer IP address

of a host to datalink-layer address?

Answer: ARP (Address Resolution Protocol)

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Question 26:

What are the network number, subnet number and host number for IP address

135.194,192.100 and mask 255.255.128.0 ?

Answer: The IP address is class B, so the network number is 7.194

The mask selects the leftmost 17 bits which is gives just a 1-bit subnet

number; the subnet number is 1.

Host number is 40.100

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Question 27:

How many addresses are spanned by (that is, the maximum number of hosts in

the subnet) the CIDR address 205.12.192.0 with 20 bit subnet mask

255.255.240.0 ? What is the range spanned (give the low and high host

addresses)?

Answer: With a 20 bit subnet mask, the number of hosts is spanned by 12

bits, giving 4096 hosts. The range is 205.12.192.0 to 205.12.255.255

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Question 28:

Reverse path forwarding for broadcast eliminates duplicate packets

of the same broadcast reaching nodes - True or False?

Answer: False

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Question 29:

What is the name of the technique used to reduce the size of routing

tables and the time for computing them?

Answer: Hierarchical structuring of network (routers/host addresses)

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Question 30:

Why does the Offset field in the IP header specify the offset in 8-byte

units?

Answer: The offset field is 13-bits long and an IP packet can have maximum

65536 bytes length (2\*\*16). Possible values for offset are 0 to 65535 in

bytes and only with 8-byte units, this range can be specified in 13 bits.

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Question 31:

A router has built up its routing table as given. The router can deliver

packets directly over interfaces 0 and 1, or can forward to routers R2,

R3 or R4. What does the router do with each of the packets (a) to (e) it

receives?

Routing Table:

SubnetNumber SubnetMask NextHop

128.96.39.0 255.255.255.128 Interface 0

128.96.39.128 255.255.255.128 Interface 1

128.96.40.0 255.255.255.128 R2

194.4.153.0 255.255.255.192 R3

default R4

The destinations of the packets received are:

(a) 128.96.39.10 (b) 128.96.40.12 (c) 128.96.40.151

(d) 192.4.153.17 (e) 192.4.153.90

Answer:

The router masks the destination address of packet with SubnetMask and

matches with SubnetNumber and accordingly sends the packet corresponding to

the matching entry in routing table. For no match, the packet is sent to

the default router.

(a) on Interface 0 to the host (using ARP)

(b) to R2

(c) to default router R4

(d) to default router R4

(e) to default router R4

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Question 32:

Differentiate between flow control and congestion control.

Answer:

Flow control is to establish good rate between sender and receiver to

ensure that sender is not too fast or too slow with respect to reciver.

Congestion control is to regulate the load from host into the network to

eliminate the situation that the network is unable to handle the traffic.

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Question 33:

In token ring, what is token holding time? What purpose does it serve?

Answer:

Token holding time is the maximum time a station can use the token (when it

gets a free token) after which it must put out a free token for other

stations on the ring. It ensures that no station can monopolise the token

for long periods resulting in unbounded delays for other stations wanting

to transmit.

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Question 34:

Name three functions of monitor in a token ring which make the token ring

robust.

Answer:

Detecting and resolving

(i) duplicate tokens -eliminate

(ii) lost tokens - regenerate

(iii) continuously busy token (transmitting station crash)

(iv) clearing the ring of garbled frames

(v) taking action when ring breaks

[any three will do].

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END OF ANSWER KEY

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