Computer Science Department

1996 Examinations

B228 Computer Communications

C329/D15 Communications and Networks

Answer THREE questions

The use of Electronic Calculators is not permitted in this examination.

Q.1 a) i) The CSMA-CD *Medium Access Control* (MAC)algorithm used on the Ethernet employs “*Collision Detection*”. What is collision detection, how is it implemented and what advantages does it confer?

[6 marks]

ii) Show that the mechanism employed for collision detection on the Ethernet imposes a limit on the frame size for a particular length of cable. What problems does this cause if CSMA-CD is considered as a MAC protocol for a MAN?

[14 marks]

b) IEEE Committee 802.6 has developed a Metropolitan Area Network standard called Distributed Queue Dual Bus (DQDB) (formerly QSPX)

i) Describe the topology and basic physical operation of the proposed network. (You do **not** need to describe the distributed queue medium access protocol).

[5 marks]

ii) The diagram shows packet mode operation on a DQDB network with four stations. Each station has two counters; a `queue counter' Q which counts downstream requests and a `down counter' D which records the station's position in the queue. The counters relate to requests made on bus X for transmission slots on bus Y, currently only C has a request outstanding.

```
 ---------------------------------------->  X
   ┌───┐     ┌───┐     ┌───┐     ┌───┐
   │ A │     │ B │     │ C │     │ D │
   └───┘     └───┘     └───┘     └───┘
<----------------------------------------    Y

   Q   D     Q   D     Q   D     Q   D

   0   0     0   0     0   0     0   0
   0   0     0   0     0   1     1   0
```

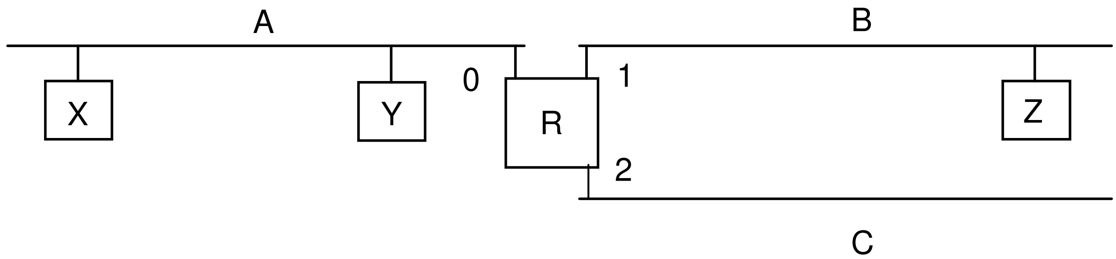
Show how the values of the counters will change as A, D, and B make requests (in that order) on bus X, followed by the passage of four free slots on bus Y.

[8 marks]

Q2. a) Describe the principal characteristics of the "*Internet Protocol*" (*IP*) as used on the Internet. (Your answer should refer to the *service* provided by the protocol, *addressing* and *fragmentation*).

[9 marks]

b) In the diagram below, R is an Internet router between three Ethernets A, B and C. Host X has IP address 128.16.5.2, Z has address 128.20.4.3. The interfaces of R (0, 1 and 2) have addresses 128.16.5.9 and 128.20.4.12 and 128.14.9.7 respectively. There are no other routers on A, B or C.



i) What can be said about the IP address of Y?

[2 marks]

ii) Explain how address resolution works when X sends an IP datagram to Y for the first time. How are things different when X sends to Y for a second time and how does the mechanism cope with a change to Y's Ethernet address?

[10 marks]

iii) Outline the IP address mappings and address resolution mappings which take place in X and R when X sends an IP datagram to Z. Your answer should make it clear what IP addresses are carried in any IP datagrams.

[12 marks]

Q.3 *You may find the following formulae useful in this question:*

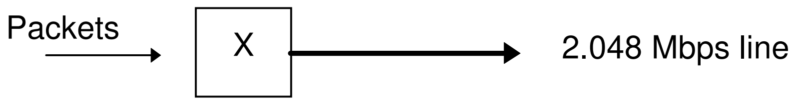
Given an M/M/1 queuing system with an infinite queue and customers arriving at mean rate λ with service times having a mean $1/\mu$ sec:

The probability that there are n customers in the system is $\rho^n(1-\rho)$ *where* $\rho = \frac{\lambda}{\mu}$.

The average number of customers in the system is $\frac{\lambda}{\mu-\lambda}$

Average delay per customer is $\frac{1}{\mu-\lambda}$

a) In the diagram, X is an interface which receives packets and transmits these on a 2.048Mbps line. Packet sizes are negative exponentially distributed with a mean size of 1024 bits. Packets arrive for transmission at a mean rate of 1000 packets/sec; inter-arrival times are negative exponentially distributed.



i) Assuming infinite buffering in *X*, calculate the mean number of packets in *X* and the mean delay imposed by *X*.

[4 marks]

ii) Suppose, instead, that the 2.048Mbps is operated as 20 independent 102.4Kbps sub-channels using Time Division Multiplexing. Incoming packets are distributed to sub-channels in strict rotation. Calculate the mean number of packets in *X* and the mean delay imposed by *X* in this new configuration.

[7 marks]

b) i) A code designed to correct all single bit errors uses code words having *m* message bits and *r* check bits. Show that *m* and *r* must satisfy the inequality:

$$m + r + 1 \le 2^r$$

[8 marks]

[Question 3 continued over page]

[Question 3 continued]

ii) The code-word below is a *Hamming Code* for 7-bit ASCII calculated with even parity and having one bit in error. Explain how the check bits are calculated in this code and identify the bit which is in error.

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

[10 marks]

iii) Given that the *Hamming Code* above can correct all 1-bit errors verify that the inequality in i) is satisfied and state what must be the minimum *Hamming Distance* of the code.

[4 marks]

Q4. a) i) Outline the principal characteristics of *"Asynchronous Transfer Mode"* (ATM). Your answer should indicate what aspects of ATM cells determine that ATM must adopt a virtual-circuit style of operation.

[7 marks]

ii) ATM has been chosen as the multiplexing technique to support *"Broadband ISDN"* (*B-ISDN*). Briefly outline what B-ISDN is and what kinds of services it is intended to support. Why has ATM been chosen to support B-ISDN in preference to the enhancement of pre-existing technologies such as circuit-switching or X.25?

[14 marks]

b) A "*Go-back-N*" *"ARQ"* protocol has a *"3-bit sequence number space".* Explain what these terms mean and illustrate how the protocol will fail if the transmit window is set to 8.

[12 marks]

Q5. a) Briefly describe the *World-Wide Web* as deployed on the Internet. Your answer should include explanations of; *HTML*, *URL*, *HTTP* and “WWW-browser”.

[11 marks]

b) Two Internet users decide to exchange images via file transfer. Both have scanners which record images as a series of 16-bit integers. Discuss the problems that may arise with this arrangement and relate these problems to the OSI Presentation Layer concepts “*abstract syntax*” and “*concrete syntax*”.

[11 marks]

c) A Protocol Data Unit (PDU) for a simple protocol consists of a “*header*” followed by a “*data*” part. The header contains an “*address*” section, followed by three integer fields for sequence number, acknowledgement number and data length. An *address* is an ASCII string specifying a host name, together with an integer Transport port. The *data* part is an arbitrary collection of bytes. Illustrate how the syntax of such a PDU might be specified using the ISO Abstract Syntax Notation 1 (ASN.1).

[Marks will not be deducted for minor syntax errors]

[11 marks]