

BITS, Pilani-Dubai Campus, Knowledge Village, Dubai
IIIrd Year Second Semester 2003-2004
Degree: B.E.(Hons) Branch: C.S.E

COURSE NO. : CS UC 461

COURSE TITLE : COMPUTER NETWORKS

Time : 180 mts Date : 10-6-2004 Marks: 65
Comprehensive examination (Closed book)

Part A

*Answer all the questions. All questions carry equal marks (10*2=20)*

- Q1. Why is there a need for DHCP protocol?
- Q2. How using limited radio frequencies base stations are able to manage the mobile communication between subscribers?
- Q3. Outline the difference between a gateway and a router.
- Q4. I have multiplexed digital voice packets from 4 channels using TDM. Let each digital sample of voice channel is represented using 8 bits. What should be the storage capacity required to store the multiplexed channels for a duration of 5 secs.
- Q5. Assume that a voice channel occupies a bandwidth of 4 KHZ. We need to multiplex five voice channels into a link. What is the maximum bandwidth of the link if there is a need for a guard band of 5 KHZ between the channels to prevent interference.
- Q6. Outline Why there is a need for separating data and control in networks?
- Q7. Outline the broad classes of medium access protocol with relevant examples.
- Q8. I want to transfer packets from two different applications like FTP and HTTP from a computer A in network1 to another computer B in network2 via internet. Which layer of internet protocol distinguishes the packets from the two applications of computer A and how? Which layer of the internet protocol uniquely identifies computer A or B?
- Q9. Outline any one technique using which jittering can be removed in network traffic?
- Q10. Outline briefly the difference in circuit switching and datagram packet switching.

Part B

*Answer all the questions. All questions carry equal marks (5*9=45 marks)*

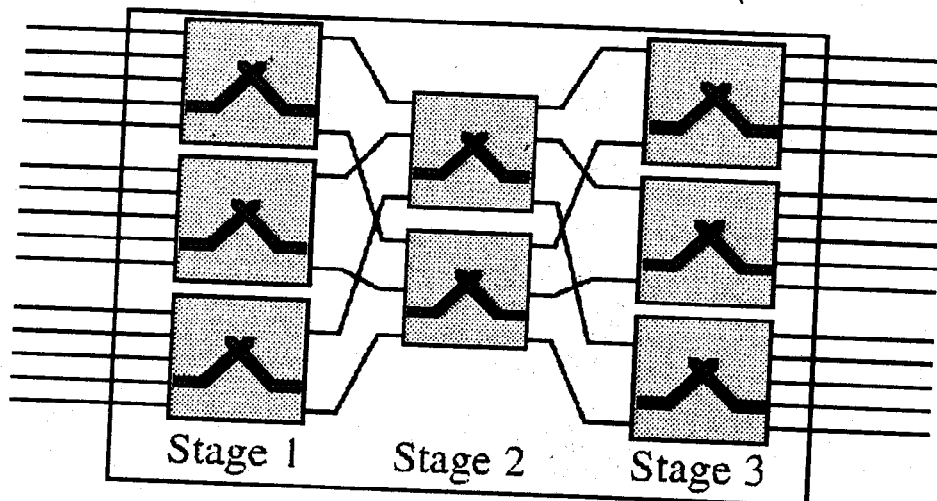
- Q1. a) Outline why there is a need for multiple access protocol in computer networks? (3)
b) Outline with relevant diagram a Taking turns type of multiple access control protocol. (3)
c) Outline how in Ethernet lan multiple nodes share a common medium? (3)
- Q2. a) Outline the features of ATM networks that are responsible for providing integrated service for voice, video and data traffic? (3)
b) Outline the difference in routing of STM packets, datagram packets and ATM packets
c) Assume that there are three channels carrying variable bit rate traffic as follows to an ATM switch which does the statistical multiplexing via a single output link. The

bandwidth of output link is equal to 0.5 Mbits/sec. Channel 1 has peak traffic of 1 Mbits/sec, channel 2 with peak traffic of 5 Mbits/sec and channel 3 with peak traffic of 9 Mbits/sec. Channel 1 peak traffic, channel 2 peak traffic and channel 3 peak traffic will overlap for a maximum of 0.1 sec.

If every channel is statistically multiplexed at the output at a rate of 0.1 M bits/sec then what should be the minimum size of the buffer needed in the ATM switch for achieving the same? What is the statistical multiplexing gain in the above scenario?(3)

- Q3. a) Outline why there is a need for traffic shaping in networks and the means to achieve the same.(3)
 b) Outline the difference between integrated and differentiated services for improving the QOS in internet.(3)
 c) Give an example for improving QOS using integrated and differentiated services in networks.(3)

- Q4. a) Outline the relative merits and demerits of using multistage cross bar switches over single stage cross bar switch.(3)
 b) With respect to the given diagram outline the difference in terms of cross over points compared to a single stage cross bar switch.(3)



- c) Outline a scenario where there is a need to combine both the time and space division switching.(3)

- Q5. a) Why there is a need for storing and forwarding IP packets in router?(3)
 b) Outline the need for routing table in each router and the means to reduce its size.(3)
 c) With relevant diagram explain the concept of distance vector routing in routers(3)

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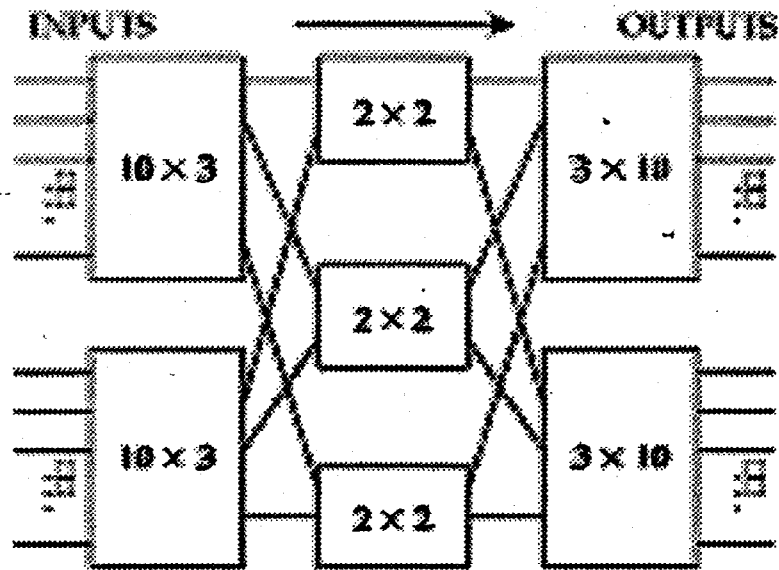
Time : 50 mts Date : 23-5-2004
Test: 2

Marks: 36

*Answer all the questions. All questions carry equal marks
Answering and evaluation scheme*

- Q1a) Why is there a need for subnetting in an organization? 3 (marks)
b) What is the difference between subnetting and CIDR addressing? 3(marks)
- Q2. Consider a scenario where there are 100,000 telephone channels carrying digitized voice packets. Let them get switched using time division switching employing Time slot interchange. Within the TSI, I am using a memory chip whose read or write access time is 50 nsec. In the above scenario justify whether the access time of the memory chip will serve the purpose for the above mentioned time division switching. If not what should be the max access time of the memory chip? (6 marks)
- Q3a) With relevant examples explain how response time can be traded for throughput in the case of processing of multiple network packets through interrupt driven technique. (3 marks)
b) Outline with the help of an example how the concept of randomization is applied in the design of computer networks . (3 marks)
- Q4.a) In the case of ATM networks how maintaining resources reservation information in the form of soft state is better than that using hard state. (3 marks)
b) With relevant to ATM networks outline how the concept of separating data and control will lead to improved performance? (3 marks)

Q5.



a) Find out the savings in terms of cross over points compared to a single stage switch which replaces the above multistage switches. (3 marks)

b) Compare the relative merits and demerits of multistage cross bar switch over single stage cross bar switch. (3 marks)

Q6. Assume an organization is having a network of 10 computers. Let the total number of IP addresses assigned to the organization are 5. Let at any point of time 5 computers are connected to the internet for a short duration at regular intervals. In the above scenario outline an appropriate methodology by which internet access to the above computers in the LAN can be managed successfully. (6 marks)

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Time : 50 mts Date : 23-5-2004

Marks: 36

Test: 2

*Answer all the questions. All questions carry equal marks
Answering and evaluation scheme*

Q1a) Why is there a need for subnetting in an organization? 3 (marks)
Consider an organization which is assigned class B address-Let the total number of nodes be equal to 65536-Let a router is employed within the organization to route the IP traffic into network-Without proper subnetting the router has to have entry for all 65536 computers within the network. The above addresses can be split into 256 subnets where each subnet carries a traffic of 256 addresses. Thus the number of entries in the router is only 256 instead of 65536 addresses. Thus using subnetting we can improve the efficiency of routing within an organization.

b) What is the difference between subnetting and CIDR addressing? 3(marks)
Class B address is very much shortage-suppose we want to allocate 2048 IP addresses to a network($8 * 256$). Minimum what we need is a class B -But instead of that we can use 3 bits of class C (Network address) to select any one of the network -Least significant 8 bits of class C can be used to represent a node in the network. But now routers in the core network must now carry a prefix indication which is 21 which specifies the network number. This kind of routing is called CIDR

The subnetting allows us to arbitrarily partition IP address into a network part and a host part which is known only to the router inside an organisation

Q2. Consider a scenario where there are 100,000 telephone channels carrying digitized voice packets. Let them get switched using time division switching employing Time slot interchange. Within the TSI, I am using a memory chip whose read or write access time is 50 nsec. In the above scenario justify whether the access time of the memory chip will serve the purpose for the above mentioned time division switching. If not what should be the max access time of the memory chip? (6 marks)

For 100,000 telephone circuits

Each circuit reads and writes memory once in every 125 ms.

Number of operations per second : $100,000 \times 8000 \times 2$

Read/write access time = $1 / (100,000 \times 8000 \times 2) = 0.625$ nsec which is less than 50 n.sec. Hence current specified memory chip will not serve the purpose. The max access time should be less than or equal to 0.625 nsec

Q3a) With relevant examples explain how response time can be traded for throughput in the case of processing of multiple network packets through interrupt driven technique. (3 marks)

Consider an example of processing packets through interrupt driven technique. On receiving a packet, a host adapter usually raises an interrupt to inform the CPU that it has some work to do. The time taken in fielding an interrupt can be a significant overhead in packet processing, thus motivating batching. A common strategy while batching interrupts is to raise an interrupt a fixed delay after receiving a packet. This constraints the worst case response time, while increasing the throughput if several packets arrive back-to-back. Appropriate numerical computation should be provided.

b) Outline with the help of an example how the concept of randomization is applied in the design of computer networks. (3 marks)

Randomization is a powerful tool for building robust systems. Consider a system where many stations share a single broadcast medium. A simple algorithm to share the medium is for a station to sense if the medium is idle, and if so transmit a packet. Suppose stations A and B both have packets to send and they simultaneously realize that the medium is idle. They both pick a random time interval so that their retransmissions are unlikely to collide. Thus randomization allows us to break the ties cleanly

Q4. a) In the case of ATM networks how maintaining resources reservation information in the form of soft state is better than that using hard state. (3 marks)

State refers to a memory system used to influence the future behaviour. Each ATM switch stores per-VCI information such as the amount of resources reserved for that VCI. Unless we explicitly inform the switch, the state persists and other connections can not access the reserved resources. Thus hard state can lead to complicated designs to remove garbage. In case of soft state the state associated with a connection has a predefined interval during which it is valid. At the end of this time, the state is automatically removed. To maintain its state a connection must periodically refresh its state.

b) With relevant to ATM networks outline how the concept of separating data and control will lead to improved performance? (3 marks)

Consider virtual circuits like ATM. During call establishment we set up a routing entry and reserve resources for that VCI. So no control information need be carried with a data packet other than the VCI itself. Any changes in the connection state are carried in a separate signaling channel. Thus we can build fast switching hardware that does not be aware of anything other than the data path.

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Time : 50 mts Date : 4-4-2004

Marks: 30 Test: 1

Closed book

*Answer all the questions. All questions carry equal marks
Answering and evaluation scheme*

Q1. Assume that an organization has 24000 networks connected across the internet. Let each network supports 1024 computer nodes. Justify which class of internet address can be assigned to the organization. (5 marks)

No of address bits for specifying the nodes in the computer = 10 bits.

No of address bits for specifying the network = 15 bits as $2^{15} = 32768$

In the above scenario class B addressing is the preferred one as it has 16 bits network address and 16 bits node address.

Q2. Assume that a voice channel occupies a bandwidth of 4 KHZ. We need to multiplex four voice channels into a link. What is the maximum bandwidth of the link if there is a need for a guard band of 5 KHZ between the channels to prevent interference. Show the configuration using frequency domain if the starting frequency for the first channel is 100 KHZ. (5 marks)

Ist channel frequency = 100K to 104 K

IInd channel frequency = 109 to 113K

IIIrd channel frequency = 118 to 122K

IV th channel frequency = 127K to 131K

B.W = 131 - 100 = 31K

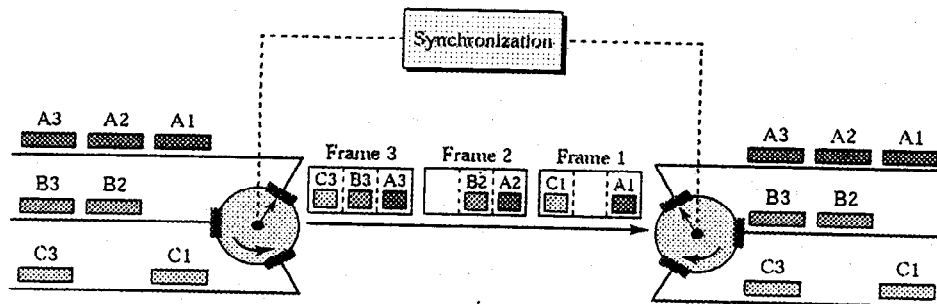
Relevant conf explained by diagram

Q3. Outline with the help of a diagram how packets are routed from a node in network 1 to a node in network 2 using network, data link and physical layers of internet protocol. (5 marks)

Using frequency/time division multiplexing all the calls at the source can be frequency/time multiplexed and carried via a single highbandwidth line thus improving the materials cost.

b) Outline with the help of a diagram how time-division multiplexing of voice channels takes place. (3 marks)

Figure 6.14 Interleaving



Drawing relevant diagram as above and explaining how voice packets from different channels are time interleaved with respect to time axis. The sampling frequency of each voice channel is 8000 samples/sec. Voice packets from different channels are time multiplexed with respect to time axis and combined via a single link

Q6. Assume that there are three variable bit rate channels carrying the traffic as follows to an ATM switch which does the necessary multiplexing via a single output link. Channel 1 peak traffic: 1 Mbits/sec and channel 2 with peak traffic of 3 Mbits/sec and channel 3 with peak traffic of 5 Mbits/sec. Peak traffic may happen at all the channels at the same time for a maximum duration of 0.2 secs. If the bandwidth of the output link is 0.8 Mbits/sec then what should be the minimum capacity of the buffer required in case of statistical multiplexing. (5 marks)

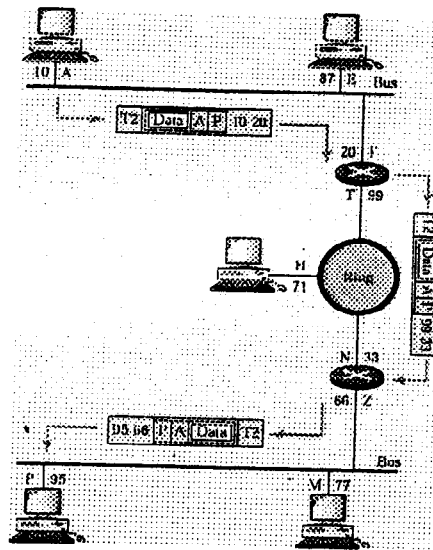
The maximum input traffic = 1 + 3 + 5 = 9 Mbits/sec;

The B.W of output traffic = 0.8 Mbits/sec

The overlap duration = 0.2 sec;

Max capacity of the buffer = $(9 - 0.8) \times 0.2 = 8.2 \times 0.2 = 1.64$ Mbits

Figure 2.11 Example 2



In the above diagram A represents the source IP address and P represents the destination IP address. First the packet is forwarded to the router F whose physical address is 20 via the datalink layer. The router whose network or IP address is F forward the packet to another router whose physical address is 33 by looking at its translation table and changing the datalink addresses. Both the routers(F, T & N,Z) are part of the ring topology. Router (N,Z) is part of the network of the final destination node That router routes the packet to the destination node whose IP address is P by changing the datalink addresses once again.

Q4. Assume that there are three variable bit rate channels carrying the traffic as follows to an ATM switch which does the necessary multiplexing via a single output link. Channel1 peak traffic: 10 Mbits/sec and channel2 with peak traffic of 7 Mbits/sec and channel 3 with peak traffic of 9 Mbits/sec. Channel1 peak traffic and channel2 peak traffic may happen at the same time whereas channel3 peak traffic will not coincide with that of channel1 and channel2. If the bandwidth of the output link is 0.6 Mbits/sec then what is the minimum statistical multiplexing gain? (5 marks)

Steps are very important

The peak traffic at any point of time due to channel1 and channel2 = $10 + 7 = 17$ Mbits/sec.

The peak traffic due to channel3 alone = 9 Mbits/sec.

Since channel1 and channel2 traffic do not coincide with channel3 the maximum traffic at the input is = 17 Mbits/sec

Statistical multiplexing gain = Maximum input traffic/output traffic = $17/0.6 = 28.33$.

Q5. a) Why is there a need for multiplexing in the case of voice packets from different channels? (2 marks)

With the help of multiplexing there is no need for having one to one connection for all the callers and callees subscribed to the source and destination telephone exchanges.