Department of Computer Science and Engineering

COSC 4213: Computer Networks II (Fall 2006)

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Date: October 24, 2006

Midterm Examination

Instructions:

- Examination time: 75 min.
- Print your name and CS student number in the space provided below.
- This examination is closed book and closed notes.
- There are 6 questions. The points for each question are given in square brackets, next to the question title. The overall maximum score is 100.
- Answer each question in the space provided. If you need to continue an answer onto the last page, clearly indicate that and label the continuation with the question number.

FIRST NAME: _____

LAST NAME: _____

STUDENT #: _____

Question	Points
1	/ 20
2	/ 20
3	/ 10
4	/ 20
5	/ 15
6	/ 15
Total	/ 100

1. Multiple Choice [20 points] *time: 15 min*

Circle the correct answer(s) for the following statements. For each statement, you will obtain 0 marks if the number of circled answers is more/less than appropriate.

(1.1) TCP/IP Model

In the TCP/IP model, encryption and decryption are functions of _____ layer .

(a) data-link

(b) network

(c) transport

(d) application

(1.2) Ethernet Addressing

Ethernet uses _____ physical addresses that are imprinted on computers' network interface cards (NICs).

(a) 32-bit

(b) 64-bit

(c) 6-byte

(d) none of the above

(1.3) IP Addressing

Which of the following is true for the IP address 231.1.2.3?

(a) the netid is 231.1.2

(b) the class is D

(c) the hostid is 1.2.3

(d) none of the above

(1.4) IP Addressing

A host with an IP address of 142.5.0.1 needs to test internal software. Which of the following addresses could be used as the destination address in the packet?

(a) 1.1.1.1

(b) 127.1.1.1

(c) 142.0.0.0

(d) none of the above

(1.5) IPv6

Suppose one IPv6 router wants to send a datagram to another IPv6 router, but the two are connected via intermediate IPv4 routers. If the two IPv6 routers use tunnelling, then:

(a) the sending IPv6 router creates an IPv4 datagram and puts it in the data field of an IPv6 datagram

(b) the sending IPv6 router creates one or more IPv6 fragments, non of which is larger than the maximum size of an IPv4 datagram

(c) the sending IPv6 router creates an IPv6 datagram and puts it in the data field of an IPv4 datagram

(d) the sending IPv6 router creates an IPv6 datagram and intermediate IPv4 routers will reject the IPv6 datagram

(1.6) ICMP Protocol

Who can send ICMP error reporting messages?

(a) routers

(b) hosts

(c) a and b

(d) none of the above

(1.7) Multicast / Broadcast

In _____ , the router always forwards the received packet through only one of its interfaces.

(a) broadcasting

(b) multicasting

(c) a and b

(d) none of the above

(1.8) IGMP Protocol

An IGMP packet is carried in an _____ packet .

(a) Ethernet frame

(b) ICMP

(c) IP

(d) UDP

(1.9) Unicast Routing

In Distance Vector routing, each node periodically shares its routing table with _____ and whenever there is a change.

(a) every router in the network

(b) its immediate neighbours

(c) one neighbour

(d) none of the above

(1.10) TCP Protocol

The inclusion of the checksum in the TCP segment is _____ .

(a) optional

(b) mandatory

(c) at the discretion of the application program

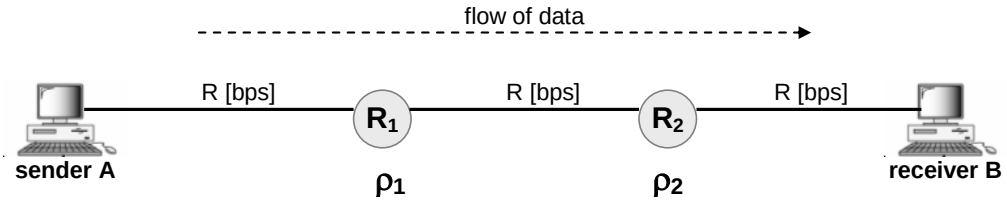
(d) none of the above

2. Queueing Theory / Packet Switching [20 points] *time: 15 min*

Let us consider a simple packet-switching system as shown in the figure below.

- The path from sender A to receiver B passes through two intermediate routers.
- Each router has an input queue of size 1 [Mbit].
- The three links support the same data rate R=10 [kbps].

In all the subsequent questions, show your work to receive credit!



(a) [6 points] Assume the utilization of the first router (R_1) is $\rho_1 = 0.2$, the utilization of the second router is $\rho_2 = 0.3$, and sender A generates and sends one packet of size 10 [kbit] every 3 seconds. What is the rate at which packets arrive at receiver B?

(b) [6 points] The assumptions remain the same as in (a); except, sender A generates and sends only 3 packets in total. What is the overall time required to deliver these three packets to receiver B? (Propagation delay ≈ 0.)

(c) [5 points] The assumptions are the same as in (a); except, the utilization of the second router (R_2) changes to $\rho_2 = 1.2$. What is the rate at which packets arrive at receiver B in this case?

(d) [3 points] The assumptions remain the same as in (c). What is the maximum size to which queues in routers R1 and R2 grow? (Answer for each queue individually.)

3. Subnetting [10 points] *time: 10 min*

An organization has been assigned the network address: 140.25.0.0, and it needs to create a set of subnets that support up to 25 hosts on each subnet.

(a) [4 points] What is the subnet mask you would use to do this?

(b) [3 points] What is the maximum possible number of such subnets in the given network? The use of special address must be avoided!

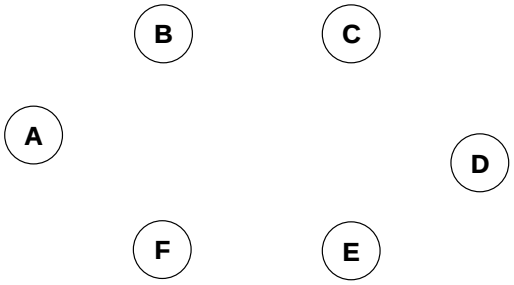
(c) [4 points] Given that there are 25 hosts on each subnet, how much of the address space is being wasted (in percentages)?

4. Routing [20 points] *time: 15 min*

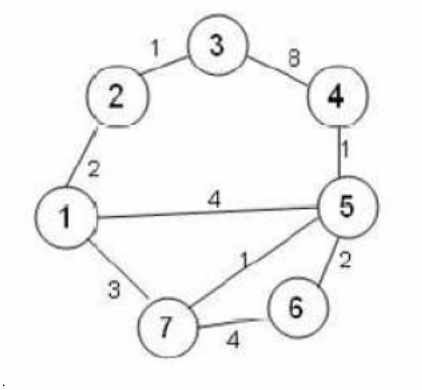
(a) [12 points] The nodes participating in the Link State algorithm in one network are broadcasting the following link-state packets. Based on these packets,

- Draw the network topology and assign link costs.
- Run the Link State (Dijkstra) algorithm to determine the shortest path from D to A. (Clearly specify what this path is.)

Router B		Router C		Router D		Router E		Router F	
A	4	B	3	C	3	A	5	B	6
C	3	D	3	F	5	C	2	D	5
F	6	E	2			F	8	E	8



(b) [8 points] Consider a network topology as shown in the picture, and a synchronous version of Distance Vector algorithm (in one iterative step all the nodes compute their distance tables at the same time and then exchange them). Suppose that at each iteration, a node exchanges its minimum cost with its neighbours and receives their minimum cost. Assuming that the algorithm begins with each node knowing only the cost to its immediate neighbours, what is the maximum number of iterations required until the distributed algorithm converges?



5. Multicasting [15 points] *time: 10 min*

(a) [10 points] Suppose two multicast groups (A, B) are formed and get to choose their multicast addresses at exactly the same time. The groups choose their respective multicast addresses, from the pool of all available multicast addresses, randomly and independently of each other.

Now, assume we know group A has picked the following multicast address: 224.7.7.7. What is the probability that group B chooses the same address?

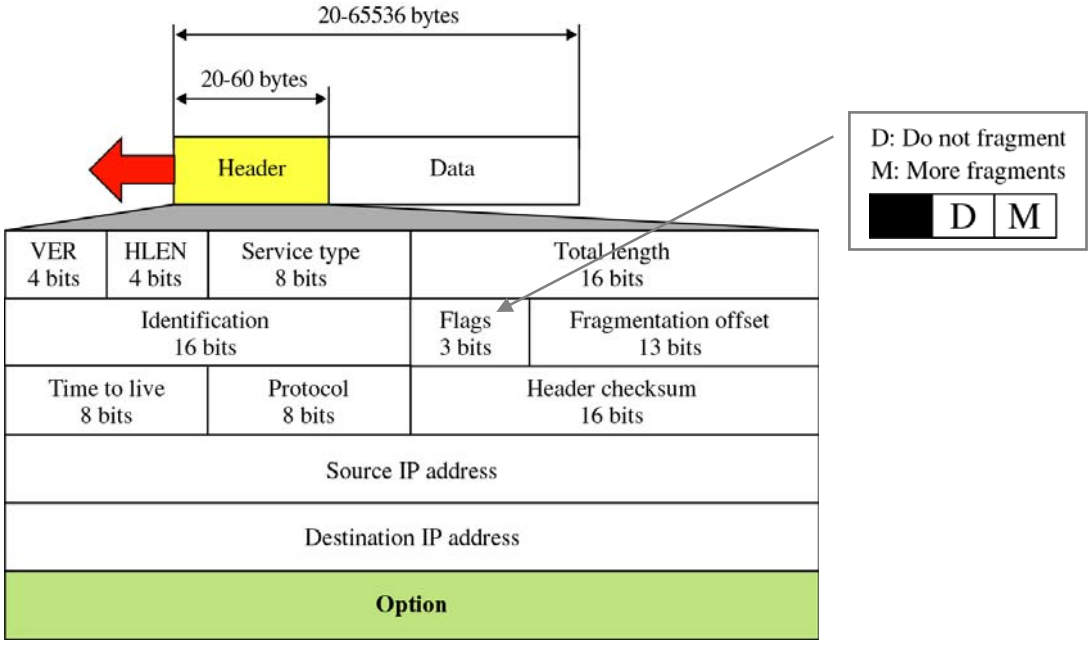
(b) [5 points] A system uses Reverse Path Forwarding (RPF) algorithm to build multicast trees and deliver multicast packets. Currently, there are 100 active multicast sources, each generating a single stream of multicast traffic for/to one of 5 existing groups. What is the number of RPF multicast trees formed in the system?

6. IP Fragmentation [15 points] *time: 10 min*

An IP datagram carrying 10000 bytes of data must be sent over a link (i.e. network) that has an MTU of 4468 bytes. Assume the datagram has no Options, and the Identification number is 218.

How many fragments will be generated?
State the values (in decimal numbers) of the following fields for each of the fragments:
Identification, Total Length, D-bit, M-bit, Fragmentation Offset.

The format of the IP header is shown on the subsequent page.


20-65536 bytes
20-60 bytes
Header
Data
D: Do not fragment
M: More fragments
D
M
VER
4 bits
HLEN
4 bits
Service type
8 bits
Total length
16 bits
Identification
16 bits
Flags
3 bits
Fragmentation offset
13 bits
Time to live
8 bits
Protocol
8 bits
Header checksum
16 bits
Source IP address
Destination IP address
Option