

# ITS 323 – ASSIGNMENT 2

*Due Friday 19 September 2008, 12:30pm*

*10% of the final course mark*

Name: \_\_\_\_\_

ID: \_\_\_\_\_

Mark (max: 60):

## Instructions

1. This is an individual assignment. You must complete the assignment *on your own*. You should not work with others on this assignment – if you need help, then you should ask the lecturer!
2. The assignment can be neatly handwritten or typed on a computer.
3. You must give the final answers for questions on the space provided on this Assignment.
4. Include any calculations on the sheets provided (including back of sheets). Note that the calculations must be clear (hint: perform the actual calculations on a separate piece of paper, and when you have the final solution, write the calculations neatly on the assignment sheets).
5. Copying and other forms of plagiarism (e.g. copying answers from the Internet or textbooks) will be penalised.
6. You must submit a hardcopy of the assignment. Staple at the top left hand corner. Do not include plastic covers or bind the assignment in other ways. Email submission is not accepted.
7. Hints and/or clarifications of questions may be posted on the ITS323 mailing list.

## Assumptions

Unless it is stated in the question, you can make the following assumptions:

1. Speed of transmission is the speed of light:  $3 \times 10^8$  m/s
2. 1GB = 1000MB; 1MB = 1000KB; 1KB = 1000B; 1B = 8 bits
3. b = bit; B = Byte
4. Give the IP address in dotted decimal notation.

## Question 0 - Preliminaries

Step 1: If your ID contains any 0's, then replace each zero (0) with a one (1). \_\_\_\_\_

Step 2: Write your ID in reverse order. The result is referred to RID. \_\_\_\_\_

The following variables will be used in the assignment:

- A = first 8 digits of RID \_\_\_\_\_
- B = all 10 digits of RID \_\_\_\_\_
- C = first 2 digits of RID \_\_\_\_\_

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**Question 1** [14 marks: 0, 2, 2, 2, 2, 2, 2, 2]

Using A from Question 0, take every two digits to form a dotted decimal IP address. For example, if my ID is 4912345670 then the IP address is: 17.65.43.21.

IP Address: \_\_\_\_\_

Assuming your computer is using this calculated IP address, answer the following questions:

a) If classful addressing is used:

i. What is the class of the IP address? Class: \_\_\_\_\_

ii. How many computers, other than yours, can be located on the same network as yours?

Number of computers: \_\_\_\_\_

iii. What IP address would your computer send to in order to reach all other computers on your network?

IP Address: \_\_\_\_\_

b) If classless addressing is used:

i. What is the network address with subnet mask /21?

IP Address: \_\_\_\_\_

ii. How many computers, other than yours, can be located on the same network as yours?

Number of computers: \_\_\_\_\_

iii. What IP address would your computer send to in order to reach all other computers on your network?

IP Address: \_\_\_\_\_

iv. What subnet mask would you use if you want to have a maximum of (C x 100) computers on your network (where C is from Question 0)?

Subnet mask: \_\_\_\_\_

**Question 2** [15 marks: 2, 1, 12]

In this question you will generate a network of 8 nodes. Your network can be defined in a 8x8 matrix, where the elements in the matrix identify the link cost from one node (row) to another (column). A value of “-“ means there is no link from the node in the row to the node in the column (obviously, there is no link from node 1 to node 1, and so on). To generate your matrix, write your value of B from Question 0 into the *empty* boxes in the matrix below, row by row (that is, left to right in the first row, then continue left to right in the second row, and so on). Repeat the 10 digits as needed.

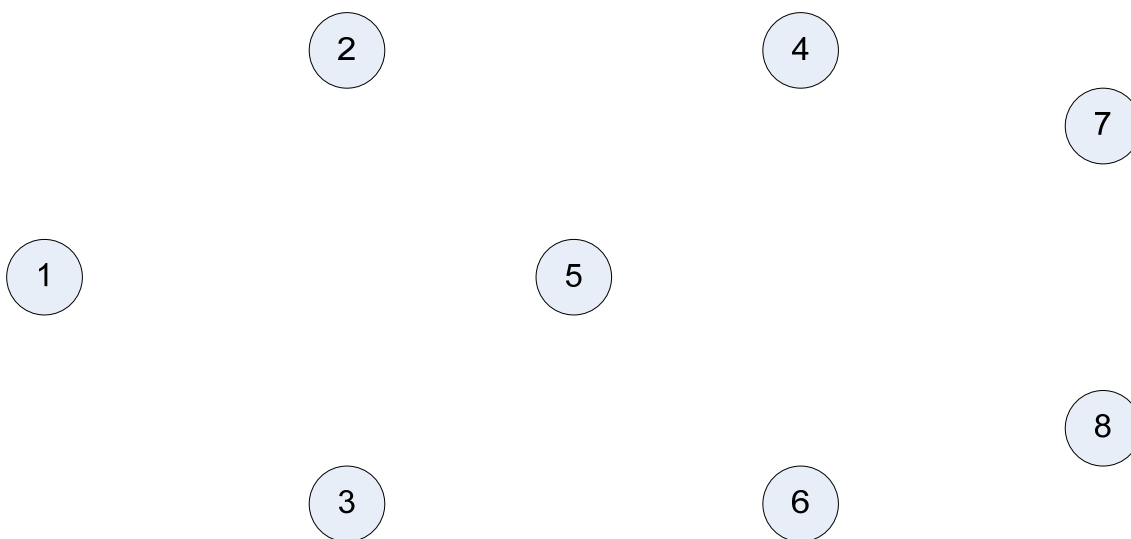
For example, if B is 1765432149, then the first empty entry (column 2, row 1) would be 1, the second empty entry (column 3, row 1) would be 7, and the third empty entry (column 1, row 2) would be 6. The last empty entry (column 7, row 8) would be 3.

- a) Complete your network connectivity matrix.

**Network Connectivity Matrix**

		To node ...							
		1	2	3	4	5	6	7	8
From Node ...	1	-			-	-	-	-	-
	2		-	-			-		-
	3		-	-	-			-	-
	4	-		-	-				-
	5	-				-		-	-
	6	-	-				-	-	
	7	-		-		-	-	-	
	8	-	-	-	-	-			-

- b) Draw your network, indicating the direction of links and costs, on the figure below.



- c) Assuming least-cost routing is used, complete the routing tables for nodes 1 and 5. (You may use any approach to determine the routing tables, however you should describe the approach you use, and any calculations if used). You will lose 2 marks for each incorrect value – so be careful, and make sure you check the least-cost routes.

<b>Node 1</b>		
<b>Destination</b>	<b>Next Node</b>	<b>Cost to Destination</b>

<b>Node 5</b>		
<b>Destination</b>	<b>Next Node</b>	<b>Cost to Destination</b>

Include any relevant calculations or explanation of the approach you used.



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**Question 3** [15 marks]

In your network from Question 2, assume an application on node 1 has  $C \times 2000$  bytes of data to send to an application on node 8.

You should make the following assumptions:

- IP is the internetworking protocol used, and the routing protocol used selects the least cost path for all packets.
- Switched 100Mb/s Fast Ethernet is used on each subnet. In addition to the standard IEEE 802.3 MAC frame, the IEEE 802.3 Physical layer adds an 8 byte header to the MAC frame. Also, although CSMA/CD is not used, there is an Inter Frame Gap (IFG) between each frame sent (that is, after completing transmission of one frame, the transmitter must wait for IFG before starting transmission of the next frame). The IFG is the time to send 96 bits.
- The application at node 1 fragments the data into messages such that IP Fragmentation will not be needed, and (where possible) the maximum sized MAC frame will be used.
- Propagation delay of each link is the link cost, given in  $10^3$ 's of microseconds. For example, if the link cost from node 1 to node 2 is 5, then the propagation delay for that link is  $50\mu\text{s}$  (microseconds).
- Queuing delays and processing delays are 0.
- No errors occur over the links or at nodes.
- You can ignore any overheads introduced by transport or application layer protocols.
- You can ignore the time needed in discovering the route (only consider data transfer).

a) Calculate the total time it takes to transfer the data. \_\_\_\_\_

b) Calculate the throughput achieved with the data transfer. \_\_\_\_\_

Clearly show your calculations and state any additional assumptions you make.



**Question 4** [16 marks: 0, 0, 2, 1, 3, 4, 2, 1, 1, 2; Bonus 6]

On your PC you can use programs and commands to view and edit the details of your computers interfaces and connections. In this question you will use some simple commands on your own computer.

Perform the following tasks either on:

1. Your personal PC or laptop while connected to the Internet (that is, if you are using your laptop, make sure you have an active Internet connection when performing the tasks).
2. An SIIT lab computer.

Do not use your friends computer – that is, make sure you perform the tasks yourself on your own computer. The intention is that everyone performs the tasks on their own.

In Microsoft Windows XP, the following tasks can be performed by opening a Command prompt (e.g. go to “Start” menu, select “Run...” and enter the program “cmd”).

In Linux (such as Ubuntu) you can perform the tasks in a shell.

a) What computer did you use for the tests? (circle only one)

- a. Home/Dormitory desktop computer
- b. Personal Laptop
- c. SIIT Lab computer in Room \_\_\_\_\_ (enter the room number)
- d. Other (describe) \_\_\_\_\_

b) What operating system did you use during the test? (circle only one)

WindowsVista    WindowsXP    Ubuntu    MacOSX    Other: \_\_\_\_\_

c) Look at the interfaces of your computer and record the details in the tables below.

- Windows XP: `ipconfig /all`
- Ubuntu Linux: `ifconfig`

In Windows, each interface may be called an *adapter*. In Linux, the output will normally also include the *loopback* interface (Windows normally does not show this).

If you only have one interface, only complete one table. If you have two (or more) interfaces, complete both tables. Depending on the operating system, not all values in the tables below are shown – if they are not shown, you can calculate them from the other values.

Interface 1:

Interface Type or Name	
MAC Address	
IP Address	
Subnet Mask	
Broadcast Address	



Interface 2 (if present):

Interface Type or Name	
MAC Address	
IP Address	
Subnet Mask	
Broadcast Address	

d) Using the IEEE address assignment database at <http://standards.ieee.org/regauth/oui/>, determine the manufacturer of your Ethernet card.

*Manufacturer:*

e) Look at the routing table for your computer and record the routes (depending on your computer and network, there may be multiple entries).

- Windows XP: `route print`
- Ubuntu Linux: `route`

Note that Gateway refers to the Next Router. To learn what Windows route command shows, simply type `route`. For Linux, try `man route`.

Entry	Destination	Mask	Gateway	Interface	Metric
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

- f) Select at least 4 entries from your routing table (if your table has less than 4, then select all entries). For each entry describe how the entry is used. For example, “Entry 1: if a packet is destined to a computer on network X.Y.Z.0, then the packet is sent to gateway A.B.C.D via interface Q”. If there are any special addresses used, make sure you describe how they are used.

Entry \_\_\_ :

Entry \_\_\_ :

Entry \_\_\_ :

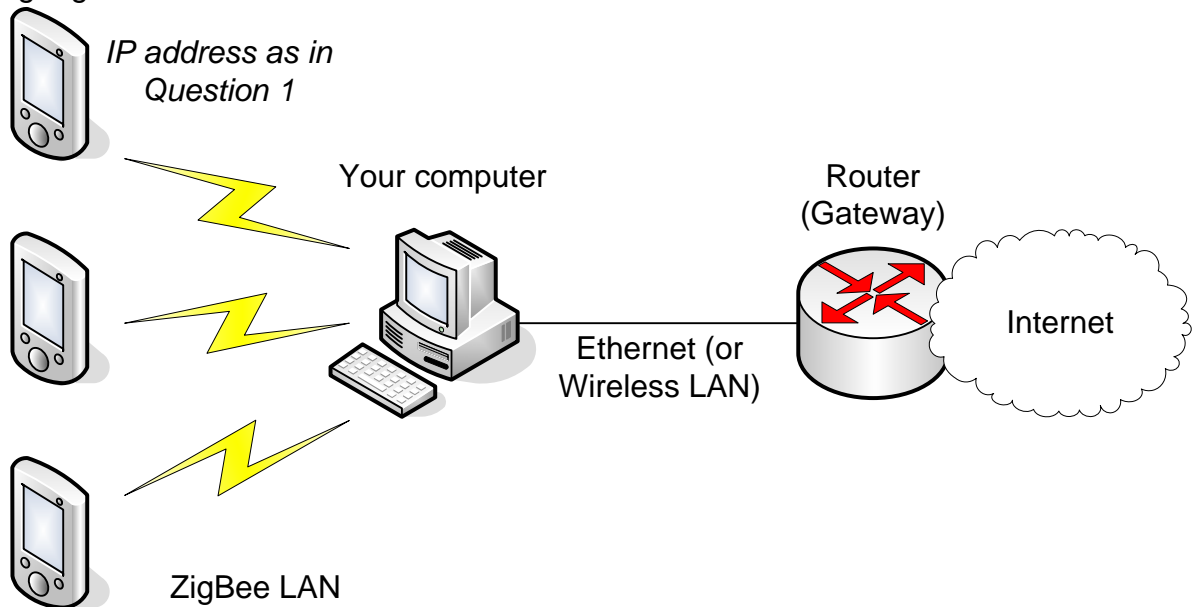
Entry \_\_\_ :

- g) Both Windows and Linux typically report a *default* entry. What is that value in your computer, and explain how/when it is used?

*Answer (and explanation):*

Assume your computer has an additional interface that uses the short range wireless technology called ZigBee (IEEE 802.15). Three mobile devices (such as electronic games, phones and sensors) connect to your computer using ZigBee, and then your computer connects to the Internet via an existing (Ethernet or Wireless LAN) interface as given in part (c). Assume one of the mobile devices using ZigBee has the IP address you used in Question 1. The network would look like the figure below:

Mobile Devices  
Using ZigBee



h) Select an IP address for the ZigBee interface on your computer.

*IP address of computer ZigBee interface:*

i) Select the IP addresses of the other two ZigBee mobile devices (remember, the first ZigBee device uses the IP address from Question 1)

*IP address of ZigBee Mobile Device 2:*

*IP address of ZigBee Mobile Device 3:*

j) Complete a suitable routing table for the first ZigBee mobile device (with IP address as in Question 1). Use a *default* entry if appropriate.

Destination	Mask	Gateway	Interface	Metric

- k) [Bonus question] With the operating system of your computer, explain what you need to do to enable your computer to forward packets from ZigBee devices to the Internet. You should explain in enough detail such that someone with good knowledge of your operating system (for example, me) could follow the instructions and configure the computer.