

ITS323 – Assignment 2

Guidelines

- Deadline: Wednesday 16 September 2009, 1pm. We will discuss the assignment answers in class after submission – late assignments will receive 0 marks.
- Total marks: 70 (10% of final grade)
- Bonus marks (up to 15 marks) may be given to groups that produce exceptional reports/answers.
- Group assignment: work in groups of 2 – each students must contribute to the assignment.
- You must submit evidence of calculations. For example, if you use Scilab (or other mathematics software) you must submit your source code and in your assignment answers explain how/where the code was used. If you use Excel (or other spreadsheet software) you must submit the spreadsheet and in your assignment answers explain how/where the spreadsheet was used. If you calculate by hand (not recommended, but allowed), you must include all calculations in the assignment answers.
- Report: use the supplied Word/OpenOffice template for your reports. Submit the report via email (to steve@siit.tu.ac.th) in PDF format only. The report must be named:
`groupX-report.pdf` where X is your group number.
- Attachments: any source code/spreadsheets etc. must be submitted as attachments in the same email as the PDF. Do not use zip/tar/rar etc. Give meaningful names, e.g.:
`groupX-q1answers.sci`
`groupX-q3answers.xls`
- Updates, hints and questions about the assignment will be announced via the its323 mailing list.

Background

Consider an internet as shown in Figure 1. Hosts are labelled with numbers (e.g. Host1, Host2, Host3). Routers are labelled with letters (e.g. A, B,C). Other devices are labelled by their name.

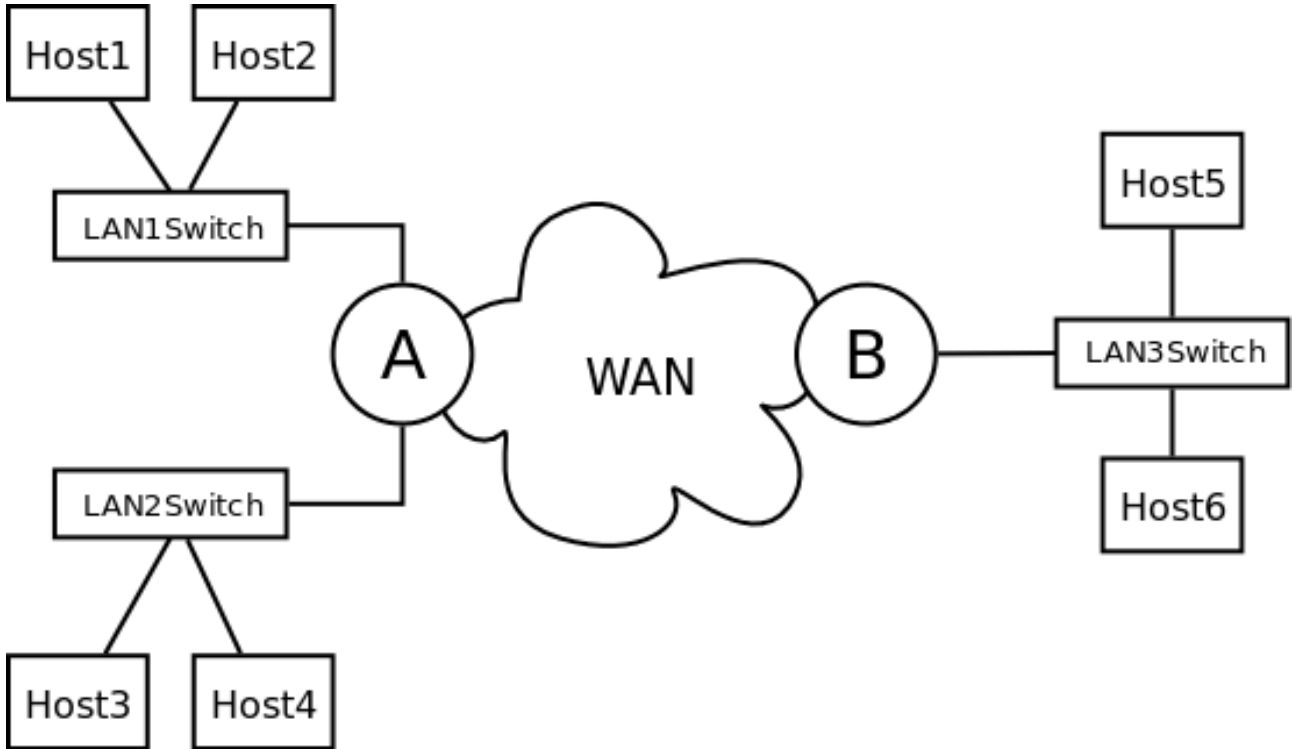


Figure 1: Example internet

There are three (3) LANs, and routers A and B are connected via a WAN. The WAN comprises a set of routers as shown in Figure 2.

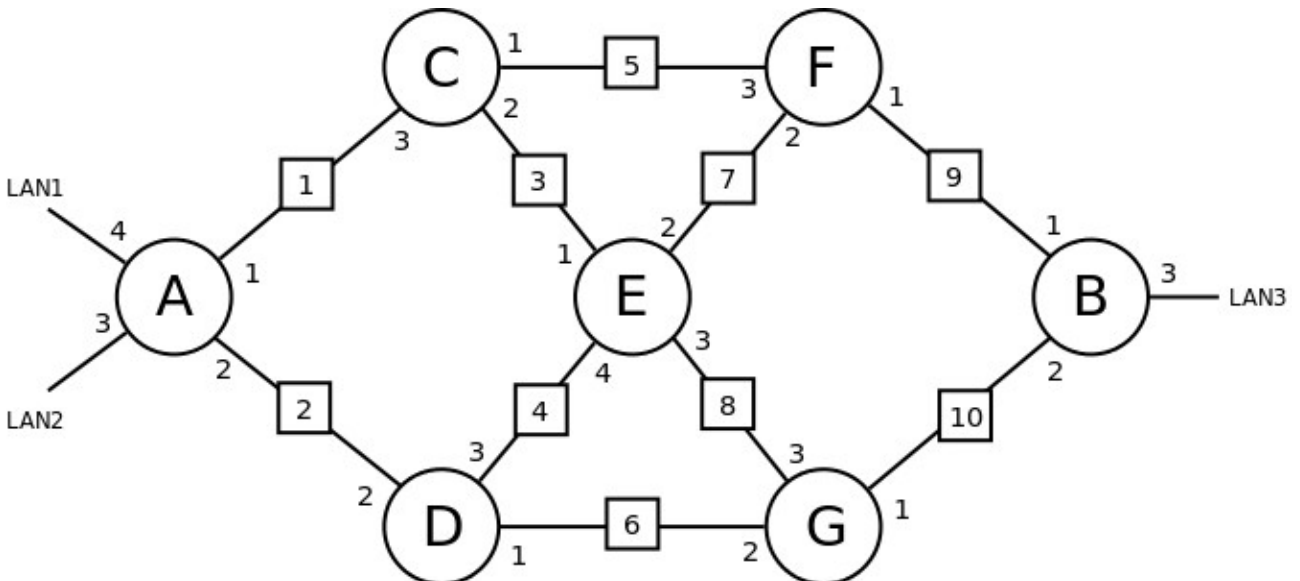


Figure 2: WAN topology

Links are labelled by a number in a small square on the link. Refer to an interface of a router or switch using numbers, e.g. router A has two interfaces: A1 and A2.

Each LAN uses switched 100Mb/s full-duplex Fast Ethernet.

Each WAN link is full-duplex, and the data rate and propagation delay in one direction for each direction is assigned per Group and available at <http://ict.siiit.tu.ac.th/~steven/its323/protected/a2-data.txt>

You will use your group number in some questions. In Question 1, you will need to convert your group number to an 8-bit binary number. In this assignment, the 1st bit is always the left most of a binary number. In Question 4, *GroupNumber* refers to the decimal value of your group number.

Question 1 [10 marks]

Assume classful IP addressing is used in all networks. Within the LANs, class C addresses are used, and within the WAN class B addresses.

Your group has a range of Class B IP addresses that you can select from. The first 4 bits of your groups Class B addresses must be the bits “1000”. The next 8 bits of your groups Class B addresses must be your group number.

Example:

1 0 0 0 $G_1 G_2 G_3 G_4 G_5 G_6 G_7 G_8$ x x x x x x x x x x x x x x x x

where G are the bits from your group number, and x are bits that you may choose.

Your group has a range of Class C IP addresses that you can select from. The first 5 bits of your groups Class C addresses must be the bits “11001”. The next 16 bits of your groups Class C addresses must be your group number repeated twice (that is, your group number followed by your group number).

Example:

1 1 0 0 1 $G_1 G_2 G_3 G_4 G_5 G_6 G_7 G_8 G_1 G_2 G_3 G_4 G_5 G_6 G_7 G_8$ x x x x x x x x x x

where G are the bits from your group number, and x are bits that you may choose.

Using the above IP addresses, assign them to each router and host in your network. List the addresses in a table similar to below. Add as many rows as necessary.

Device	Interface	IP Address
Host1	1	a.b.c.d
Router A	1	w.x.y.z
Router A	2	e.f.g.h

Question 2 [5 marks]

The cost of each WAN link is a function of link data rate (in Mb/s) and link propagation delay (in ms):

$$\text{cost} = (120/\text{rate}) + 2 * \text{delay}$$

- a) Complete a table that lists the data rate, delay and cost for each link. Use as many rows as necessary. Make sure you give the links in order within the table (e.g. links 1,2,3,4,5, ...)

Link	Data Rate [Mb/s]	Prop. Delay [ms]	Cost
1	10	4	9
2	...	...	...
3	...	...	...

Question 3 [20 marks]

Assume the 3 LANs are the only destination networks in your internet. If least cost routing is used,

- a) list the least cost paths for each router to each LAN and,
 b) complete the routing tables for each host and router.

From	To	Path	Cost
Router A	LAN1	e.g. A-B-C-D	e.g. 20
Router A	LAN2	...	...
Router A	LAN3	...	...
Router B	LAN1	...	...
Router B	LAN2	...	...
Router B	LAN3	...	...
Router C	LAN1	...	...
...

For the routing tables, for each row you must give the destination name (e.g. LAN1, LAN2, LAN3) and corresponding IP address, as well as the name of the interface of the next router and its corresponding IP address. You must use “direct” if the destination is directly attached, and may use “*” as a wildcard (meaning any value). Use as many rows and tables as necessary.

Routing Table for Router A

Destination		Next Router	
Name	IP	Name	IP
LAN1	a.b.c.d	B1	w.x.y.z
LAN2	e.f.g.h	direct	direct

Question 4 [20 marks]

Consider the shortest path from Host1 to Host5. An application on Host1 is sending data to an application on Host5 using a Stop-and-Wait ARQ protocol. Each DATA message contains a 25 byte header plus ($GroupNumber * 1000$) bytes of data. An ACK message contains only a 25 byte header. The application messages (DATA and ACK) are sent directly within an IP datagram (Hint: consider the IP header in calculations). No fragmentation is used, and header of lower layers (data link, physical) can be ignored. You may assume that Host1 always has data to send to Host5, and that the total propagation and processing/queuing delay from host to router over the Ethernet LAN is 1us.

- a) Assuming no errors on the path (e.g. no packet loss), what is the maximum throughput that can be achieved over the path? (round to the nearest kb/s)

Assume Host1 uses a timeout interval that is 20% larger than the expected time to fully receive an ACK. Note that timer is started after Host1 has fully transmitted the DATA message.

- b) What is the timeout interval to be used? (round to the nearest millisecond)

Assume 1 in every ($GroupNumber * 10$) DATA messages transmitted by Host1 are dropped by one of the routers in the WAN.

- c) What is the average throughput for the data transfer from Host1 to Host5? (round to the nearest kb/s)
- d) Explain the difference between the throughput in parts (a) and (c). For example, why are the values different from each other, and what factors impact on the size of the difference?
- e) Assuming the network topology and packet sizes cannot be changed, if there were more packet errors (e.g. 1 in 5) explain approaches that could be used to increase the throughput in the presence of errors. Also explain any limitations of these approaches.

Question 5 [15 marks]

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. Each group should complete the following tasks on at least one computer. You must use the command line programs to complete the tasks (not the GUI-based programs).

- a) Describe your computer that you performed the tasks on, including the owner (e.g. personal laptop or SIIT lab computer), hardware, operating system.
- b) Describe the network devices (interfaces) available in the computer (e.g. does it have wireless LAN, Ethernet, Bluetooth, other) and for each device indicate the maximum data rate supported.
- c) Use command line tools to view configuration information for each of the network interfaces. Two example tools are:

1. Windows: *ipconfig*

2. Linux: *ifconfig*

For each interface you should list in a table all addresses associated with the interface.

- d) Using the IEEE address assignment database at <http://standards.ieee.org/regauth/oui/>, determine the manufacturer of your Ethernet card (and Wireless LAN if relevant).
- e) Use command line tools to view the routing table for your computer. Two example tools are:
 1. Windows: *route print*
 2. Linux: *route* (or *route -n*)

For each interface you should list in a table the routing table entries, showing at least the Destination and Next Router addresses. (Hint: Gateway means Router). Be careful with the special addresses listed by the command line tool (e.g. *, 0.0.0.0) – they may have different meanings in different software.

- f) Explain what each routing entry means. For example, when would the entry be used (sending to a server on the Internet? sending to another computer within your network?).