

ITS 413 – ASSIGNMENT 1

First name: _____ Last name: _____

ID: _____

Total Marks: _____

out of 100

Due Date: Friday 29 December 2006, 9am (you can hand in before the start of the lecture)

I certify that, unless otherwise acknowledged, all work carried out in this assignment is my own.

Sign Name: _____ Date: _____

Guidelines

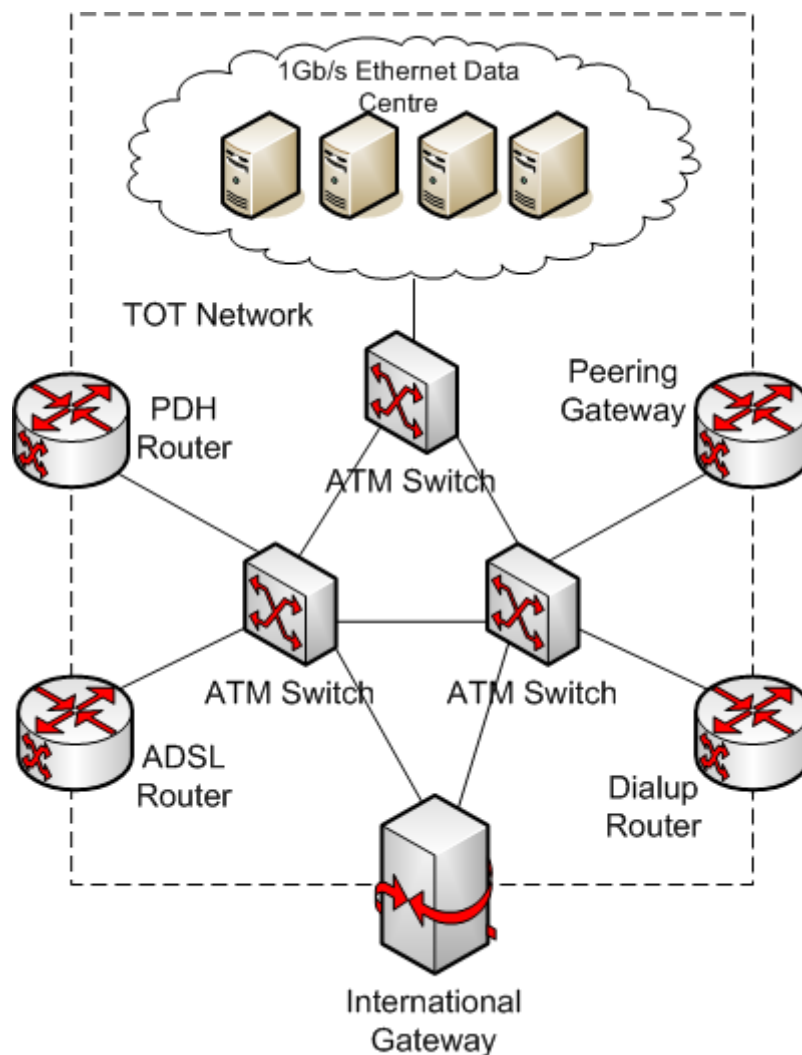
1. This is an individual assignment. You are not allowed to work with other students, including checking your answers and providing help (if someone wants help, they should ask me!).
2. The assignment must be either neatly written or typed on a computer. It should be handed in on A4 sheets with a single staple in the top left corner. No plastic sleeves etc.
3. You must attach this Cover Sheet (including name, ID and signature) to the front of your assignment.
4. I only accept hardcopies of the assignment – that is, I will not accept an emailed copy of assignment.
5. Show all your working out and calculations (especially Q2). If you get the answer wrong, you may still receive marks for your calculations. If you only provide an answer (and no calculations), then you will be penalised.
6. State and explain any assumptions that you make (especially Q1).
7. When you are asked to discuss or explain something, then it is important that your explanation is very clear to the reader (me). Ambiguous or unclear explanations may receive 0 marks.
8. There are many resources on the Internet, especially for Q3. You should of course make use of them, but do not restrict your study to just one resource (e.g. Wikipedia). You should use multiple sources, and acknowledge all sources in your references. Also make sure you write in your own words and draw your own diagrams.

Question 1 [38 marks]

A company has several offices, as well as external customers, that need to communicate with each other. They have different requirements and constraints:

- The Bangkok office has 30 users sharing a 100Mb/s Ethernet network. They require Internet access at typical office speeds (aggregate less than 2Mb/s), and use a leased line from TOT.
- The Pathumthani office has 20 users sharing a 100Mb/s Ethernet network, requiring similar Internet access as the Bangkok Office. They also want to provide wireless coverage inside the office building, and outside near the cafeteria.
- The company's network manager has three PCs at home, and wants broadband Internet access from home. Only the ISP TT&T provide broadband to his area. TT&T use ATM inside their network, and have a STM-1 connection to TOT.
- TOT are providing web and other Internet service hosting for the company at TOT's Bangkok Data Centre. TOT also have a STM-4 connection to an International Gateway.

The network architecture for the TOT ISP part of the network is shown below:



- a) Complete the network architecture for the company network, indicating the following [14 marks]:
- The main devices in each network (including layer 2 and layer 3 devices, as well as end-user devices)
 - The link technologies used (including protocols and speeds)
 - You do not need to draw all user devices (for example, PCs, laptops), but it must be clear what network technologies they are using.
 - You do not need to re-draw the internal TOT network (for example, inside the dashed box). You only need to indicate the TOT edge devices, for example routers and gateways.
 - You do not need to use the same notation as given in the TOT network – but you must make sure every item is clearly labelled.
 - You do not need to draw anything beyond the International Gateway (for example, networks of ISPs other than TOT and TT&T).

- b) In your above network design, discuss the following design decisions (1-2 short paragraphs for each; your design decisions should explain why you chose a particular technology):
1. Technology for Bangkok office to ISP connection [2 marks]
 2. Technology for Network managers home to ISP connection [2 marks]
 3. Technology for connecting wireless users [2 marks]
- c) Assume a 3rd remote office in Chiang Rai with a 5 users (using 10Mb/s Ethernet) needs Internet access, but there are no fixed phone lines available to the office. List and describe three technology options available for obtaining Internet access in the Chiang Rai office. [6 marks]
- d) Assuming one of the three technologies you described, with the service provided by TOT, modify your network architecture diagram (including the TOT network if needed) to include the Chiang Rai office. [3 marks]
- e) Draw the protocol stacks (assume a standard Internet stack is used by all clients) for the following network devices:
1. PDH Router on TOT network [3 marks]
 2. Router on Bangkok Office Ethernet network [3 marks]
 3. Wireless client in Pathumthani office [3 marks]

Question 2 [22 marks]

There are three IEEE 802.11b wireless LAN clients (stations A, B and C) all with data to transmit to an access point (station D). Assume the following conditions in the network:

- All stations are within transmission range of each other.
- All stations use 11Mb/s data rate for all transmissions (DATA, ACK, RTS, CTS packets).
- Basic access scheme is used for all transmissions (RTS/CTS are not used)
- Time $t = 0$ is at the instant when the first higher layer packet (i.e. from the Network layer) is sent to the MAC layer on station A.
- DIFS = 50 μ s; SIFS = 10 μ s; Slot time = 20 μ s
- Size of ACK, RTS and CTS packets is 14 bytes
- The higher layer packet is carried as PAYLOAD in a MAC DATA frame. The DATA frame also has a HEADER of 34 bytes
- Round all packet transmission durations to the nearest μ s
- All clients transmit the DATA frames to the access point.
- At the following times, a higher layer packet is sent to the MAC layer for transmission at the corresponding client:
 - Client A: 0 μ s with payload of 653 bytes
 - Client A: 80 μ s with payload of 1341 bytes
 - Client B: 130 μ s with payload of 653 bytes
 - Client C: 120 μ s with payload of 1341 bytes
- When a client has to select a random value to determine the number of slots it must backoff, it will select the following values (in order):
 - Client A: 3, 12, 27, 18

- Client B: 9, 25, 30, 15
 - Client C: 3, 8, 22, 11
- a) For the network and conditions described, draw a timing diagram for all four stations. You must clearly show and label all the following elements: interframe spaces; backoff intervals; deference intervals; frame types. The diagram does not have to be to scale. [12 marks]
- b) From the timing diagram in part (a), for each client (stations A, B and C) calculate the average higher layer throughput. The higher layer throughput for a *single packet*, given in Mb/s, can be calculated as the amount of payload sent by the station sending the packet between the time when:
- The packet is sent to the MAC layer (from the higher layer), and
 - The packet has been successfully sent to the destination, that is, when the ACK frame has been successfully received.
- When a station sends multiple packets, the station higher layer throughput is the average over all packets it has sent. [6 marks]
- c) Explain briefly the conditions that would lead to a collision between the transmissions of client B and C. [4 marks]

Question 3 [40 marks]

Write a summary of the technology (or protocol) assigned to you. The summary should be about 2 pages (12pt font on A4 sheet, excluding figures etc.). You can use dot points, numbered lists, tables, figures, and references – but these do not count towards the page limit.

Some of the questions you should address include:

- Who is standardising and developing the technology? (Standards organisations, companies, consortiums, ...)
- What is the current status of the technology? (currently used, used in the past, experimental usage, being developed, being researched, ...)
- What are the uses of the technology? (for example, applications – what do people use or plan to use it for)
- Who are the users?
- What are the main principles of operation of the technology?
- What protocols and standards are used?
- How does it compare to other technologies and protocols we have covered in the course?
- What are the advantages and disadvantages compared to other similar technologies?
- Where does it fit in the protocol stack?

You should include (your own) diagrams of:

- Network architecture or topology, that illustrates the components in the network and how they are related or interconnected. Components may include: users, other networks (LANs, MANs, WANs, Internet), network devices (switches, routers, servers, ...), links (wired, wireless).

- Protocol stack that illustrates where it fits in a layered model and how it relates to other protocols.
- And any other block diagram, protocol stack, state diagram or message sequence that may be useful in explaining the technology concepts.

The summary should focus on the technology – how it works, how it relates to other technologies and its uses. We are not concerned much about the history, motivation or commercial operations (you should not write more than 1-2 small paragraphs on history or motivation).

Some guidelines:

- Remember to reference all your sources of information
- You must use multiple sources of information to get different viewpoints, and then write the summary yourself from your understanding. For example, using only a Wikipedia article for your summary will be penalised – you may even be punished for plagiarism.

The topics are:

1. City Wide Wireless Mesh Networks using 802.11 and 802.16, including public access networks and private networks (e.g. emergency services)
2. Home Networking, including networking computers, consumer appliances and entertainment equipment
3. Autoconfiguration in IPv6, including stateless and state-based approaches for assigning IP addresses in wired and wireless networks
4. TCP/IP Implementations in Windows Operating Systems (or you can choose Linux)

Your topic is:

<i>Name</i>	<i>Topic</i>
Ms.Sasiphan Ngammaneevat	1
Mr.Piya Limcharoen	2
Mr.Vorapoj Patamapas	3
Mr.V-ris Jaijongrak	4
Ms.Phetai Kovitanupong	1
Mr.Ekapop Techateerapreeda	2
Mr.Wongsagorn Nimmit	3
Mr.Jeeranat Mavichak	4
Mr.Analayo Korsakul	1
Ms.Saisuree Chaichanakol	2
Ms.Salila Jarupat	3
Mr.Napat Natathanapat	4
Mr.Surachat Kiatsommart	1
Ms.Amy Amika Tharnpipitchai	2
Mr.Chalit Sirichaoranichkarn	3
Mr.Chaiwat Singkarinta	4