Name……..….ID……..……..Section…….……Seat No……..….

Sirindhorn International Institute of Technology
Thammasat University

Midterm Examination: Semester 2/2006

Course Title : ITS 413 Internet Technologies and Applications

Instructor : Dr Steven Gordon

Date/Time : Friday 12 January 2006, 9:00 – 12:00

Instructions:

- This examination paper has 12 pages (including this page).
- Condition of Examination
  Closed book (No dictionary, No calculator allowed)
- Students are not allowed to be out of the exam room during examination. Going to the restroom may result in score deduction.
- Turn off all communication devices (mobile phone etc.) and leave them under your seat.
- Write your name, student ID, section, and seat number clearly on the answer sheet.
- The space on the back of each page can be used if necessary.

Question 1 [9 marks]

Assume you have a choice of the following technologies:

- Fast Ethernet
- ADSL
- PDH
- SDH
- Wireless LAN
- Bluetooth

For the following scenarios, select *two* technologies that may be suitable (e.g. Fast Ethernet and ADSL), and give an advantage and disadvantage of one of the selected technologies versus the other (e.g. advantage of Fast Ethernet compared to ADSL; disadvantage of Fast Ethernet versus ADSL).

a) Interconnect the SIIT Bangkadi and SIIT Rangsit campus LANs
b) Interconnect Thammasat University to Thai Internet Service Provider (e.g. CAT or TOT)
c) Connect a network of computers and laptops within house

Question 2 [9 marks]

List three approaches that may be used for transporting Internet (IP) traffic over optical networks. Compare the three by giving an advantage and disadvantage of each approach.

Question 3 [8 marks]

Explain the difference between a centralised wireless network and a decentralised wireless network. Give an example of each type of network.

Question 4 [20 marks]

Assume a company has a Fast Ethernet network deployed in their 3 storey office building. The network consists of fixed PCs, 3 servers (for internal applications) and a single router which provides connectivity to the Internet (via a 2Mb/s E1 connection). The entire network is on one IP subnet. In addition to the current network, the company wants to install a wireless LAN to provide coverage of the entire building to allow laptop and PDA users to be mobile in the office.

a) Draw the network topology showing the existing network as well as the new wireless LAN. You do not have to draw every individual PC or laptop/PDA, but should draw all other devices, and specify the technologies/protocols used to connect devices, including data rates.
b) Justify your design of the wireless LAN. That is, explain why you chose certain technologies and certain network topology.
c) Draw a protocol stack for the following devices:
    i. The router.
    ii. Wireless LAN access point
    iii. Wireless LAN enabled laptop
d) What is an alternative to using the E1 connection for Internet connectivity? What is an advantage of the alternative?

Question 5 [8 marks]

Describe two methods for a laptop to discover an IEEE 802.11 access point. Draw a time sequence diagram for each method (that is, a diagram that shows the exchange of messages against time).

Question 6 [24 marks]

a) Using the lines below, draw a diagram that illustrates the normal operation of IEEE 802.11 DCF in Basic Access mode when one station (A) transmits to another (B). Make sure you *clearly* label each component.

A _____

B _____

b) Explain a reason why the random backoff is used.

c) Assume you have a scenario with a single client A continuously transmitting DATA frames to another client B using Basic Access mode. (By continuously transmitting, it means A always has a DATA frame that needs to be sent). There are no other nodes transmitting in the network. Client B does not send any data to client A (only Acknowledgements). Derive an expression for the throughput, T. You can assume all DATA frames have a payload of p bytes, and a header of h bytes. You must describe (or define) all other variables in your equation.

d) Explain what we mean by a "collision" in DCF.

e) Why do we want to avoid collisions in DCF?

f) Explain two ways in which a collision can occur in DCF.

Question 7 [17 marks]

The five elements of a protocol are: service; assumptions; vocabulary; encoding; protocol rules.

a) Describe each of the five elements.
b) What is the vocabulary for IEEE 802.11 DCF in RTS/CTS mode (you can ignore any 802.11 management procedures like joining and leaving the network – concentrate only on the data transfer phase of DCF)?
c) What assumptions would a transport protocol (such as TCP or UDP) make about the following features of IP:
    i. Ordering of IP datagrams
    ii. Reliability of IP datagrams
d) If you were to create a state machine to describe IEEE 802.11 DCF Basic Access:
    i. Describe three states of the sender of the DATA frame.
    ii. Describe three events that can occur at the sender.

Question 8 [6 marks]
Autoconfiguration in IPv6 allows nodes with IEEE 802 LAN adapaters to use their 48-bit IEEE MAC address to create a link-local IPv6 address. Although IEEE MAC addresses are supposed to be unique, this cannot be guaranteed.

a) Explain how duplicate address detection is performed.
b) Explain a scenario where stateless IPv6 autoconfiguration is more appropriate than using server-based (e.g. DHCP) configuration of IP addresses.

Question 9 [14 marks]

Assume SIIT created two experimental IPv6 networks, one at Bangkadi and one at Rangsit. (These are separate from the existing SIIT IPv4 networks – you should ignore the SIIT IPv4 networks)

a) Explain how the two SIIT IPv6 networks can be interconnected using *tunneling* if the ISP who provides the connection between Bangkadi and Rangsit only has an IPv4 network.
b) Draw a network topology diagram, including any important devices, that illustrates your solution.
c) Draw example packet formats (including header names, e.g. “TRANSPORT Header”, but not header fields) for packets on each of the three networks:
    i. SIIT Bangkadi
    ii. SIIT Rangsit
    iii. ISP

Question 10 [25 marks]

Assume a TCP client has already established a connection with a TCP server. They agreed that the first byte sent (in either direction) would have sequence number 1. The TCP server has a 5000 byte buffer (and the TCP client knows this, that is, the advertised window was 5000 in the connection establishment). (a) With the following conditions, draw a time sequence diagram illustrating the transfer of data between client and server:

- The client application has data to send at the following times:
  - 2000 bytes at time 0ms
  - 2000 bytes at time 80ms
  - 2000 bytes at time 200ms
- The server application reads from its buffer at the following times:
  - 2000 bytes at time 350ms
  - 4000 bytes at time 550ms
- The round time time is 100ms
- The congestion control window is infinite (that is, you can assume the TCP client is only limited by the advertised flow control window – the congestion control window does not limit the client).
- The maximum segment size is infinite
- The server sends an ACK immediately when it receives a DATA segment (there is no processing delay)

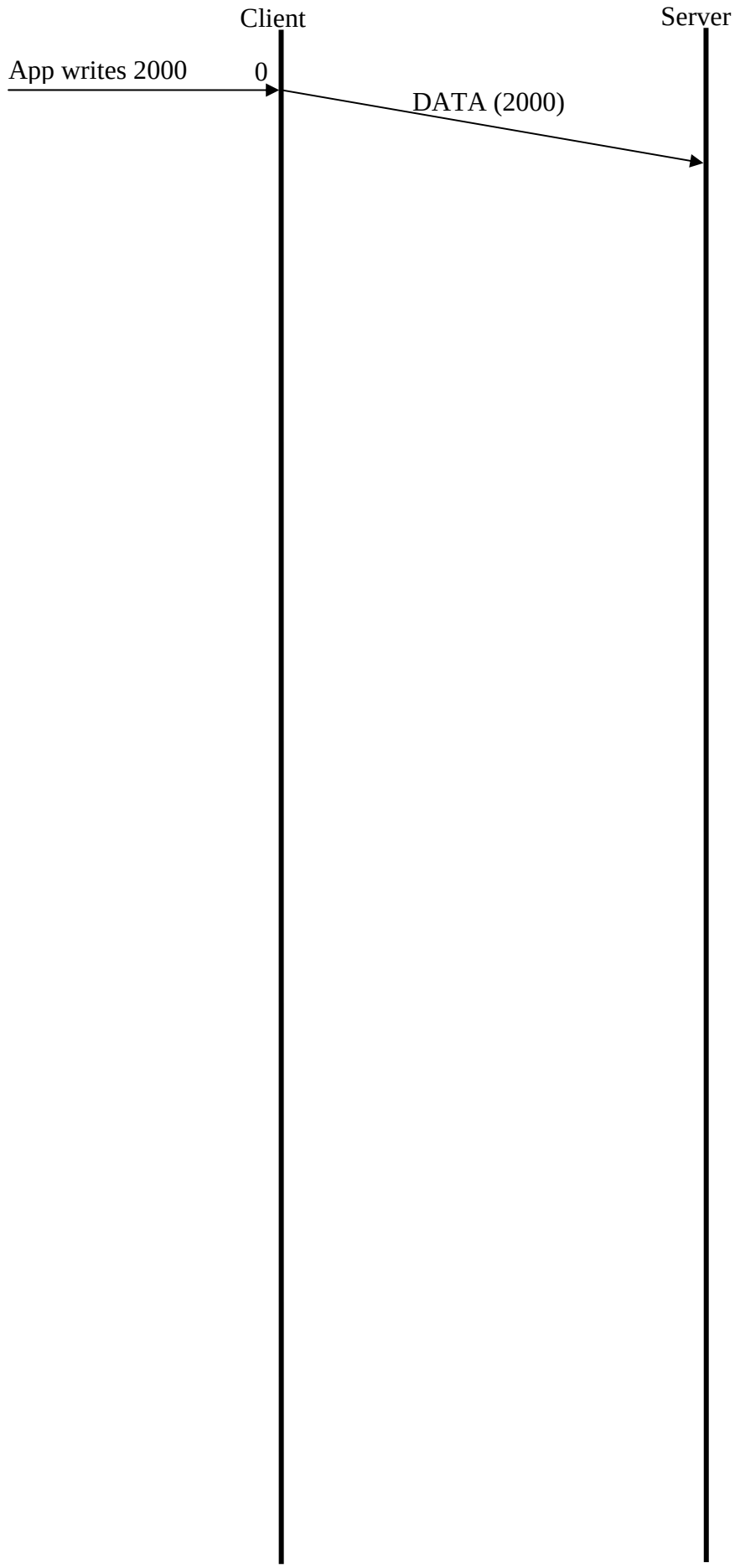
Your diagram must clearly show:

- The time when each segment is sent
- TCP packet/segment types
- The size of each DATA segment sent
- The Ack number of each ACK segment sent
- The window size advertised in each ACK segment sent

The diagram below shows the first segment sent. You should follow this format.

Answer the following questions:

b) At what time is the final ACK segment received
c) What is the purpose of the server advertising its window/buffer size?


Client
Server
App writes 2000
0
DATA (2000)