PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination: Semester 1 **Academic Year:** 2009-2010

Date: July 29, 2009 **Time:** 09:00 – 12:00

Subject Number: 241-643 **Room:** R300

Subject Title: The Internet and its Protocols

Name: _____

Student Number: _____ Signature: _____

Exam Duration: 3 hours

This paper has 10 pages (including this page).

Authorised Materials:

- Anything the student can carry, except for mobile phones and other communication devices.

Instructions to Students:

- *Answer questions in English.* Good English is **not** required.
- Attempt all 7 questions.
- Write the answers in the spaces provided in the examination paper.
- Anything illegible is incorrect.
- Answer briefly where possible, essays are **not** required.
- The marks allocated for each question are shown next to that question. There are 100 marks total for this examination. This will contribute 20% of the course total.

Question 1. *(20 marks)*

The new version of the Internet Protocol, version 6 (IPv6) contains no checksum field in its packet headers. The previous version, IPv4, did contain a header checksum.

Give reasons why the designers of IPv6 decided that the checksum field was not necessary in IPv6.

Explain any disadvantages that omitting the checksum field might cause.

Question 2. *(10 marks)*

The specification of the Transmission Control Protocol (TCP) uses a Finite State Machine (FSM) to (partly) specify the operations of opening and closing connections.

Explain the advantages of using an FSM in a protocol specification (you can use TCP as an example.)

Contrast the use of the FSM with other specification methods.

Question 3. *(40 marks)*

A) For TCP that is not using window scaling (that is: the window scale option is not present) complete the missing entries in the table to show the (approximate) maximum possible TCP throughput (in bits/second) for each of the combinations of Round Trip Time (RTT) measured in milliseconds, and network bandwidth, measured in bits/second:

		Round Trip Time *(ms)*			
		0.5	1.0	20.0	128.0
Bandwidth *bits/sec*	128000				
	2000000				
	10000000				
	100000000				
	1000000000				

[20 marks]

B) Indicate for which of the above combinations window scaling would assist in improving TCP's throughput, and which value of the window scale option would achieve best results. You can assume that there will not be a problem with memory for TCP buffers that might otherwise limit the maximum window size.

[5 marks]

C) Explain the requirements for a host to use the window scaling protocol. That is, in what circumstances is it permitted for a host to scale the window size it sends to its partner host.

[5 marks]

D) Explain a problem that might occur if the window scaling option was permitted to have a value of 15 or greater. Illustrate the problem using an example.

[10 marks]

Question 4. *(5 marks)*

An IP datagram arrives at its destination with the Time to Live (for IPv4) or Hop Count (for IPv6) field containing the value 255.

What conclusion(s) can the receiving node draw from this fact, and why?

You can assume either IPv4 or IPv6 for your answer. Nothing in this question, other than the name of the header field, depends upon which IP version is in use.

Question 5. *(5 marks)*

UDP packets carry a checksum that protects the UDP header, UDP payload (user data) and parts of the IP header (the pseudo-header). Use of the checksum is optional, when the packet is carried over IPv4. When the checksum is not present the checksum field has all bits set to zero.

However, when using IPv6, the checksum is mandatory, and may not be omitted (a zero value is an error).

Explain why that change was made.

Question 6. *(10 marks)*

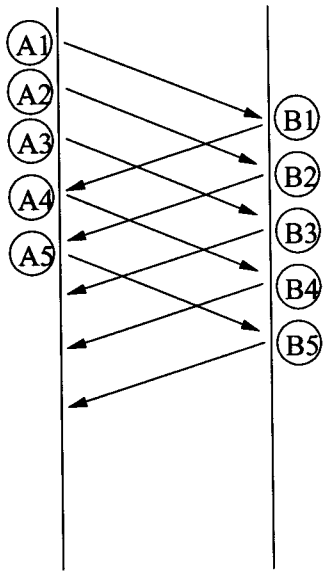
Explain the role of the sequence number in the TCP 3-way handshake, used to initialise a new instantiation (instance) of a connection.

Why is the 3-way handshake required?

Are there any circumstances in TCP, or any TCP derived protocol, where the 3-way handshake can be avoided? If so, explain those circumstances and how TCP operates correctly without the 3-way handshake.

Question 7. *(10 marks)*

The figure and table below show a packet exchange during a TCP connection in ESTABLISHED state between two nodes A and B.



	Seq	Ack	Window Size	Data Octets
A1	10000	4560	8192	1000
A2	11000	4560	8192	1000
B1	4560	11000	4000	0
A3	12000	4560	8192	1000
B2	4560	12000	3000	0
A4	13000	4560	8192	1000
B3	4560	13000	1000	0
A5	14000	4560	8192	1000
B4	4560	14000	0	0
B5	4560	14000	0	0

All packets labelled An (for any n) are sent from the IP address of host A, port number 12123, to the IP address of host B, port number 9876. All packets labelled Bn (for any n) are sent from the IP address of host B, port number 9876, to the IP address of host A, port number 12123. That is, all packets shown are part of the same IP connection.

The A (ACK) flag is set in all packets (but not shown), no other flags are set in any packets. The contents of other relevant fields from the packet headers are shown in the table, which also shows the number of data packets for the application protocol are present in each of the packets.

In the table, fill in the values for what you would expect to be the next two packets transmitted that belong to this connection. Also show the packet direction and sequencing on the time line diagram.

Note that there is not necessarily one correct answer for this question, so also explain on the following page why the particular packets you have shown in the table are the next two packets.