

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination: Semester 1

Academic Year: 2004-2005

Date: October 7, 2004

Time: 09:00 – 12:00

Subject Number: 240-574

Room: 300

Subject Title: Special Topics in Information Network Engineering I
(The Internet and its Protocols)

Exam Duration: 3 hours

This paper has 5 pages (including this page).

Authorised Materials:

- Anything the student can carry.

Instructions to Students:

- *Answer questions in English.* Good English is **not** required.
- Attempt all 12 questions
- Write answers in an answer book
- **Clearly Number** the answers. It is **not** required that questions be answered in order.
- Anything illegible is incorrect.
- Show all calculations, not just the final result.
- Answer briefly where possible, essays are **not** required.
- The marks allocated for each question are shown next to that question. There are 180 marks total for this examination. This will contribute 60% of the course total.

Question 1.*(12 marks)*

An Internet Protocol (IP) version 4 packet header contains a length field, defined as the total length of the IP packet (or fragment) of which the header is part.

An IP version 6 packet header contains a length field, defined as the length of the IP packet (or fragment) not including the size of the header.

Explain why this change was made when IPv6 was created.

Question 2.*(8 marks)*

The table below shows 3 TCP sequence numbers, expressed in decimal hexadecimal, and binary. (The three representations are each of the same number, and are given here simply to avoid the need to do any conversions.)

	Decimal	Hex	Binary
A	500000000	1DCD6500	00011101110011010110010100000000
B	1500000000	59682F00	01011001011010000010111100000000
C	3000000000	B2D05E00	10110010110100000101111000000000

Which sequence number (A, B, or C) is the biggest?

Which sequence number (A, B, or C) is the smallest?

Explain your answer.

Question 3.*(20 marks)*

Fire-walls and Network Address Translation (NAT) each cause (different) problems for the traditional File Transfer Protocol (FTP).

Explain what features of FTP cause difficulties when each of fire-walls and NAT are present between the FTP client and FTP server.

Explain how FTP can be used, or has been adapted, to overcome the problems caused by fire-walls and NAT.

Question 4.*(20 marks)*

List as many advantages as you can think of for using a grammar to define a protocol. Also list any disadvantages.

Does it make a difference what kind of protocol is being defined to the decision whether to use a grammar to help with the specification?

What alternative methods of protocol specification exist, and when might they be better choices than grammars?

Question 5.*(16 marks)*

The IPv6 Neighbor Discovery Protocol includes four sub-protocols (and more). The four relevant here are (1) Neighbour Discovery itself (Neighbor Solicitation and Neighbor Advertisement), (2) Router Advertisements (and Router Solicitation), (3) Neighbor Unreachability Detection, and (4) Duplicate Address Detection.

For each of those four, is it:

- A) a modification of a protocol that is widely used (for a similar purpose) in IPv4, and in this case, which protocol?
- B) a modification or enhancement of a protocol that is rarely used, or not used for the same purpose, in IPv4, and in this case, which protocol?
- C) an entirely new protocol in IPv6, and in this case, why was no equivalent required or used in IPv4?

Question 6.*(12 marks)*

Give two (2) different methods that have been successfully used in Internet protocols to allow the protocol concerned to be extended.

Given an example of a mechanism intended to be used to allow for protocol extension that has not been successful. Why did this mechanism fail?

Question 7.*(16 marks)*

Calculate (approximately) the maximum possible throughput of a TCP connection where the round trip time between the two end points is 500 milliseconds (half of a second). Assume that there is unlimited bandwidth available on all links, no congestion, no packet loss, etc. Calculate the maximum throughput when

- A) No window scaling is used
- B) Window scaling is used to its maximum possible effect.

Question 8.*(12 marks)*

A client making a Domain Name System (DNS) query is expecting a reply larger than the normal maximum DNS packet size of 512 bytes. Give two different methods by which the client may successfully receive the reply.

Question 9.*(12 marks)*

Explain the process of address resolution (or neighbour discovery). When is it required, and why? When is it not required?

Question 10.*(20 marks)*

Some protocols use a binary packet format with fixed fields, others protocols use a binary packet format with an encoded representation of what the various data represents, and yet other protocols use a text based packet format, with words (or strings that approximate words) as the field identification.

Given an example of a protocol of each type.

Explain in what circumstances each might be a suitable technique to use when a new protocol is to be defined.

Question 11.*(12 marks)*

ICMP is an integral part of the IP (version 4) protocol, as ICMPv6 is of the IP version 6 protocol. Explain the role of ICMP (and ICMPv6) as part of the Internet protocol (version 4 and 6). Indicate what problems would arise, or what would be impossible to achieve, if ICMP did not exist, or it was for some reason impossible to use ICMP.