Friday, May 18, 2007
2:30p.m. – 4:15p.m.

University of Glasgow

DEGREES OF M.Sci., M.Eng., B.Eng., B.Sc., M.A. and M.A. (Social Sciences)
COMPUTING SCIENCE 3T:
NETWORK SYSTEM ARCHITECTURE 3

(Answer all 3 questions.)

1. **(a)** Many of the early decisions regarding the Internet architecture were driven by the requirements of the US Department of Defense. In what ways is this legacy both a help and a hinderance to the Internet of today?

[2]

(b) It has been said that UDP offers a service "which traded reliability for the primitive delay characteristics of the underlying network substrate".

(i) Explain the meaning of this statement. [2]

(ii) Give two examples of applications for which such a service is attractive. [2]

(iii) Why do such applications use UDP instead of raw IP packets? [1]

(c) Compare circuit switching (co-cs), datagram packet switching (cl-ps) and virtual circuit packet switching (co-ps). Your answer should include a brief description of each method, one associated advantage and one disadvantage and a comment on the overhead associated with the switching method.

[6]

(d) There have been numerous studies on the statistics of the packet sizes in the Internet backbone. Three common findings are the occurrence of a very large number of packets sized approximately 40 bytes, the occurrence of a large number of packets of sized approximately 1500 bytes and the presence of very few packets larger than 1500 bytes.

(i) Explain the reason for each finding. [4]

(ii) What differences (if any) in the distribution of packet sizes on the Internet would you expect if such a study were conducted in 10 years' time? Justify your answer. [3]

2. **(a)** Identify and briefly describe the key functions of any three layers in the OSI reference model. Name an exemplar protocol in each layer; expand any acronyms in your answer.

[6]

(b) What is encapsulation and why is it commonly carried out in data networks?

[3]

(c) Briefly describe the role and operation of a sliding window algorithm, mentioning one advantage and one disadvantage of such an algorithm relative to a stop-and-wait algorithm.

[4]

(d) Since hosts on the Internet typically have both an IP address and MAC address, it may be tempting to assume the nature of both addresses must be very similar. Briefly outline the salient differences between the IP address and MAC address of a typical host on the Internet. Your answer should consider factors such as the relative address sizes and structures, how the addresses are allocated, organisations responsible for developing the relevant standards, layers in which the addresses are typically used, how the mapping between the two addresses is carried out and the manner in which both addresses are used to switch/route data to a host.

[7]

3. **(a)** Briefly describe the main use of the sockets API.

[2]

(b) Many programs using the sockets API use the `sockaddr_in` structure.

(i) What is the role of this structure? [1]

(ii) What is A, B, C and D in the definition of `sockaddr_in` below and why is each term essential?

```
struct sockaddr_in {
    short int A;
    unsigned short int B;
    struct in_addr C;
    unsigned char D;
};
```

[4]

(c) Describe in words (do not write code) your internal design of the TCP client for the ECHO service, carefully explaining each call made to the sockets API. For each call to the API list the parameters necessary to complete the call and explain why each parameter is necessary.

[9]

(d) List the sequence of calls to the sockets API that the ECHO server should have made in order to be able to interact with the TCP client and state the purpose of each call.

[4]