

THE BRITISH COMPUTER SOCIETY
THE BCS PROFESSIONAL EXAMINATION
Professional Graduate Diploma
NETWORK INFORMATION SYSTEMS

29th April 2005, 2.30 p.m.-5.30 p.m.
Answer THREE questions out of FIVE. All questions carry equal marks.
Time: THREE hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. **Figure 1** below shows the protocol layers in the ISO Open System Interconnection (OSI) protocol.

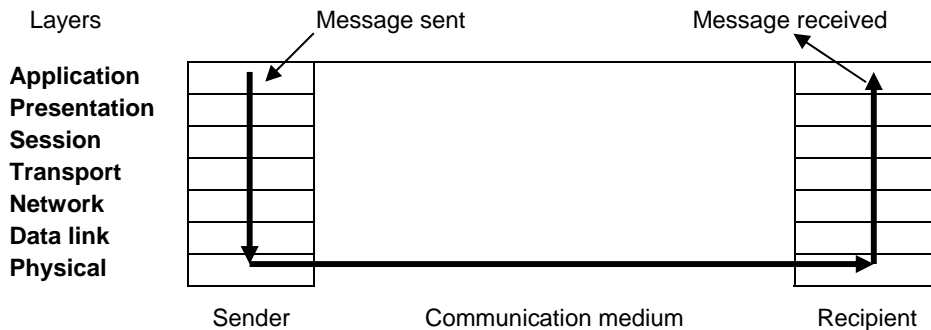


Figure 1: OSI Protocol Model

- a) Explain the function of each layer and give examples of actual protocols used in practice. **(14 marks)**
- b) Internetwork protocols are overlaid on underlying networks as shown in **Figure 2** below.

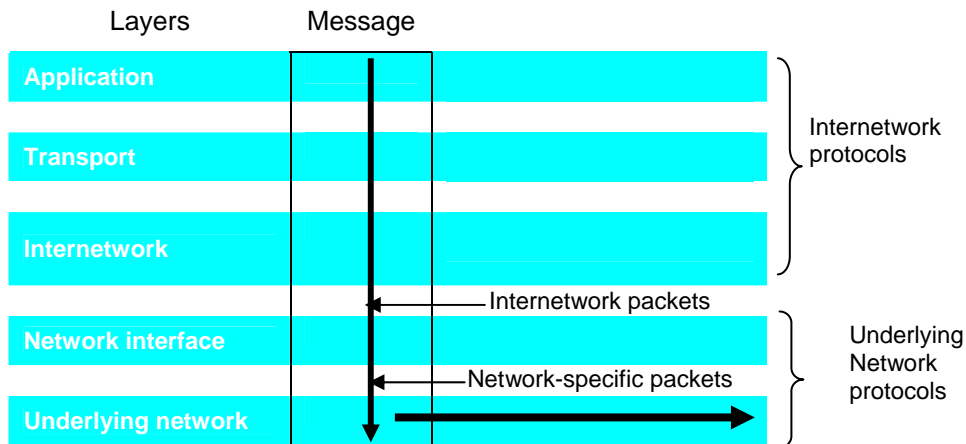


Figure 2: Internetwork Layers

The network interface layer accepts internetwork packets and converts them into packets suitable for transmission by the transport layer of a specific underlying network. The underlying network consists of the transport, network, data link and physical layers of all the real networks that constitute the internetwork. Discuss the following relevant issues:

- i) Packet assembly **(3 marks)**
- ii) Virtual circuit packet delivery **(4 marks)**
- iii) Datagram packet delivery **(4 marks)**

2. a) Briefly describe each of the following terms:
- ii) Public key encryption
 - iii) Message digest
 - iii) Digital signature
 - iv) Digital certificate
- (12 marks)
- b) Describe how a message digest can be used to validate the integrity of a data file. How is a digital signature an improvement over a message digest for validating the integrity of data files. (6 marks)
- c) Describe how a digital certificate is used by a server to establish trusted communication between a *client* and a server. (7 marks)
3. The *Network File System* (NFS), developed by a major market leader, has been widely adopted in industry and in academic environments since its introduction in the mid 1980s.
- a) **Figure 3** below shows local and remote file systems accessible on an NFS client. Design goals of NFS with reference to transparency include: i) Access transparency, ii) Location transparency, iii) Failure transparency, iv) Performance transparency, and v) Migration transparency. Explain these design goals and comment on the extent to which they have been achieved. (15 marks)

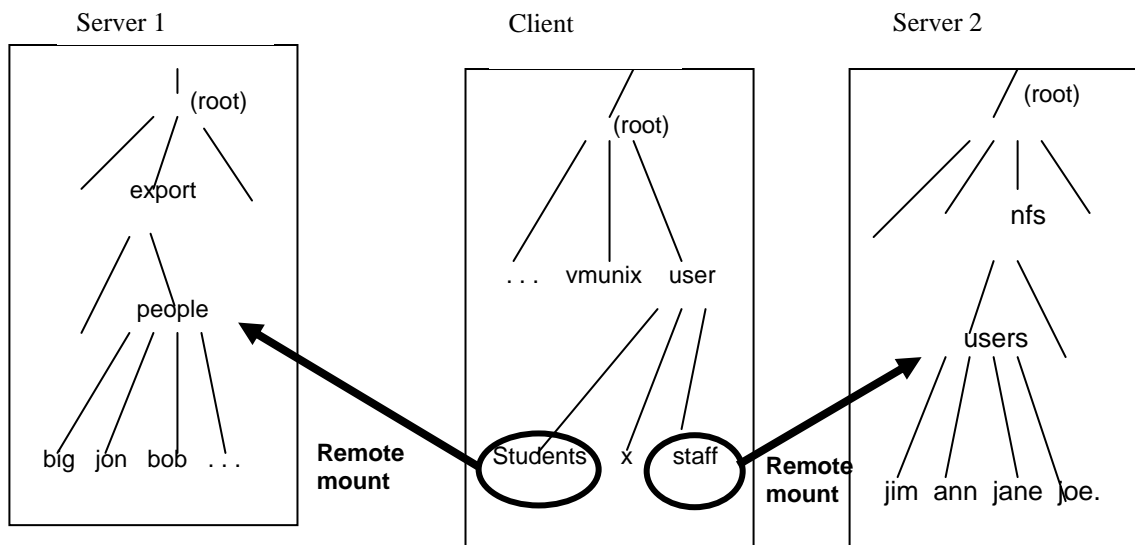


Figure 3: Local and remote file systems accessible on a NFS client

- b) The software architecture of NFS clients and servers is shown in **Figure 4** on the next page. The components of NFS concerned with the mounting of remote file systems are not shown. Processes using NFS are referred to here as *user level client processes* in order to distinguish them from *NFS client* module which resides in the UNIX kernel on each client computer.

Describe the communication operations involved in this architecture.

(10 marks)

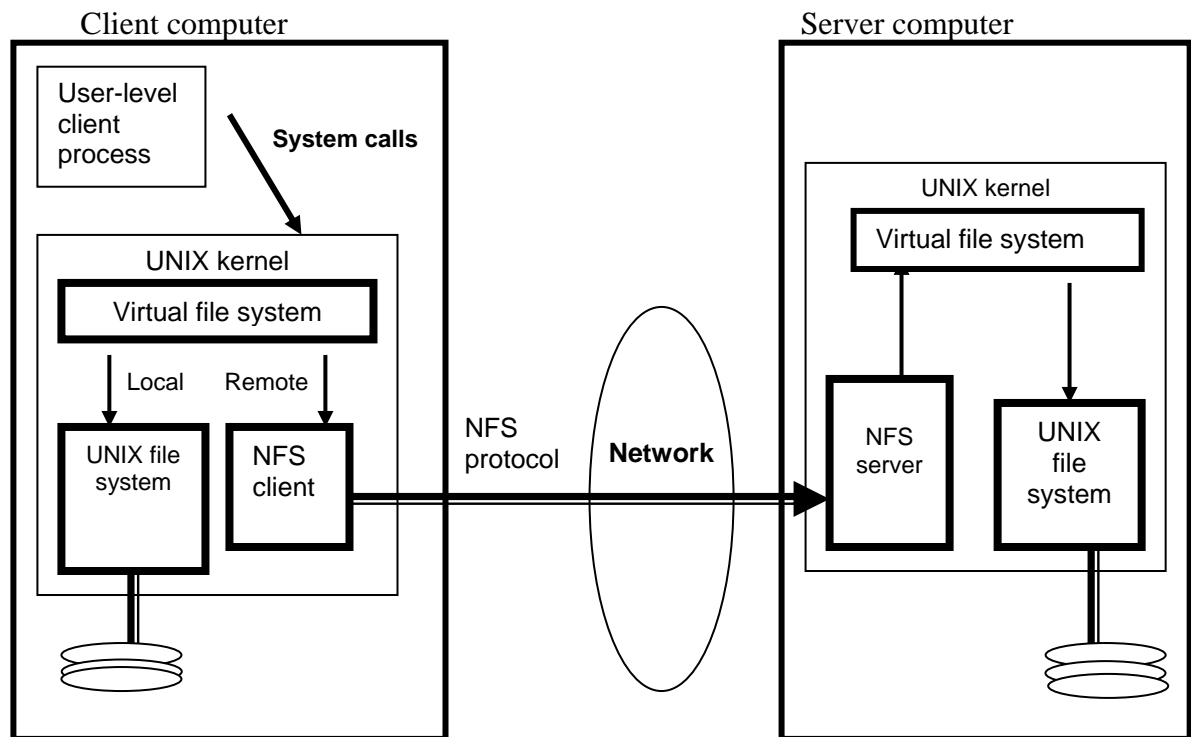


Figure 4: NFS Software Architecture

4. a) Describe the functionality of a repeater, a bridge and a router for use with IP traffic on Local Area Networks, giving details of what information is transferred and what filtering can be performed. **(10 marks)**
- b) For each of the following local area network (LAN) problems identify whether each of a repeater, a bridge or a router can solve the problem. In each case describe, using different scenarios where appropriate, how the device could solve the problem and identify which device is the best solution.
 - i) The LAN requirements exceed the maximum cable length for a single segment. **(3 marks)**
 - ii) The LAN interconnects several departments of the organization. The total traffic exceeds the maximum bandwidth for a single LAN. **(3 marks)**
 - iii) One department on the LAN generates a lot of internal network traffic and needs to be on a separate subnet. **(3 marks)**
 - iv) One department exchanges confidential information internally and does not want its data to be intercepted by a packet sniffer run from a machine in another department. **(3 marks)**
 - v) One or more departments use a different domain and IP address range to the others. **(3 marks)**
5. a) Describe how the POP3 protocol can be used to view and retrieve remote mail and identify the major advantages and disadvantages of using this protocol. **(7 marks)**
- b) Describe how the IMAP4 protocol can be used to view and retrieve remote mail and identify the major advantages and disadvantages of using this protocol. **(7 marks)**
- c) Describe how the ESMTP protocol is used to send electronic mail between two mail transport agents (MTA). Specify the checks which the MTA's should perform to prevent them from being used to deliver spam mail. **(11 marks)**