

Computer Science Department
1998 Examinations
D52 - Network Architecture

Answer THREE questions

(The use of electronic calculators is not permitted in this examination)

1. Broadband ISDN (B-ISDN) is based on Asynchronous Transfer Mode (ATM) technology in which data is transferred in small, fixed-sized cells.

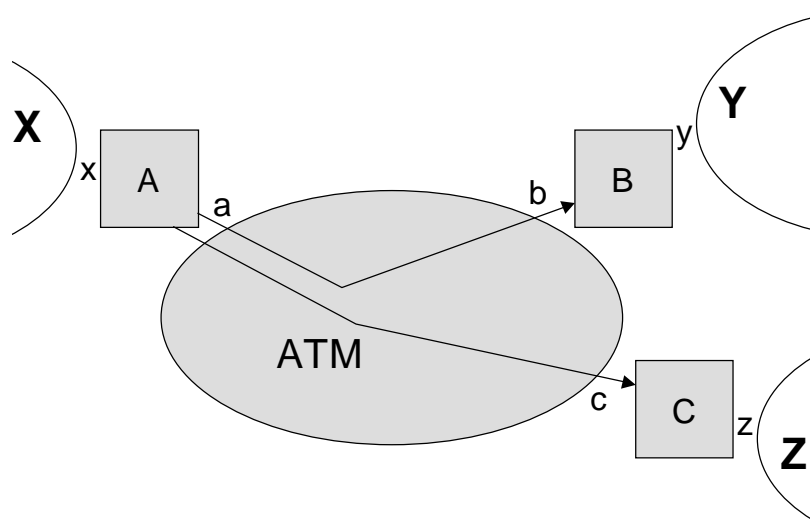
a) i) BRIEFLY present THREE arguments which support the use of ATM technology for integrated services traffic.

[3 marks]

ii) For each of your arguments above BRIEFLY present a contrary argument which refutes the case for ATM.

[3 marks]

b) The figure below shows three machines (A, B and C) each of which has an interface (a, b and c) to a public ATM network together with an interface (x, y, and z) to three other networks. The figure also shows a pair of Virtual Channel Connections (VCC) connecting A to B and C.



i) Describe the way in which the VCCs are identified at a, b, and c and explain why a VCC may have different identifiers at its two end-points.

[6 marks]

ii) Interfaces a, b, and c have “global” (E.164) addresses. In what sense are such addresses global and when might they be used?

[5 marks]

[Question 1 continued on next page]

[Question 1 continued]

iii) Suppose X, Y and Z are IP networks whilst A, B and C are acting as IP routers. Outline how IP addresses might be allocated to the interfaces in the figure.

[3 marks]

iv) Provide a detailed illustration of the steps that take place as A relays an IP datagram received on its interface x to a host on Z via the ATM network. (Assume that all necessary tables have been set up and that the VCCs are used as point-to-point connections, i.e. LANE is not being used.)

[13 marks]

2. a) You have been hired as an open systems consultant by a university department to investigate their current Internet e-mail services. After some measurements have been taken, you notice the following:

- a lot of directory service referrals are taking place, and mostly to the same destination (an eminent university in the US)
- on some occasions quite a few academics are reporting that contact from outside via e-mail is lost

Prepare a short report for the head of the department identifying what you think is wrong with the e-mail service, and your suggestions for improvement. Include in your answer a brief introduction to e-mail systems as the head of department's background is in another area.

[18 marks]

b) In your analysis of the e-mail services in the department, you notice that the directory system being used is the OSI X.500 standard, and that it is only really used as a name to address resolution facility. You suggest that the department would benefit greatly from an automated exam results process, and that the X.500 directory system could be used for this purpose. Prepare a second short report that puts forward your idea, and includes a design of a suitable structure for the database. Specify the database record structure using ASN.1.

[15 marks]

3. a) Compare and contrast the characteristics that a transport service should possess in order to provide efficient support for the following applications:
- i) Access from a browser to a WWW server;
[3 marks]
 - ii) An "Internet phone" service;
[3 marks]
 - iii) A "nameserver" service (e.g. the Internet "Domain Name Service" (DNS)).
[3 marks]
- b) Compare and contrast the characteristics of the transport services normally used to support the Internet and OSI management services ("SNMP" and "CMIP"). Discuss the advantages that the designers of these two management services expected to gain from their choice of transport protocol.
[10 marks]
- c) A large WWW server can have many (>100) TCP connections. In an SNMP-based managed system for such a server each TCP connection would be represented as a row of a table. In an OSI/CMIP-based managed system each TCP connection would be represented as a *managed object*. The fields of the SNMP table would correspond to the attributes of the managed object. Each would include the IP address of the remote TCP host. We wish to monitor the server from a remote managing application and detect when a TCP connection is set up from a particular IP address.
- Describe the mechanisms available from SNMPv1, SNMPv2 and CMIP for achieving this. Your answer should include consideration of the time between a relevant connection being set up and this being detected by a managing application and the network load imposed by the monitoring operation over time.
[14 marks]

4. You are designing a facility for medical staff at a top London hospital that is distributed between two sites. A suitable database that can store the very large amount of information needed for X-rays or Magnetic Resonance Images (MRI scans) can only be located in the site away from most of the medical staff who will need to access this information.

a) You need to provide a report on the protocol facilities that can be used to guarantee complete reliability of the transfer of the information. Assuming a reliable bit transfer service is provided by a Transport layer, briefly describe the functionality that needs to be provided on top of the Transport service. In particular, identify a suitable set of application service elements (ASEs) for the application layer, and briefly describe their functionality. Include in your report details of their usage of other OSI upper layers.

[11 marks]

b) How might you simplify this functionality in the light of a less error prone network compared to that assumed in the definition of the OSI 7 layer model?

[11 marks]

c) Other functionality that may be needed in this application would be compression facilities. Suggest a suitable type of compression algorithm for this application. Since compression facilities are often processor intensive, it has been suggested that these functions be combined with other processor intensive functions in the upper layers. What sort of function(s) do you think are processor intensive in the upper layer architecture, and do you think that compression can be usefully integrated at this level?

[11 marks]

5. Figure 1 shows 4 LANs P, Q, R and S interconnected by three transparent bridges A, B, and C. The path costs for the LANs are shown as encircled values.

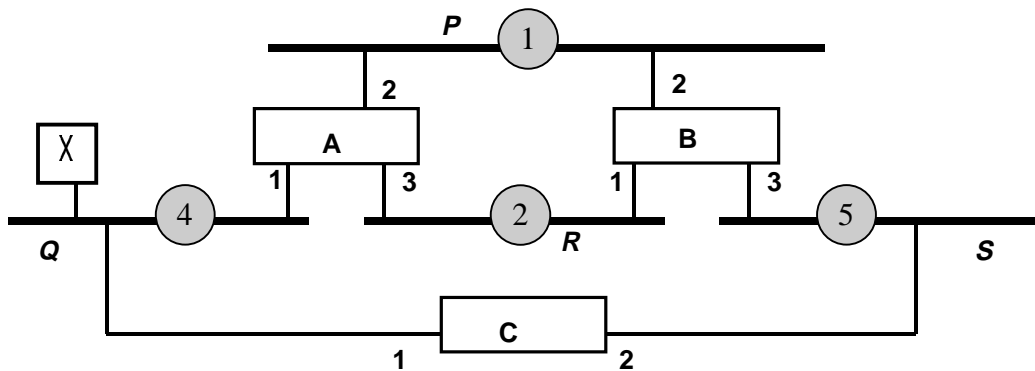


Figure 1

Through reference to Figure 1:

- a) Describe a looping problem that arises when a frame is transmitted from 'X'.

[6 marks]

- b) Suppose that the bridges in the diagram above all operate the IEEE *spanning tree algorithm* and that the algorithm has stabilised with A being the agreed root bridge.

- i) What would be the root ports of B and C?

[2 marks]

- ii) What would be value of the "path cost to root" in BPDUs received by C directly from A and B?

[2 marks]

- iii) Which ports would be set to "blocked"?

[6 marks]

- iv) Suppose B and C are informed by an operator that the cost of LAN S has reduced to 1. Explain clearly what would now be the effect of a new BPDU sent from B to C followed by one from A to C.

[8 marks]

[Question 5 continued on next page]

[Question 5 continued]

- c) A source *A* (see Figure 2) uses IP multicast to send a stream of data to two receivers *B* and *C* via links *x*, *y* and *z* and multicast router *M*. Outline how the Internet Resource Reservation Protocol (RSVP) would operate so as to reserve network resources to support this activity.

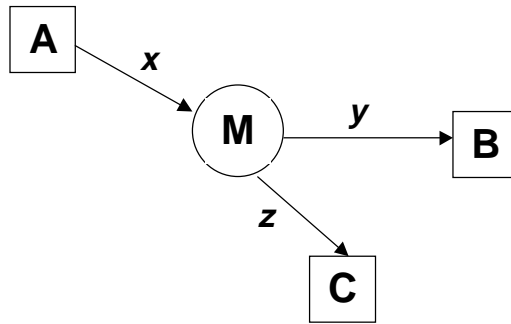


Figure 2

[9 marks]