OLLSCOIL NA hÉIREANN, GAILLIMH
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

SEMESTER II EXAMINATIONS, 2003

B.E. DEGREE EXAMINATION (ELECTRONIC ENGINEERING)
B.E. DEGREE EXAMINATION (ELECTRONIC AND COMPUTER ENGINEERING)

TELECOMMUNICATION SOFTWARE APPLICATIONS

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Duration of examination: *Three* Hours

Instructions: Answer any *Five* questions.

1. *(a)* Asynchronous Transfer Mode networks operate using *short fixed-length cells.* Describe *two* advantages and *two* disadvantages of this approach compared to packet switched networks which use variable length packets.

[4 marks]

(b) Outline the role of the *Virtual Circuit Identifier (VCI)* in the operation of an ATM network. Describe a scenario where the *Virtual Pipe Identifier (VPI)* might be used as an alternative to using the VCI.

[4 marks]

(c) Compare the way in which the various ATM Adaptation Layers (AAL) attempt to handle the following problems that are typically encountered in ATM networks.

- Segmentation and re-assembly of application layer PDU,
- Individual cell loss,
- Multiple consecutive cell loss,
- Bit errors,
- Cell jitter.

[8 marks]

(d) A computer application utilises a 5000 bit application service data unit for transmission to transfer data over an ATM network. Determine the number of padding

bytes required and the resultant efficiency of this transmission if (i) AAL3\4 and (ii) AAL5 is used.

Figure 1 located at the end of this paper may be of use in completing this question.

[4 marks]

2. *(a)* Outline the rationale behind the process of *IP packet fragmentation* and illustrate how it is practically supported using the standard IP packet header.

[5 marks]

(b) Describe the difference between *class based* and *classless* addressing used in IP networks particularly focusing on the scalability, efficiency and router search complexity of the two approaches.

A company is planning to use 440 IP hosts within its own IP network. Determine the address utilisation efficiency if this organization uses class based addressing or a suitable classless addressing scheme.

[8 marks]

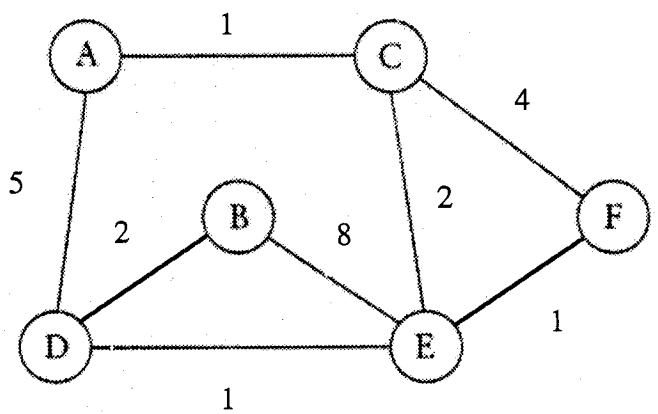
(c) Describe the role and operation of an Address Resolution Protocol (ARP) in BOTH a broadcast based network, such as Ethernet, and a switched network, such as ATM.

[7 marks]

3. *(a)* Describe the aims and operation of the OSPF algorithm as an example of a *Link State Routing Algorithm* used in IP networks.

[6 marks]

(b) Determine the routing table at node C in the network below using a forward search algorithm.



[5 marks]

(c) Outline the parameters which impact upon the link cost metrics used in IP routing algorithms.

[4 marks]

(d) "*Virtual Private Networks (VPN)* can be implemented using third-party's IP networks with the use of *secure IP Tunnels*". Explain what you understand by this statement.

[5 marks]

4. *(a)* Explain the meaning of the following terms in the context of a *transport layer protocol*:

- Port number,
- End-to-end protocol,
- Byte-oriented protocol,
- Connection oriented protocol.

[8 marks]

(b) Contrast the operation of the TCP sliding window protocol with that of a data link layer sliding window protocol under the following headings:

- Re-transmission timeout duration,
- Flow control,
- Re-transmission buffer operation.

[6 marks]

(c) A TCP implementation measures the round trip time (RTT) for a pair of specific TCP segment as 120 ms and 100 ms (in that order). The estimated RTT prior to this first of these particular TCP segments being transmitted is 135 ms. Determine the TCP timeout period at the end of this period of time using:

(i) The original TCP timeout update algorithm (using α=0.8),
(ii) The Jacobson-Karels algorithm with (μ=1, ϕ=4, δ=0.2 and an initial deviation estimate of 10 ms)

What would be the final timeout value, using the above two algorithms, if the 120 ms sample RTT was measured as a result of a TCP timeout and segment retransmission?

[6 marks]

5. *(a)* Describe how the following queuing paradigms can be used to implement resource allocation in routers.

(i) Priority based FIFO,
(ii) Fair queuing,
(iii) Weighted fair queuing.

[6 marks]

(b) A router implementing a "per flow" fair queuing algorithm currently has three flows established. The table below outlines the arrival time (in system clock ticks), source flow and packet length of incoming packets to this router.

Packet	Source Flow	Arrival Time (Clock Ticks)	Frame Length (Bits)
A	1	0	170
B	1	50	100
C	3	120	100
D	2	160	120
E	2	180	100
F	3	200	140
G	1	230	150
H	3	250	120
I	2	300	100

You may assume that the system clock tick period of the router is one bit period in duration.

Determine the order in which these packets will be transmitted. Your answer must clearly indicate the methodology used in determining your answer.

[4 marks]

(c) Describe the difference between the *Integrated Services (Intserv)* and *Differentiated Services (Diffserv)* approach to QoS provision in an IP network environment. Your answer should illustrate actual examples of different QoS service levels supported by each paradigm.

[6 marks]

(d) Describe the operation of the *Resource Reservation Protocol (RSVP)* in an IP network supporting Quality of Service (QoS).

[4 marks]

6. *(a)* The standard TCP congestion control algorithm is based around the following four mechanisms:

(i) Slow Start,
(ii) Additive Increase\Multiplicative Decrease,
(iii) Fast Retransmit with Fast Recovery.

Describe the operation of these mechanisms and outline the circumstances in which they would operate.

[6 marks]

(b) Describe the operation of a specific example of a (i) *router-centric* and (ii) *host-centric congestion avoidance* algorithm. Your answer should also indicate a relative advantage of each approach.

[8 marks]

(c) A RED algorithm is operating on a specific outgoing queue within an IP router. The current average queue length is 3600 bytes.

- Queue length averaging factor of 0.2,
- Maximum Queue Length Threshold = 6000 bytes,
- Minimum Queue Length Threshold = 3000 bytes,
- Maximum Probability Drop =0.4

An IP packet destined for this queue has just been dropped as a result of the RED algorithm. The following are the details of the subsequent packets destined for this outgoing queue.

Packet Number	Packet Size	Actual Queue Length (prior to the packet's arrival)
1	500 bytes	3500 bytes
2	600 bytes	3800 bytes
3	500 bytes	4200 bytes

Determine the probability that packet number 3 will be the next packet to be dropped as a result of the RED algorithm.

[6 marks]

7. *(a)* Explain why *delay* is a serious concern in VoIP networks and, hence, describe three different sources of delay that commonly occur in a VoIP network.

[4 marks]

(b) Describe the methods used in a VoIP network to deal with *jitter* and *packet loss* such that audible distortion is minimized. Your answer should describe TWO techniques for handling EACH of the above problems.

[6 marks]

(c) Describe and compare the relative complexities of the SIP and H.323 signalling protocols by considering the procedures necessary to establish a *basic* voice call using both signaling protocols.

[6 marks]

(d) Clearly explain the difference between the following entities used in VoIP networks

- *Gatekeeper* and *Gateway,*
- *SIP redirect server* and *SIP proxy server.*

[4 marks]

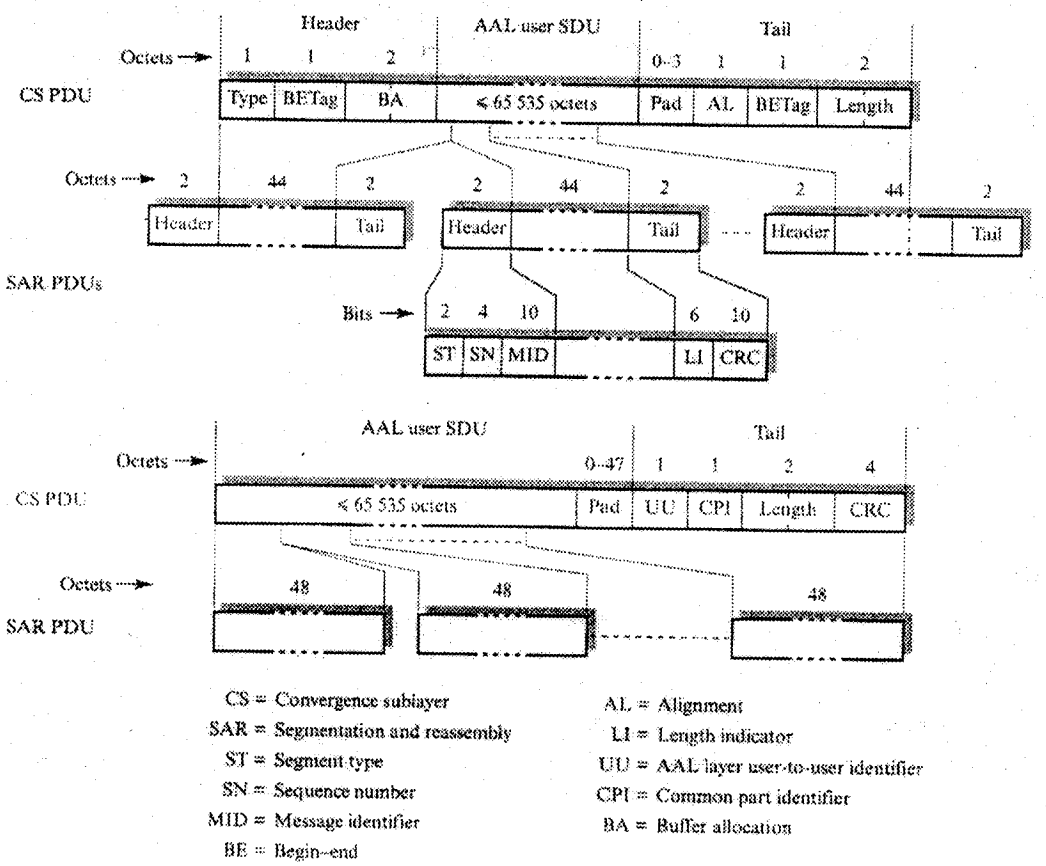


Figure 1 – Structure of AAL3\4 and AAL5 PDUs