6   Computer Networking (AWM)

(a) An older home-network router has an upload bandwidth of 1Mbit/s to the Internet, and a 100kbyte first-in first-out (FIFO) buffer for packets awaiting transmission. Packets have a maximum transmission unit (MTU) of 1500 bytes.

(i) If the buffer is completely full, how long does it take the router to transmit all of the bytes in the buffer? [2 marks]

(ii) Suppose the router supports two FIFO queues, one high-priority for interactive applications (like Voice over IP) and the other lower-priority for all remaining traffic. If a VoIP packet arrives when the queue for interactive applications is empty, what is the maximum time before the router starts transmitting the VoIP packet? (Assume that the router does not preempt any ongoing packet transmission.) [2 marks]

(b) Consider the delay at each node (router or switch) in a network given by this equation:

$$d_{\text{node}} = d_{\text{proc}} + d_{\text{queue}} + d_{\text{trans}} + d_{\text{prop}}$$

For each term: d_{proc}, d_{queue}, d_{trans} and d_{prop}

(i) explain what it represents;

(ii) state one way to reduce it; and

(iii) indicate a typical range of values in a 1Gbit/s local area network with link-length less than 500m.

State your assumptions throughout. [4 × 3 marks]

(c) A lecturer remarks that "centralised multiplexing" offers potential gains in efficiency over non-centralised multiplexing.

Give *two* reasons why this could be so. In each, state clearly what feature must be *centralised* to achieve these gains. [4 marks]