8 EXERCISES

1. [R02] What are the advantages and disadvantages of the different MAC protocols when network access is controlled either by round-robin or time-sharing strategies and when network access is not controlled?
   - When does token ring outperform Ethernet?
   - What would be more useful for transmitting video or audio data?
   - Like reservation-based time division multiplexing, you could also think of frequency division multiplexing. How does this work and what are its advantages and disadvantages over time division multiplexing?
2. [R03] The following statements are either true or false. State them accordingly, giving reasons for your answers.
   - Connection-oriented networks are capable of doing better flow control compared with connectionless networks.
   - TCP is a better protocol for real-time media transfer compared with UDP.
   - In the OSI model, the most consistent and complete levels of agreement found among network manufacturers should be in the Transport and Network layers.
   - Connectionless networks are preferred for real-time multimedia communications compared with connection-oriented networks.
   - In connection-oriented networks, the number of total bytes transferred is less than that of connectionless networks.
   - Pay-per-view on cable television—which means only those who pay or agree to pay for a program can view the transmission—is a multicast protocol.
3. [R02] The following questions deal with issues that relate to Quality of Service (QoS) in different multimedia applications.
   - What does Quality of Service (QoS) mean?
   - Give three possible ways in which QoS is measured, briefly explaining each.
   - Consider these application scenarios of multimedia communication:
     Video-on-demand
     Teleconferencing

   What are the main differences in the Quality of Service requirements in these cases?
4. [R02] Transmission error is common in networked communication.
   - What is error rate and how is it measured? Mention why errors occur.
   - How does a receiver detect errors?
   - How does a sender detect errors?
   - What course of action can a sender/receiver have in a connection-oriented network to detect and correct errors? How does this change in a connectionless network?
5. [R03] Routing of data can be achieved via explicitly or implicitly setting up connections between a sender and receiver or via a completely connectionless manner.
   - What is the main difference between connectionless and connection-oriented networks?

- How is packet delivery achieved in both cases?
- Give a sample protocol used in the industry for both cases.
- Which is more reliable? Give reasons.
- Which type is usually used for real-time multimedia communications?
- Which one has a better ability to control network flow?

6. [**R03**] Network congestion refers to a state when a network throughput goes down due to multiple senders on a network simultaneously sending data.
   - What is meant by network congestion and how does the leaky bucket protocol try to control it?
   - When this protocol is used, you normally see a burst of packets/data followed by a steady stream of packets/data. A computer has a maximum packet size of 1000 bytes and produces data at 10 million bytes/sec. The bucket size is 1 million bytes and the network maximum throughput is 50 million bytes/sec. How long can a burst at maximum speed last?
7. [**R03**] The token bucket scheme limits the length of time a traffic burst can enter a network. The token arrival rate is 4×10^6 bytes/second and the maximum output data rate is 3232 megabits/second.
   - What bucket capacity is needed to limit the burst to 10 milliseconds?
   - Using this bucket capacity that you have computed, how long will it take the sender to send 2,010,000 bytes of data when the bucket is 25% full?
8. [**R04**] A computer accesses large video files over a widely distributed network from two computers *A* and *B*. With *A*, it uses a connectionless protocol to get the data, whereas with *B*, it uses a connection-oriented protocol. The path from a source computer node to the destination computer *B* is five hops long, that is, there are 5 links (with 4 intermediate switches). Each link has a transmission capacity of 1 Mbps (10^6 bits per second). For the following questions, ignore processing and queuing delays at the switches and propagation delays along the links. Also ignore any headers that are added to the message/packets.
   - A single 1 megabit message is sent from source to destination. How long will it take until it is fully received at the destination, that is, until the last bit of the message reaches the destination?
   - Now suppose that the message is broken up into 10 packets of 100 kilobits (or 10^5 bits) each. The packets are sent out from the source node one after the other, with no delay between one packet and the next. How long will it take until the last packet is fully received at the destination?
9. [**R04**] QoS requirements are needed to ensure a guaranteed network performance for applications.
   - What is QoS and how is it measured?
   - How can QoS be effectively implemented for large-band networks?
   - Is your method applicable to narrowband networks? If not, mention a few ways in which narrowband networks could implement QoS.