Indian Institute of Space Science and Technology
Department of Avionics

Quiz-I

AV 321: Computer Networks, January-May 2024

Name:

Student Number:

Date: 15/02/2024

Max Score: 15

Assume suitable data necessary, if any. However, clearly state the assumptions made.

1. (2 points) Draw and explain the Internet Protocol stack. Compare and contrast with ISO-OSI protocol stack.

2. (3 points) Describe the design, novelty aspects, as well as the individual responsibilities of team members of your Track-2 R&D product. Technical details are needed.

3. (3 points) Compare and Contrast Circuit Switching and Packet Switching technologies.

4. (3 points) In a layered protocol stack similar to the Internet Protocol stack with 5 layers, an encapsulation mechanism is utilized. The Application, Transport, and Network layers have a header of 20, 22, and 30 bytes each. The Data link and physical layers have a Header as well as Trailer of 22 bytes each. What will be the size of the transmitted physical layer data when the application layer payload is 100 bytes. Also estimate the percentage overhead due to the encapsulation.

5. (4 points) Consider a 15Mbps link that is used by many users in a network. Each user is typically active only at 10% of the time and when a user is active, the data rate generated is 1Mbps. Estimate the following: *(a)* the number of users that can be supported if the network is circuit switched and *(b)* the probability of the network facing the situation of 4 times the number of users estimated in the above case *(a)* being active at any given time. Can the network support the users obtained in the case *(b)*? Explain what happens if all the users of case *(b)* are active. Assume a suitable large number of node population, if necessary.

Best of luck

Indian Institute of Space Science and Technology
Department of Avionics

Quiz-II

AV 321: Computer Networks, January-May 2024

Name:

Student Number:

Date: 27/03/2024

Max Score: 16

Assume suitable data necessary, if any. However, clearly state the assumptions made.

1. (1 point) What does a D/G/3/20/1000 queuing system represent?

2. (2 points) Compare and Contrast the following:

   a. Connection-less and Connection-oriented sessions
   b. HTTP and Persistent HTTP

3. (3 points) Explain the major elements of delay in a computer network. Explain with a quantitative example about the end-to-end delay in a computer network from a source node to its destination. For your example, estimate the end-to-end delay.

4. (4 points) In a computer network, a router uses an M/M/1/K queuing model to handle incoming packets. The arrival rate of packets (λ) follows a Poisson distribution with an average arrival of 12 packets per second, and the service rate (μ) follows an exponential distribution with an average departure rate of 10 packets per second. The router's buffer can hold a maximum of 5 packets, including the packet being served (K = 6).

   a) Determine the average number of packets in the system (L)
   b) Calculate the average time a packet spends in the system (T)
   c) Determine the average number of packets in the queue (Lq)
   d) Determine the average time spend in the queue (Tq)
   e) Find the probability of packet not lost due to buffer overflow (P_nonloss).

5. (3 points) What are the different dimensions of a bit? In an RF wireless communication network, a symbol is created using 8 information bits. The devices in the network uses 1200-byte packets. Transmitter/receiver antennas use unitary gain. If the data rate of the physical layer channel is 100 Megabits per second, estimate the following:
   a. The physical length of the symbol?
   b. Physical length of the packet?
   c. The temporal duration of the symbol?
   d. Transmission times of the symbol and packet

6. (3 points) Provide (i) detailed technical design of your innovative R&D product development activity with the timeline for completion, (ii) provide role of the members, and (iii) major feedback received during your mid-term review of the Track-2 activity.

Best of luck

Indian Institute of Space Science and Technology (IIST)
Department of Avionics [www.iist.ac.in]

6th Semester B.Tech ECE Semester Finals
AV 321: Computer Networks, Jan-May 2024

Name:
Student ID:
Date: 1/05/2024 **Duration: 3 hours** **Max Score: 50**

Make suitable assumptions, if necessary, and clearly state them. Answers should be marked with question/branch question numbers properly. Clear and legible steps are necessary for answers.

1. **(5 points)**
   a. What design considerations are required to be taken when designing a transport layer protocol? Briefly explain with examples.
   b. Draw the header format of TCP segment and explain the fields in brief.

2. **(5 points)** Derive the throughput expression for TCP Reno. Using a similar approach, derive the throughput expression for TCP Tahoe assuming the *slowstart-threshold* is fixed. Describe three possible techniques to enhance TCP throughput.

3. **(5 points)** Consider a smart-home IoT system where a camera attached to an entrance door frame of a smart house uses TCP Reno for its transport layer. The entrance camera is configured in such a way that when an object (person or animals) appears at a specific location, a switch is turned ON which further turns the IoT camera ON for a duration of five minutes. The camera has a Black and White image frame of size 1024x1024 pixels at the rate of 25 frames per second when it is turned ON. Each pixel can operate at 128 Grey scale levels. The IoT server is located far away from the camera on the Internet cloud provided by a service provider. Camera is connected to the local router with a 10Mbps CSMA/CD link.
   a. Assume that the transport layer connectivity is carried over a network that faces a loss of 1 packet in 10000 packets. The round-trip time between the camera and the IoT server is about 100milli seconds. Default value of the segment size is 2048 bytes.
   b. Will the end-to-end connection provide enough throughput for carrying the data generated by the camera? Estimate the throughput and prove your answer.
   c. If your answer to (c) is No, then explain what happens to the data generated by the camera?

4. **(5 points)** What is fairness of a protocol? Is TCP a fair protocol? If so, explain in detail. When you design a transport layer protocol, in what situations you should give fairness a significant design consideration?

5. **(5 points)** What are link state and distance vector routing protocols? Describe the operation of Dijkstra's routing algorithm and find out the routes from node D to other nodes when using Dijkstra's routing protocol on the network topology shown in Figure 1.

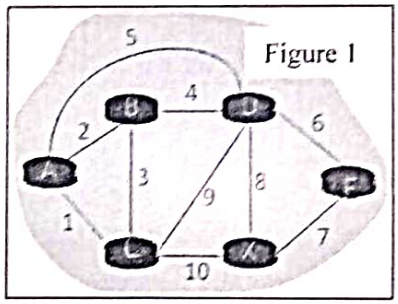

Figure 1

6. **(5 points)** How the routing process is scaled to handle millions of nodes in the Internet. Explain with detailed examples.

7. **(5 points)** What are the responsibilities of data link layer? How the packet transfer between layers is different in data link layer and other higher layers. What difference exists for packet encapsulation in data link layer?

8. **(5 points)** Consider five nodes P, Q, R, S and T, with packets always available, contending for access to a channel using slotted ALOHA. The transmission probability of each node to access the channel is τ. Assuming each slot is numbered from 1, 2.....N, estimate the following:
    a. Efficiency of the network?
    b. Probability that one of the nodes succeeds in slot 5?
    c. Probability that first success occurs in slot 4?
    d. Probability that node S succeeds for the first time in slot 3?

9. **(5 points)** Consider a satellite network system with one satellite that carries one transponder with 4Mbps full duplex transmission capacity. The satellite transponder accepts communication packets from four regional ground stations and forwards the packets to the Gateway Earth Station for further packet processing. Assume the packet lengths are distributed exponentially with mean length 2500 bits where the channel arbitration mechanisms used are (i) slotted ALOHA on the uplink (regional ground stations to satellite) and (ii) point-to-point link between satellite and Gateway Earth Station. Each of the ground stations carry packet traffic of 100 packets per second whose inter-arrival time is exponentially distributed. The packets from the uplink channel(s) are placed in a queue at the satellite before forwarded by the downlink channel to the Gateway Earth Station. Estimate the following:
    a. What is traffic intensity faced by the queuing system at the transponder?
    b. Is the entire satellite system stable as far as the communication networking is concerned?
    c. What is the average waiting time of packets in the system?
    d. Instead of slotted ALOHA, if you provide TDMA or FDMA for the uplink (ground stations to Satellite) with equal bandwidth per ground station, what will be the above results (a), (b), and (c).

10. **(5 points)** Provide the detailed design for your Internet-based R&D product. Provide details of how your design was modified or improved after the mid-term review feedback. Also provide the detailed technical contributions of the team members. A detailed discussion on the commercial success of your product, if commercialization possibility exists, shall be provided. Your estimate can include potential market size, users adoption of your internet-based R&D product, and cost of item, service rates/subscription rates, operational expenses for scaled up services, as well as potential profit/loss estimates.

----------All the best----------