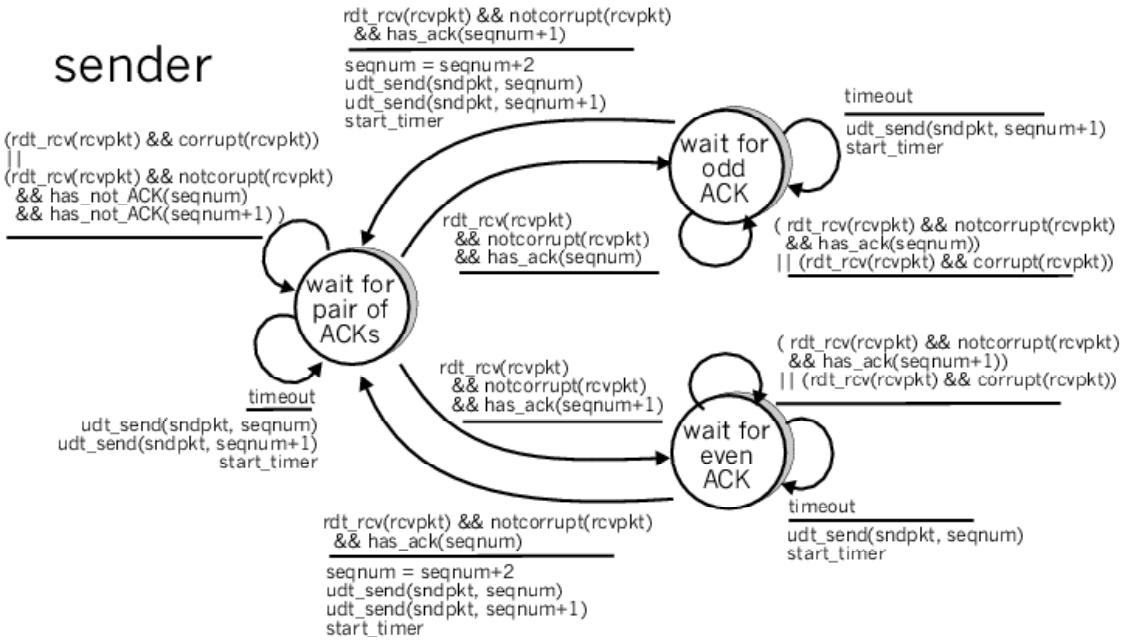
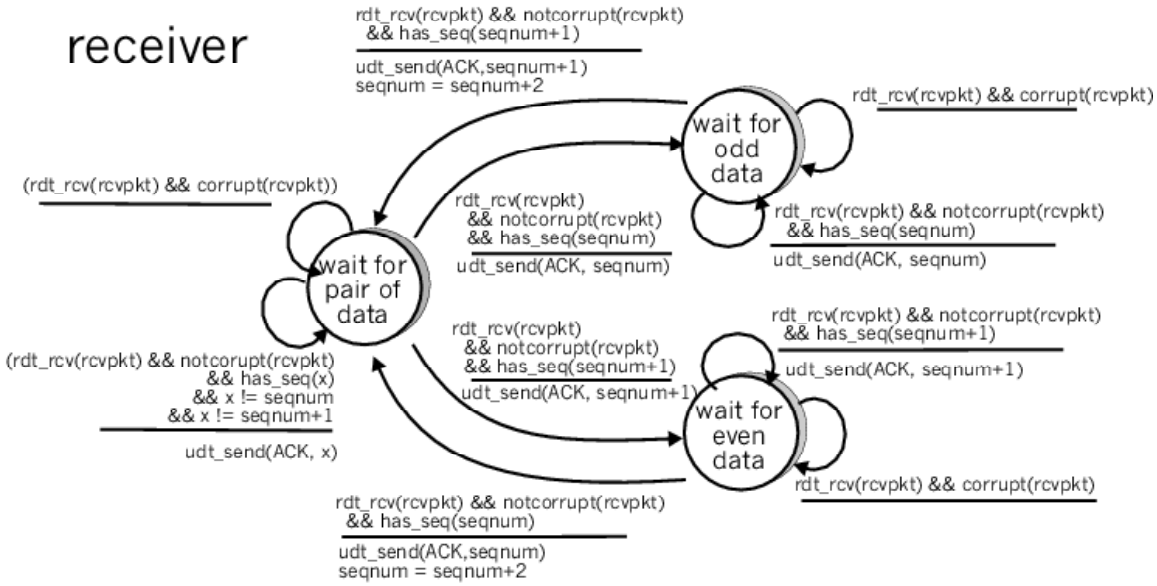
There are 110 points in total. Problems 15 and 17 are 10 points. Good Luck!

1. What are design principles behind internet? Please list two and explain why?
2. ADSL and cable modem have different network topologies. Please describe how topologies differences may affect their performance.
3. What is circuit switching? What is packet switching? What is FDM? What is TDM?
4. Consider a packet of length L which begins at end system A, travels over one link to a packet switch, and travels from the packet switch over a second link to a destination end system. Let d_i, s_i, and R_i denote the length, propagation speed, and the transmission rate of link i for $i = 1, 2$. The packet switch delays each packet by d_{proc}. Assuming no queueing delay, in terms of d_i, s_i, R_i, ($i = 1, 2$), and L, what is the total end-to-end delay for the packet?
   Suppose now the packet is 1000 bytes, the propagation speed on both links is 2.5 x 10^8 m/s, the transmission rates of both links is 1 Mbps, the length of the first link is 4000 km, and the length of the last link is 1000 km. For these values, what is the end-to-end delay?
5. Explain briefly what is ISO/OSI 7-layer protocol reference model? What are the advantages of dividing the network protocol into layers? What are the possible problems behind it?
6. Different applications have different QoS requirements such as delays, bandwidth, losses, and so on. Please give three applications and describe their QoS requirements.
7. What protocol services are provided or not provided by TCP? What protocol services are provided or not provided by UDP? Why do we need both TCP and UDP protocols?
8. Some applications such as POP3 and HTTP are stateless. Some maintain “states” such as IMAP. Please describe the advantages and disadvantages of both schemes.
9. What is P2P architecture? What is client-server architecture? Pleas also give an example for both. What is hybrid of client-server and P2P?
10. Let a web page consist of many objects which include texts, graphs, and videos. What may we experience when we read the web page if we use a persistent HTTP with no parallel connections? What may we experience when we read the web page if we use a non-persistent HTTP?
11. What is web caching? Please draw a graph to explain the advantages of web paging.
12. Using graphs to explain the differences in multiplexing/demultiplexing between UDP and TCP.
13. There are four types in DNS Resource Records (RRs), what are they and what are they used for? If you want to let your file server and your mail server to have the same aliased name to your customer, how can the DNS help you? Please use an example to explain it.
14. What is DHT? What is circular DHT? How to handle peer churn? When there is a new joining node or a leaving node, how to maintain connection?
15. Explain the operations of the following FSM (Hint: The send will send a pair of messages at a time). You can answer this problem on the problem sheet directly if you want. (10)





16. Briefly explain the operations of TCP congestion control. Your explanation must include slow star phase, congestion avoidance phase, and the condition of experiencing losses.
17. What is Go-Back N? What is Select Repeat? Please write pseudo codes for senders and receivers for both of them. (10)
18. How is TCP RTT estimated? Explain the design reason behind it.
19. Please draw graphs to explain why 2-way hand shake may fail and 3-way hand shake are needed.
20. What are causes/costs of congestions?