Assignment -2 (50 points)

Due on September 28, 2020 23:59

Client-Server vs Peer-2-Peer (10 points)

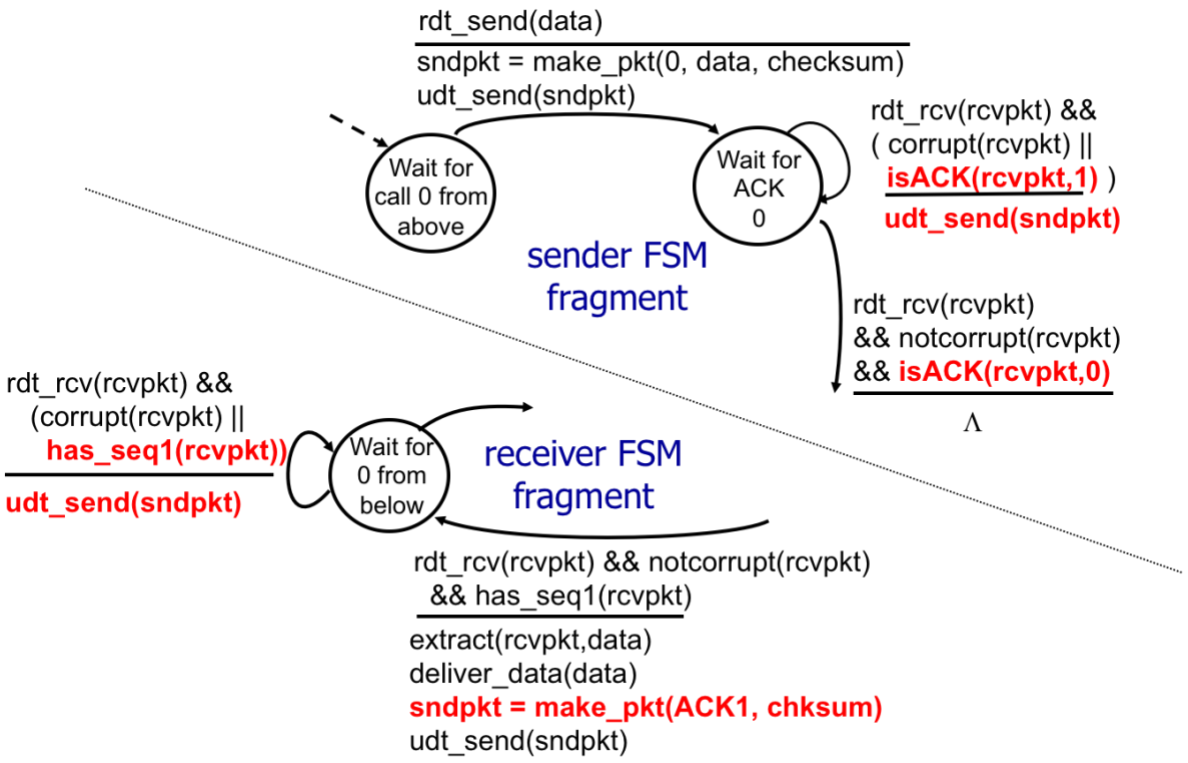
1. Microsoft distributes OS updates regularly. Suppose it has to release an update to the operating system that is 100 MB in size. The number of users it has to distribute the update to is N. The bandwidth coming out of Microsoft is unlimited, however the server pool they have can support a maximum of 1,000 simultaneous downloads. The clients are mixed, 50% of them have: 1Mbps download and 500 Kbps upload capacity. The remaining 50% of them have 5Mbps download and 500Kbps upload capacity. Assume that the P2P system is "perfect", i.e. all nodes can immediately start uploading at full speed.
   For values of N being (i) 100,000
   (a) The total time it takes until the last client has received the patch using a client-server solution residing at Microsoft. (5 points)
   (b) The total time it takes assuming a perfect Bittorrent style P2P distribution system. (5 points)

Transport Layer (40 points)

2. A sender wishes to perform reliable communication with two receivers simultaneously. Upon receiving a packet, a receiver sends an ACK if the packet is received uncorrupted. Otherwise, it sends a NAK if the packet is corrupted. A receiver's acknowledgment can be corrupted as well. Each receiver's acknowledgment arrives at the sender as an uncorrupted ACK independently with probability *p* (i.e., After sending a packet to a receiver, the sender "knows" with probability *p* that the receiver successfully received the packet.) Assume that the sender can determine from which receiver an arriving acknowledgment belongs to (e.g., it can make the determination from the source address of the packet.)

Is it sufficient to have just two sequence numbers (i.e., just using sequence numbers 0 and 1 for packets) just like in the single-receiver case? Explain how two sequence numbers can be used or give a counter-example showing that two is not sufficient. (10 points)

3. Shown below is the partial state machine for the sender and receiver for RDT 2.2. Please complete both the sender and receiver state machines for RDT 2.2. Note that the state machine is symmetrical, and therefore the remainder of the state machine would like somewhat like what you see here, except for the sequence number value being changed. (10 points)



4. Consider packet sizes are 1000 bits, transmission rate is 1 Mbps, and propagation delay from source to destination is 15 milliseconds. Assume that acks are very small, processing time for packets and acks is negligible, and there are no errors in transmission. What will be the throughput if we use:
    a. Stop-And-Wait ARQ. (5 points)
    b. Go-back-N ARQ with a window size of 25 packets. (5 points)
5. Suppose an application layer entity wants to send an *L*-byte message to its peer process, using an existing TCP connection. The TCP segment consists of the message plus 20 bytes of header. The segment is encapsulated into an IP packet that has an additional 20 bytes of header. The IP packet in turn is packaged inside an Ethernet frame that has 18 bytes of header and trailer. Now, determine the effective goodput, i.e. the percentage of the transmitted bits in the physical layer correspond to message information, when L = 100 bytes, 500 bytes, 1000 bytes respectively? (5 points).

6. Suppose that a TCP sender measures the sample RTTs of 100 ms and 200 ms respectively during a session. If the initial value of the estimated RTT is 150 ms, What is the value of estimated RTT and RTO after the next two samples have been processed? For simplicity, assume α=0.5 and β=0.5. (5 points)

Grace Question (5 points)

7. Hosts A and B are each connected to a router R via 10Mbps links (A ----- R ------B). The propagation delay on each link is 20 microseconds. R is a store and forward device i.e. it doesn't transmit the packet on the R-B link until the whole packet is received on the A-R link. Suppose R forwards a packet 35 microseconds (processing delay) after it has finished receiving it. Calculate the total time required to transmit 10,000 bits from A to B, in the following two cases: (i) as a single packet, and (ii) as two 5000 bit packets sent one right after the other.