INST346 HW03

Transport Protocols, TCP/UDP, and Reliable Transfer

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1 The Transport Layer

1. Suppose the network layer provides the following service: The network layer in the source host accepts a destination host address and a data segment (maximum size 1,200 bytes) from the transport layer. The network layer then guarantees delivery of the segment to the transport layer at the destination host. Suppose many network application processes can be running at the destination host.
   a) Design the simplest possible transport-layer protocol that will get application data to the desired process at the destination host. Assume the operating system in the destination host has assigned a 4-byte port number to each running application process.
   b) Modify this protocol so that it provides a "return address" to the destination process.
2. Why do you think voice and video traffic are often sent over TCP rather than UDP in todays Internet?
3. Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B each send a UDP segment to Host C with destination port number 6789.
   a) Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?
   b) How does this process differ in TCP?

2 Principles of Reliable Data Transfer

1. In our RDT protocols, why did we need to introduce checksums?
2. In our RDT protocols, why did we need to introduce sequence numbers?
3. In our RDT protocols, why did we need to introduce acknowledgements?
4. In our RDT protocols, why did we need to introduce timers?

5. Suppose that the roundtrip delay between sender and receiver is constant and known to the sender. Would a timer still be necessary in protocol RDT 3.0, assuming that packets can be lost? Explain.

6. Consider the cross-country pipeline motivating example shown in section 3.4.2. Suppose that the size of a packet is 1,500 bytes, including both header fields and data.

   a) How big would the window size have to be (i.e., how many packets should be in flight simultaneously) for the 1Gbps channel utilization to be greater than 98 percent?

   b) Assume the 100th packet in your window was corrupted. After receiving a negative ACK, how many packets would be retransmitted by the sender using i) go-back-n, and ii) selective repeat?

   c) Suppose your protocol only had room for 12-bit sequence numbers. Would you use go-back-n or selective repeat as your pipeline approach? Why?

3 Fundamentals of TCP

1. Answer each of the following as **True** or **False**:

   a) Host A is sending Host B a large file over a TCP connection. Assume Host B has no data to send to Host A. Host B will not send acknowledgements to Host A because Host B cannot piggyback the acknowledgements on data.

   b) The size of the TCP `rwnd` never changes throughout the duration of the connection.

   c) Suppose Host A is sending Host B a large file over a TCP connection. The number of un-ACKed bytes that A sends cannot exceed the size of the receive buffer.

   d) Suppose Host A is sending Host B a large file over a TCP connection. If the sequence number for a segment of this connection is m, then the sequence number for the subsequent segment must be $m + 1$.

   e) The TCP segment has a field in its header for the receive window.

   f) Suppose the last `SampleRTT` in a TCP connection is equal to 1 second. The current value of TimeoutInterval for the connection will necessarily by ≥ 1 sec.

   g) Suppose Host A sends one segment with the sequence number 38 and 4 bytes of data over a TCP connection to Host B. In this same segment, the acknowledgement number is necessarily 42.

2. Suppose Host A and Host B negotiate a new TCP connection. Host A then sends two TCP segments back to back to Host B over this new connection. The first segment has sequence number 90; the seconds has sequence number 110.

   a) How much data is in the first segment?

   b) Suppose the first segment is lost but the second segment arrives at B. In the acknowledgement that Host B sends to Host A, what will be the acknowledgement number?

3. Say Host A wants to send a large file of L bytes to Host B. Assume an MSS of 1,460 bytes.

   a) What is the maximum size L of this file such that the TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.

b) For the L you obtained, how long does it takes to transmit the file? Assume that a total of 40 bytes of transport and network header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.