

تمرین شماره سه درس شبکه های کامپیوتری  
دانشکده مهندسی کامپیوتر-دانشگاه صنعتی شریف  
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1. TCP waits until it has received three duplicate ACK before performing a fast retransmit. Why do you think the TCP designers chose not to perform a fast retransmit after the first duplicate ACK for a segment is received?
2. True or False: (explain your answer)
  - a. If a Web page consists of exactly one object, then non-persistent and persistent connections have exactly the same response time performance?
  - b. Consider sending one object of size  $O$  from server to browser over TCP. If  $O > S$ , where  $S$  is the maximum segment size, then the server will stall at least once?
  - c. Suppose a Web page consists of 10 objects, each of size  $O$  bits. For persistent HTTP, the RTT portion of the response time is 20 RTT?
  - d. Suppose a Web page consists of 10 objects, each of size  $O$  bits. For non-persistent HTTP with 5 parallel connections, the RTT portion of the response time is 12 RTT?
3. Assume that TCP implements an extension that allows window sizes much larger than 64 KB. Suppose that you are using this extended TCP over a 1-Gbps link with a latency of 100 ms to transfer a 10-MB file, and the TCP receive window is 1 MB. If TCP sends 1-KB packets (assuming no congestion and no lost packets):
  - a. How many RTTs does it take until slow start opens the send window to 1 MB?
  - b. How many RTTs does it take to send the file?

- c. If the time to send the file is given by the number of required RTTs multiplied by the link latency, what is the effective throughput for the transfer? What percentage of the link bandwidth is utilized?
4. Why does UDP exist? Would it not have been enough to just let user processes send raw IP packets?
5. Both UDP and TCP use port numbers to identify the destination entity when delivering a message. Give two reasons for why these protocols invented a new abstract ID (port numbers), instead of using process IDs, which already existed when these protocols were designed.
6. Consider the effect of using slow start on a line with a 10-msec round-trip time and no congestion. The receive window is 24 KB and the maximum segment size is 2 KB. How long does it take before the first full window can be sent?
7. A TCP machine is sending full windows of 65,535 bytes over a 1-Gbps channel that has a 10-msec one-way delay. What is the maximum throughput achievable? What is the line efficiency?
8. What is the fastest line speed at which a host can blast out 1500-byte TCP payloads with a 120-sec maximum packet lifetime without having the sequence numbers wrap around?