

1. Please elaborate on the relationship among SNR (signal-to-noise ratio), BER (bit error rate) and PHY (physical layer) for wireless communications. (15%)
2. Please describe how “adaptive playout delay” works for Internet phone. (10%)
3. Consider the car-caravan analogy shown in Figure 1. Assume a propagation speed of 50 km/hour, and a toll booth takes 12 second to service a car. (15%)
  - (a) Suppose the caravan travels 200 km, beginning in front of one tollbooth, passing through a second tollbooth, and finishing just before a third tollbooth. What is the end-to-end delay?
  - (b) Repeat (a), now assuming that there are five cars in the caravan instead of ten.

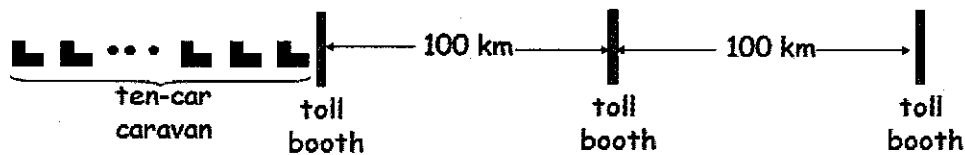


Figure 1: Car-caravan analogy

4. Stochastic Process (15%)
  - (a) Please describe Independent Increment and Stationary Increment.
  - (b) Define a Stochastic Process that has independent and stationary increments.
5. Please give the intuition (in your own words) of “Conditional Distribution of the Arrival Times” for Poisson Process. (10%)
6. Please briefly describe Superposition and Decomposition of Poisson Process. (20%)
7. True or False. (15%)
  - (a) The size of the TCP **RecvWindow** never changes throughout the duration of the connection.
  - (b) Suppose Host A is sending Host B a large file over a TCP connection. The number of unacknowledged bytes that A sends cannot exceed the size of the receive buffer.
  - (c) Host A is sending Host B a large file over a TCP connection. Assume Host B has no data to send Host A, Host B will not send acknowledgments to Host A because Host B cannot piggyback the acknowledgments on data.
  - (d) Suppose Host A is sending a large file to Host B over a TCP connection. If the sequence number for a segment of this connection is  $m$ , then the sequence number for the subsequent segment will necessarily be  $m + 1$ .
  - (e) Suppose Host A sends one segment with sequence number 38 and 4 bytes of data over a TCP connection to Host B. In this same segment the acknowledgment number is necessarily 42.