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# Computer Network Midterm Exam
## (November 11th, 2020)

1. (10%) Suppose that there are 8 cars traveling together as a caravan, and each tollbooth services (that is, transmits) a car at a rate of one car per 15 seconds as shown in Figure 1. Assume a propagation speed of 100 km/hour. Suppose the caravan travels 200 km, beginning in front of the first tollbooth, then going through the second tollbooth, and finishing the travel just after passing through the third tollbooth. What is the end-to-end delay?

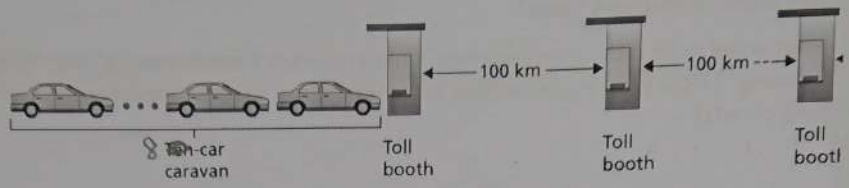


Figure 1: Caravan Analogy

2. (10 %) Suppose users share a 10 Mbps link. Also suppose each user requires 500 kbps when transmitting, but each user transmits only 18 percent of the time.
   a. When circuit switching is used, how many users can be supported?
   b. Suppose there are 200 users. Find the probability (in terms of equation) that at any given time, exactly n users are transmitting simultaneously. (Hint: Use the binomial distribution.)

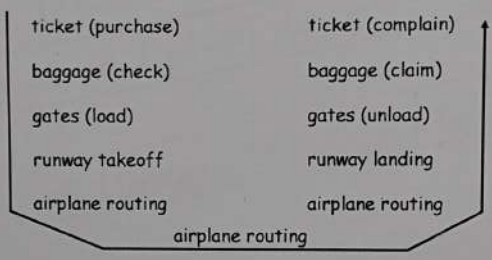


Figure 2

3. (12%) Consider the airline travel analogy in our discussion of layering (shown as Figure 2), and the addition of headers to protocol data units as they flow down the protocol stack. Is there an equivalent notion of header information that is added to passengers and baggage as they move down the airline protocol stack? If so, please describe how it works.
4. (6%) Describe how a botnet can be created, and how it can be used for a DDoS attack.
5. (15%) P2P
   a. (10%) Please describe how BitTorrent works for P2P file distribution (in your own words).
   b. (5%) Why does P2P applications diminish dramatically in recent years?
6. (12%) Assume you open a browser and enter http://www.ntu.edu.tw/about/about.html in the address bar. What happens until the webpage is displayed? Provide details about the protocol(s) used and a high-level description of the messages exchanged.
7. (5%) If you would like to access the Internet at home, what factors do you consider for your access network and physical media?
8. (15%) Assume you request a webpage consisting of one document and five images. The document size is 2K Bytes, all images have the same size of 200K Bytes, the download rate is 5 Mbps, and the RTT is 100ms. How long does it take to obtain the whole webpage under the following conditions? (Assume no

DNS name query is needed and the overheads of the request line and headers in the HTTP messages can be negligible).

a. Nonpersistent HTTP with serial connections.
b. Nonpersistent HTTP with two parallel connections.
c. Persistent HTTP with one connection.

9. (5%) The Internet provides more than one transport-layer protocol. When you develop an application, you must choose one of the available transport-layer protocols. How do you make this choice?
10. (5%) Please use "Household Analogy" in the textbook (Chapter 3) as an example to elaborate on "Transport Layer vs. Network Layer".
11. (10%) What is the main difference between "Connectionless Demultiplexing" and "Connection-oriented Demultiplexing"? How does a typical Web server implement connection-oriented demultiplexing for its connecting clients?