Exercise 1 (*Network & Internet*)

Assume a packet of length 1000 bytes to propagate over a link of distance 2500km, propagation speed 2.5×10^8 m/s, and transmission rate 2 Mbps

      (a) how long does it take a packet to propagate over the above link?

      (b) Dose this delay depend on packet length or transmission rate?

Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rate R1=500kbps, R2=2Mbps, and R3=1Mbps.

    (a) Assuming no other traffic in the network, what is the throughput for the file transfer?

    (b) Suppose the file is 4 million bytes, roughly how long will it take to transfer the file to Host B?

    (c) Repeat (b), but now with R2 reduce to 100kpbs.

Exercise 2 (*Network & Internet*)

Consider sending a file F bits over a path of Q links. Each link transmits at R bps. The network is lightly loaded such that there are no queuing delays and propagation delay is negligible. When packet switching is used, the file F bits are broken up into M packets, each packet with L bits.

a. How long does it take to send the file F over the path with Q links?

b. Suppose the network is circuit switched. The time required to set the path is T seconds. For each packet the sending layers add a total of h bits of header. How long does it take to send the file from source to destination?

c. Suppose the network is a packet-switched and a connectionless service is used. Also, suppose each packet has *2h* bits of header. How long does it take to send the file?

d. Suppose the network is a packet-switched and a connection-oriented service is used. Also, suppose each packet has h bits of header. A total of 3 extra packets are sent prior the actual file is transmitted to establish the connection (TCP handshaking). How long does it take to send the file?

e. Suppose that the network is a circuit switched with transmission rate of R bps. Assuming T set-up time and h bits of header appended to the entire file, how long does it take to send the file?

Exercise 3 (*Transport Layer*)

Assuming TCP protocol is experiencing the behavior shown in the Figure, answer the following questions in short answer.
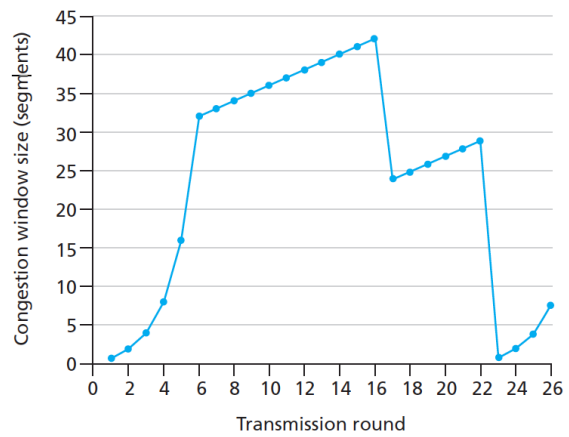
a) Identify the intervals (in round number) of time when TCP slow start and congestion avoidance is operating.

b) After the 16th transmission round, is segment loss detected by a tripleduplicate ACK or by a timeout? Repeat the same question for the 23rd round?

c) What is the initial value of ssthresh at the first transmission round?

d) During what transmission round is the 70th segment sent?

e) If two TCP flows operating on a link with R bps. How much throughput would you expect for each?

Exercise 4 (*Optical Network*)

In optical networks,

    a. Explain the basic functionality of BAIMD scheme

    b. Mention the most important performance problem that face TCP over optical wavelength networks

    c. What would be the main technical problem that faces implementing OPS

    d. If you to re-design the optical backbone network, which technology would you use? And why?

    e. Mention one problem induced when dropping-based TCPs run over optical burst switched networks.