

ELEC 331 Computer Communications

Problem Set 1

Due Date: Monday morning, September 23, 2024, at 9 am

Please “type” your answers and upload as a PDF document to UBC Canvas

Problem 1: Go to IETF’s website (<https://www.ietf.org/>) to see what they are doing. Select a project you are interested in and write a half-page summary on the problem and the proposed solution.

Problem 2: Suppose a 1 Gbps point-to-point link is being set up between the Earth and a new lunar colony. The distance from the moon to the Earth is approximately 385,000 km, and data travels over the link at the speed of light – 3×10^8 m/s.

- (a) Calculate the minimum round trip time (RTT) for the link.
- (b) Using the RTT as the delay, calculate the bandwidth \times delay product for the link.
- (c) What is the significance of the bandwidth \times delay product computed in (b)?
- (d) A camera on the lunar base takes pictures of the Earth and saves them in digital format to disk. Suppose Mission Control on Earth wishes to download the most current image, which is 25 mega bytes (MB). What is the minimum amount of time that will elapse between when the request for the data goes out and the transfer is finished?

Problem 3: Assume you wish to transfer an F bytes (B) file along a path composed of the source, destination, 6 point-to-point links, and 5 switches. Suppose each link has a propagation delay of 2 millisecond (ms) and a bandwidth of 4 mega bits per second (Mb/s). Each switch supports both circuit switching and packet switching.

For packet switching, the file is divided into packets. Each packet has 24 bytes of packet header information and 1 kilo bytes (kB) of payload. The store-and-forward packet processing at each switch incurs a 1 ms delay after the packet has been completely received. Packets can be sent continuously without waiting for acknowledgements. The file size is assumed to be a multiple of 1000 bytes.

For circuit switching, a circuit first needs to be setup through the switches. The file is then sent as one contiguous bitstream. For circuit setup, the source first needs to send a 1024-byte “connection request” message. If all the intermediate switches accept the request, then the destination will send a 1024-byte “connection reply” message to the source. Each switch incurs a 1 ms processing delay after either the “connection request” or “connection reply” message has been completely received. Assume switches introduce no delay to data traversing a circuit.

- (a) For what file size F (in bytes) is the total number of bytes sent across the network by using circuit switching to be smaller than the number of bytes sent across the network by using packet switching?
- (b) For what file size F (in bytes) is the total delay incurred before the entire file arrives at the destination by using circuit switching to be lower than the total delay incurred by using packet switching?

Problem 4: Question P18 from the eText (Kurose and Ross, 8th edition), p. 72.

Problem 5: Question P22 from the eText (Kurose and Ross, 8th edition), p. 73.