

Assignment #002

In the following 5 questions, we are sending a 30×10^6 bits MP3 file from a source host to a destination host. All links in the path between source and destination have a transmission rate of 10 Mbps. Assume that the propagation speed is 2×10^8 meters/second, and the distance between source and destination is 10,000 km.

1) Initially suppose there is only one link between source and destination.

Also suppose that message switching is used, with the message consisting of the entire MP3 file. Please calculate the transmission time (i.e. *TRANSP*) and the end-to-end delay (i.e. latency).

Answer:

$$L = 30 \times 10^6 \text{ bits}, R = 10 \text{ Mbps}, v = 2 \times 10^8 \text{ m/s}, d = 10000 \text{ km}$$

$$TRANSP = L/R = 3s, \quad PROP = d/v = 0.05s$$

$$latency = TRANSP + PROP = 3.05s$$

2) Referring to the above question, how many bits will the source have transmitted when the first bit arrives at the destination?

Answer:

$$PROP \times R = 0.05s \times 10 \text{ Mbps} = 0.5 \text{ Mbits}$$

3) Now suppose there are two links between source and destination, with one router connecting the two links. Each link is 5,000 km long. Again

suppose the MP3 file is sent as one message. Suppose there is no congestion, so that the message is transmitted onto the second link as soon as the router receives the entire message. Please calculate the end-to-end delay (i.e. latency) .

Answer:

$$d_1 = d_2 = 5000km$$

$$TRANSP_1 = TRANSP_2 = 3s$$

$$PROP_1 = d_1/v = PROP_2 = d_2/v = 0.025s$$

$$latency = TRANSP_1 + TRANSP_2 + PROP_1 + PROP_2 = 6.05s$$

4) Now suppose that the MP3 file is broken into 3 packets, each of 10×10^6 bits. Ignore headers that may be added to these packets. Also ignore router processing delays. Assuming store and forward packet switching at the router, Please calculate the total delay (i.e. latency).

Answer:

原来的一个文件分成3份，每份大小为原来的三分之一，则就每份来说，其TRANSP为原来的三分之一，即1s。而传播时延仍为每段0.025s。第一份packet不需等待，其latency=2.05s。第二份在1s后开始传输，第三份在2s后开始传输，则总的latency=2s+2.05s=4.05s。

5) Now suppose there is only one link between source and destination, and there are 10 FDMA (frequency division multiple access) channels

in the link. The MP3 file is sent over one of the channels. Please calculate the end-to-end delay (i.e. latency).

Answer:

$$R' = R/10 = 1Mbps$$

$$TRANSP' = L/R' = 30s, \quad PROP = d/v = 0.05s$$

$$latency' = TRANSP' + PROP = 30.05s$$

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