COMP 431 Internet Protocols & Services

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1) Consider a client computer on the East coast of the United States and a server on the West coast. Assume there is a single 5,000 *km*, 2 Mbps network link that interconnects these computers. The client generates a 1,500 byte request for the server and transmits this request is a single network packet. The server receives the request, processes the request, and generates a 1,500 byte response that it transmits back to the client. Assume the server requires 20 *ms* process the request and generate its response and that the propagation speed on the link is 2.5x108 *m/s*.

*a*) Compute the delay between the generation of the request at the client and the receipt of the server’s response at the client.

**Total propagation delay: 10000000 / 250000000 = .04 seconds**

**Total transmission delay = 24000 bits / 2000000 bps = .012 seconds**

**Response delay = .02 seconds**

**Total delay = .072 seconds**

*b*) Assume the link between the client and the server is upgraded to a 1 Gbps link. What effect does this upgrade have on the value you computed in part (*a*)? What effect would upgrading the link to 10 Gbps have?

**1 Gbps:**

**Total propagation delay: 10000000 / 250000000 = .04 seconds**

**Total transmission delay = 24000 bits / 1000000000 bps = .000024 seconds**

**Response delay = .02 seconds**

**Total delay = .060024 seconds**

**17% increase**

**10 Gbps:**

**Total propagation delay: 10000000 / 250000000 = .04 seconds**

**Total transmission delay = 24000 bits / 10000000000 bps = .0000024 seconds**

**Response delay = .02 seconds**

**Total delay = .0600024 seconds**

**Still only a 17% increase**

*c*) Assume the link remains at 2 Mbps but the server is replaced with a newer model that is twice as fast as the existing server. What effect does this upgrade have on the value you computed in part (*a*)?

**Twice as fast server:**

**Total propagation delay: 10000000 / 250000000 = .04 seconds**

**Total transmission delay = 24000 bits / 2000000 bps = .012 seconds**

**Response delay = .01 seconds**

**Total delay = .062 seconds**

**(72 – 62) / 72 = .139 (14% increase)**

*d*) Assume the original server is moved to the East coast such that the (2 Mbps) network link between the client and the server is now only 50 *km* in length. What effect does this change have on the value you computed in part (*a*)?

**Total propagation delay: 10000000 / 250000000 = .0004 seconds**

**Total transmission delay = 24000 bits / 2000000 bps = .012 seconds**

**Response delay = .02 seconds**

**Total delay = .0324 seconds**

**~56% decrease in delay**

*e*) Assume the same scenario as in part (*a*) but that now there are 10 network switches on the network link between the client and the server. What effect does this change have on the value you computed in part (*a*)?

**Total propagation delay: 10000000 / 250000000 = .04 seconds**

**Total transmission delay = 24000 bits / 2000000 bps \* 12 (because of 10 switches) = .12 seconds**

**Response delay = .02 seconds**

**Total delay = .192 seconds**

**(72 – 192) / 72 = -167%**

2) Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of *R* = 2 *Mbps*. Suppose the propagation speed over the link is 2.5 x 108 *m/s*.

*a*) Calculate the value *R* x *dprop*. This expression is called the *bandwidth-delay product*,

*bdp = 2 Mbps \* 20,000,000 m / 2.5e8 m/s = = 160000 bits*

*b*) Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one large message. What is the maximum number of bits that will be in the link at any given time?

*160,000 bits*

*c*) What does the bandwidth-delay product represent (intuitively)?

The carrying capacity of the link

*d*) What is the width (in meters) of a bit in the link? Is it longer than a football field?

*20000000 m / 160000 bits = 125 m - yes*

*e*) Derive a general expression for the width of a bit in terms of the propagation speed *s*, the transmission rate *R*, and the length of the link *m*.

width of a bit = distance/bdp = distance/(bandwitch \* delay), thus delay = d/s, or speed/bandwidth

# Submitting Your Worksheet

You should upload your worksheet to your *comp431/submissions/worksheets* directory on Linux *before* 5PM. Refer to the procedure described in Worksheet 1 for instructions. Be sure to name your worksheet with your login name, a hyphen, and the worksheet number (*e.g.*, if I were submitting the worksheet I’d name it *jeffay-2.docx*). Remember that the worksheets are not graded so don’t be nervous about submitting an incomplete solution.