COMP 556 Project 1

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Measurement

Method

In this project we aim to measure the data and bandwidth independent delay between two clear servers as well as the underlying bandwidth of the network link. The naive way to approximate the bandwidth described in the handout is not accurate because it does not take bandwidth independent delay into account. Therefore, we propose the following method to calculate the bandwidth independent delay and the approximation of bandwidth.

To implement our estimator under the constraints of the ping pong model we basically cloned our client.c into a separate file called measurement.c that supported sending ping pong messages over a range of sizes.

1. We send two messages through the ping-pong client and server. Denote their length as l_1 bytes and l_2 bytes. We let l_1 to be very small and l_2 to be large. We measure the latencies to transfer between client and server twice. Denote the latencies as t_1 and t_2.
2. Since the bandwidth independent delay is independent of the size of the data we transmit, we assume that it is a constant time value, no matter how much data we send. Then, $\Delta t = t_2 - t_1$ is the bandwidth dependent delay of transmitting $l_2 - l_1$ bytes twice. Note that $l_2 - l_1$ effectively cancels out the data independent delay and we get an estimation of data dependent bandwidth.
3. Therefore, $BW_{true} = \frac{(l_2 - l_1) * 8 * 2}{t_2 - t_1}$ is the true bandwidth of the network link based on our above assumption.
4. To get a closer approximation of the bandwidth independent delay, we first calculate the bandwidth dependent delay for l_1. The delay is $\frac{l_1}{BW}$. Then the bandwidth independent delay is $t_1 - \frac{l_1 * 8 * 2}{BW}$.
5. We average the latencies of 50 runs to get the final result.

Measurement and Result

We send 500 messages per run, and average over 50 runs. The size of the message start from 10 bytes, and the step size between two consecutive messages is $(65535 - 10)/500$. This is to make sure the size of the last message does not exceed 65535 bytes. The average latencies is shown in fig. 1. We can see that when the data size is very small, it still takes around 0.1 ms to transmit, which is due to the bandwidth independent delay. When the data size grows, the latency is also increasing because of the bandwidth dependent delay.

We choose two messages that represent the trend to calculate the bandwidth, i.e. $l_1 = 260$ bytes, $l_2 = 65379$ bytes, $t_1 = 0.086$ ms, $t_2 = 0.296$ ms. Then the true bandwidth is 4961447619 bps, which is about 4.96 Gbps.

Then, the bandwidth independent delay is $0.086 - 260 * 8 * 2/BW = 0.08516$ms. As we can see, it is very close to the latency of transmitting small amount of data. This is expected as the data becomes smaller the entire transmission overhead for transporting such a packet over the network should converge to the data independent delay.

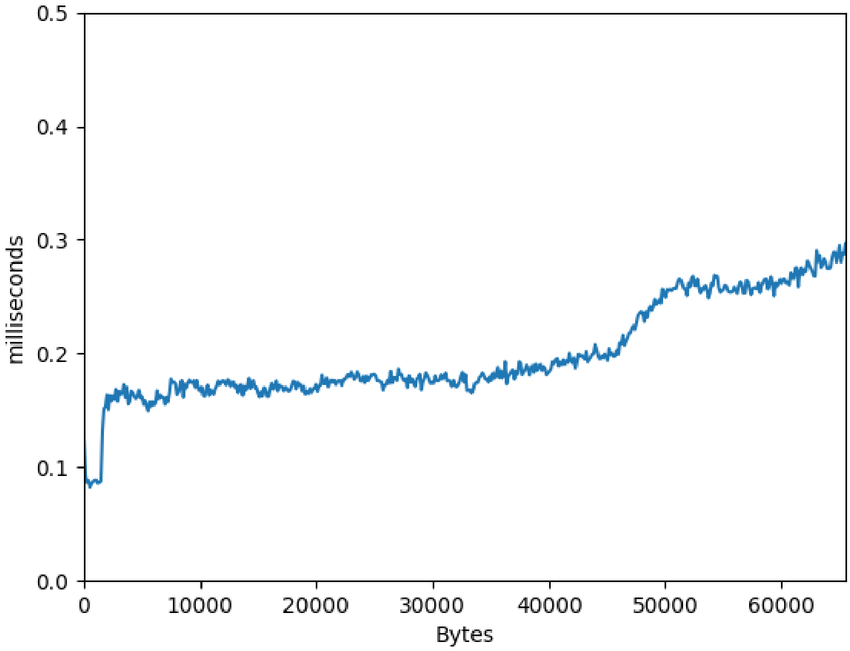

Figure 1: The latencies of sending messages back and forth between the client and the server.