Part III Measurement

March 2021

(We take this part as optional for COMP429.)

Our measurement method involves analyzing code to find what are possible sources of delay that are irrelevant to network bandwidth, measuring average ping-pong message time delay, and estimating network bandwidth.

After measuring the network's performance in transmitting ping-pong messages, the client and server send/receive a special message that contains only one byte data for the same times as the ping-pong program (this message differs from the ping-pong message in size so that we can treat this special message as speed testing message). The latency of each exchange is computed by wrapping two $gettimeofday$ around send/recv functions in the client program, and equals $(endtime.tv\_sec - starttime.tv\_sec) * 1000000L + (endtime.tv\_usec - starttime.tv\_usec)$. We then compute the average latency of the exchanges of the special message by dividing the total latency by the number of exchanges. Given the formula of computing latency (y) based on datasize (x), bandwidth ($\frac{1}{k}$), and independent delay (b), we are able to derive the values of k and b with both the average latency of the two messages and the two data sizes known. Let y_1 be the average latency of the special message, y_2 be the average latency of the ping-pong message, x_1 be the size of the special message, namely 1, x_2 be the total size of the ping-pong message. $k = \frac{y_1 - y_2}{x_1 - x_2}$, and $b = y_1 - kx_1 = y_1 - k = y_1 - \frac{y_1 - y_2}{x_1 - x_2} = y_1 - \frac{y_1 - y_2}{1 - x_2}$. Thus, the independent delay equals $y_1 - \frac{y_1 - y_2}{1 - x_2}$, and the bandwidth equals $\frac{1 - x_2}{y_1 - y_2}$. The specific value of independent delay of our program is 0.045 milliseconds, and the value of bandwidth is 1265.436 Mbps.

A few points worth noting:

1. In order for a precise measurement, we reduce system calls to minimum.

2. The speed of TCP transmission is normally slow at first. As the number of transmissions increments, the speed increases drastically until it reaches the maximal value. Thus, to measure the test speed practically and accurately, we place the test speed block after the ping-pong message transmission.

3. We choose the size of the special message to be less than 10 in order to differentiate test messages from ping-pong messages.

4. The number of message exchanges to perform is a "control variable". The client and the server performs the transmission of the special message for the

same times as the ping-pong program as the "independent variable" narrows to datasize.