CS536 Project 1

September 23, 2014 Long Zhen

A. Data Rates vs. File Size

File Size	T_x	R_x
1 KB	17	431
100 KB	336	554
500 KB	497	487
10 MB	611	582
20 MB	556	537
30 MB	390	384
40 MB	424	419
50 MB	442	448
60 MB	465	459
70 MB	544	537

Table 1: Fixed 1000-Byte Package Size File Transmission Table, Unit: bits/microsec

- Observation: When the file size is less than 500 KB (In other words, when files are small), $T_x < R_X$. As the file is becoming larger and larger (Especially, larger than 500 KB), $T_x \approx R_x$. T_x is just slightly larger than R_x.
- I just expect $T_x \approx R_x$. And R_x should be slightly smaller than T_x because of the network delays.
- I agree with the measurements. I think I forget to consider about the effects of file I/O. When the file is very small, the file I/O overhead could be significant because of the disk rotation delay and seeking delay.

  Example 1 *The program needs to read 1 KB file from disk,* $T_{total} = T_{seek} + T_{rotate} + T_{read}$. *When the program needs to read 10 KB file from disk, the data is highly likely to be contiguous. Therefore,* $T_{total2} = T_{seek} + T_{rotate} + 10T_{read}$. *As we know that, comparing to* T_{read}, $T_{seek} + T_{rotate}$ *are usually very large. That is why the speed rate will become slow. As the file becomes larger, the average speed rate will be stable. For instance, every 100 KB there is one* $T_{seek} + T_{rotate}$.

B. Data Rates vs. Packet Size

Packet Size	T_x	R_x
30 Bytes	305	304
100 Bytes	440	436
300 Bytes	580	572
500 Bytes	582	572
700 Bytes	580	572
900 Bytes	578	572
1100 Bytes	582	572
1300 Bytes	580	573
1400 Bytes	580	573

Table 2: Fixed 50-MB File Size File Transmission Table, Unit: bits/microsec

- Observation: At the beginning of the experiment, with the package size increasing, both T_x and R_x are increasing too. However, at some point, no matter how the package size is increased, both rates are nearly constant.
- This is exactly what I expect. Since the file being sent is the same (same size), the file I/O overheads should be exactly identical. The only different is the network delays. Considering the experiment environment is the XINU lab, all the workstations should have very similar environment. The propagation delay (depending on distance) and transmission delay (depending on bandwidth) should be very similar. Therefore, the performance depends on processing and queuing delays. If the package size is too small, the program has to frequently rewrite the buffer, which will increase processing delay. Also, if the buffer is small, the average package arriving rate may increase, which may also increase a little bit of total delay. However, it is not true that "the larger package size is, the better data rate is". Because if the package size is large, the program has to wait for the buffer writing completion to process it. At some point, when the balanced is reached, the performance will not become better with the package size increasing.
- I agree with the measurements.

Data Rates vs. Load Variations

Connection Number	Average T_x	Average R_x
1	578	571
2	443	438
3	434	431
4	378	377
5	285	273

Table 3: Fixed Package and File Size with Multiple Transfers, Unit: bits/microsec

- Observation: As the number of simultaneous connections become bigger, both data rates are decreasing.
- This is exactly what I expect. Both file size and package size are fixed. Therefore, file I/O overhead and processing delay will become very similar or nearly identical. The difference here is queuing delay. Since the bandwidth of the workstation is fixed, with the number of simultaneous connections increasing, at each given time, the bandwidth each thread can get will surely decrease. Therefore, some of packets are going into waiting queues. The queuing delay will increase. The average data transfer rate will decrease (However, due to the scheduling and some other factors, some thread may have higher rate. For example, in the experiment of 3 simultaneous connections, T_x are 260, 578, 466).
- I agree with the measurements.

D&E. iperf Network Bandwidth Measure and Analysis

Connection Number	Bandwidth	Average Bandwidth
1	571	571
2	275, 343	309
3	285, 399, 215	299
4	244, 203, 206, 257	227
5	222, 133, 148, 123, 191	163

Table 4: iperf Network Bandwidth Measurements

- The result is the same as what I get from section VI-C. When there are multiple clients are connecting the server at the same time, because of the fixed physical bandwidth, the workstation can still send the fixed number of packets. However, there are packets from multiple threads. So each thread can only send partial packets. The rest packets are going into the waiting queue. It just looks like those threads are sharing the bandwidth.