Cpt S 411

**Assignment #:** PA1

**Participants:**

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I certify that I have listed above all the sources that I consulted regarding this assignment, and that I have not received or given any assistance that is contrary to the letter or the spirit of the collaboration guidelines for this assignment. I also certify that I have not referred to online solutions that may be available on the web or sought the help of other students outside the class, in preparing my solution. I attest that the solution is my own and if evidence is found to the contrary, I understand that I will be subject to the academic dishonesty policy as outlined in the course syllabus.

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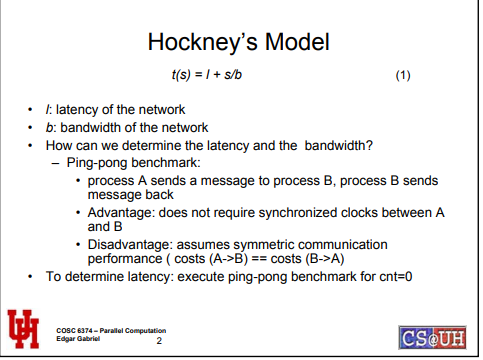
# Blocking Data

|  |  |  |
| --- | --- | --- |
| Message Size(Bytes) | Send Avg | Recv Avg |
| 1 | 20 | 19.4 |
| 2 | 20 | 19.4 |
| 4 | 20 | 19.2 |
| 8 | 20 | 19.8 |
| 16 | 20.1 | 19.6 |
| 32 | 20 | 19.8 |
| 64 | 20 | 19.5 |
| 128 | 20 | 19.6 |
| 256 | 20.1 | 19.6 |
| 512 | 20 | 19.2 |
| 1024 | 20 | 19.7 |
| 2048 | 20 | 19.6 |
| 4096 | 19.8 | 20.1 |
| 8192 | 19.6 | 20 |
| 16384 | 19.7 | 20 |
| 32768 | 20.1 | 20.1 |
| 65536 | 20 | 21 |
| 131072 | 20 | 21 |
| 262144 | 20.5 | 22 |
| 524288 | 21.6 | 24.9 |
| 1048576 | 25.4 | 29.1 |
| 2097152 | 33.2 | 38.2 |

# Non Blocking Data

|  |  |  |
| --- | --- | --- |
| Message Size(Bytes) | Send Avg | Recv Avg |
| 1 | 20 | 19.5 |
| 2 | 20 | 19.4 |
| 4 | 20 | 19.3 |
| 8 | 20 | 19.4 |
| 16 | 20.1 | 19.6 |
| 32 | 20 | 19.7 |
| 64 | 20 | 19.5 |
| 128 | 20 | 19.3 |
| 256 | 20 | 19.5 |
| 512 | 20 | 19.4 |
| 1024 | 20 | 19.8 |
| 2048 | 20.1 | 19.5 |
| 4096 | 19.6 | 20 |
| 8192 | 19.5 | 20 |
| 16384 | 20 | 20 |
| 32768 | 20 | 21 |
| 65536 | 20 | 21 |
| 131072 | 20.3 | 22 |
| 262144 | 20.4 | 22 |
| 524288 | 21.9 | 25 |
| 1048576 | 25.4 | 29 |
| 2097152 | 33.2 | 38.1 |

# Derivation

To derive the latency, and bandwidth of a network the Hockney Model is used. 

If we look at the data that we plotted above we know that all tests have a fixed cost of ~19ms when sending a message. If we take that fixed cost and plug it into the model as the latency, we will be able to use the formula to determine what the bandwidth of the network is for each message size.

## Blocking Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Message Size(Bytes) | Send Avg w/out latency(ms) | Recv Avg w/out latency(ms) | Send(byte/ms) | Receive (Byte/ms) |
| 1 | 1 | 0.4 | 1 | 2.5 |
| 2 | 1 | 0.4 | 2 | 5 |
| 4 | 1 | 0.2 | 4 | 20 |
| 8 | 1 | 0.8 | 8 | 10 |
| 16 | 1.1 | 0.6 | 14.54545 | 26.66667 |
| 32 | 1 | 0.8 | 32 | 40 |
| 64 | 1 | 0.5 | 64 | 128 |
| 128 | 1 | 0.6 | 128 | 213.3333 |
| 256 | 1.1 | 0.6 | 232.7273 | 426.6667 |
| 512 | 1 | 0.2 | 512 | 2560 |
| 1024 | 1 | 0.7 | 1024 | 1462.857 |
| 2048 | 1 | 0.6 | 2048 | 3413.333 |
| 4096 | 0.8 | 1.1 | 5120 | 3723.636 |
| 8192 | 0.6 | 1 | 13653.33 | 8192 |
| 16384 | 0.7 | 1 | 23405.71 | 16384 |
| 32768 | 1.1 | 1.1 | 29789.09 | 29789.09 |
| 65536 | 1 | 2 | 65536 | 32768 |
| 131072 | 1 | 2 | 131072 | 65536 |
| 262144 | 1.5 | 3 | 174762.7 | 87381.33 |
| 524288 | 2.6 | 5.9 | 201649.2 | 88862.37 |
| 1048576 | 6.4 | 10.1 | 163840 | 103819.4 |
| 2097152 | 14.2 | 19.2 | 147686.8 | 109226.7 |

Looking at the table of calculations above the network bandwidth seemed to range from 1byte/ms -201,649 bytes/s. However, if we drop all the data that had a send/recv time that is less than 1ms we get a much more focused range of 29789 bytes/ms – 201,649 bytes/ms. This data also leads to a conclusion that the network buffer size is somewhere between 32,768 Bytes – 65,536 Bytes because this is the first jump in time we get when we look at average send/receive time without latency included.

**Latency:** 19ms

**Network Bandwidth:** 29789 bytes/ms – 201,649 bytes/ms.

**Network Buffer:** 32,768 Bytes – 65,536 Bytes

## Non-Blocking Data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Message Size(Bytes) | Send Avg w/out latency(ms) | Recv Avg w/out latency(ms) | Send(byte/ms) | Receive (Byte/ms) |
| 1 | 1 | 0.5 | 1 | 2 |
| 2 | 1 | 0.4 | 2 | 5 |
| 4 | 1 | 0.3 | 4 | 13.33333 |
| 8 | 1 | 0.4 | 8 | 20 |
| 16 | 1.1 | 0.6 | 14.54545 | 26.66667 |
| 32 | 1 | 0.7 | 32 | 45.71429 |
| 64 | 1 | 0.5 | 64 | 128 |
| 128 | 1 | 0.3 | 128 | 426.6667 |
| 256 | 1 | 0.5 | 256 | 512 |
| 512 | 1 | 0.4 | 512 | 1280 |
| 1024 | 1 | 0.8 | 1024 | 1280 |
| 2048 | 1.1 | 0.5 | 1861.818 | 4096 |
| 4096 | 0.6 | 1 | 6826.667 | 4096 |
| 8192 | 0.5 | 1 | 16384 | 8192 |
| 16384 | 1 | 1 | 16384 | 16384 |
| 32768 | 1 | 2 | 32768 | 16384 |
| 65536 | 1 | 2 | 65536 | 32768 |
| 131072 | 1.3 | 3 | 100824.6 | 43690.67 |
| 262144 | 1.4 | 3 | 187245.7 | 87381.33 |
| 524288 | 2.9 | 6 | 180789 | 87381.33 |
| 1048576 | 6.4 | 10 | 163840 | 104857.6 |
| 2097152 | 14.2 | 19.1 | 147686.8 | 109798.5 |

Once again if we take out an average latency of 19ms we can get our real send/receive averages that each message size took. Using this “real” time I we are able to calculate an average Network Bandwidth of 1byte/ms-187,245bytes/ms. If we look at the data we can find a drop off in the “actual” send time of a message around a message size of 16,384-65,536 Bytes. This would suggest that somewhere in that range of messages sizes we would find the network buffer size. If we only use the data from this point onward to calculate the bandwidth, we get a range of 16,384 bytes/ms - 187,245 bytes/ms.

**Latency:** 19ms

**Network Bandwidth:** 16,384 bytes/ms - 187,245 bytes/ms.

**Network Buffer:** 16,384 Bytes - 65,536 Bytes