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| Assignment 2: Susmita Mondal (20310071) | | | | | | | | |
| Client-server programming (TCP and UDP Sockets) | | | | | | | | |
| Prerequisite 1 and 2 (a &b [“truncate” is used and the size is verified]) is done and a test file named Test.txt (10 KB) has been created. | | | | | | | | |
| 3) To evaluate the following aspects, the Table has been created | | | | | | | | |
| **File Name** | **Original File Size** | **TCP Connection Time Taken (Seconds)** | **UDP Connection**  **Time Taken (Seconds)** | **TCP Connection Throughput (KB/s)** | **UDP Connection Throughput (KB/s)** | **Remarks** | **TCP Connection Received File Size** | **UDP Connection Received File Size** |
| Anthem.txt | 127.8 KiB (130,855 bytes) | |  | | --- | | 0.0025 | | 0.0005 | | 0.0032 | | Avg. = 0.0011 | | |  | | --- | | 0.0025 | | 0.0027 | | 0.1622 | | Avg. = 0.0558 | | |  | | --- | | 49847.992 | | 216055.15 | | 38882.671 | | Avg. = 86640.94 | | |  | | --- | | 47.556 | | 47.551 | | 44.043 | | Avg. = 46.38 | |  | |  | | --- | | 127.8 KiB | | No Change | | |  | | --- | | 93.0 KiB | | 27% Less Size | |
| Candide.txt | 224.4 KiB (229,736 bytes) | |  | | --- | | 0.0048 | | 0.0009 | | 0.0010 | | Avg. = 0.0022 | | |  | | --- | | 0.0408 | | 0.0028 | | 0.0025 | | Avg. = 0.0154 | | |  | | --- | | 47155.802 | | 229611.617 | | 218107.611 | | Avg. = 164958.34 | | |  | | --- | | 103.034 | | 114.704 | | 114.719 | | Avg. = 110.82 | |  | |  | | --- | | 224.4 KiB | | No Change | | |  | | --- | | 205.4 KiB) | | 224.4 KiB | | Avg. = 214.9 KiB [4% to 8% Less Size] | |
| Carmilla.txt | 176.7 KiB (180,908 bytes) | |  | | --- | | 0.0044 | | 0.0010 | | 0.0014 | | Avg. = 0.0023 | | |  | | --- | | 0.0026 | | 0.0051 | | 0.0064 | | Avg. = 0.0047 | | |  | | --- | | 40362.785 | | 165118.883 | | 125567.15 | | Avg. = 110349.61 | | |  | | --- | | 47.553 | | 47.494 | | 47.462 | | Avg. = 47.50 | |  | |  | | --- | | 176.7 KiB | | No Change | | |  | | --- | | 93.0 KiB | | 47% Less Size | |
| Dracula.txt | 860.8 KiB (881,473 bytes) | |  | | --- | | 0.0091 | | 0.0037 | | 0.0064 | | Avg. = 0.0064 | | |  | | --- | | 0.0099 | | 0.0050 | | 0.0053 | | Avg. = 0.0067 | | |  | | --- | | 95974.429 | | 234802.103 | | 135716.927 | | Avg. = 155497.82 | | |  | | --- | | 297.428 | | 156.185 | | 224.58 | | Avg. = 220.06 | |  | |  | | --- | | 860.8 KiB | | No Change | | |  | | --- | | 583.8 KiB | | 305.8 KiB | | 439.8 KiB | | Avg. = 443.13 KiB [32% to 64% Less Size] | |
| Leviathan.txt | 1.2 MiB (1,254,930 bytes) | |  | | --- | | 0.0095 | | 0.0051 | | 0.0056 | | Avg. = 0.0067 | | |  | | --- | | 0.0225 | | 0.0181 | | 0.0153 | | Avg. = 0.0186 | | |  | | --- | | 130853.515 | | 243640.913 | | 221666.384 | | Avg. = 198720.27 | | |  | | --- | | 467.074 | | 396.54 | | 475.834 | | Avg. = 446.48 | | Largest of the 5 Files | |  | | --- | | 1.2 MiB | | No Change | | |  | | --- | | 922.5 KiB | | 781.5 KiB | | 936.5 KiB | | Avg. = 880.17 KiB [23% to 36% Less Size] | |
| Test.txt | 10.0 KiB (10,240 bytes) | |  | | --- | | 0.0009 | | 0.0003 | | 0.0007 | | Avg. = 0.0006 | | |  | | --- | | 0.0061 | | 0.0026 | | 0.0137 | | Avg. = 0.0075 | | |  | | --- | | 8417.378 | | 22590.229 | | 10690.647 | | Avg. = 13899.42 | | |  | | --- | | 5.104 | | 5.113 | | 5.085 | | Avg. = 5.101 | | Smallest of the 5 Files | |  | | --- | | 10.0 KiB | | No Change | | |  | | --- | | 10.0 KiB | | No Change | |

* 1. Time comparison

|  |  |  |  |
| --- | --- | --- | --- |
| File Name | TCP | UDP | Remarks |
| Leviathan.txt - Largest of the 5 Files | 0.0067 Seconds | 0.0186 Seconds | TCP is faster in both the cases compared to UDP connection. |
| Test.txt (10 KB) | 0.0006 Seconds | 0.0075 Seconds |

* 1. Achieved throughput comparison:

|  |  |  |  |
| --- | --- | --- | --- |
| File Name | TCP | UDP | Remarks |
| Anthem.txt | 86640.94 KB/s | 46.38 KB/s | TCP connection has better throughput in all the cases compared to UDP connection. |
| Candide.txt | 164958.34 KB/s | 110.82 KB/s |
| Carmilla.txt | 110349.61 KB/s | 47.50 KB/s |
| Dracula.txt | 155497.82 KB/s | 220.06 KB/s |
| Leviathan.txt | 198720.27 KB/s | 446.48 KB/s |
| Test.txt | 13899.42 KB/s | 5.101 KB/s |

* 1. File size comparison:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| File Name | Original Size | TCP | UDP | Remarks |
| Anthem.txt | 127.8 KiB | 127.8 KiB | 93.0 KiB [27% Less Size] | TCP connection has no change in the file sizes for all the cases. But UDP connection file transfer has some amount of difference in the sizes for all the files. |
| Candide.txt | 224.4 KiB | 224.4 KiB | 214.9 KiB [4-8% Less Size] |
| Carmilla.txt | 176.7 KiB | 176.7 KiB | 93.0 KiB [47% Less Size] |
| Dracula.txt | 860.8 KiB | 860.8 KiB | 443.13 KiB [32-64% Less Size] |
| Leviathan.txt | 1.2 MiB | 1.2 MiB | 881.17 KiB [23-36% Less Size] |
| Test.txt | 10 KiB | 10 KiB | 10 KiB [No Change] |

In case of small sized files, in both the cases no data is lost. Less data size can be termed as data loss. In comparison to the original file, there are significant number of differences. The next segment highlights some high-level differences. It is true for every file generated by TCP and UDP connections.

* 1. For the comparison of “wc” and “diff”, I used one TCP and one UDP text file with one original text file for simplicity and the table has been created according to that. But this comparison is possible for every file generated by the TCP and UDP connection.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| File Name = Anthem.txt | TCP (Process ID: 12944) “wc” | UDP (Process ID:15348)  “wc” | TCP (Process ID: 12944) “diff” with the original file | UDP (Process ID:)  “diff” with the original file |
| |  |  | | --- | --- | | “wc” | | | -c  Byte count | 130855 | | -l  Line count | 2535 | | -m  Character count | 130179 | | -w  Word count | 22249 | | |  |  | | --- | --- | | -c | 130855 | | -l | 2535 | | -m | 130179 | | -w | 22249 |   No Change | |  |  | | --- | --- | | -c | 95232 | | -l | 1861 | | -m | 94638 | | -w | 16372 |   Difference is there | No Change | * Context (-c): 1859,2535 * Unified (-u): -1859,677 +1859,4 * Case insensitive (-i): 1862,2535c1862 * Diff: 1862,2535c1862   Difference is there |

TCP file transfer is more reliable than UDP file transfer. No significant difference is there between the original file and the file downloaded by TCP connection. But there is significant number of differences between original file and the file downloaded using a UDP connection.

**Experimentation with socket configurations.**

* File size is 10KB for every experiment = Test.txt
* File size is 10KB for every experiment = Leviathan.txt
* Packet tracing is done by the loop back address in the Wireshark
* To know the difference better, table has been created

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Client Buffer Size | Server Buffer Size | TCP Packet Exchange | UDP Packet Exchange | Original File Size | TCP File Size | UDP File Size | “diff” output for TCP and original file | “diff” output for UDP and original file |
| 2048 Bytes | 1024 Bytes | 18 | 6 | 10 KiB | No Change in File Size | No Change in File Size | No Difference | No Difference |
| 102 | 480 | 1.2 MiB | No Change | 645.0 KiB [Loss] | No Difference | 11044,20693c11044 – Signifies Difference |

B.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Client Buffer Size | Server Buffer Size | TCP Packet Exchange | UDP Packet Exchange | Original File Size | TCP File Size | UDP File Size | “diff” output for TCP and original file | “diff” output for UDP and original file |
| 512 Bytes | 1024 Bytes | 41 | 20 | 10 KiB | No Change in File Size | No Change in File Size | No Difference | No Difference |
| 95 | 2452 | 1.2 MiB | No Change | 572.0 KiB [Loss] | No Difference | 1725,4374c1725– Signifies Difference |

C.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Client Buffer Size | Server Buffer Size | TCP Packet Exchange | UDP Packet Exchange | Original File Size | TCP File Size | UDP File Size | “diff” output for TCP and original file | “diff” output for UDP and original file |
| 2048Bytes | 512 Bytes | 30 | 21 | 10 KiB | No Change in File Size | No Change in File Size | No Difference | No Difference |
| 88 | 2453 | 1.2 MiB | No Change | 808.0 KiB [Loss] | No Difference | 22002,23001c14828– Signifies Difference |

D.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Client Buffer Size | Server Buffer Size | TCP Packet Exchange | UDP Packet Exchange | Original File Size | TCP File Size | UDP File Size | “diff” output for TCP and original file | “diff” output for UDP and original file |
| 1024 Bytes | 1024 Bytes | 28 | 11 | 10 KiB | No Change in File Size | No Change in File Size | No Difference | No Difference |
| 930 | 1227 | 1.2 MiB | No Change | No Change | No Difference | No Significant Difference |

* In case of UDP “diff” with original file, it shows more than 1 differences in various places of the files. I have highlighted only 1 of the differences.
* Though TCP takes more packets in case of smaller data, but it provides reliable data transmission without any loss of data.

E. There are 2 possible cases I noticed.

1) If I try to run all the server and client programs concurrently it might run but shows “port unreachable” and received data is of 0 Byte in one of the processes.

2) If I try to run TCP server-client in one window and UDP server-client in another window of the IDLE, it shows “address in use” in one of the processes.

I think it is not possible because it uses loop back address and only 1 process and only one thread which is running occupying the port and address. So, 2 simultaneous operations cannot run together.