**Client-Server Data Transmission Tests**

**Overview**

This document presents the results of a series of tests on client-server data transmission using two protocols (TCP and UDP), two mechanisms (streaming and stop-and-wait), and various message sizes. The goal of the tests was to measure the time to transfer various amounts of data under different conditions.

**Options**

The following options were available for the client and server:

**Protocol**

* **TCP**: A connection-oriented protocol that provides reliable, ordered, and error-checked delivery of data.
* **UDP**: A connectionless protocol that provides unreliable, unordered, and unchecked delivery of data.

**Mechanism**

* **Streaming**: Data is sent continuously without waiting for an acknowledgment from the receiver.
* **Stop-and-wait**: Data is sent one message at a time, and the sender waits for an acknowledgment from the receiver before sending the next message.

## Results

The following tables summarize the results of the tests for each combination of protocol, mechanism, and message size.

# TCP Stop-Wait - 10 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 2.023 | 32264 | 2097152000/2097126003.2 |
| 65000 | 1 GB | 1.073 | 16132 | 1048576000/1048537004.8 |
| 65000 | 500 MB | 0.532 | 8066 | 524288000/524262003.2 |
| 65000 | 100 MB | 0.114 | 1614 | 104857600/104825104.0 |
| 65000 | 10 MB | 0.012 | 162 | 10485760/104823154.24 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 3.829 | 64528 | 2097152000 / 2097119508 |
| 32500 | 1 GB | 1.737 | 32264 | 1048576000 / 1048543508 |
| 32500 | 500 MB | 1.081 | 16132 | 524288000 / 524255508 |
| 32500 | 100 MB | 0.208 | 3227 | 104857600 / 104825108 |
| 32500 | 10 MB | 0.208 | 323 | 10485760 / 10463015.6 |

# TCP Stop-Wait - 100 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 2.201 | 32264 | 2097152000/2097120153.92 |
| 65000 | 1 GB | 1.036 | 16132 | 1048576000/1048532455.36 |
| 65000 | 500 MB | 0.516 | 8066 | 524288000/524250304.64 |
| 65000 | 100 MB | 0.101 | 1614 | 104857600/104823154.24 |
| 65000 | 10 MB | 0.011 | 162 | 10485760/10468862.08 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 3.772 | 64528 | 2097152000 / 2097124706.72 |
| 32500 | 1 GB | 1.746 | 32264 | 1048576000 / 1048546757.2 |
| 32500 | 500 MB | 1.122 | 16132 | 524288000 / 524257457.52 |
| 32500 | 100 MB | 0.198 | 3227 | 104857600 / 104827057.52 |
| 32500 | 10 MB | 0.017 | 323 | 10485760 / 10463665.44 |

# TCP Streaming- 10 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 1.292 | 32264 | 2097152000/2097152000 |
| 65000 | 1 GB | 0.635 | 16132 | 1048576000/1048576000 |
| 65000 | 500 MB | 0.307 | 8066 | 524288000/524288000 |
| 65000 | 100 MB | 0.057 | 1614 | 104857600/104857600 |
| 65000 | 10 MB | 0.005 | 162 | 10485760/10485760 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 1.913 | 64528 | 2097152000/2097152000 |
| 32500 | 1 GB | 0.929 | 32267 | 1048576000/1048576000.4 |
| 32500 | 500 MB | 0.526 | 16132 | 524288000/524288000 |
| 32500 | 100 MB | 0.085 | 3227 | 104857600/104857600 |
| 32500 | 10 MB | 0.010 | 323 | 10485760/10485760 |

# TCP Streaming - 100 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 2.273 | 58238 | 3785359360/3785359360.04 |
| 65000 | 1 GB | 0.993 | 25974 | 1688207360/1688207360.04 |
| 65000 | 500 MB | 0.375 | 9842 | 639631360/639631360.04 |
| 65000 | 100 MB | 0.063 | 1776 | 115343360/115343360 |
| 65000 | 10 MB | 0.005 | 162 | 10485760/10485760 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 3.508 | 116474 | 3785359360/3785359360.52 |
| 32500 | 1 GB | 1.646 | 51952 | 1688207360/1688207360.4 |
| 32500 | 500 MB | 0.634 | 19682 | 639631360/639631360.36 |
| 32500 | 100 MB | 0.116 | 3550 | 115343360/115343360.16 |
| 32500 | 10 MB | 0.018 | 323 | 10485760/10485760 |

# UDP Stop-Wait - 10 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 12.352 | 32264 | 2097152000/2097152004 |
| 65000 | 1 GB | 5.826 | 25974 | 1688207360/1048576004 |
| 65000 | 500 MB | 2.762 | 8066 | 524288000/524288004 |
| 65000 | 100 MB | 0.521 | 1614 | 104857600/104857604 |
| 65000 | 10 MB | 0.055 | 162 | 10485760/10485760 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 22.050 | 64528 | 2097152000/2097152004 |
| 32500 | 1 GB | 10.669 | 32264 | 1688207360/1048576004 |
| 32500 | 500 MB | 5.317 | 16132 | 524288000/524288004 |
| 32500 | 100 MB | 1.181 | 3227 | 104857600/104857604 |
| 32500 | 10 MB | 0.128 | 323 | 10485760/10485760 |

# UDP Stop-Wait - 100 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 20.935 | 58238 | 3785359360/3785359380 |
| 65000 | 1 GB | 9.123 | 25974 | 1688207360/1688207376 |
| 65000 | 500 MB | 3.455 | 9842 | 639631360/639631372 |
| 65000 | 100 MB | 0.591 | 1776 | 115343360/115343368 |
| 65000 | 10 MB | 0.055 | 162 | 10485760/10485760 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 39.214 | 116474 | 3785359360/3785359380 |
| 32500 | 1 GB | 17.104 | 51946 | 1688207360/1688207376 |
| 32500 | 500 MB | 6.441 | 19682 | 639631360/639631372 |
| 32500 | 100 MB | 1.206 | 3550 | 115343360/115343368 |
| 32500 | 10 MB | 0.101 | 323 | 10485760/10485760 |

# UDP Streaming - 10 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 8.746 | 32264 | 2097152000/2097152004 |
| 65000 | 1 GB | 4.331 | 16132 | 1048576000/1048576004 |
| 65000 | 500 MB | 2.160 | 8066 | 524288000/524288004 |
| 65000 | 100 MB | 0.434 | 1614 | 104857600/104857604 |
| 65000 | 10 MB | 0.048 | 162 | 10485760/10485764 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 17.267 | 64528 | 2097152000/2097152004 |
| 32500 | 1 GB | 8.645 | 32264 | 1048576000/1048576004 |
| 32500 | 500 MB | 4.317 | 16132 | 524288000/524288004 |
| 32500 | 100 MB | 0.830 | 3227 | 104857600/104857604 |
| 32500 | 10 MB | 0.082 | 323 | 10485760/10485764 |

# UDP Streaming- 100 Runs

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 65000 | 2 GB | 15.841 | 58238 | 3785359360/3785359380 |
| 65000 | 1 GB | 7.162 | 25974 | 1688207360/1688207376 |
| 65000 | 500 MB | 2.711 | 9842 | 639631360/639631372 |
| 65000 | 100 MB | 0.476 | 1776 | 115343360/115343368 |
| 65000 | 10 MB | 0.044 | 162 | 10485760/10485764 |

| **Buffer** | **Message Size** | **Elapsed Time** | **Number of Messages** | **Sent/Received Bytes** |
| --- | --- | --- | --- | --- |
| 32500 | 2 GB | 30.842 | 116474 | 3785359360/3764492717.6 |
| 32500 | 1 GB | 13.794 | 51946 | 1688207360/1677826473.6 |
| 32500 | 500 MB | 5.146 | 19682 | 639631360/634493349.6 |
| 32500 | 100 MB | 0.905 | 3550 | 115343360/114399649.6 |
| 32500 | 10 MB | 0.083 | 323 | 10485760/10485764 |

**Conclusion**

The choice of protocol and mechanism can have a significant impact on the time to transfer data over a network, especially for different message sizes. In general, TCP Streaming provides the fastest transmission times for all scenarios. UDP Stop-and-Wait mechanism are significantly slower than UDP Streaming mechanism for all message sizes. The results of these tests can be used to inform decisions about the appropriate protocol and mechanism to use for different types of data transmission scenarios based on the written code.