Feature Demonstrations

Below is a breakdown of all functionality implemented in the network-emulator project.

Sequence & Acknowledgment Numbers

Sequence numbers are implemented with hard-coded values starting at 500 on the server side, and 0 on the client side. Sequence numbers are incremented based on the size of the data it is carrying which is counted by number of characters. The emulator uses single repeat style of acknowledgments where every packet is acknowledged, and every packet in the window has a timer. Duplicate Acknowledgements are noted in the emulator but are simply dropped as the window size settings are static in the simulation

Sequence Numbers from the Client Side

```
/usr/lib/jvm/java-1.8.0-openjdk-1.8.0.65-3.b17.fc22.x86_64/bin/java ...
Connected to the target VM, address: '127.0.0.1:43509', transport: 'socket'
Client - Creating Socket
TCPEngine - Attempting to connect to localhost on port 8000
TCPEngine - Creating Client input and output socket buffers
Client - Socket Created
Client - Creating Listener Thread
Client - Listening Thread Created
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 0
PacketBuilder - Sending Packet Seq: 0 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: 5
WindowManager - Window Has Room. Size: 6. Slots taken: 0
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 1
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 1
PacketBuilder - Sending Packet Seq: 200 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: 4
WindowManager - Window Has Room. Size: 6. Slots taken: 1
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 2
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 2
PacketBuilder - Sending Packet Seq: 400 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: 3
WindowManager - Window Has Room. Size: 6. Slots taken: 2
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 3
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 3
PacketBuilder - Sending Packet Seq: 600 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: 2
WindowManager - Window Has Room. Size: 6. Slots taken: 3
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 4
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 4
PacketBuilder - Sending Packet Seq: 800 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: 1
WindowManager - Window Has Room. Size: 6. Slots taken: 4
```

Sequence Number & Acknowledgement Numbers Returned on the Server Side

```
ServerSocketListener - Recieved A Packet: Seq: 400 Ack: 500 PacketType: 100 Sender: [Client] Recipient: [Server] WindowSize: 3
PacketBuilder - Sending Packet Seq: 500 Ack: 400 Type: 200 Src: [Server] Dst: [Client] WindowSize: 5
DataAssembler - Adding Packet
DataAssembler - Returning Status of EOT. It is: false
ServerSocketListener - Recieved A Packet: Seq: 200 Ack: 500 PacketType: 100 Sender: [Client] Recipient: [Server] WindowSize: 4
PacketBuilder - Sending Packet Seq: 500 Ack: 200 Type: 200 Src: [Server] Dst: [Client] WindowSize: 5
DataAssembler - Adding Packet
DataAssembler - Returning Status of EOT. It is: false
ServerSocketListener - Recieved A Packet: Seq: 1000 Ack: 500 PacketType: 100 Sender: [Client] Recipient: [Server] WindowSize: 0
PacketBuilder - Sending Packet Seq: 500 Ack: 1000 Type: 200 Src: [Server] Dst: [Client] WindowSize: 5
DataAssembler - Adding Packet
DataAssembler - Returning Status of EOT. It is: false
ServerSocketListener - Recieved A Packet: Seq: 800 Ack: 500 PacketType: 100 Sender: [Client] Recipient: [Server] WindowSize: 1
PacketBuilder - Sending Packet Seq: 500 Ack: 800 Type: 200 Src: [Server] Dst: [Client] WindowSize: 5
DataAssembler - Adding Packet
DataAssembler - Returning Status of EOT. It is: false
ServerSocketListener - Recieved A Packet: Seq: 400 Ack: 500 PacketType: 100 Sender: [Client] Recipient: [Server] WindowSize: 3
PacketBuilder - Sending Packet Seq: 500 Ack: 400 Type: 200 Src: [Server] Dst: [Client] WindowSize: 5
DataAssembler - Adding Packet
DataAssembler - Returning Status of EOT. It is: false
```

Acknowledgements Returned to The Client

```
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 6
ClientSocketListener - Recieved A Packet: Seq: 500 Ack: 1000 PacketType: 200 Sender: [Server] Recipient: [Client] WindowSize: 5
ClientSocketListener - The Packet is an ACK. Checking/Updating Window
Packet Acknowledged and Found. Acknowledging Now
DataAssembler - Returning Status of EOT. It is: false
ClientSocketListener - Recieved A Packet: Seq: 500 Ack: 800 PacketType: 200 Sender: [Server] Recipient: [Client] WindowSize: 5
ClientSocketListener - The Packet is an ACK. Checking/Updating Window
Packet Acknowledged and Found. Acknowledging Now
DataAssembler - Returning Status of EOT. It is: false
ClientSocketListener - Recieved A Packet: Seq: 500 Ack: 800 PacketType: 200 Sender: [Server] Recipient: [Client] WindowSize: 5
ClientSocketListener - The Packet is an ACK. Checking/Updating Window
Packet Acknowledged and Found. Acknowledging Now
DataAssembler - Returning Status of EOT. It is: false
ClientSocketListener - Recieved A Packet: Seq: 500 Ack: 600 PacketType: 200 Sender: [Server] Recipient: [Client] WindowSize: 5
ClientSocketListener - The Packet is an ACK. Checking/Updating Window
Packet Acknowledged and Found. Acknowledging Now
DataAssembler - Returning Status of EOT. It is: false
ClientSocketListener - Recieved A Packet: Seq: 500 Ack: 400 PacketType: 200 Sender: [Server] Recipient: [Client] WindowSize: 5
```

Duplicate Acknowledgement Recieved By the Server when sending Data to the Client

```
ServerSocketListener - Recieved A Packet: Seq: 500 Ack: 0 PacketType: 200 Sender: [Client] Recipient: [Server] WindowSize: 5
ServerSocketListener - It is an ACK packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 0
PacketBuilder - Sending Packet Seq: 1200 Ack: 500 Type: 100 Src: [Server] Dst: [Client] WindowSize: 5
WindowManager - A Duplicate ACK has been received. Seq:500 Ack: 0 Type: 200 Src: [Client] Dst: [Server]  WindowSize: 5
WindowManager - Window Has Room. Size: 6. Slots taken: 0
WindowManager - A Duplicate ACK signals that your timer preferences settings are too short and should be extended. For this Emulation, the duplicate ACK will simply be dropped
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 1
Server - Sending Packet
```

Timers & Timeouts

Timers are used on the sending side to determine when to re-transmission. The timers increment exponentially when they are triggered.

Timeouts Occurring on the Client Side

```
WindowManager - The current Window Size is : 6. The number of slots taken are: 6
PacketBuilder - Sending Packet Seq: 76800 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: -1
WindowManager - Window Has Room. Size: 6. Slots taken: 6
WindowManager - Found Duplicate Packet in the Window. Overwriting...
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 6
PacketMeta - Packet 77000 has failed to be ACK'd in time. Resending
WindowManager - The current Window Size is : 6. The number of slots taken are: 6
PacketBuilder - Sending Packet Seq: 77000 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: -1
WindowManager - Window Has Room. Size: 6. Slots taken: 6
WindowManager - Found Duplicate Packet in the Window. Overwriting...
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 6
PacketMeta - Packet 77200 has failed to be ACK'd in time. Resending
WindowManager - The current Window Size is : 6. The number of slots taken are: 6
PacketBuilder - Sending Packet Seq: 77200 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: -1
WindowManager - Window Has Room. Size: 6. Slots taken: 6
WindowManager - Found Duplicate Packet in the Window. Overwriting...
WindowManager - Window Has Now Had Packet Added. Size: 6. Slots taken: 6
PacketMeta - Packet 77400 has failed to be ACK'd in time. Resending
WindowManager - The current Window Size is : 6. The number of slots taken are: 6
PacketBuilder - Sending Packet Seq: 77400 Ack: 500 Type: 100 Src: [Client] Dst: [Server] WindowSize: -1
WindowManager - Window Has Room. Size: 6. Slots taken: 6
WindowManager - Found Duplicate Packet in the Window. Overwriting...
```

Window Size

Window size is statically enforced at the beginning of the simulation. The window size is not adjusted through the transaction. The window size is used on the sender side to control how many packets can send at the same time. If the window is full, the sending side can not send it is blocked and must wait to try again. The simulator here will sleep for 600ms before retrying again

The Window Full on the Client Side

```
Client - Sending Packet
WindowManager - The current Window Size is : 6. The number of slots taken are: 6
PacketBuilder - Can't Add Packet 74400 To Window. Window Is Full
Client - Couldn't Send - Sleeping and Trying Again
PacketMeta - Packet 73200 has failed to be ACK'd in time. Resending
```

Packet Drop & Packet Delay

The simulator will drop and delay packets based on parameters passed at inialization. The BER parameter will adjust the Bit Error Rate in a percent which is calculated into a probably as to whether to drop a given packet. The Average Packet delay sets the mean packet delay in ms that is used to calculate a delay time for each packet as it travels through the emulated internet

Packet Drop on the Internet

```
Client2Internet - Client is Sending Data. Listening to Client
Client2Internet - Back from read
Client2Internet - Received Packet Seq: 600 Ack: 500 Src: [Client] Dst: [Server] Type: 100 WindowSize: 2
Client2Internet - Packet with Seq: 600 is being dropped
Client2Internet - Client is Sending Data. Listening to Client
Client2Internet - Back from read
```

Packet Delay on the Internet

```
Server2Internet - Server is Sending Data. Listening to Server
Server2Internet - Back from read
Server2Internet - Received Packet Seq: 500 Ack: 3800 Src: [Server] Dst: [Client] Type: 200 WindowSize: 5
Server2Internet - Sending Packet with Seq: 500
Server2Internet - Sending Data to Client
Internet Tools - Delay Time Set. It is: 21ms
Server2Internet - Server is Sending Data. Listening to Server
Server2Internet - Back from read
Server2Internet - Received Packet Seq: 500 Ack: 3600 Src: [Server] Dst: [Client] Type: 200 WindowSize: 5
Server2Internet - Sending Packet with Seq: 500
Server2Internet - Sending Data to Client
Internet Tools - Delay Time Set. It is: 39ms
Server2Internet - Server is Sending Data. Listening to Server
Server2Internet - Back from read
Server2Internet - Received Packet Seq: 500 Ack: 4200 Src: [Server] Dst: [Client] Type: 200 WindowSize: 5
Server2Internet - Sending Packet with Seq: 500
Server2Internet - Sending Data to Client
Internet Tools - Delay Time Set. It is: 33ms
Server2Internet - Server is Sending Data. Listening to Server
```