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1. System Specification and Design

1.1 Overview

This project implements a network communication simulation using the Stop-and-Wait (S&W) protocol. It models two senders (S1, S2) and two receivers (R3, R4) communicating over a lossy network link via a switch.

The simulation continues until specific number of packets are correctly received by each receiver, measuring throughput, retransmissions, and packet/ACK drops.

The packers were sent one by one so we resorted to sending an N number of packets in when one time which called Go-Back-N (GBN) protocol.

1.2 Task and Data Structure

Packet

- **Header**
  - Source
  - Destination
  - Packet Length
  - Sequence Number
- **Payload**
  - Data

Figure 2: Packet Structure

Task	Description
Sender	Send data to one of the receivers in order
Receiver	Receive data from one of the receivers in order
AckHandle	Handle incoming Acks,updates window and frees memory
Monitor	Tracks Packet stats when delivered and ends scheduler

Table 1: tasks description

Ack

- Source
- Destination
- Sequence Number

Figure 1: Ack Structure

Note: there is switch but it is not created as a task but as a functions that simulate packets and Ack delay or drop (forward_data_callback and forward_ack_callback).

1.3 System design

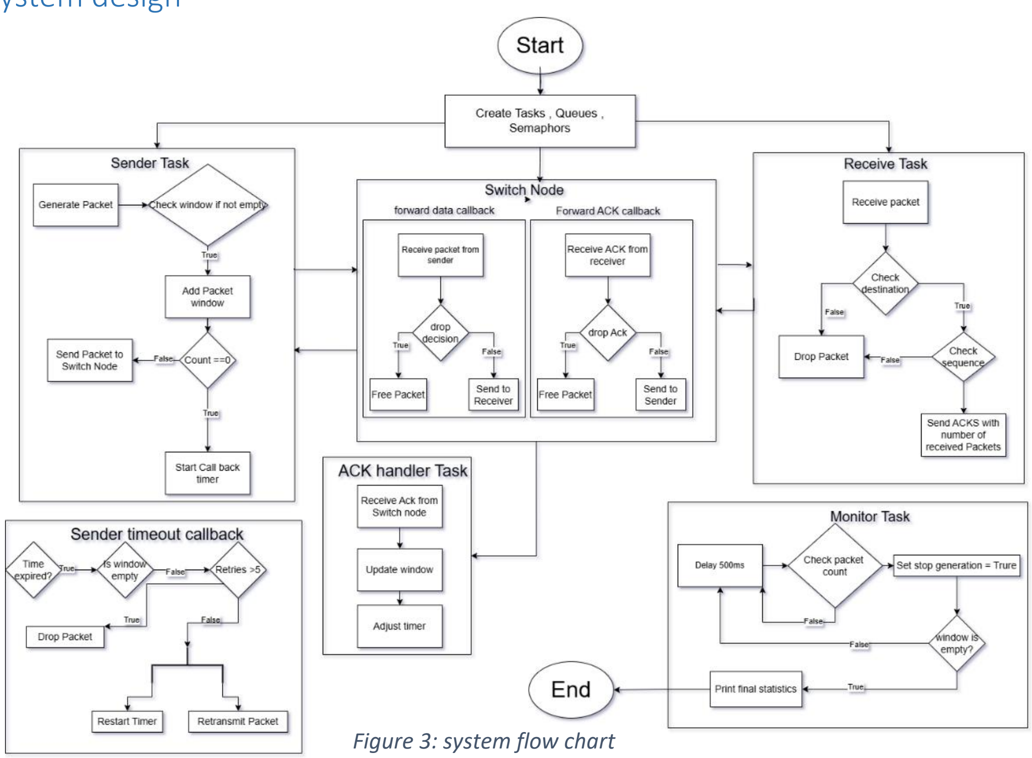

Figure 3: system flow chart

Note: in generating packet section we select the sender, receiver and length of the packet.

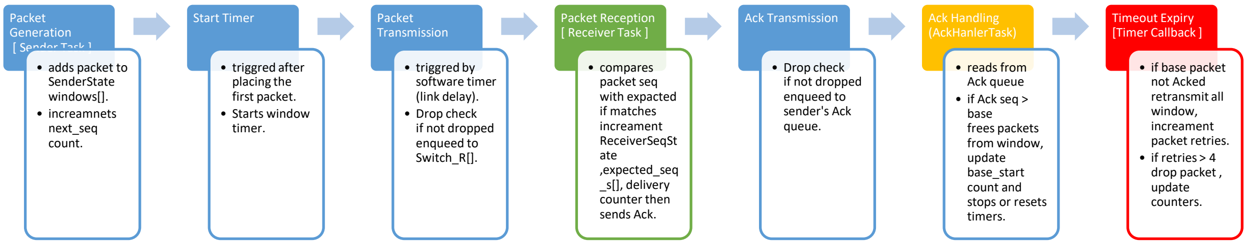

Figure 5: common operations and their interaction with the system

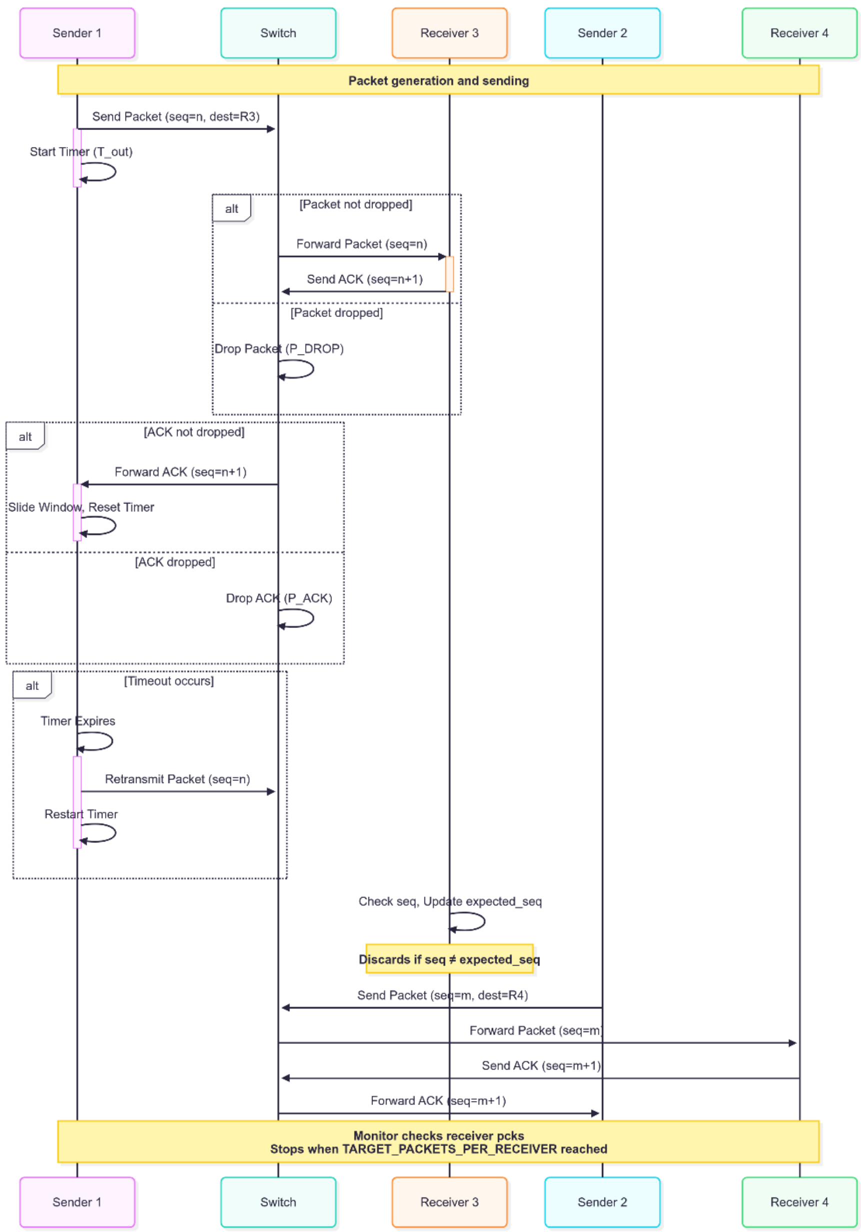

Figure 6: Sequence Diagram of the system

2. Results and Discussion

Part 1:

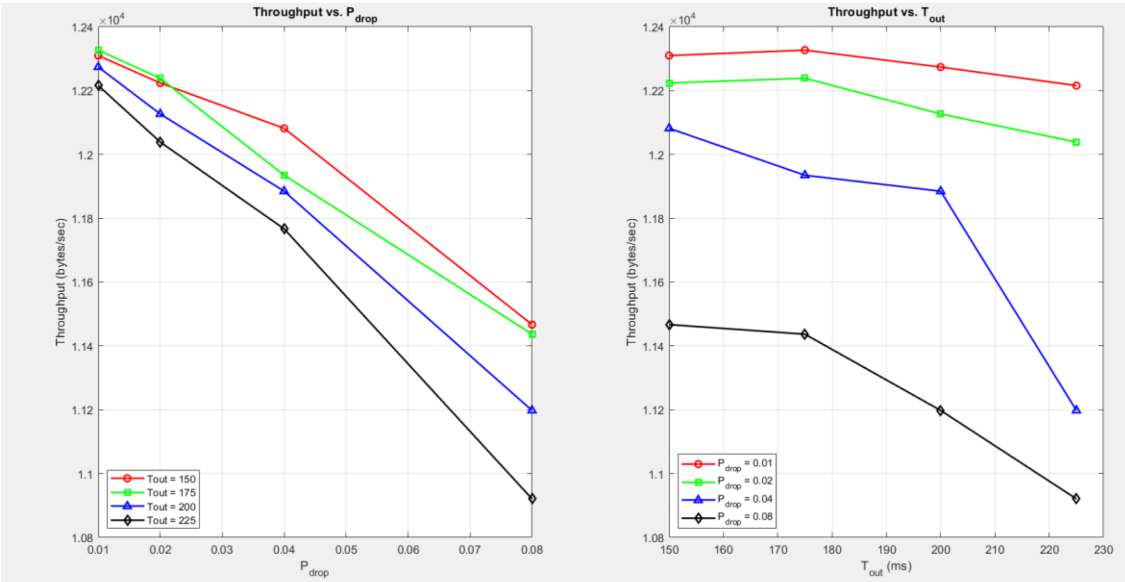

Figure 7: plot of 2 requirements

Tout P-drop	150	175	200	225
0.01	1.0097	1.0094	1.0088	1.0102
0.02	1.0198	1.0194	1.0198	1.0199
0.04	1.0328	1.0369	1.0348	1.0417
0.08	1.0861	1.0833	1.0791	1.0889

Table 2: Average number of transmissions for different Tout and P-drop

There is no packet drop, all the packets transmitted in less than 4 times.

Part 2:

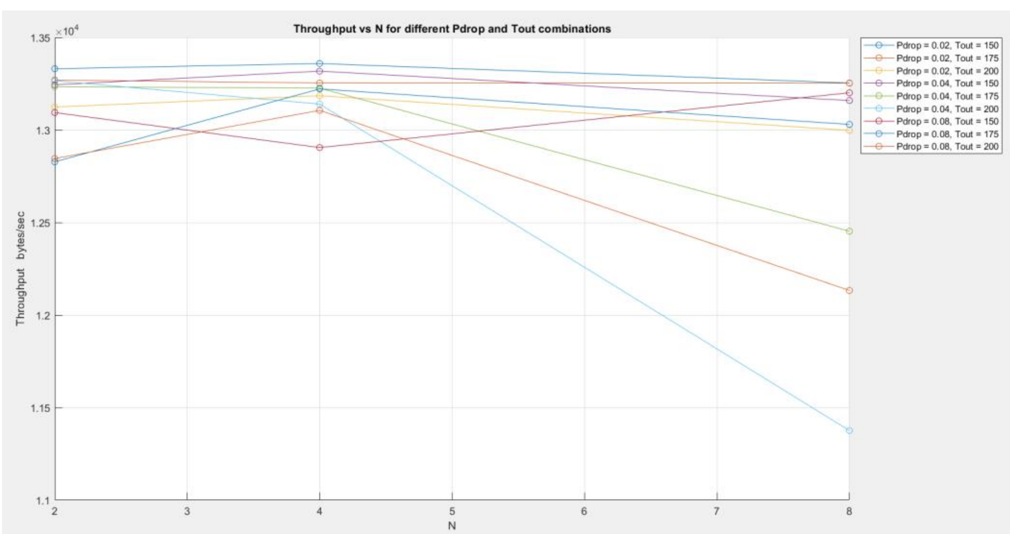

Figure 8: Through vs N for different P-drop and Tout

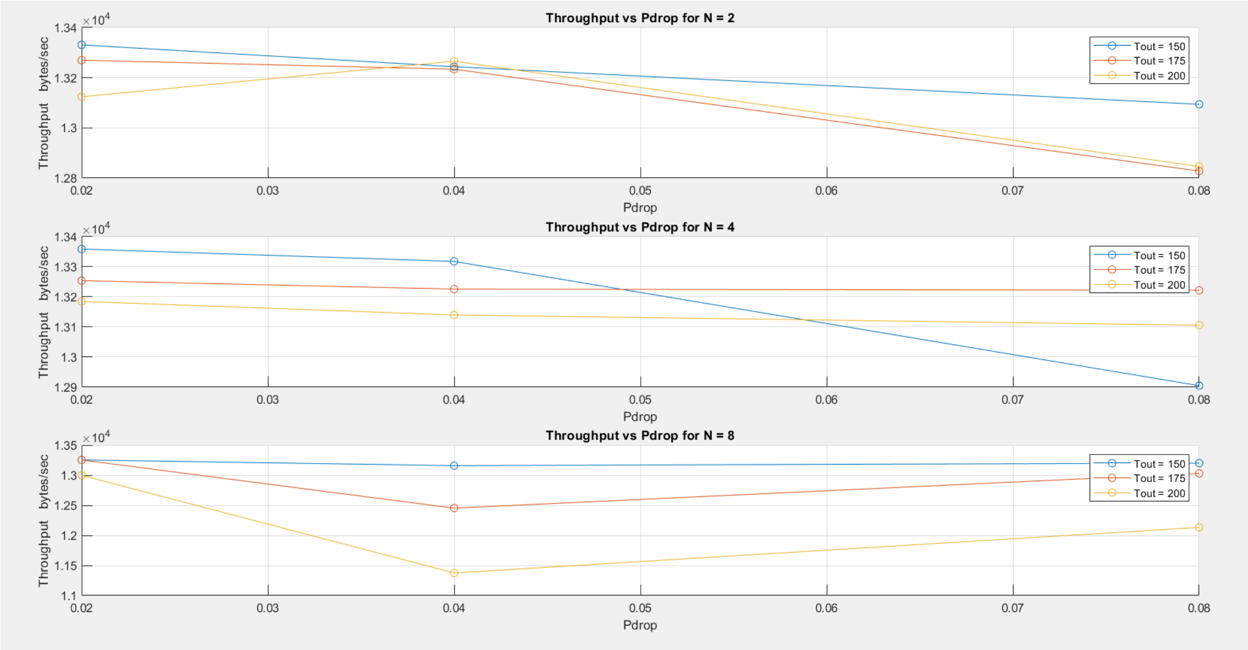

Figure 9: Throughput vs P-drop for different Tout and N

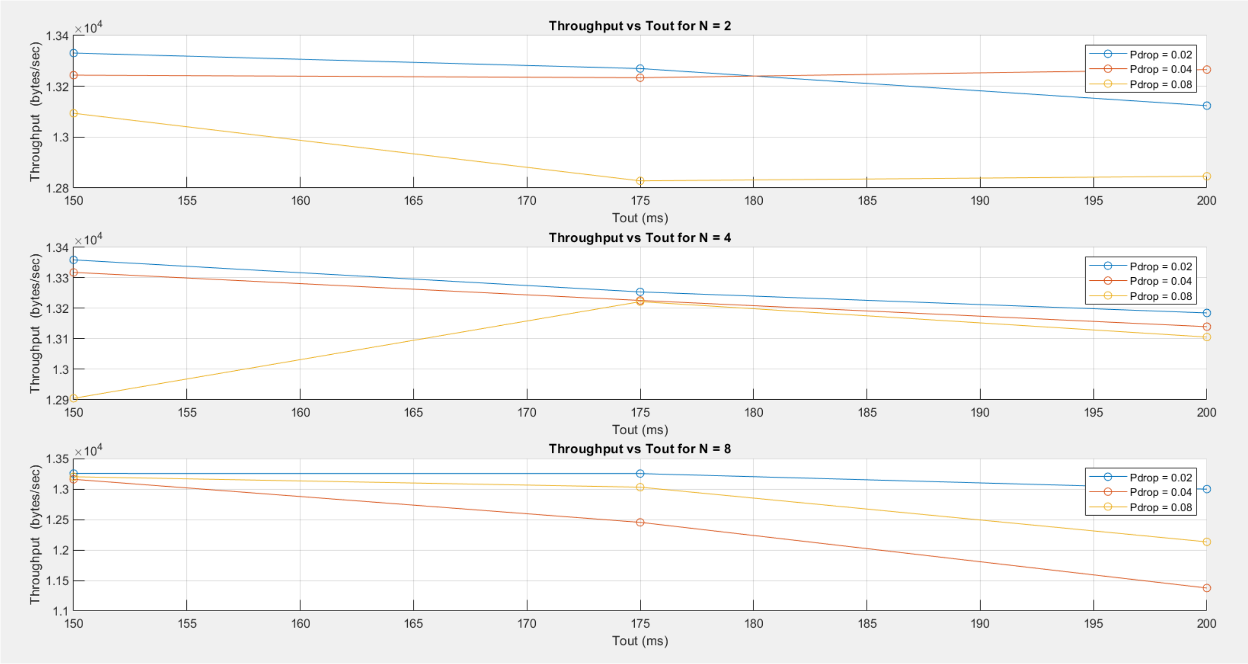

Figure 10: Throughput vs Tout for different P-drop and N

There is no packet drop, all the packets transmitted in less than 4 times.

N / Pdrop - Tout	1(S&W)	2	4	8
0.02 - 150	12224	13331	13359	13254
0.02 - 175	12239	13270	13254	13253
0.02 - 200	12127	13124	13185	12998
0.04 - 150	12082	13244	13318	13159
0.04 - 175	11935	13234	13226	12453
0.04 - 200	11885	13266	13140	11376
0.08 - 150	11467	13094	12905	13201
0.08 - 175	11437	12828	13222	13030
0.08 - 200	11198	12846	13106	12133

Table 3: Throughput values in different cases

Discussion

- The throughput value increases with the order of N, because for larger N it allows the sender to keep sending packets without waiting for ACKs and that reduces the ideal time for the sender.
- For same N when P-drop increases the throughput decreases as number of total transmission increase which increases the time.
- Throughput generally decreases with higher Tout, due to the reduction of retransmissions.
- Increasing P-drop results in reduced throughput across all configurations, as expected due to increased packet loss and retransmissions.
- At higher drop rates, the advantage gain from increasing the window size disappear.
- At higher drop rates, Go-Back-N maintains most of its peak throughput (with large N), while Stop-and-Wait drops large amount of its best-case performance, highlighting Go-Back-N is better in lossy environments.
- For same N the average transmission increase with increasing P-drop as increasing P-drop make more packets drops which require more transmission times for the same total received packets.
- Increasing N, the chance of that a single packet loss increases which triggers retransmission for multiple packets, and that increases the average transmission.
- Actual drops mean the packets dropped after 4 retries in our case its zero at all N's because the drop possibility is very low and the number of retries is high which gave us a nearly 0 % possibility to drop for out rangeof simulation.

Reference

[1] M. Wolf, Computers as components : principles of embedded computing system design. Waltham, Ma: Elsevier/Morgan Kaufmann, 2012.