Computer Networks Assignment

Stop-and-Wait ARQ, Go-Back-N ARQ, and Congestion Control Simulation

October 10, 2025

Objective

To implement and analyze data transmission reliability and congestion control mechanisms in the Transport Layer through coding simulations of:

- Stop-and-Wait ARQ
- Go-Back-N ARQ
- TCP Congestion Control

Task 1 – Stop-and-Wait ARQ Simulation

Objective: Implement reliable frame transmission using Stop-and-Wait ARQ protocol.

Requirements:

1. Transmit one frame at a time and wait for acknowledgment.
2. Introduce random frame loss with probability.
3. Implement timeout and retransmission.
4. Display frames sent, acknowledged, and retransmitted.

Expected Output Example:

```
Sending Frame 0
ACK 0 received
Sending Frame 1
Frame 1 lost, retransmitting...
ACK 1 received
```

Deliverables:

- Source code: `stop_and_wait.py` or `.c`
- Output screenshot

Task 2 – Go-Back-N ARQ Simulation

Objective: Implement sliding window protocol using Go-Back-N ARQ.

Requirements:

1. Use window size N.
2. Receiver sends cumulative acknowledgments.
3. On frame loss, retransmit all frames from the lost one.
4. Adjustable parameters: total frames, window size, loss probability.

Expected Output Example:

```
Sending frames 0 3
ACK 1 received
Frame 2 lost, retransmitting frames 2 4
ACK 4 received
Window slides to 5 8
```

Deliverables:

- Source code: `go_back_n.py` or `.c`
- Output screenshot

Task 3 – TCP Congestion Control Simulation

Objective: Simulate TCP congestion window (`cwnd`) growth and reduction.

Requirements:

1. Implement Slow Start, Congestion Avoidance, and Timeout phases.
2. On successful ACK ⇒ increase `cwnd`.
3. On packet loss ⇒ multiplicative decrease of `cwnd`.
4. Plot `cwnd` vs. transmission rounds using Matplotlib.

Expected Output:

- Plot showing exponential and linear growth phases followed by drop.
- Example output: `cwnd_plot.png`

Deliverables:

- Source code: `congestion_control.py`
- Generated plot: `cwnd_plot.png`