Go-Back-N Protocol: A Visual Implementation

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1. Introduction

The Go-Back-N (GBN) protocol is a streamlined sliding window protocol used for reliable data transmission over unreliable networks. It emphasizes efficiency by allowing multiple frames to be sent without waiting for individual acknowledgments, but requires retransmission of all frames after a lost or damaged one.

1.1 Core Principles

- Sliding Window Transmission: Sender can send multiple frames (up to window size) before waiting for an ACK.
- Cumulative Acknowledgment: Receiver only acknowledges the highest contiguous packet received correctly.
- Go-Back Mechanism: If a packet is lost or corrupted, sender retransmits that packet and all subsequent packets in the window.
- No Out-of-Order Acceptance: Receiver discards any packet received out-of-order.

1.2 Key Components

- Sender Window: Defines the range of frames that can be sent without waiting for ACKs.
- Receiver Logic: Accepts packets in sequence, discards out-of-order frames.
- Acknowledgment System: Uses ACKs for cumulative acknowledgment; timeouts for detecting packet loss.

2. Visual Implementation

Our project visualizes the GBN protocol using HTML5 Canvas, offering a clear, dynamic representation of packet flow, loss, and retransmission.

2.1 Visual Elements

- Network Representation: Includes sender and receiver modules, sliding windows, and moving packets.
- State Indicators: Show packet status (e.g., in transit, lost, acknowledged), timer bars, and window boundaries.

- Protocol Operations: Demonstrates packet sending, loss simulation, acknowledgment, and retransmission of sequences.
- Example: When a packet is lost, the simulation highlights the lost packet, triggers a timeout, and initiates retransmission of that packet and all subsequent packets in the window.

3. Implementation Details

3.1 State Management
- Packet States: Ready → Sent → Acknowledged → Retransmitted (if required)
- Window Movement: Sliding as ACKs are received; blocked when awaiting retransmission
- Sequence Tracking: Sequence numbers with modulo arithmetic to simulate wraparound

3.2 Error Handling
- Loss Simulation: Random packet loss using user-defined probability
- Timeout & Retransmission: Packet loss detected via timer expiry, followed by go-back retransmission
- Synchronization: Ensures sender waits for correct ACKs before progressing

4. Educational Value
- Concept Clarity: Visually shows the impact of packet loss and how retransmission works in GBN.
- Interactive Learning: Users can adjust parameters like window size and loss rate to observe different outcomes.
- Protocol Comparison: Helps compare GBN with Selective Repeat or Stop-and-Wait protocols.
- Practical Exposure: Useful for students and developers to understand transport layer reliability.

Conclusion
The Go-Back-N Protocol is an essential part of transport layer reliability mechanisms. Though simpler than Selective Repeat, it trades bandwidth efficiency for implementation simplicity. Our visual implementation demystifies the internal workings of GBN by providing clear insights into packet flow, window operation, and retransmission mechanics. Through this simulation, learners gain a practical grasp of how data reliability is ensured even over lossy networks, thereby laying a solid foundation for advanced protocol understanding and network programming.