

Selective Repeat Protocol Visualization - Writeup

1. Introduction

The Selective Repeat Protocol (SRP) enables reliable data transmission over unreliable channels by allowing multiple packets in transit simultaneously, individual acknowledgment, and selective retransmission of only lost or corrupted packets. This protocol excels in networks with high bandwidth-delay products or significant error rates. Our visualization offers an interactive demonstration of Selective Repeat in action, illustrating complex interactions between sender and receiver that are difficult to grasp from theoretical descriptions alone.

2. Implementation

Built with HTML5, CSS3, and JavaScript, the visualization includes:

- Configuration Panel: Adjust window size, packet count, loss probabilities, and timeout duration
- Simulation Visualization: Shows sender, receiver, transmission channel, and color-coded packets with animated transmission and dynamic window markers
- Statistics and Logging: Real-time statistics on packets sent, delivered, and lost, plus efficiency calculations and event logs

The implementation follows these operational steps:

- Initialization of packet objects and sliding window
- Sending process with individual packet timers
- Reception and acknowledgment handling (including simulation of losses)
- Window advancement based on acknowledgments
- Error recovery through selective retransmission and performance analysis

3. Educational Value

The visualization serves as an educational tool by:

- Making abstract protocol concepts visible and interactive
- Enabling experimentation with different parameters
- Providing immediate feedback through animations and statistics
- Demonstrating key networking concepts like window-based flow control, efficient error recovery, timeout management, and protocol overhead

Understanding Selective Repeat is valuable for network protocol design, performance optimization, and TCP understanding, as many concepts in Selective Repeat are present in TCP, the foundation of internet communications.

4. Technical Challenges

Key challenges included synchronization between animations and protocol logic, creating intuitive visual representations, and ensuring performance across devices. These were addressed through an event-driven architecture, strategic visual design with color-coding and animation, and optimization techniques to prevent memory leaks and ensure smooth performance across hardware capabilities.

5. Conclusion

This visualization bridges the gap between theoretical network concepts and practical understanding, demonstrating how web technologies can create effective educational tools for complex technical concepts. It helps users develop intuition about protocol behaviour under various conditions, making it valuable for students, educators, and networking professionals alike. Future enhancements could include comparing Selective Repeat with other reliable transport protocols, introducing variable network delays, or implementing more complex network topologies.