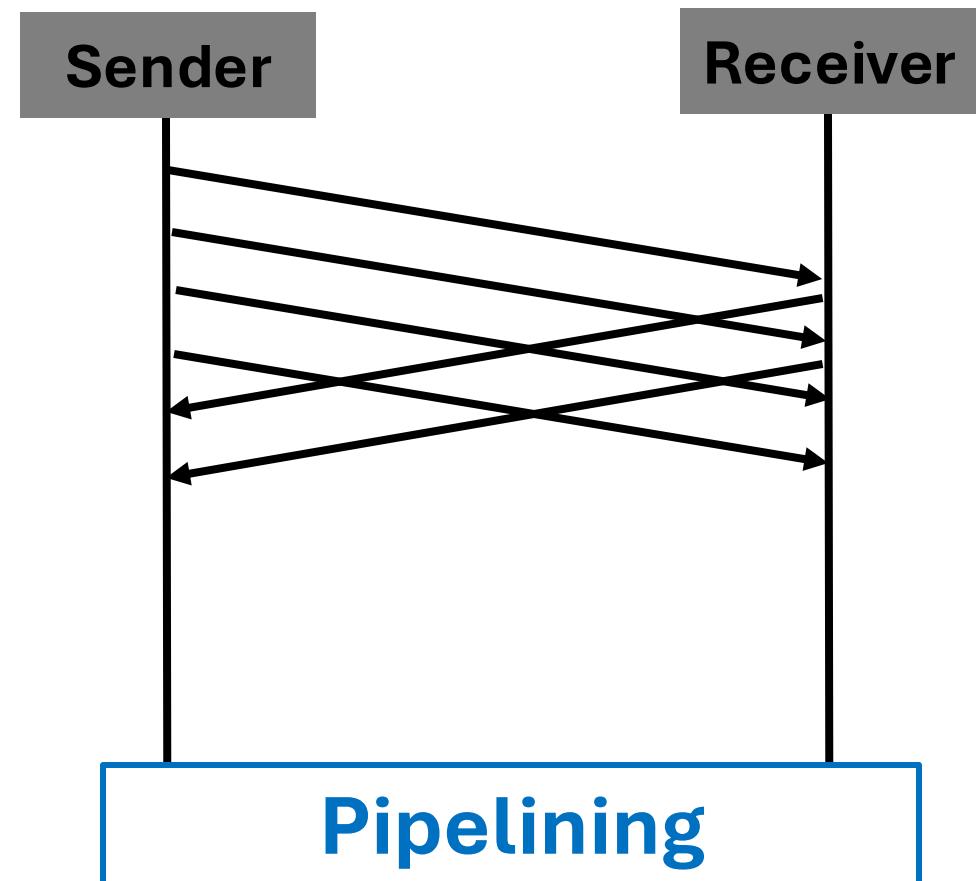
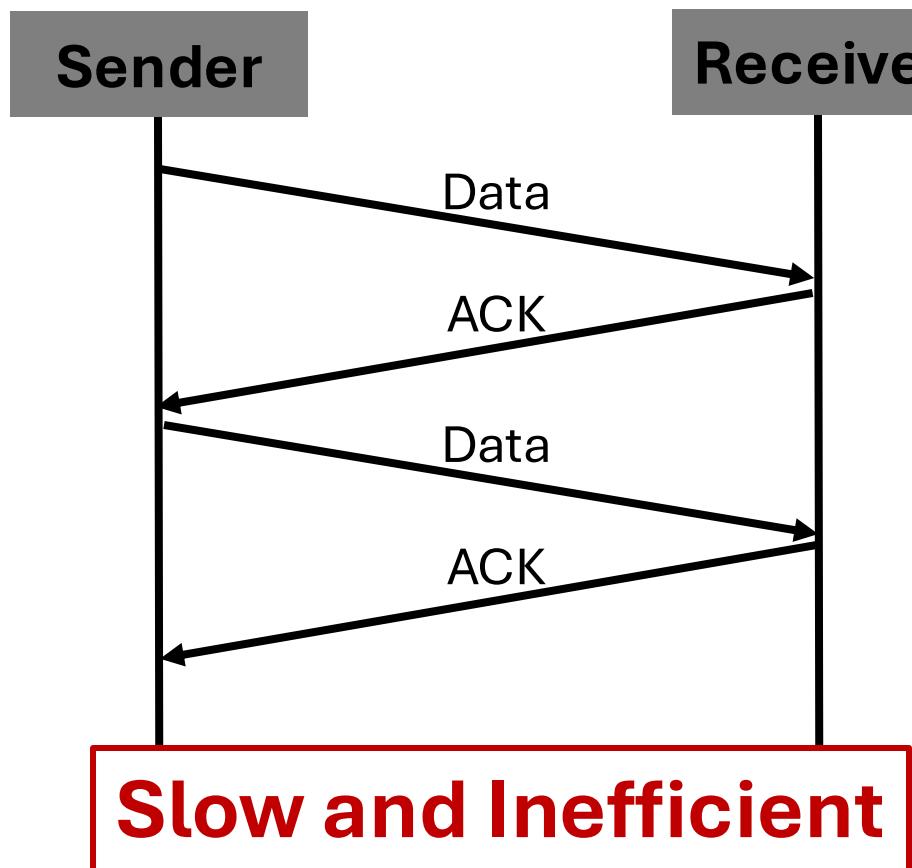


Fast and Reliable TCP: Sliding Window & Cumulative ACKs

**CS698 Assignment
Fall 2025
Christina Shin**

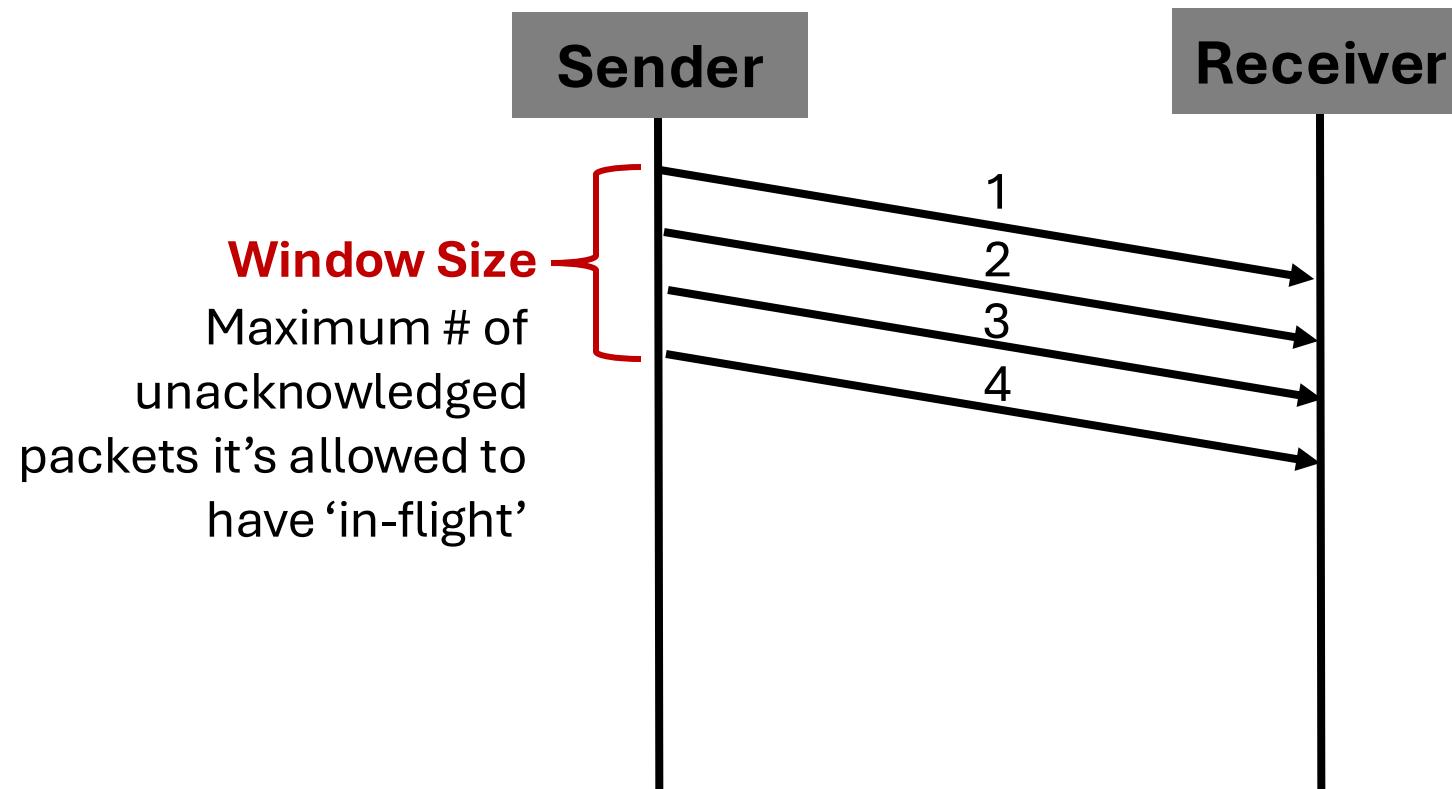
Motivation

- Why Do We Need Sliding Windows?



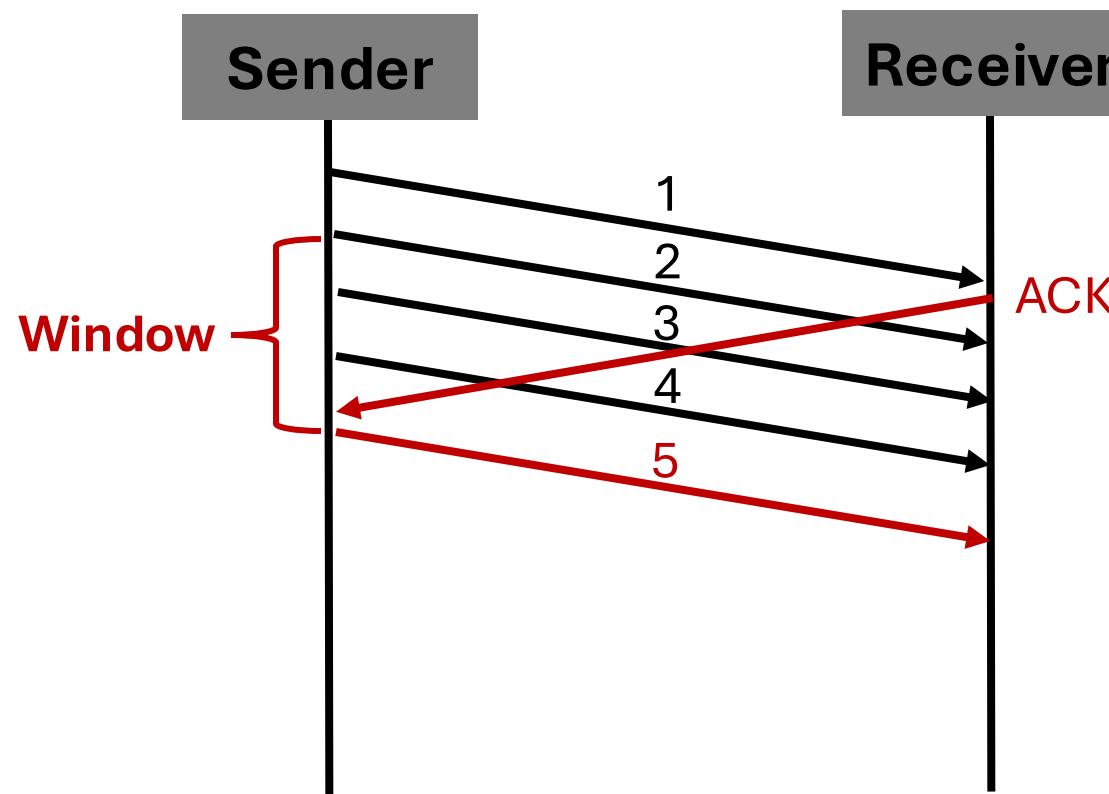
Sliding Window – Basic Idea

- Send multiple packets before ACKs



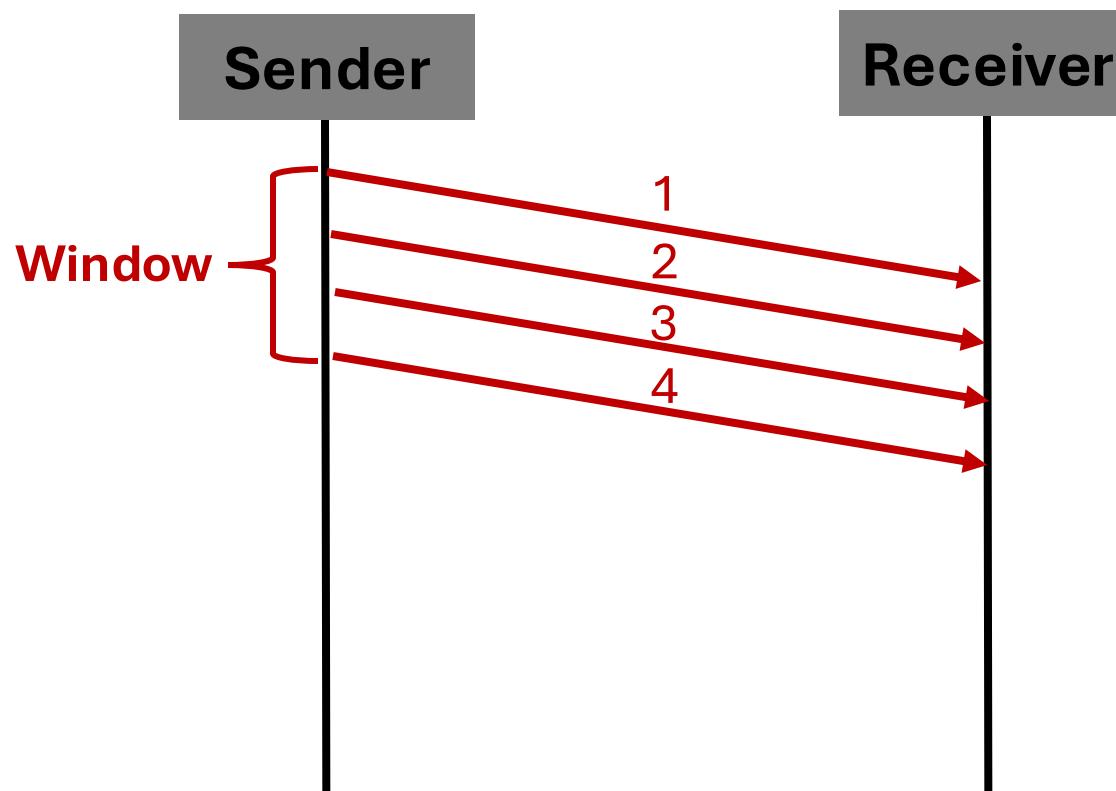
Sliding Window – Basic Idea

- Slides the window when ACK comes in



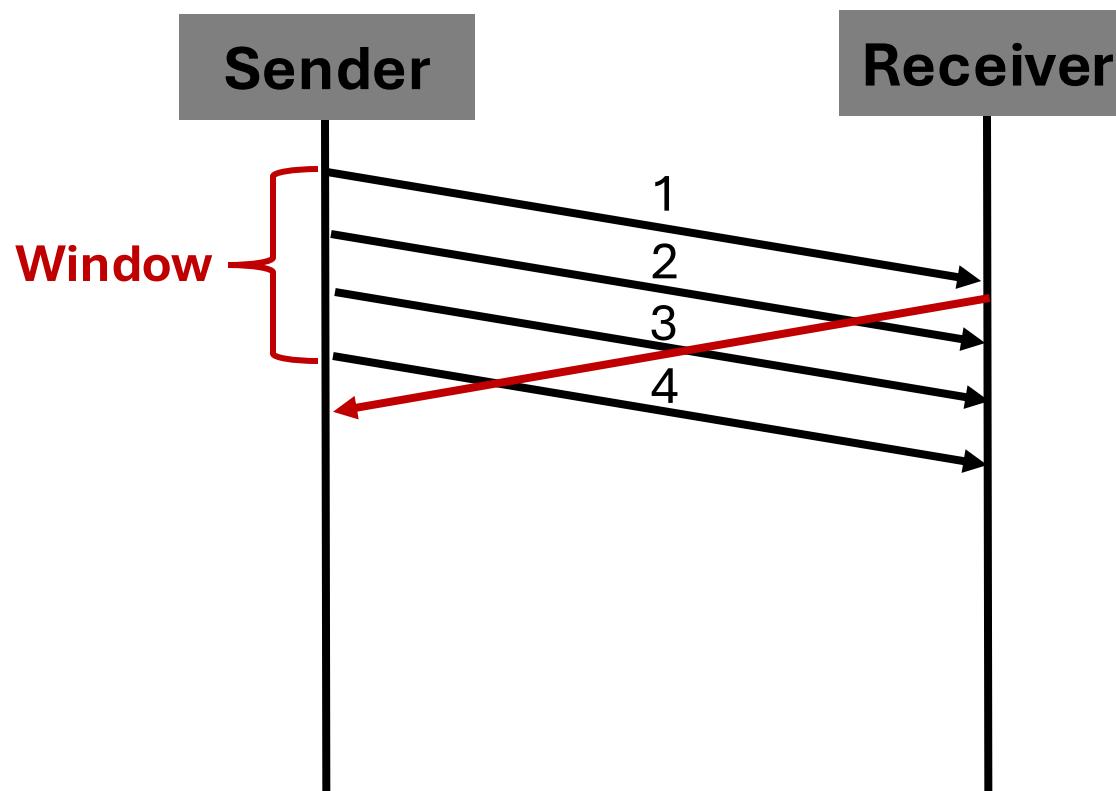
Sliding Window – Example

- An example with a window size of 4



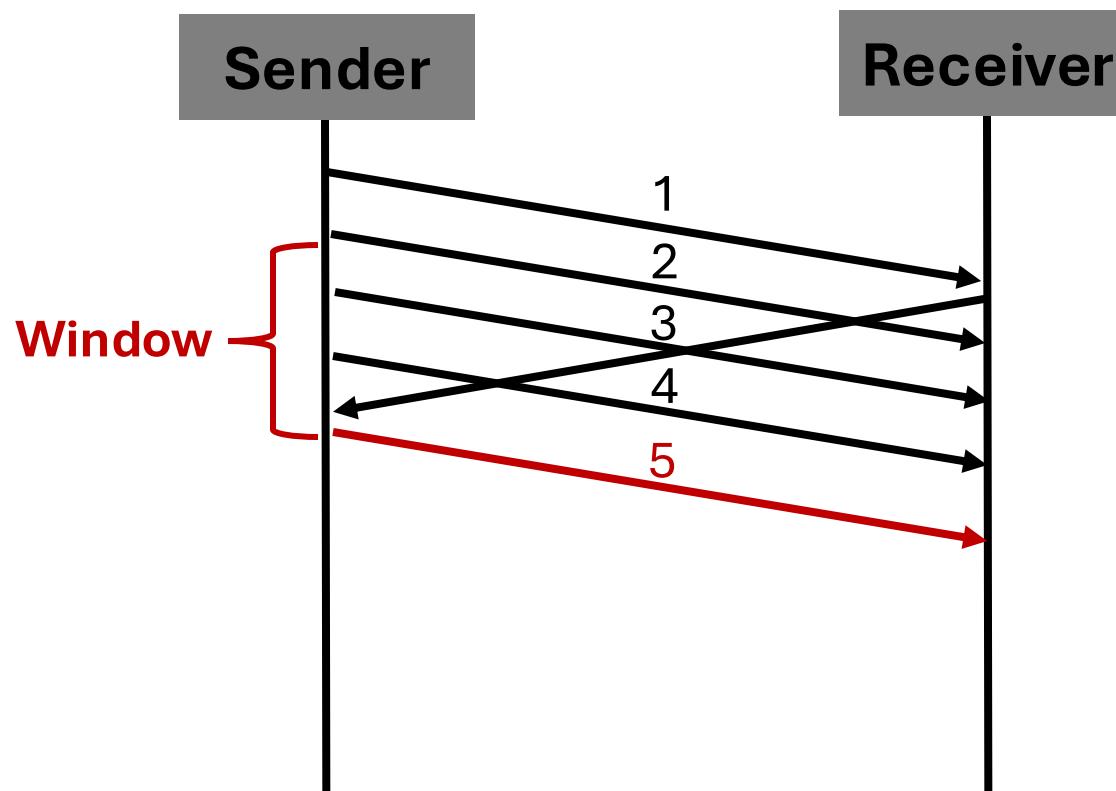
Sliding Window – Example

- An example with a window size of 4



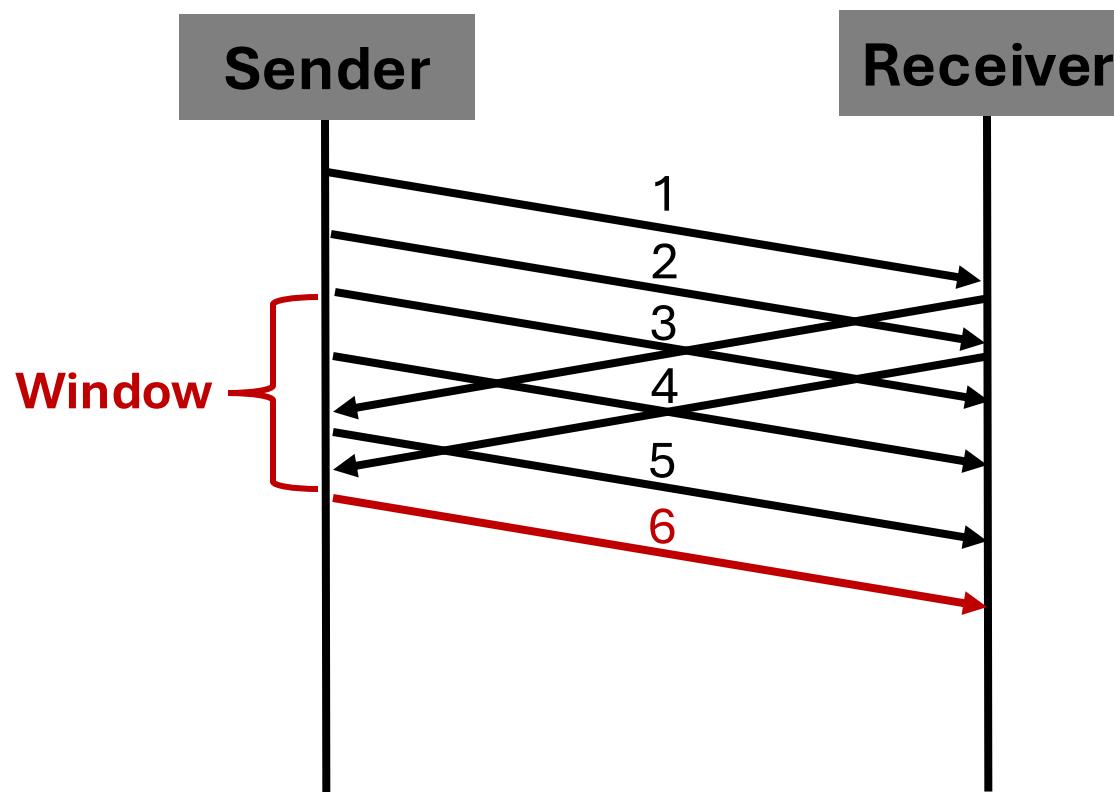
Sliding Window – Example

- An example with a window size of 4



Sliding Window – Example

- An example with a window size of 4



Cumulative ACKs

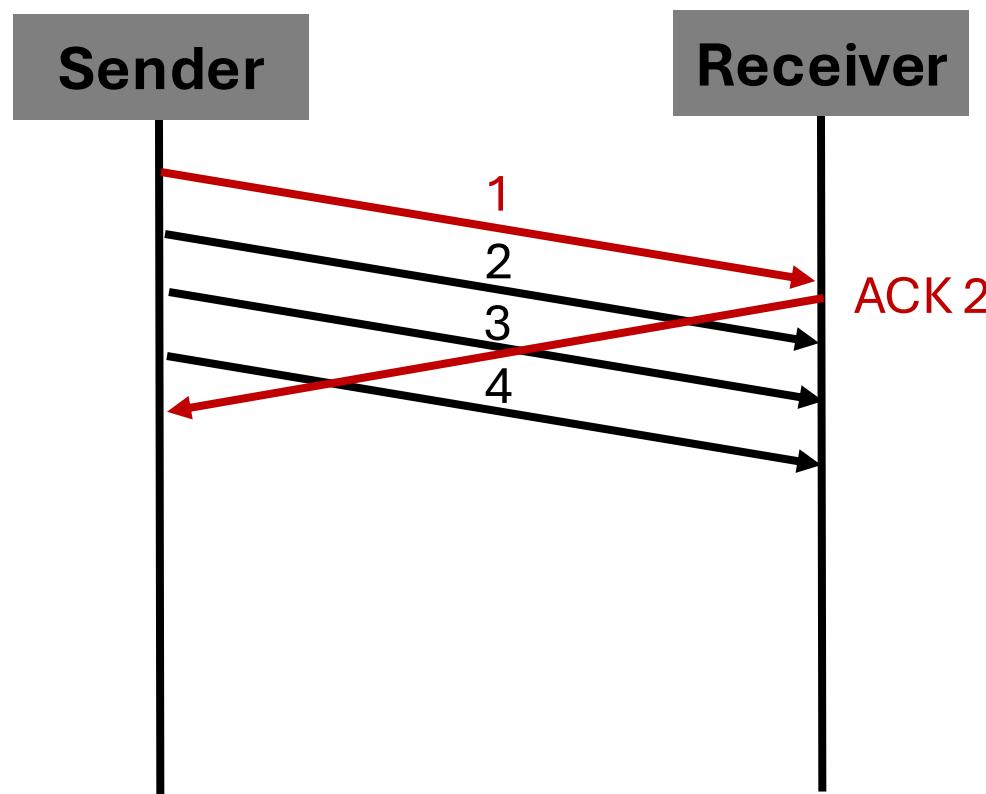
- **What is a cumulative ACK?**

The ACK number represents the next expected packet

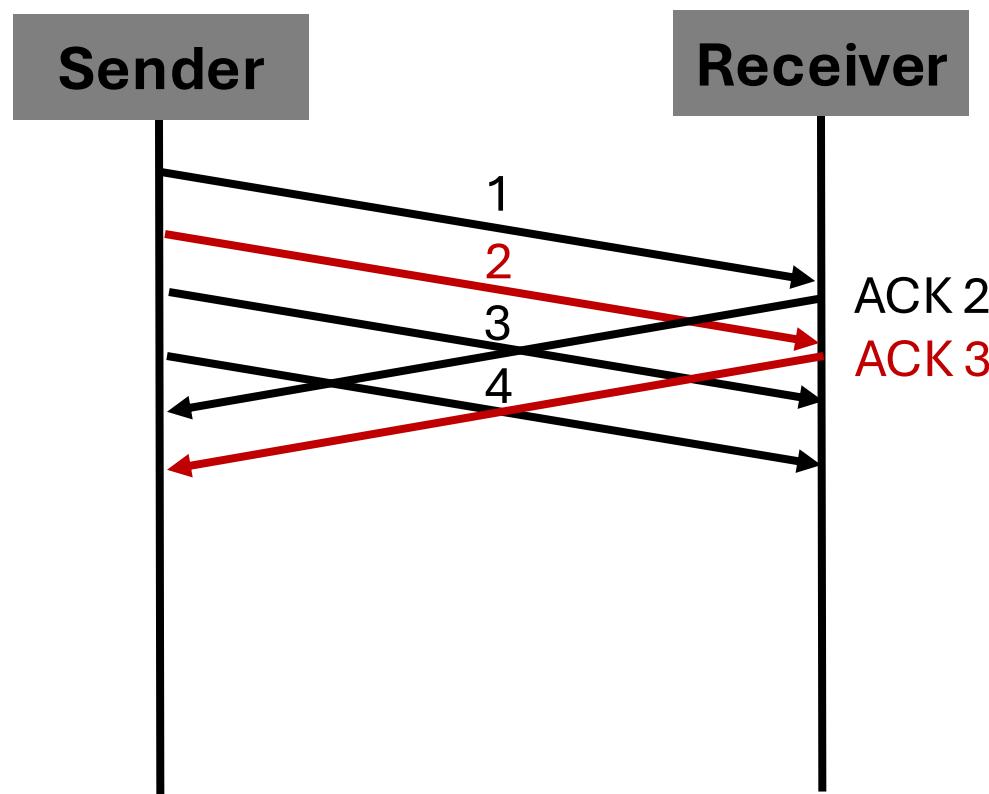
“ACK 5”

“I have received everything up to 4, and I’m now expecting 5!”

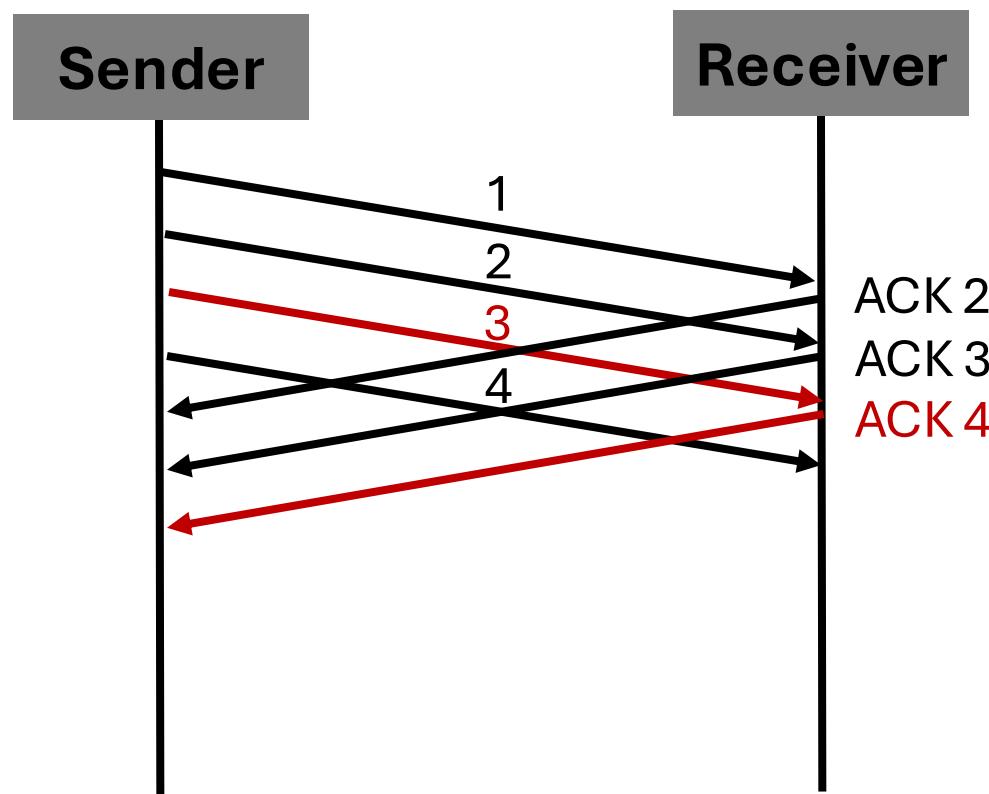
Cumulative ACK – Example



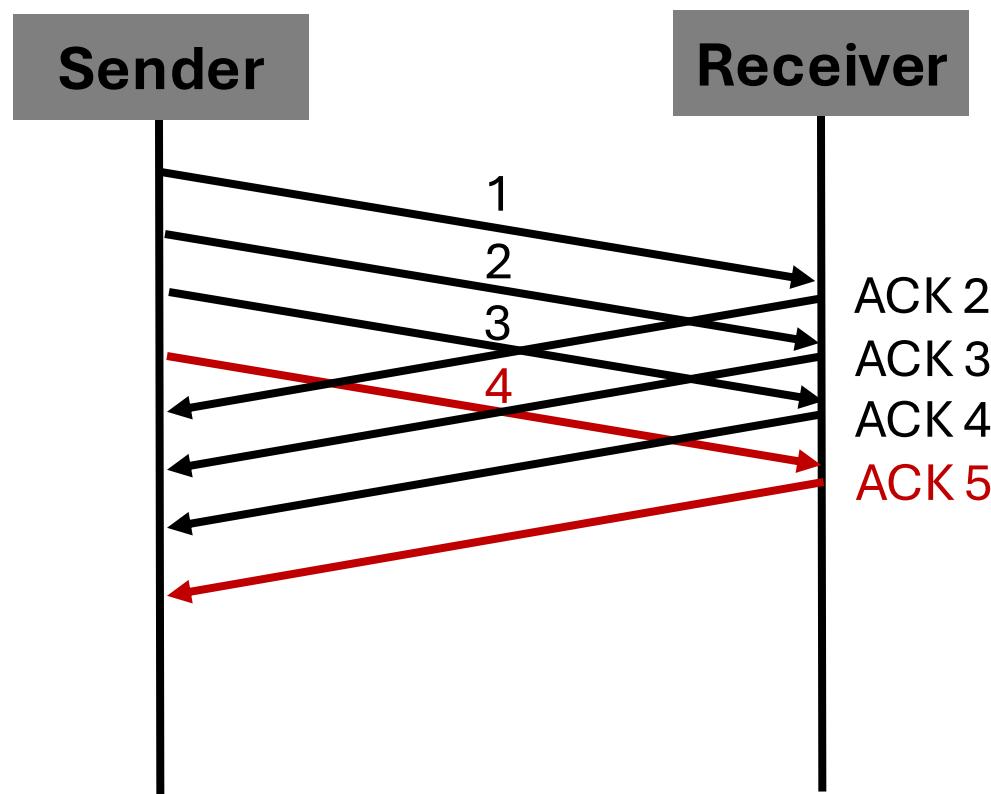
Cumulative ACK – Example



Cumulative ACK – Example

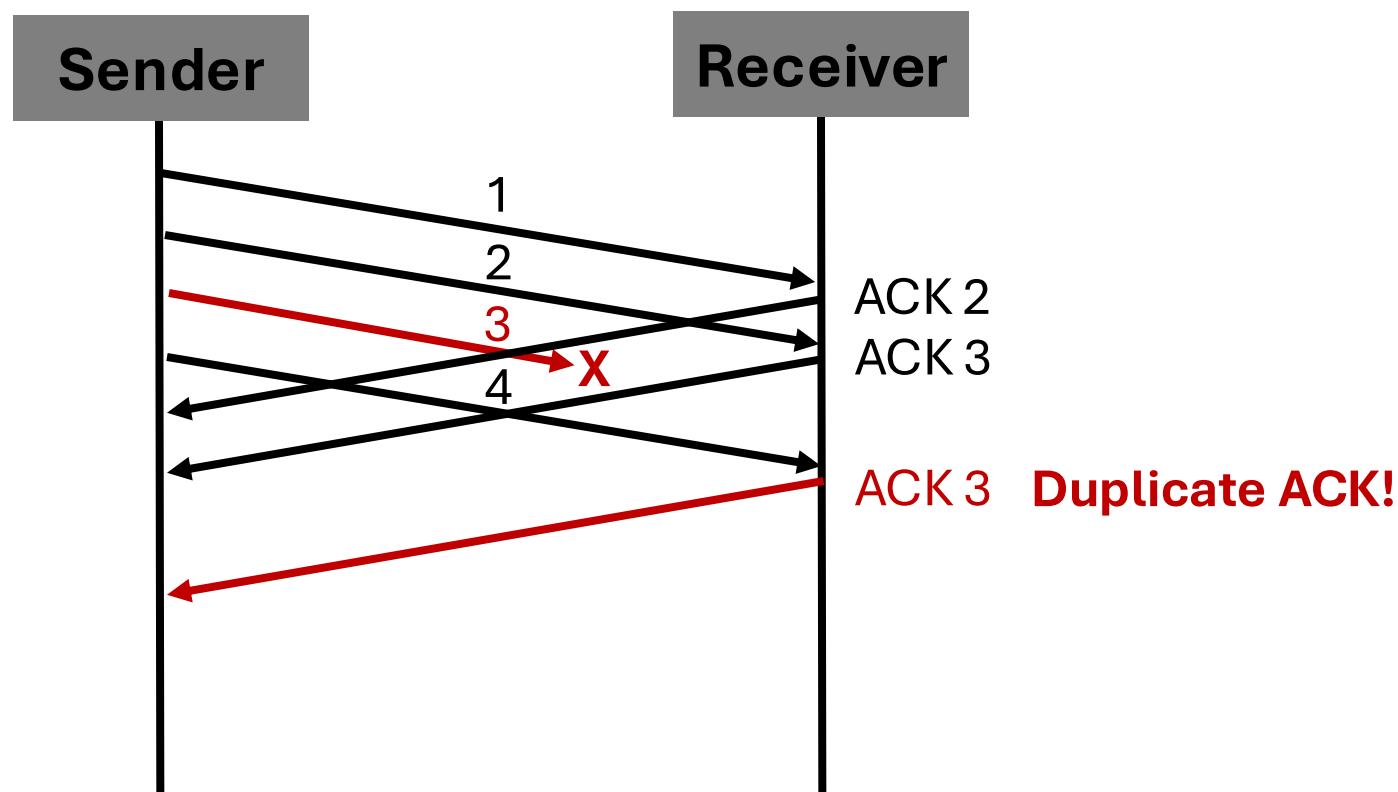


Cumulative ACK – Example



Cumulative ACK – Loss Handling

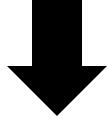
- What if a packet is lost?



Putting it all together

Sliding Window = Parallelism

Cumulative ACKs = Efficient Feedback



TCP with
Reliable
High-throughput
Adaptive to Network

Summary

- Why sliding windows exist
- How the sender window shift
- How cumulative ACKs work
- How TCP handles loss using duplicate ACKs

References

- <https://www.geeksforgeeks.org/computer-networks/difference-between-stop-and-wait-protocol-and-sliding-window-protocol/>
- <https://www.geeksforgeeks.org/computer-networks/sliding-window-protocol-set-1/>
- <https://anirudhsk.github.io/teaching/lectures/lec5.pdf>
- <https://www.youtube.com/watch?v=LnbvhoxHn8M>

Thank you!

Email: cshin956@usc.edu