Defeating TCP Congestion Control in Three Easy Steps

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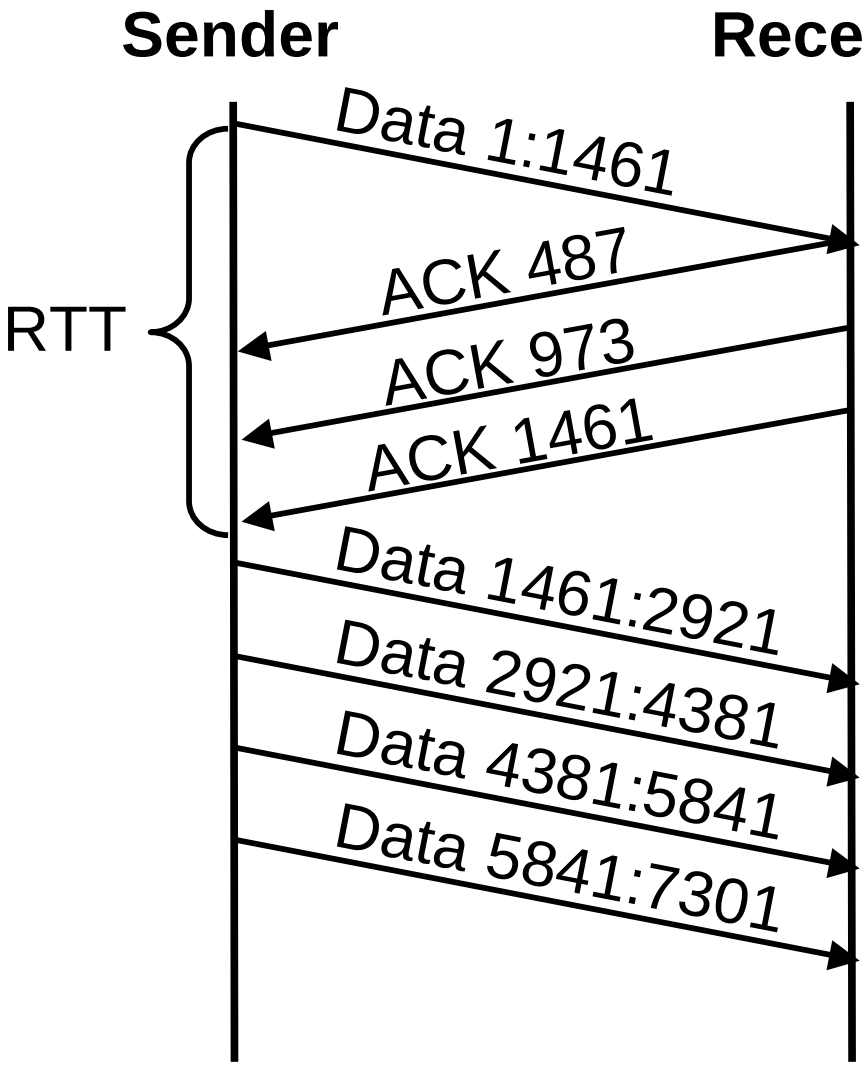
Overview

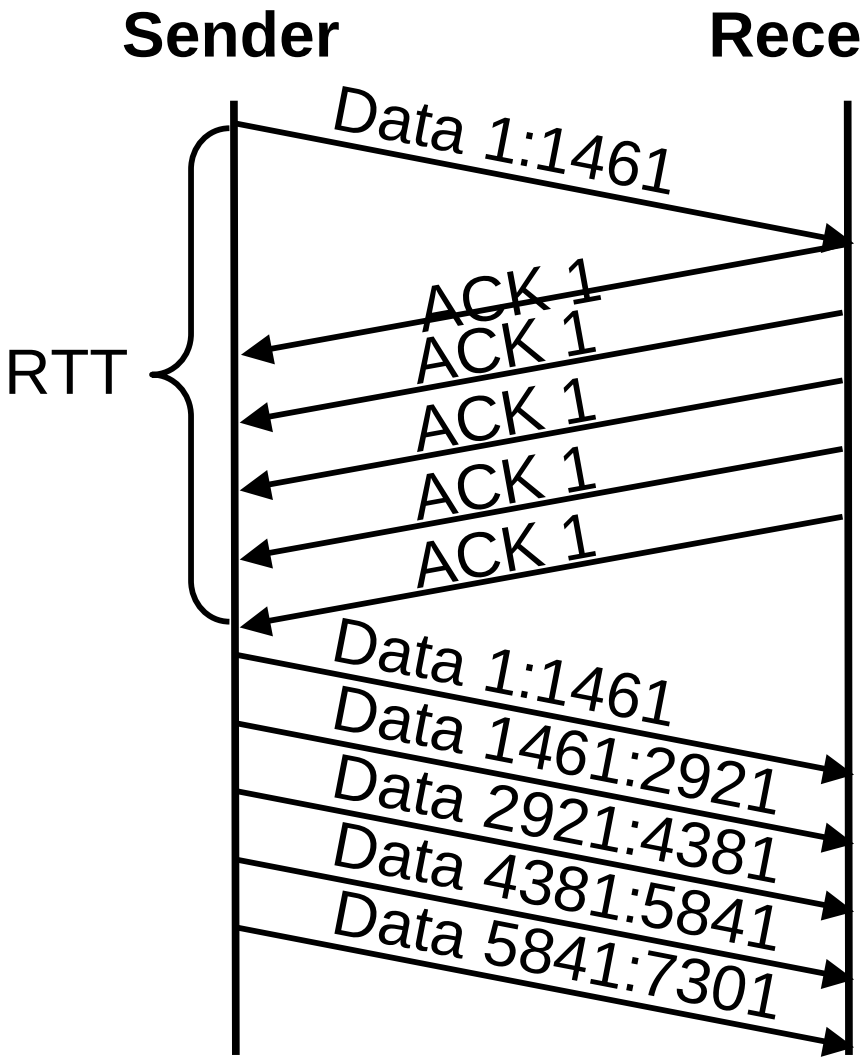
- Simple Question
  - Can a TCP client influence how fast a TCP server sends it data?
- Simple Answer
  - Oh yeah… Big time.

ACK Division



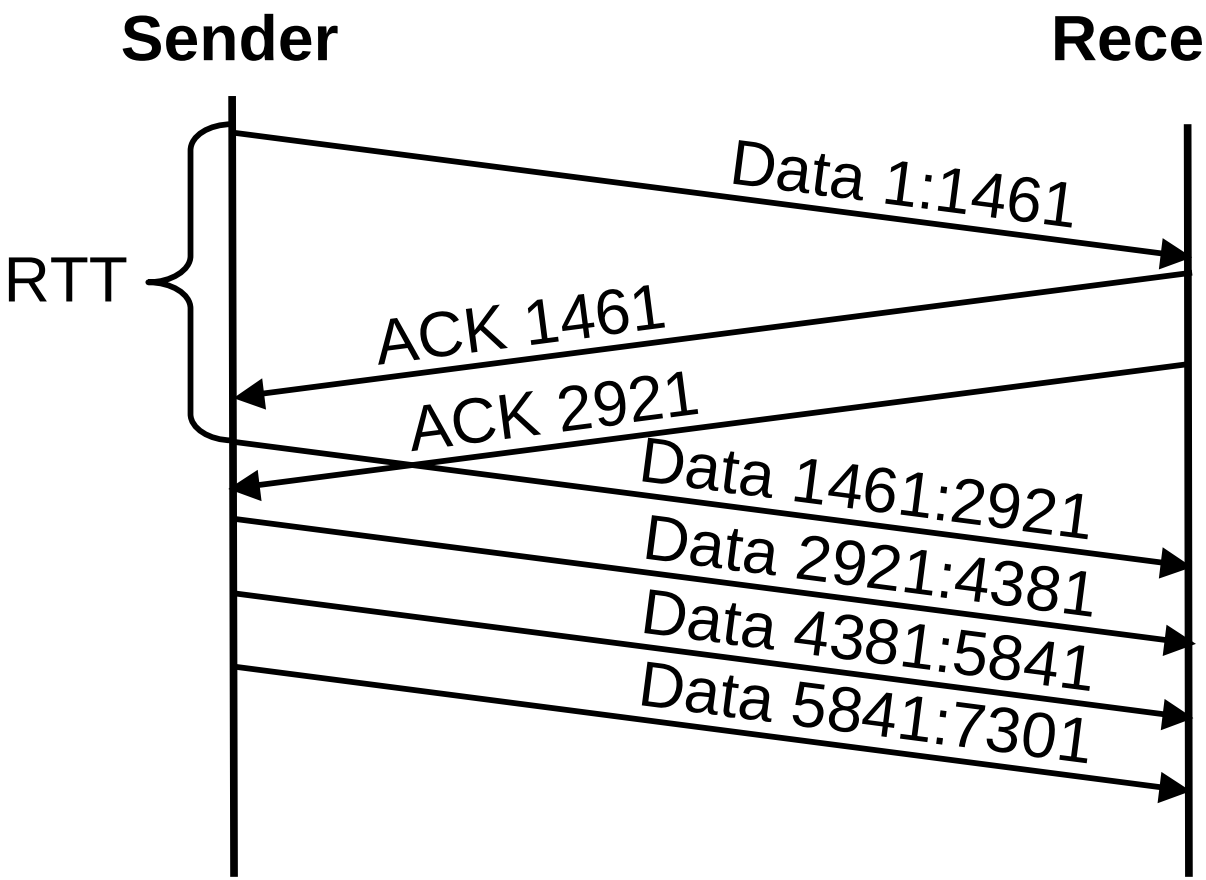
- Send M ACKs for one pkt
- Exponential growth factor proportional to M!
- Preserves end-to-end semantics

DupACK Spoofing



- Send extra duplicate ACKs
- Sender sends one pkt for each duplicate ACK
- Preserves end-to-end semantics

Optimistic ACKing



- Send ACKs early
- Sender sends pkts in proportion to ACK rate
- Violates end-to-end semantics

Implementation experience

- TCP Daytona
  - Easy to implement (<75 lines in Linux)
  - Works with all popular sender TCP stacks
- We have the world’s fastest Web browser

What to do?

- Sender-side TCP modifications can mitigate these problems
- Its possible to remove the *incentive* for receiver misbehavior using a variant on *nonces*.
  - Receiver can only hurt itself by lying
- Details can be found in:

  TCP Congestion Control with a Misbehaving Receiver, to appear *ACM Computer Communications Review*, October, 1999.

RFC 2581
Controlling the congestion window

During slow start, TCP increments cwnd by at most SMSS bytes for each ACK received that acknowledges new data.

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During congestion avoidance, cwnd is incremented by 1 full-sized segment per round-trip time (RTT).

RFC 2581
Fast Retransmit and Recovery

*Set cwnd to ssthresh plus 3*SMSS. This artificially "inflates" the congestion window by the number of segments (three) that have left the network and which the receiver has buffered.*

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For each additional duplicate ACK received, increment cwnd by SMSS. This artificially inflates the congestion window in order to reflect the additional segment that has left the network.