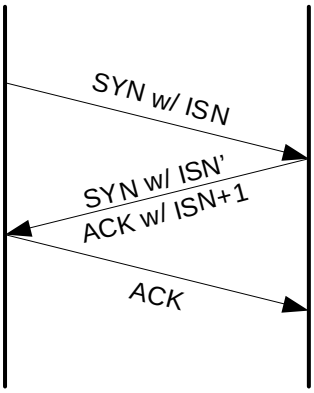
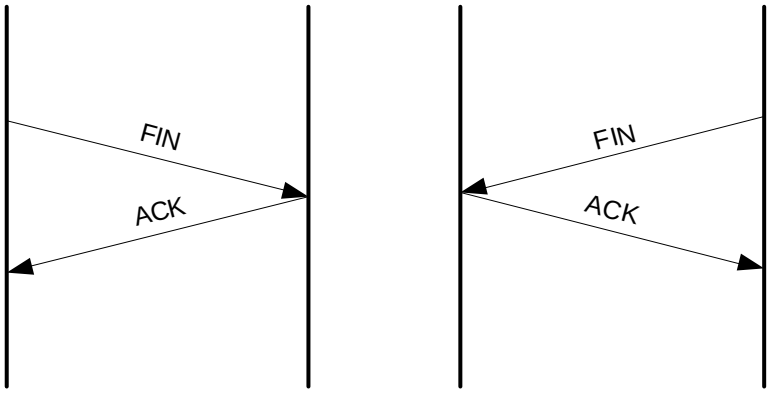
Lecture Notes for Week 5 (April 30): Congestion Control: what should hosts do?

TCP uses a 3-way handshake to setup a connection.



In theory, TCP uses a 2-way handshake in each direction to teardown the connection, but most implementations do not bother correctly ACKing FINs.



Digression: A common DoS attack is to send TCP SYNs to the target (with bogus From addresses), causing the server to allocate resources for each connection.

Sting is a tool that Tom developed which uses TCP packets to measure the internet. (In theory one could use ICMP packets, but most web servers ignore ICMP requests.) It works by sending odd-numbered TCP packets (i.e. 1, 3, 5, 7,…). One reason for doing this is that it turns off delayed ACKs, and thus gives a good measure of round-trip time. Another reason is that it allows loss-rates to be measured independently in both directions: if after sending the odd-numbered packets you send packet 2 and get no response, then you can figure out why by sending packet 4. (If you get an ACK requesting 2 then packet 2 from the client got lost; if you get an ACK requesting 6 then it was the ACK that got lost.)

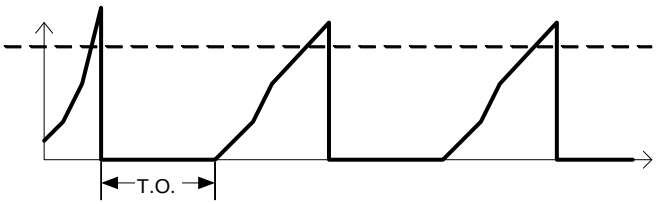
What are the goals of congestion control?
- Fairness
- Avoid Collapse
- Maximize the Net's Bandwidth

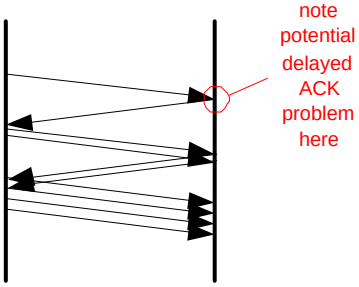
Where should it be done?
- Hosts (e.g. TCP) [problem: requires trust]
- Routers
- Use an Economic Solution

TCP uses the following 3 mechanisms:

A. Slow Start

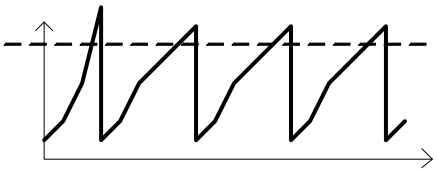
Initially set the window size at 1, and double it as long as ACKs are received. Slow Start alone would lead to a transmission pattern like this:





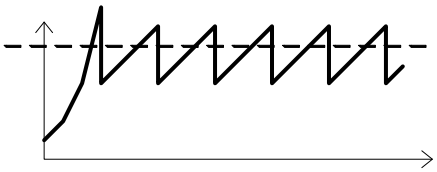
B. Fast Retransmit

Use duplicate ACKs to avoid timing-out. Slow Start combined with Fast Retransmit would look like this:



C. Fast Recovery

Use duplicate ACKs as a clock, and thus don't slow start from zero. This gives us the TCP sawtooth pattern:



The principal of additive increase / multiplicative decrease is abbreviated AIMD. AIMD will cause two TCP connections sharing a link to converge to fair use. This can be illustrated graphically: