Flow Control of TCP Protocol

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Types of Flow Control

*Rate-based control

*Delay-based control

*Window-based control

**==> TCP flow control is
window-based control**

Flow Control of TCP

Basic concept:

*A prespecified amount of data can be kept outstanding in the transmission pipe to achieve efficiency.

TCP flow control is imposed both on the sender and receiver

At the sender -- congestion window (cwnd)

Two-Phase control:

I. **Slow start** (exponetially increasing the sending rate)
II.**Congestion avoidance** (linearly increasing)

At the receiver -- advitised window

prevents a fast sender from
overflowing the buffer at a
slower receiver

At the sender (during initialization):

I. Slow Start:

(i) set cwnd = one segment,
set ssthresh = 65535bytes (64 segments)

(ii) cwnd increased by **cwnd <-- cwnd + 1**

(iii) as cwnd >= ssthresh, enters congestion avoidance

II. Congestion Avoidance:

(i) cwnd increased by
cwnd <-- cwnd + 1/cwnd

Remark: the sender takes
min(cwnd , advertised window)
as the current window size

At the sender (right after timeout expires):

I. Slow Start:

(i) set cwnd = one segment,
set ssthresh = 1/2 * (current window size)

(ii) cwnd increased by **cwnd <-- cwnd + 1**

(iii) as cwnd >= ssthresh, enters congestion avoidance

II. Congestion Avoidance:

(i) cwnd increased by
cwnd <-- cwnd + 1/cwnd

Fast retransmit and fast recovery algorithms

==> makes TCP flow control more efficient

(proposed by Jacobson in 1990)

How the receiver acknowledges the segments

* the receiver assumes that segments are arriving in sequence.

* acknowledges segments only up to
where the sequencing is maintained.

* ACK of the last segment in sequence
will be repeatedly sent to the sender
with arrival of the each segment
followed.

Fast retransmit and fast recovery algorithms

(i) as the 3rd duplicate ACK is received:

ssthresh = 1/2 * (current window size)
cwnd = ssthresh + 3 segments

(ii) cwnd = cwnd + 1

with receipt of another duplicate ACK.

(iii) as the new ACK arrives:

cwnd = ssthresh

(iv) enter congestion avoidance

What do we gain with fast retransmit and fast recovery?

(i) schedule a retransmission much earlier when timeout expires.

(ii) keeps things moving during retransmission.

(iii) avoid slow start phase.