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Revision of TCP Congestion Control

Question 1. Name the loss events that occur at 1 and 2. Explain why the congestion window is changed differently in those two cases.

- 1: duplicate ACK, congestion window reduce to half
- 2: timeout, congestion window set to zero.
- Because timeout is a more serious issue.

Question 2. What phase of the TCP congestion control algorithm coincides with the circled segment marked by 3 ?

- slow start

Question 3. What phase of the TCP congestion control algorithm coincides with the circled segment marked by 4 ?

- additive increase

Question 4: Why is the congestion window increased more rapidly at 3 than at 4?

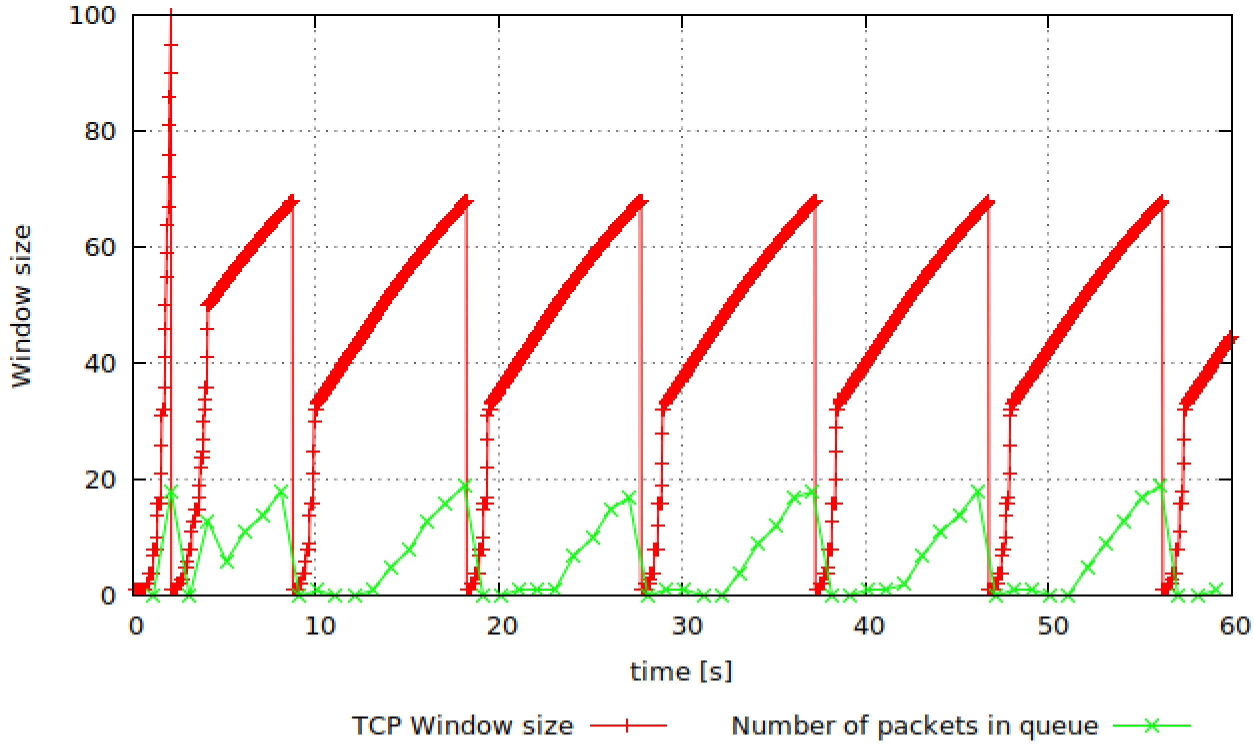
- because in 3, it increases exponentially

Question 5: Can you precisely explain what happens to the window after 2 ?

- it first enter a slow start phase, windows size doubles every RTT
- after it reaches a threshold, which is equal to CWND/2, the CWND increase by 1/CWND every RTT.

Exercise 1: Understanding TCP Congestion Control using ns-2

Question 1:



What is the maximum size of the congestion window that the TCP flow reaches in this case?

- about 69

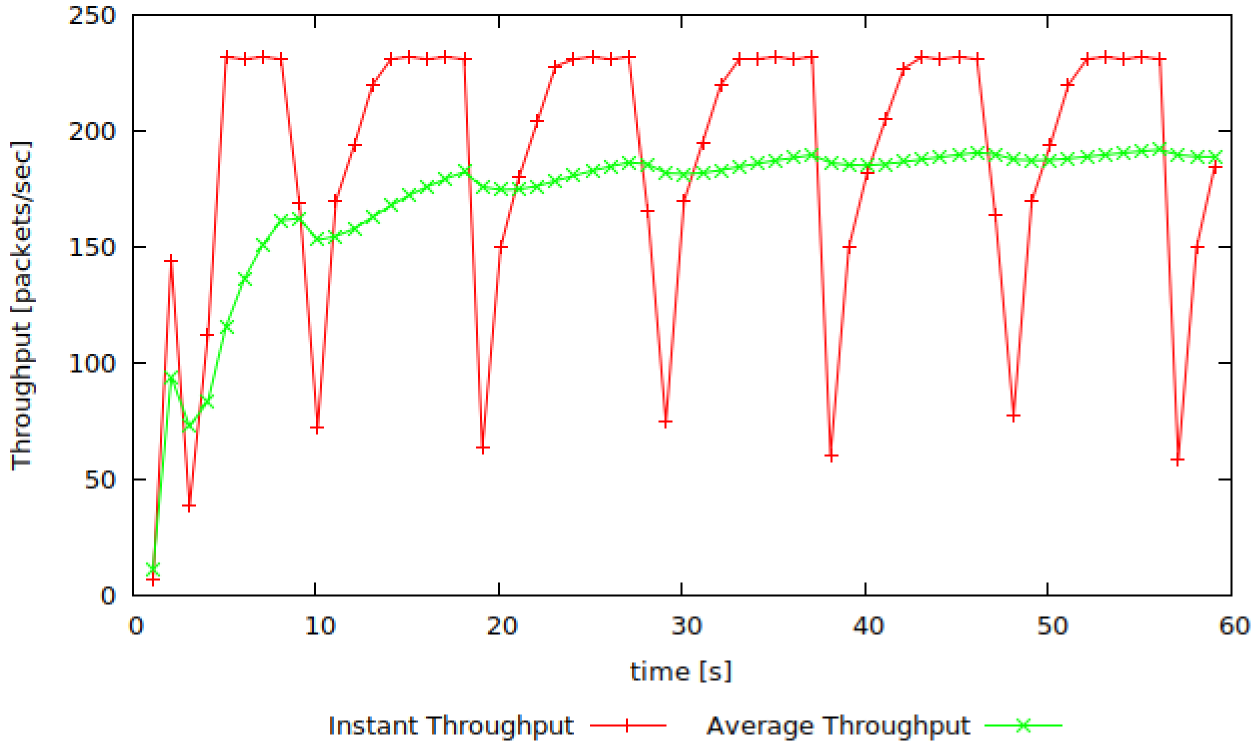
What does the TCP flow do when the congestion window reaches this value? Why?

- it set to 1
- because the queue is full, it start to drop packages.

What happens next?

- it start to grow exponentially before reach the threhold
- after that, it start to increase linearly

Question 2: What is the average throughput of TCP in this case? (both in number of packets per second and bps)



- 190 packets/second
- 190 * 540 * 8 = 820800bps

Question 3: Rerun the above script, each time with different values for the max congestion window size but the same RTT (i.e. 100ms).

How does TCP respond to the variation of this parameter?

- if we increase the max congestion windows size, the initial windows size will increase, but soon drop to 1. The fowlling windows size will be the same.
- if we decrease the max congestion windows size to a low value, so that the window size will never exceed a threshod. The window size will be stable.

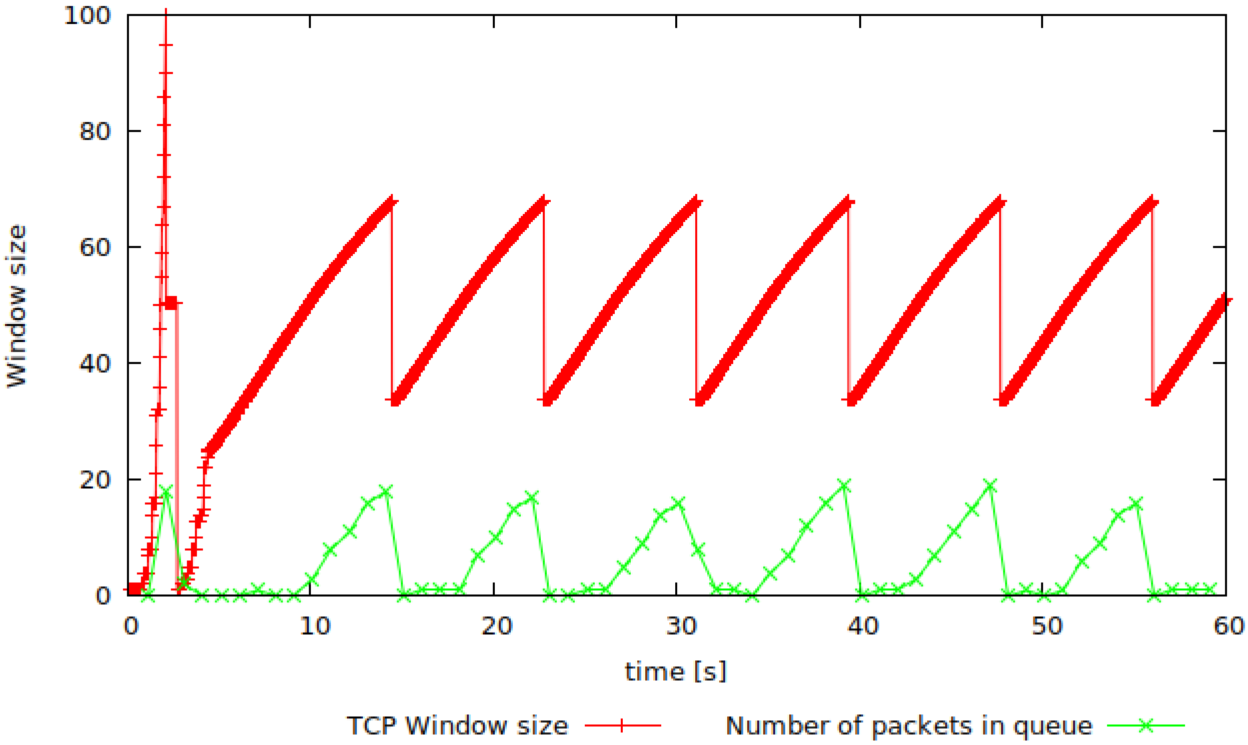
Find the value of the maximum congestion window at which TCP stops oscillating (i.e., does not move up and down again) to reach a stable behaviour. What is the average throughput (in packets and bps) at this point?

- about 65
- about 220 packets/s
- 231 * 540 * 8 = 950400bps

How does the actual average throughput compare to the link capacity (1Mbps)?

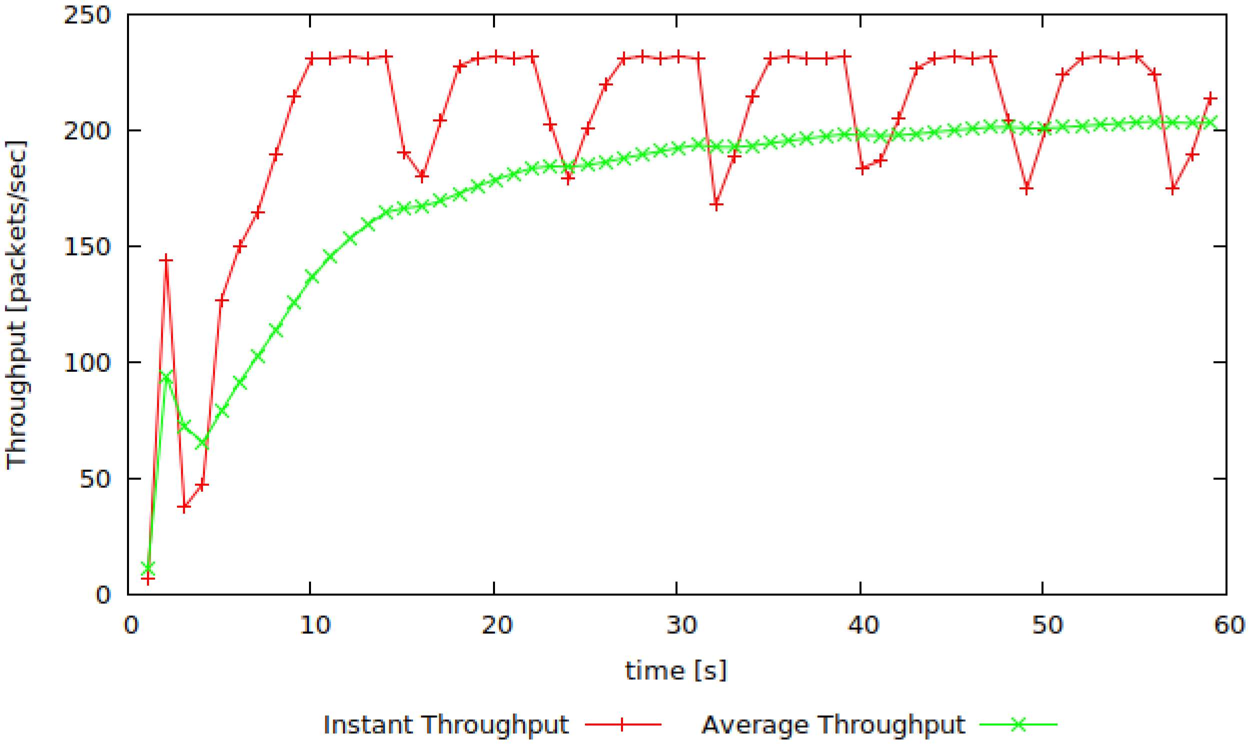
- the actual average throughput is less thant and close to the link capacity.

Question 4: Repeat the steps outlined in Question 1 and 2 (NOT Question 3) but for TCP Reno. Compare the graphs for the two implementations and explain the differences. (Hint: compare the number of times the congestion window goes back to zero in each case).



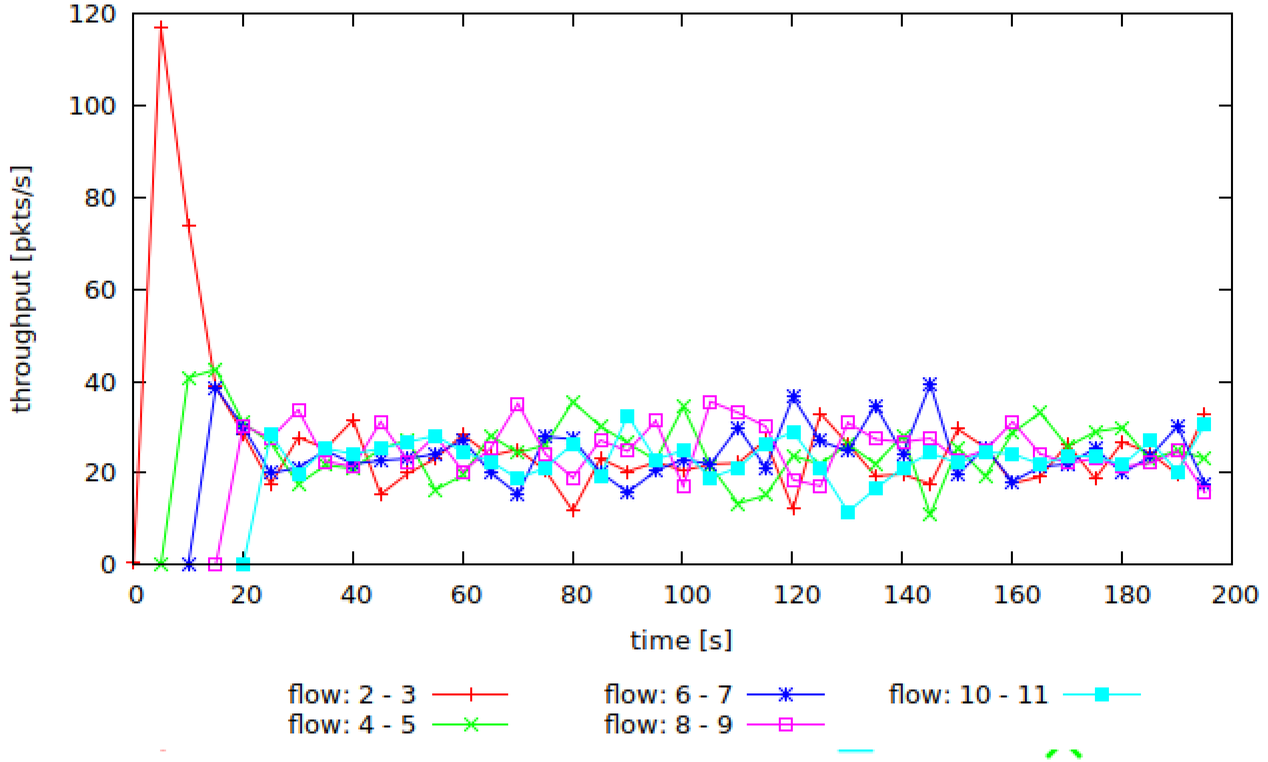
- For Tahoe, the graph goes to zero every 10 seconds
- For Reno, the graph only goes to zero at the begining

How does the average throughput differ in both implementations?



- the average throughput for Reno is highter, because the instance throughput only drops to half instead of zero in Reno.

Exercise 2: Flow Fairness with TCP



Question 1: Does each flow get an equal share of the capacity of the common link (i.e., is TCP fair) ? Explain which observations lead you to this conclusion.

-Yes, becasue all the TCP flows' throughput are about 20 packages/seconds.

Question 2.

What happens to the throughput of the pre-existing TCP flows when a new flow is created?

- the pre-existing TCP flows' throughput drops to half when a new flow is created. The new TCP flow will share the capacity with the pre-existing one.

Explain the mechanisms of TCP which contribute to this behaviour.

- TCP uses AIMD, the throughput will converges in that way.

Argue about whether you consider this behaviour to be fair or unfair.

- it is fair because every flow are treated equally
- it is unfair in some situation when we need some kind of priority; futhermore, we can cheap by increasing windows size more quickly, or open more TCP connections. That will lead to unfairenss as well.

Exercise 3: TCP competing with UDP

Question 1: How do you expect the TCP flow and the UDP flow to behave if the capacity of the link is 5 Mbps ?

- UDP will reach it max speed which is about 4M
- TCP will use the remained capacity which is about 1M

Question 2: Why does one flow achieve higher throughput than the other? Try to explain what mechanisms force the two flows to stabilise to the observed throughput.

- because UDP does not have a flow control, it will always try to deleivery files in its maximun speed.
- So that TCP can only use the remained capacity

Question 3: List the advantages and the disadvantages of using UDP instead of TCP for a file transfer, when our connection has to compete with other flows for the same link. What would happen if everybody started using UDP instead of TCP for that same reason?

- UDP does not have a flow control, it can transfer files as quickly as possible
- But if every one uses UDP instead of TCP. When the link capacity become the bottleneck, the overall speed will drop significantly. The whole network will become usable.