

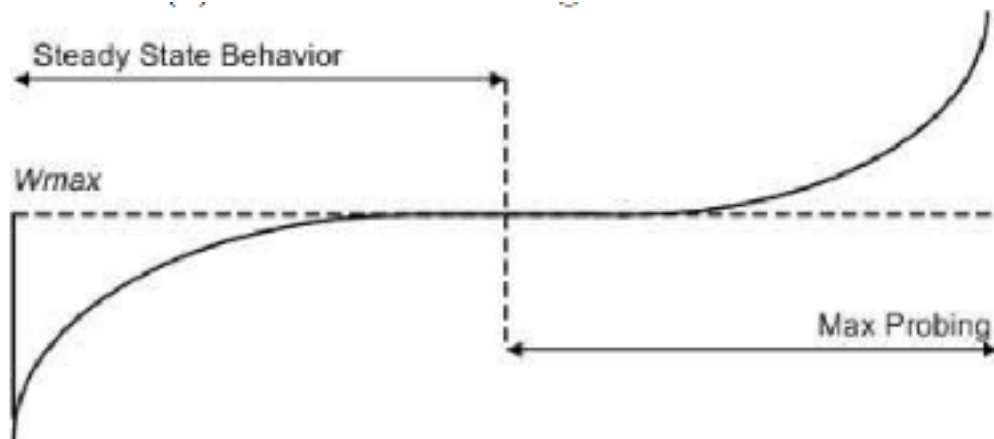
Item #1:

The increasing part of the cubic graph is cubic, while the decreasing part is $W_{lastmax}$ multiple decrease. The increasing part of the TCP reno is a straight line with slope, which is $cwnd+1$ graph, while the decreasing part is multiple decrease, the decreasing line is almost perpendicular to the horizontal as following



Item #2:

The only difference between tcp reno and cubic is shown in additive increase, which is active when window size is smaller than capacity. CUBIC window growth function is shown below, so the increasing part of cubic graph will be like the CUBIC window growth function.



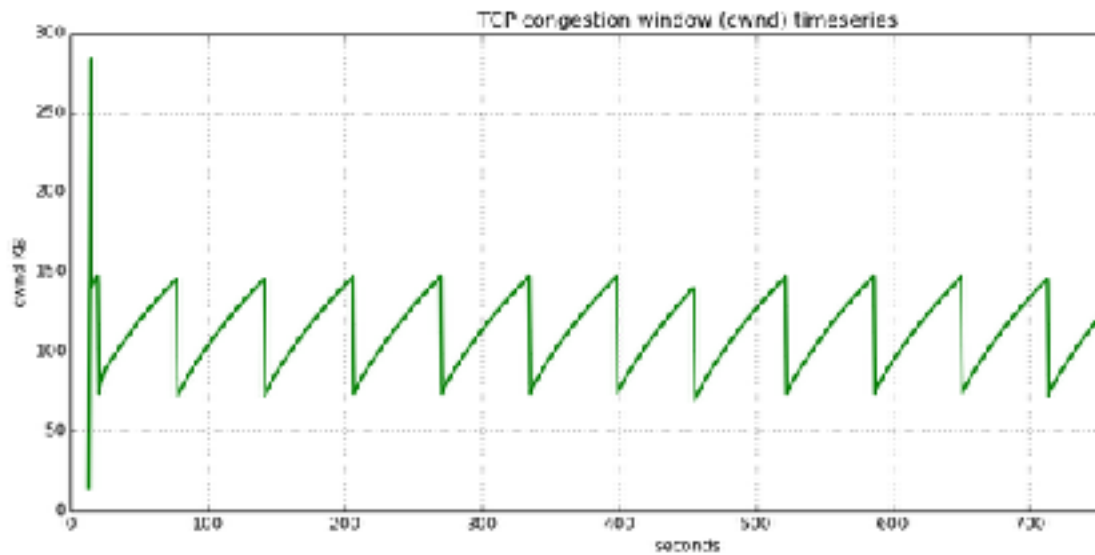
(b) CUBIC window growth function.

Item #3:

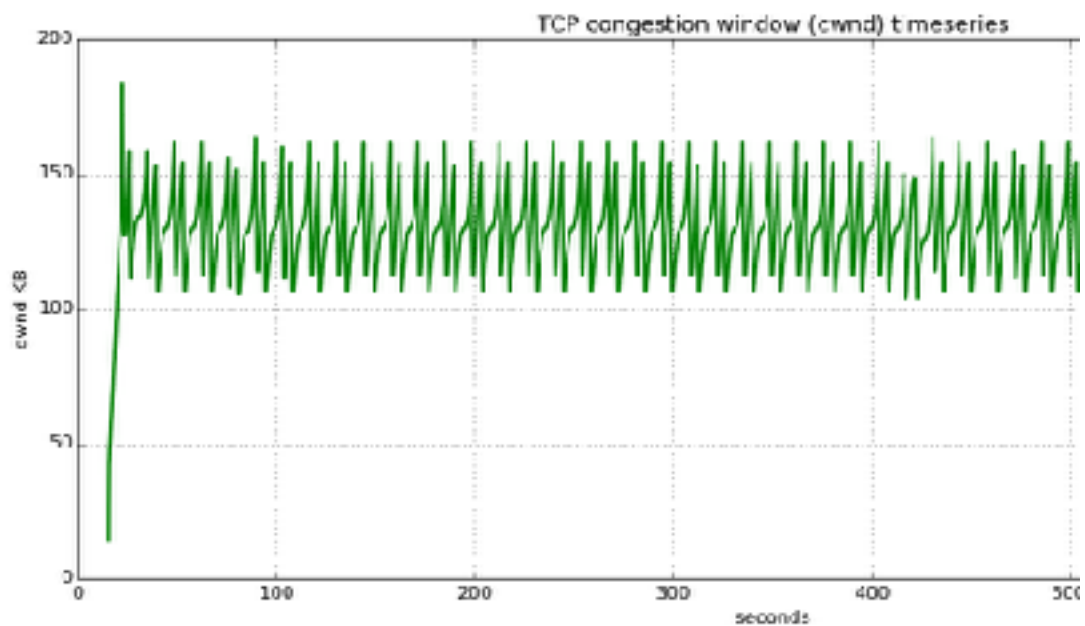
The difference is, for large queue, $cwnd$ need more time, because the tcp reno use additive increase.

Item #4:

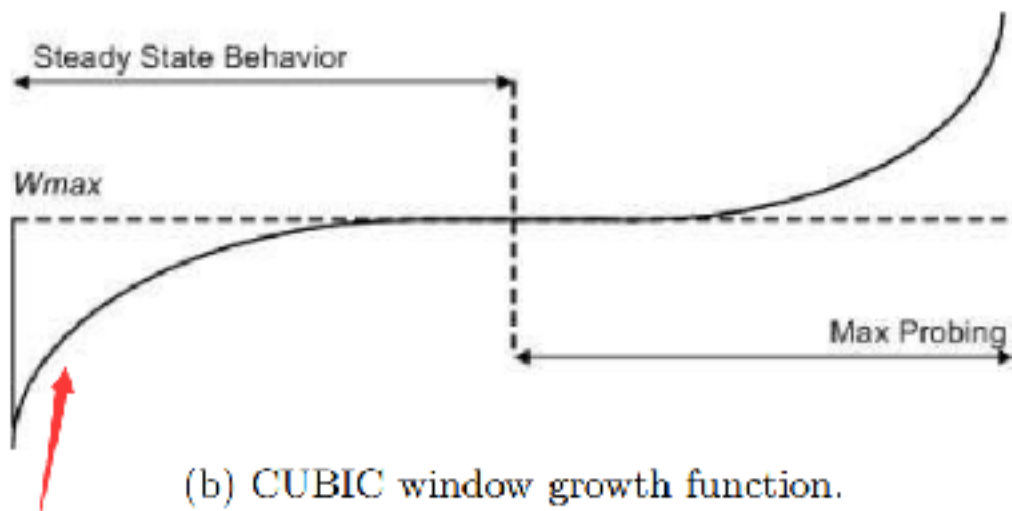
Reno takes about 80s to W_{max} , while cubic takes less than 10s to W_{max} . cubic can quickly increase when cwnd is far away from W_{max} as show the picture the red arrow pointed.



Reno Window curves



CUBIC window curves



Item #5:

I only predict the right shape, but not the quantity. I forget to change the scale, because cubic is faster when is far away from, it should be steeper than reno. small queue size match my picture better.

Item #6:

Before iperf, download 1.0s, ping 20ms

After iperf, download 4.5s, ping avg 700ms

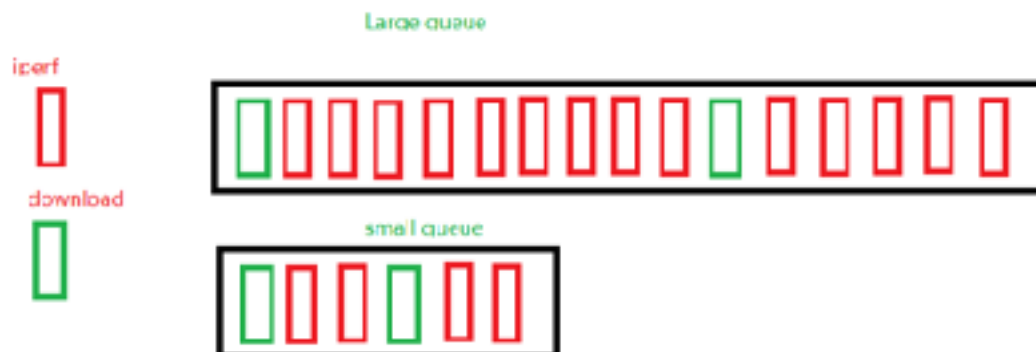
The presence of a long lived flow on the link make download time longer and make network lantency longer. Because iperf occupy the buffer that make download and ping occupy little buffer to complete its job. And iperf occupy schedule too.

Item #7:

large queue: download time 3.2s

small queue: download time 2.0s

When iperf is on, the larger the queue, iperf will occupy more size of queue, download occupy part of queue, it will take longer time to deal with longer queue. I think queue info like below picture because fairless rule.



Item #8:

Before iperf :Ping 20.2ms, download 1.0s

After iperf: ping 20.2ms, download 2.0s

When using traffic control, the presence of a long lived flow on the link not affect ping and download much.the results is my expected,Because they evenly occupy the resource, download time should 2 times than not run iperf.

Item #9:

Large queue download 4.4s

Minq download 2.8s

Tcp reno use less time download whether use large queue or small queue than cubic.

Tcp reno perform a little better. I think cubic make more aggressive increase than reno cause loss rate increase trigger retransmit finally cause download take longer time.