50.012 Networks Lab 4

Q1. What is the normal time required to download the webpage on h1 from h2?

1 second

Q2. What was your initial expectation for the congestion window size over time?

My initial expectation was for the cwnd to increase exponentially like in the slow start phase, where cwnd is multiplied by 2 with each RTT.

Q3. After starting iperf on h1, did you observe something interesting in the ping RTT?

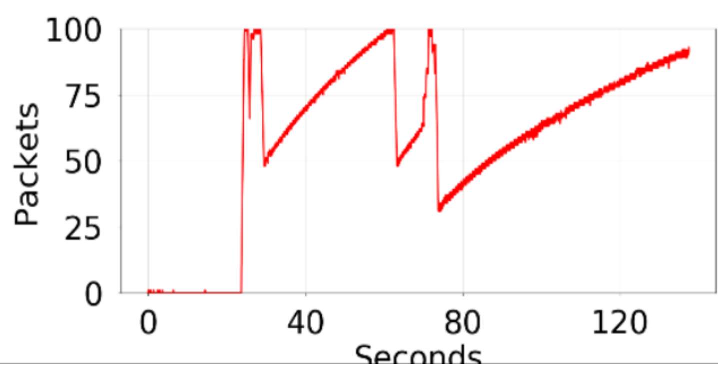
Ping RTT increased greatly when iperf was running.

Q4. After starting iperf on h1, why does the web page take so much longer to download?

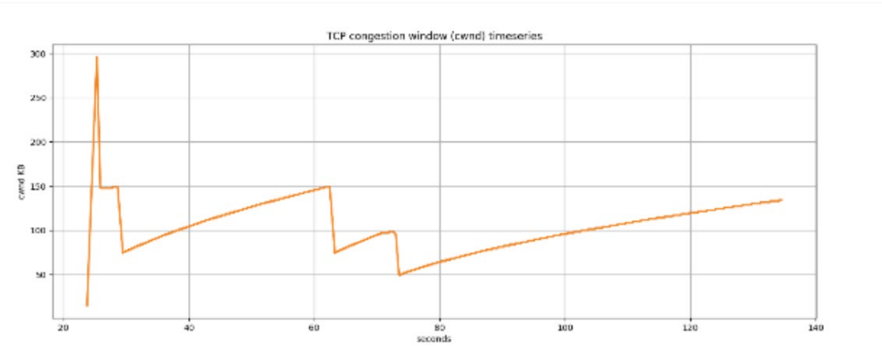
The total link bandwidth is shared with iperf. Hence, the resulting effective bandwidth would be reduced, leading to slower download speeds. Thus, the web page took much longer to download.

Q5. Please provide the figures for the first experiment (with qlen 100).

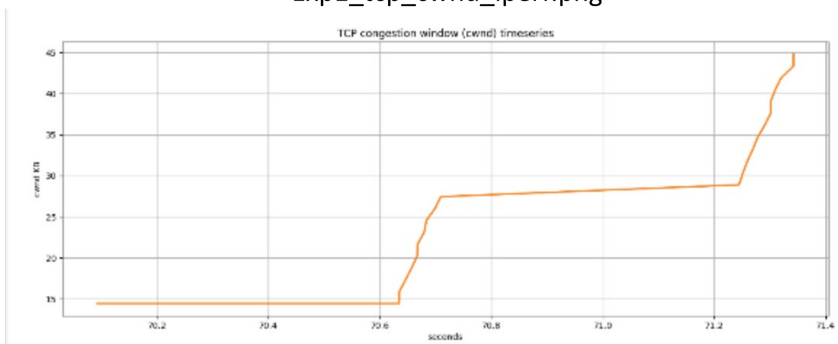
```
mininet> h2 wget h1
--2021-10-29 10:22:00--  http://10.0.0.1/
Connecting to 10.0.0.1:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 177669 (174K) [text/html]
Saving to: 'index.html'

     0K .......... .......... .......... .......... .......... 28% 36.8K 3s
    50K .......... .......... .......... .......... .......... 57% 31.6K 2s
   100K .......... .......... .......... .......... .......... 86%  354K 0s
   150K .......... .......... ...                             100% 13.4K=4.8s
```



Exp1_queue.png



Exp1_tcp_cwnd_iperf.png

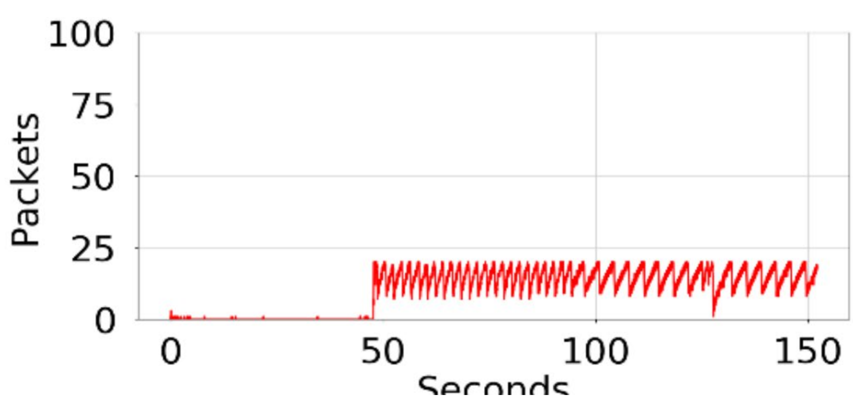


Exp1_tcp_cwnd_wget.png

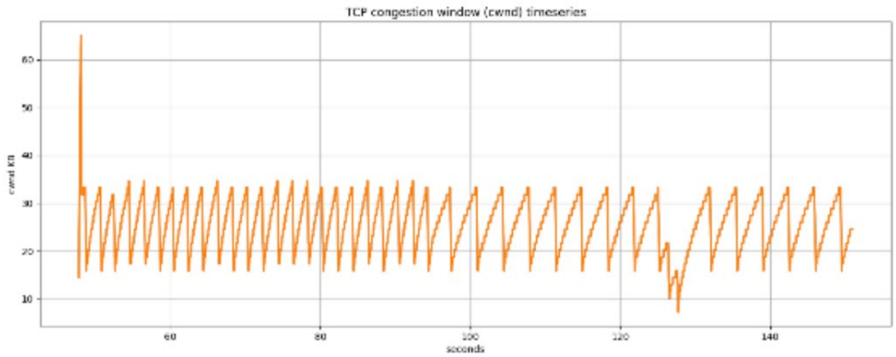
Q6. Please comment on what you can see in the figures.

The overall graph shape of exp1_queue.png and exp1_tcp_cwnd_iperf.png is a representation of tcp congestion control, with cwnd being cut by half with each lost packet, and increasing incrementally with each RTT.

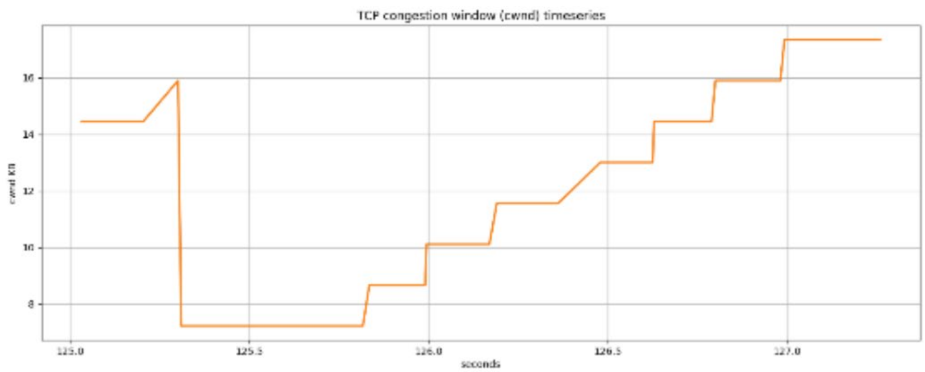
Q7. Please provide the figures for the second experiment (with qlen 20).



Exp2_queue.png



Exp2_tcp_cwnd_iperf.png



Exp2_tcp_cwnd_wget.png

Q8. Please comment on what you can see in the figures and what is different from the previous experiment. Explain the reason behind the difference.

With a smaller packet length, it takes a shorter time to fill up the buffer compared to before, and in the tcp cwnd iperf graph, there is much more frequent multiplicative decreases.

With a smaller queue, iperf experiences more frequent multiplicative decreases. This creates better TCP fairness as iperf and wget can share the bandwidth more evenly.