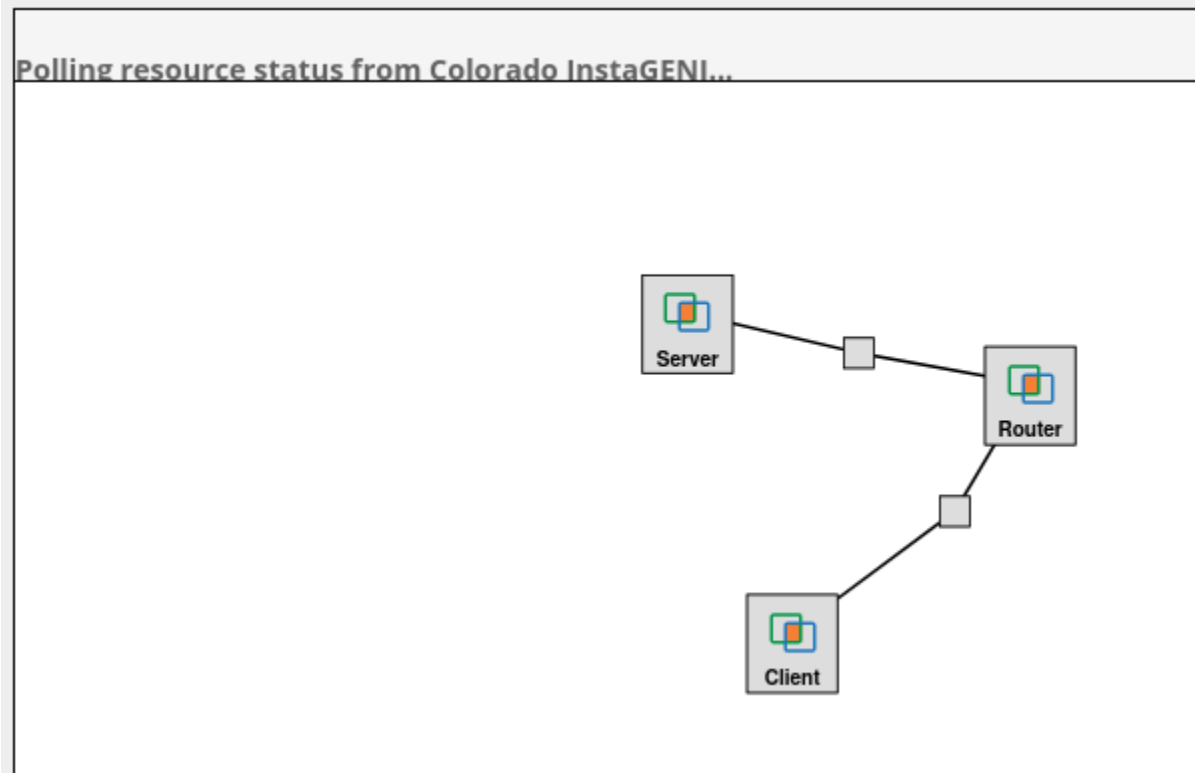
Site Topology:



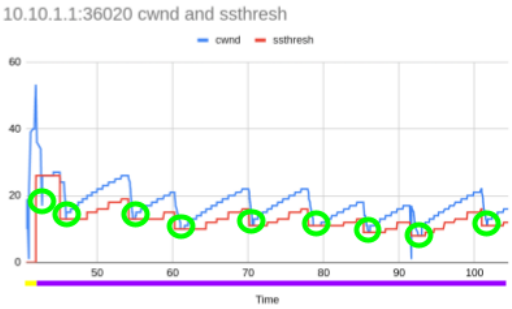
iperf output for the running results:

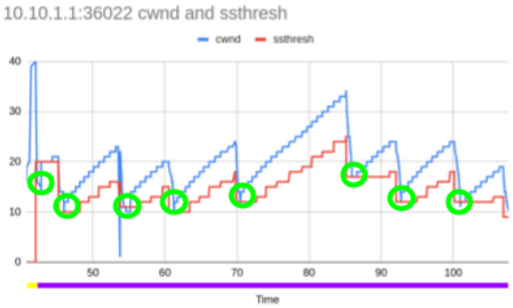
```
jboicken@client:~$ iperf -t 60 -c server -P 3
------------------------------------------------------------
Client connecting to server, TCP port 5001
TCP window size: 85.0 KByte (default)
------------------------------------------------------------
[  4] local 10.10.1.1 port 36020 connected with 10.10.2.1 port 5001
[  5] local 10.10.1.1 port 36022 connected with 10.10.2.1 port 5001
[  3] local 10.10.1.1 port 36018 connected with 10.10.2.1 port 5001
[ ID] Interval       Transfer     Bandwidth
[  4]  0.0-63.9 sec  2.50 MBytes   328 Kbits/sec
[  3]  0.0-64.0 sec  3.12 MBytes   409 Kbits/sec
[  5]  0.0-67.2 sec  2.75 MBytes   343 Kbits/sec
[SUM]  0.0-67.2 sec  8.38 MBytes  1.05 Mbits/sec
jboicken@client:~$
```

Some of the tcpprobe output: (Loaded into CSV)

53.99633126	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfa0e7	0x5edef737	15	11	232832	821616	29312
54.00845528	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfa0e7	0x5edef737	14	11	232832	822288	29312
54.02060066	10.10.1.1:36020	10.10.2.1:5001	44	0xa424ae54	0xa4241b44	26	19	298496	828550	29312
54.0326543	10.10.1.1:36020	10.10.2.1:5001	44	0xa424b3fc	0xa4241b44	26	19	298496	825399	29312
54.04465229	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51619d	0x2e50d9dd	24	18	187136	827320	29312
54.05659365	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfa68f	0x5edef737	14	11	232832	822898	29312
54.06873596	10.10.1.1:36018	10.10.2.1:5001	32	0x2e516745	0x2e50df85	24	18	187136	825840	29312
54.08070228	10.10.1.1:36018	10.10.2.1:5001	32	0x2e516ced	0x2e50e52d	24	18	187136	826074	29312
54.0925882	10.10.1.1:36018	10.10.2.1:5001	32	0x2e517295	0x2e50ead5	24	18	187136	823279	29312
54.10460058	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfa68f	0x5edef737	13	11	232832	823389	29312
54.11659896	10.10.1.1:36020	10.10.2.1:5001	44	0xa424b9a4	0xa4241b44	26	19	298496	824147	29312
54.12854839	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51783d	0x2e50f07d	24	18	187136	820804	29312
54.14076553	10.10.1.1:36018	10.10.2.1:5001	32	0x2e517de5	0x2e50f625	24	18	187136	818613	29312
54.15267031	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfac37	0x5edef737	13	11	232832	822298	29312
54.1647612	10.10.1.1:36020	10.10.2.1:5001	44	0xa424b9a4	0xa4241b44	25	13	298496	822969	29312
54.17661517	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51838d	0x2e50fbcd	24	18	187136	816739	29312
54.18853444	10.10.1.1:36018	10.10.2.1:5001	32	0x2e518935	0x2e510175	24	18	187136	816581	29312
54.20069508	10.10.1.1:36018	10.10.2.1:5001	32	0x2e518edd	0x2e51071d	24	18	187136	816416	29312
54.21261872	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfac37	0x5edef737	12	11	232832	821369	29312
54.22452981	10.10.1.1:36018	10.10.2.1:5001	32	0x2e519485	0x2e510cc5	24	18	187136	816312	29312
54.23656565	10.10.1.1:36018	10.10.2.1:5001	32	0x2e519a2d	0x2e51126d	24	18	187136	816176	29312
54.24869018	10.10.1.1:36018	10.10.2.1:5001	32	0x2e519fd5	0x2e511815	24	18	187136	816069	29312
54.26055895	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51a57d	0x2e511dbd	24	18	187136	816006	29312
54.27252235	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51b0cd	0x2e512365	25	18	187136	817435	29312
54.28468652	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51b675	0x2e51290d	25	18	187136	818700	29312
54.29667887	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51bc1d	0x2e512eb5	25	18	187136	819818	29312
54.32062324	10.10.1.1:36022	10.10.2.1:5001	52	0x5edfac37	0x5edef737	11	11	232832	822018	29312
54.33236958	10.10.1.1:36020	10.10.2.1:5001	52	0xa424b9a4	0xa4241b44	24	13	298496	821937	29312
54.34459393	10.10.1.1:36020	10.10.2.1:5001	52	0xa424b9a4	0xa4241b44	23	13	298496	819635	29312
54.34593081	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51c1c5	0x2e51345d	25	18	187136	820818	29312
54.36834173	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51c76d	0x2e513a05	25	18	187136	826330	29312
54.39245497	10.10.1.1:36020	10.10.2.1:5001	52	0xa424b9a4	0xa4241b44	22	13	298496	819148	29312
54.40425984	10.10.1.1:36020	10.10.2.1:5001	52	0xa424bf4c	0xa4241b44	22	13	298496	818709	29312
54.41625955	10.10.1.1:36020	10.10.2.1:5001	52	0xa424bf4c	0xa4241b44	21	13	298496	819800	29312
54.41781268	10.10.1.1:36018	10.10.2.1:5001	32	0x2e51d2bd	0x2e514555	25	18	187136	827848	29312
54.42817982	10.10.1.1:36020	10.10.2.1:5001	52	0xa424c4f4	0xa4241b44	21	13	298496	819243	29312
54.44020486	10.10.1.1:36020	10.10.2.1:5001	52	0xa424c4f4	0xa4241b44	20	13	298496	820245	29312

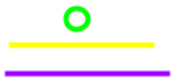
Graphs:





Additional Annotations

3rd dup ACK -
Slow Start -
Congestion Avoidance -



Plot Exercise Questions:
1. In Slow Start, we see the cwnd double with every transmission, as the cwnd increases by one with every packet that gets ACKed. In Congestion Avoidance, we see the cwnd increasing by only one each transmission because it takes all of the packets being ACKed to increase the cwnd by 1. (cwnd += 1/cwnd for each ACK)

2. When the 3rd dup Ack is reached, cwnd and ssthresh values are changed to be half of what they were. Meaning cwnd = cwnd / 2 and ssthresh = ssthresh / 2. This can be observed at the dropping points in the graphs above.

What We Learned:
In this lab, we learned how to use geni to create a Server-Router-Client topology. We learned how to configure those 3 services so that we can generate the outputs shown in the report above. We also learned how to generate and use relevant data, as packets were sent across the network. Using the data generated, we were able to generate graphs that show cwnd and ssthresh values. Using these graphs we learned how to read/understand the graphs and pinpoint key points where periods of slow start and congestion avoidance occurred as well as where timeout may have occurred.