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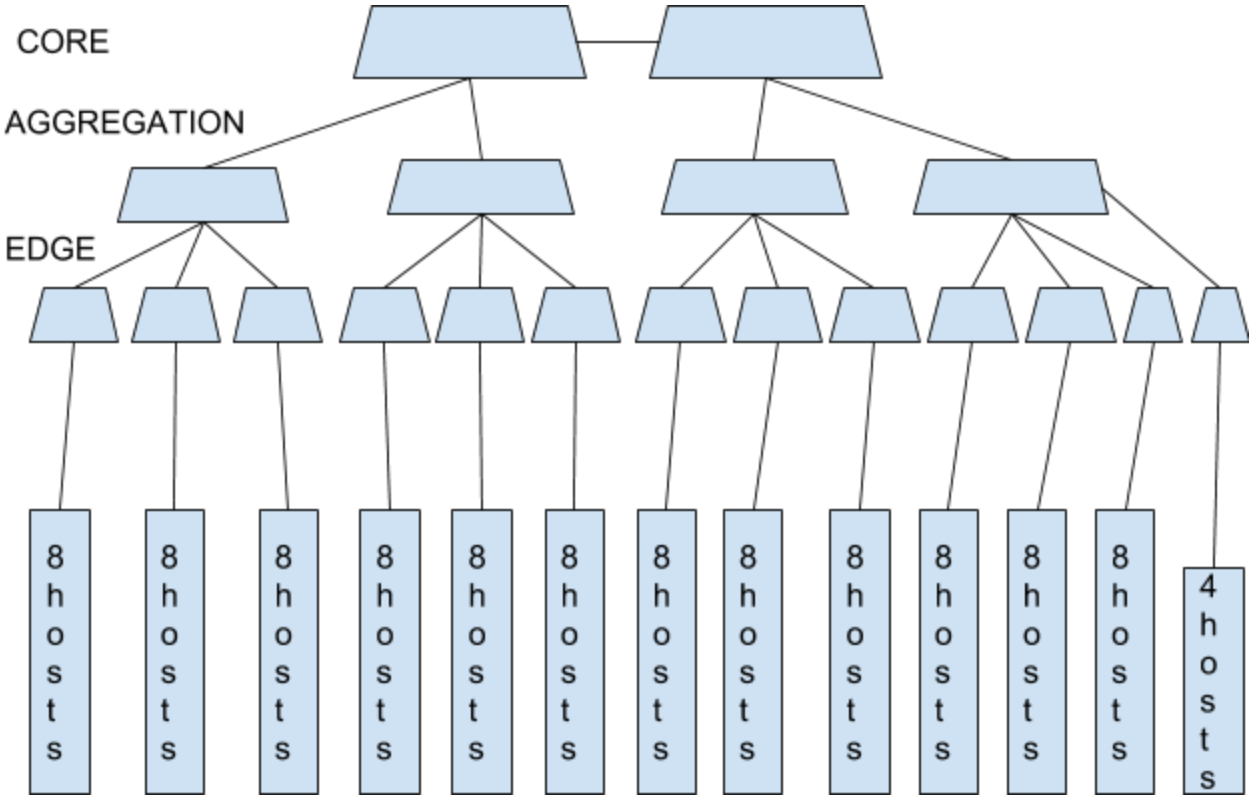
Network Topology Assignment

Overview

This assignment consisted of building a three-layer fat tree topology simulated in the mininet ova. To implement this we followed the diagram below, with 2 switches on core layer, then 4 switches on aggregation layer, and then 13 switches on edge layer connecting 100 hosts on 100mBit links.



In total, nineteen switches were used, with two primary switches on the core layer, four switches on the aggregation layer, and thirteen additional switches to connect the hosts.
With this set-up, we were able to stay under the budget of $10,000 dollars, with the primary costs coming from the numerous switches used to link the 100 hosts.For example, host 1 to host 8 are connected to the left most edge layer switch. Host 9 to host 16 are connected to the second from the left-most edge layer switch, etc,etc. We used 1GBPS links to connect the 2 switches on the core layer. We used 1GBPS links to connect each of the 4 switches on aggregation layer to the core layer. We used 100mbps links to connect each of the 13 edge layer switches to the aggregation layer switches in addition to connect each host to the edge layer switches. Total cost is $5888.

Learning Switch

The learning switch is based on the sample code in pox/pox/forwarding/l2_learning.py
Start the cmd in a seperate terminal before running the python script.
cd ~/pox
./pox.py log.level --DEBUG forwarding.l2_learning

Hypothesis

As for the topology, we concluded that there may be some bandwidth issues during periods of high load. High usage would in essence, produce a Denial of Service effect, as traffic that saturates one edge switch would affect the ability of other hosts to get data out.
To test this, we simulated the topology on mininet, and then used several xterm windows connected to the hosts, and ran iperf on each one.

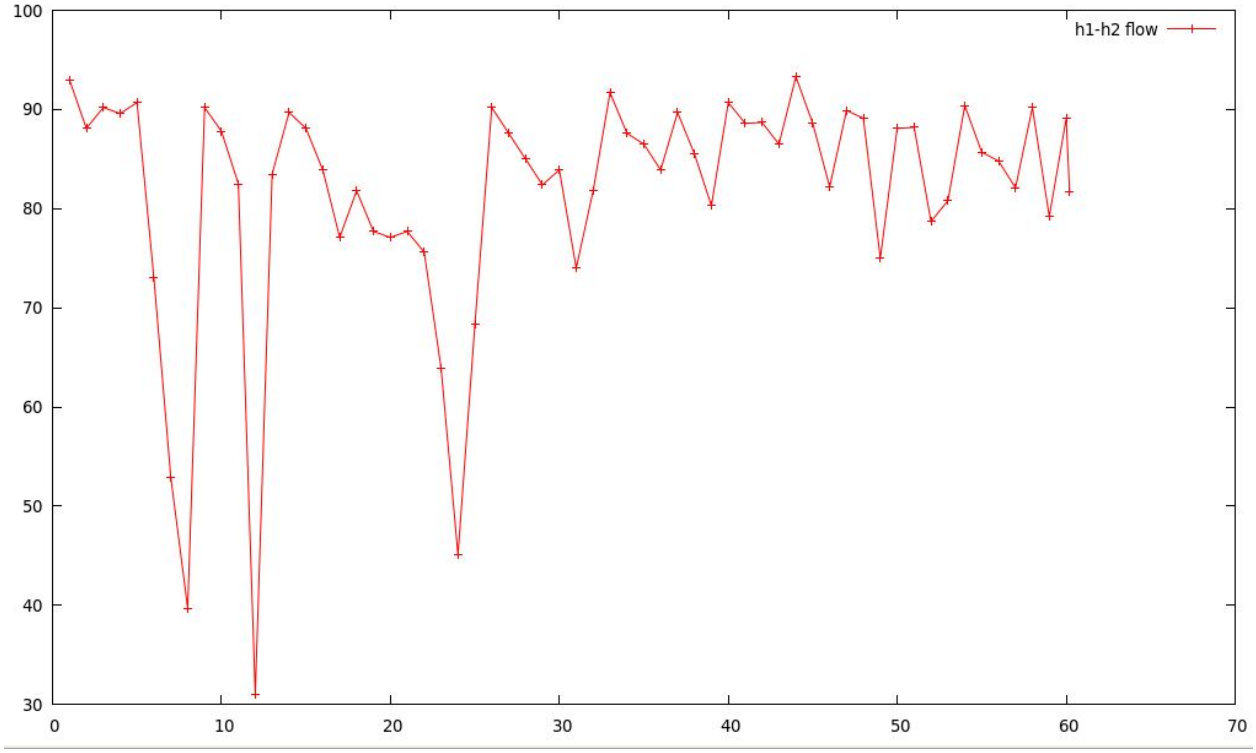
A total of 5 xterm iperf threads were used to simulate high traffic. The victim node utilized two iperf tcp servers, that were run on two different ports, 5565 and 5566. This allowed us to accurately collect data from port 5566, while maintaining a high user load on port 5565.
In order to test the throughput of the topology correctly, we aimed to test across the entire topology, hitting a host in each of the edge switches.
The tests we ran are as follows:

- Node H-1 to H2 (Same Edge Switch, Same Aggregation Switch, Same Core Switch)
- Node H-1 to H10 (Different Edge Switch, Same Aggregation Switch, Same Core Switch)
- Node H-1 to H40 (Different Edge Switch, Different Agg. Switch,Same Core Switch)
- Node H-1 to H70 (Different Edge Switch, Different Agg. Switch, Neighboring Core Switch)
- Node H-1 to H100 (Different Edge Switch, Different Agg. Switch, Neighboring Core Switch)

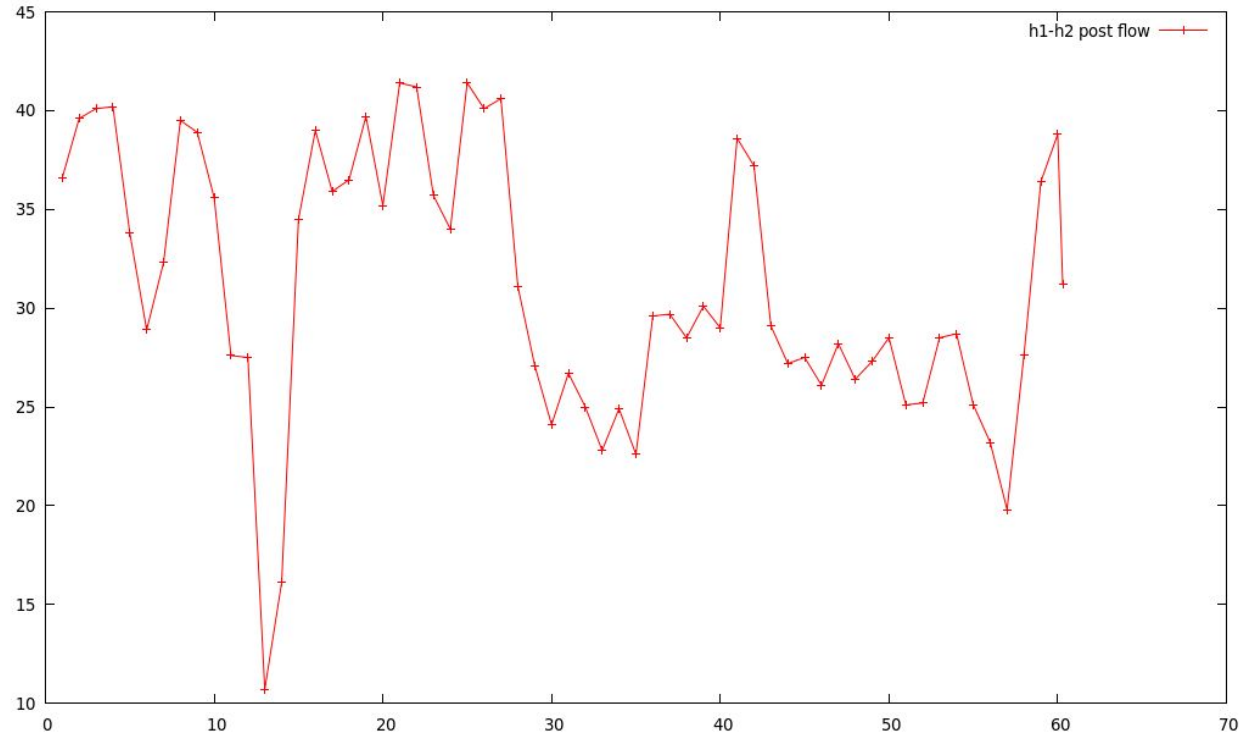
Results are shown below.

Results (X-axis = time(seconds), Y-axis = mbits/sec):

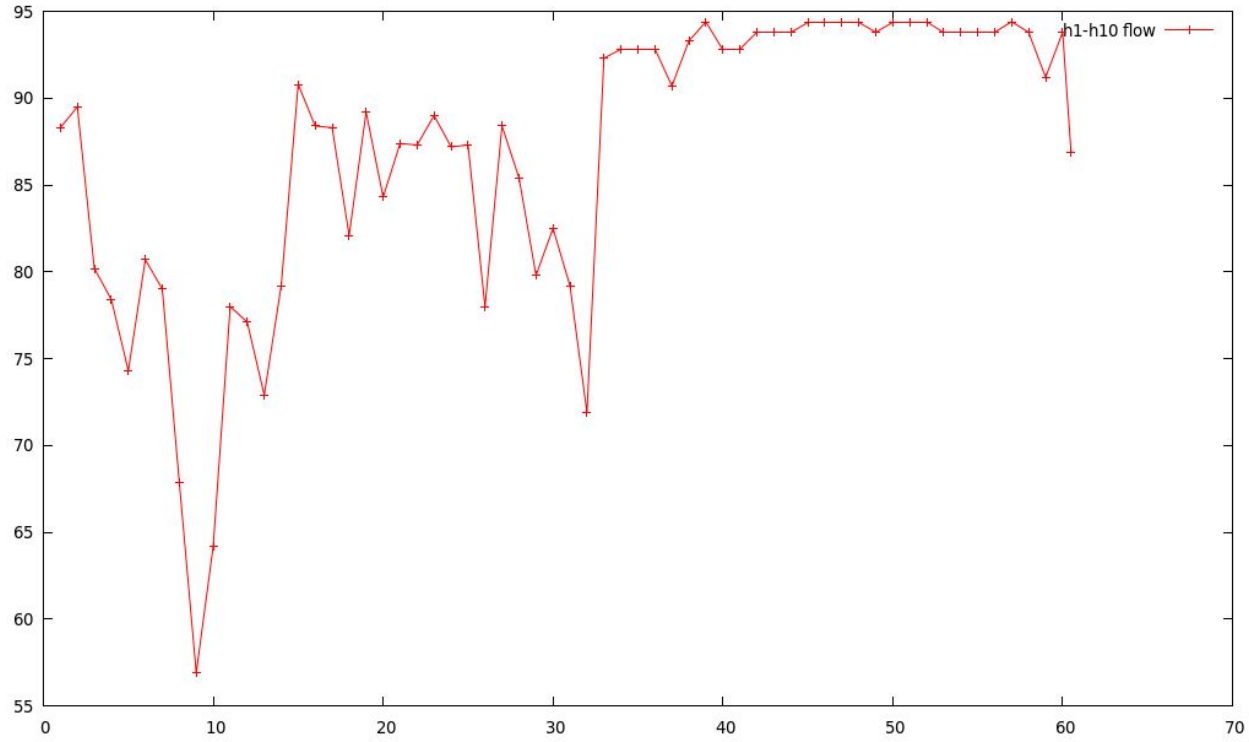
H1-H2 (Without Traffic)



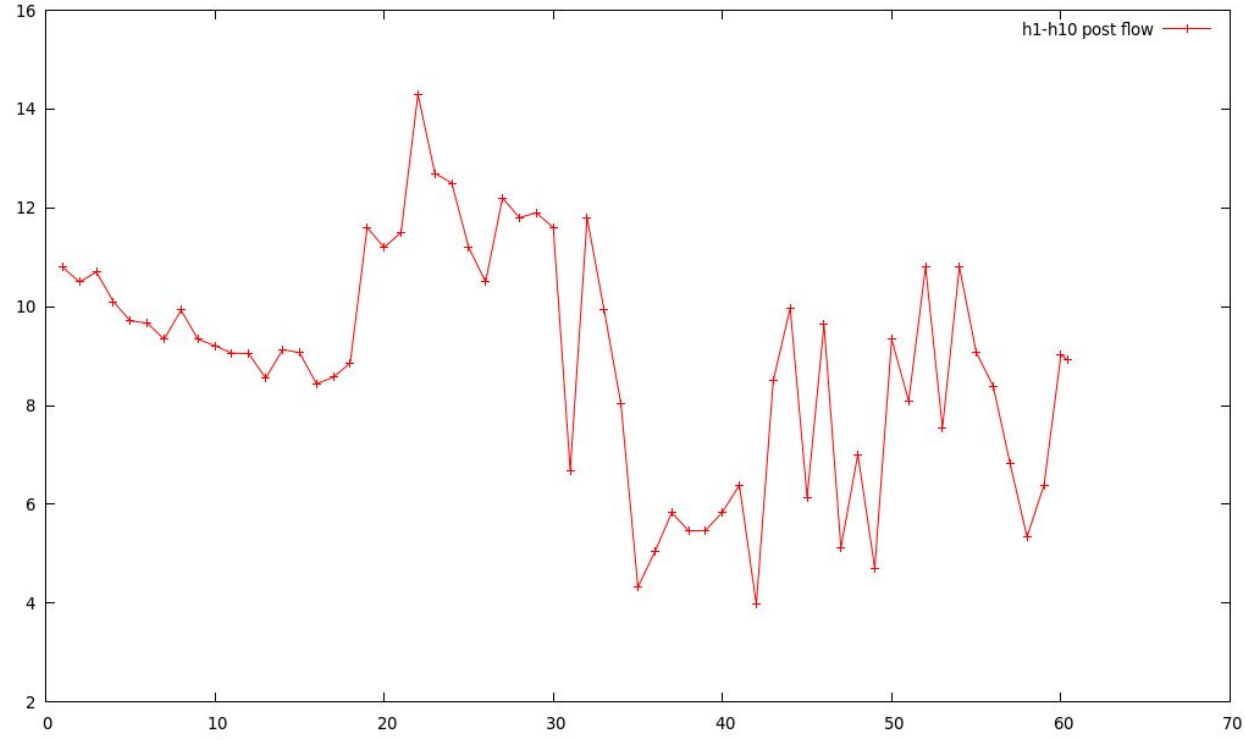
H1-H2 (With Network Traffic)



H1-H10 (Without Network Traffic)

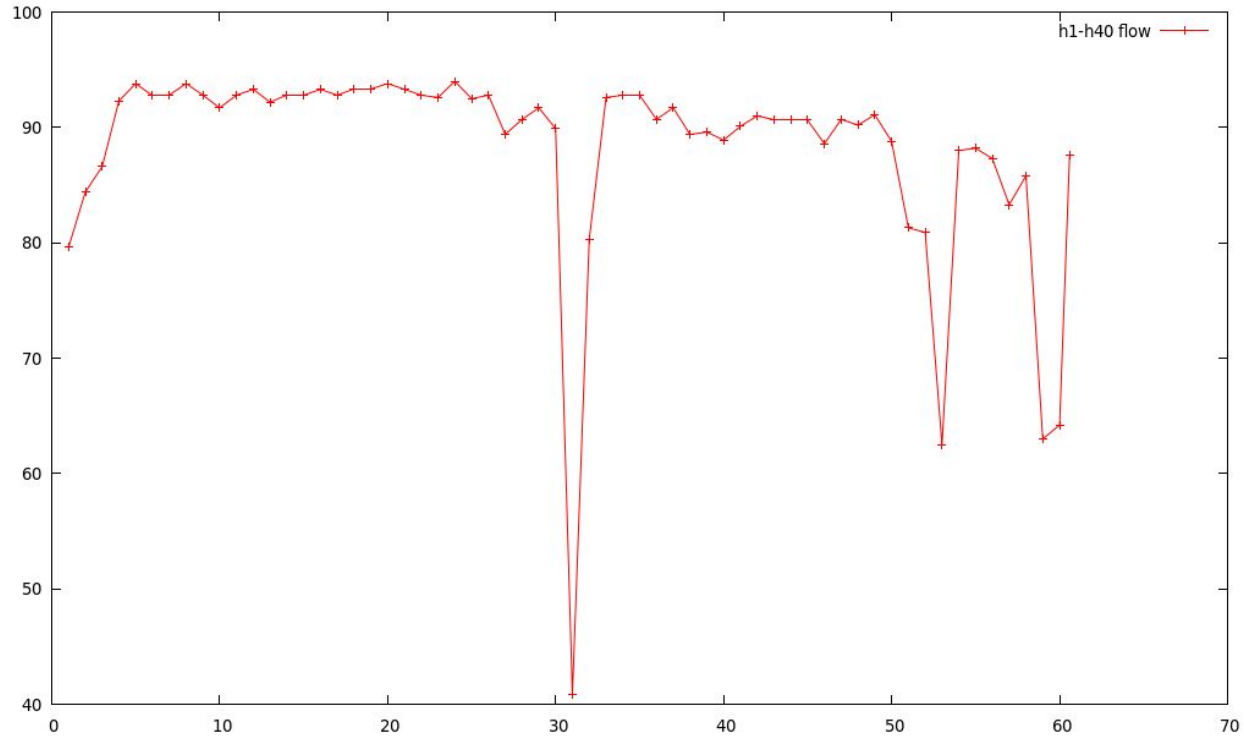


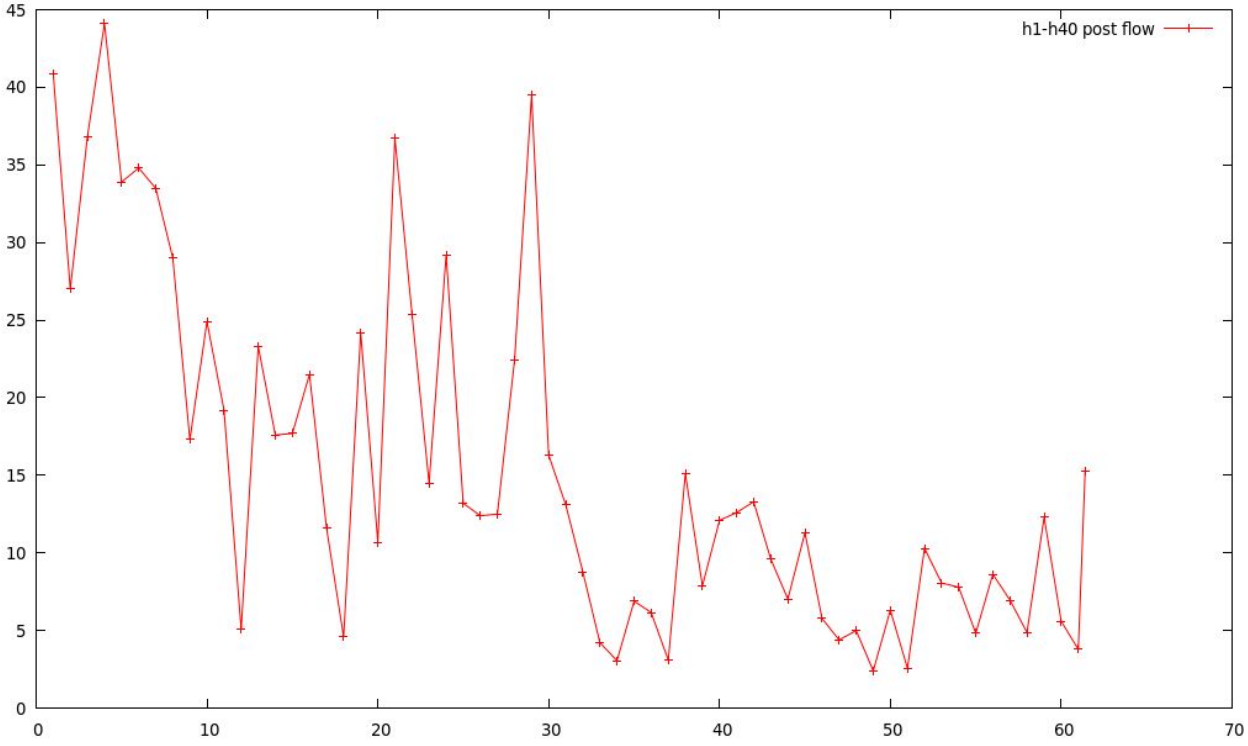
H1-H10 (With Network Traffic)



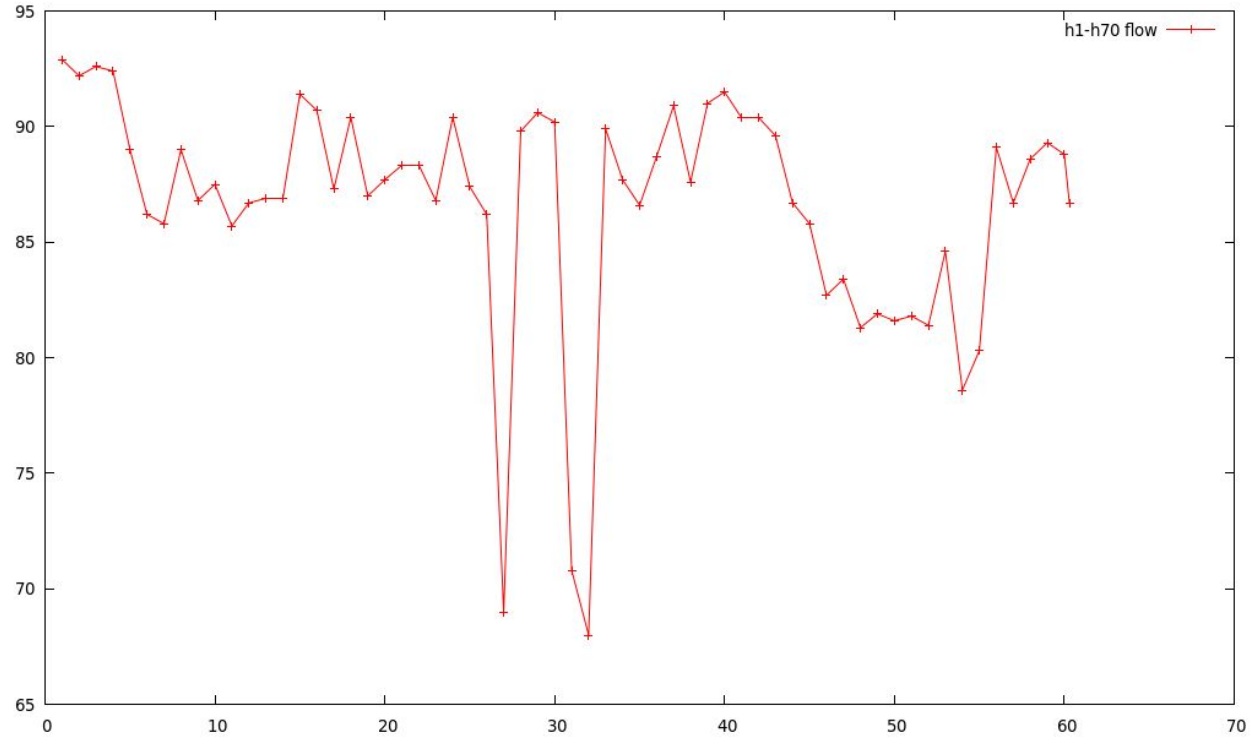
Performance dropped drastically once 5 clients were introduced, even reaching close to 5mbits/sec at some intervals.

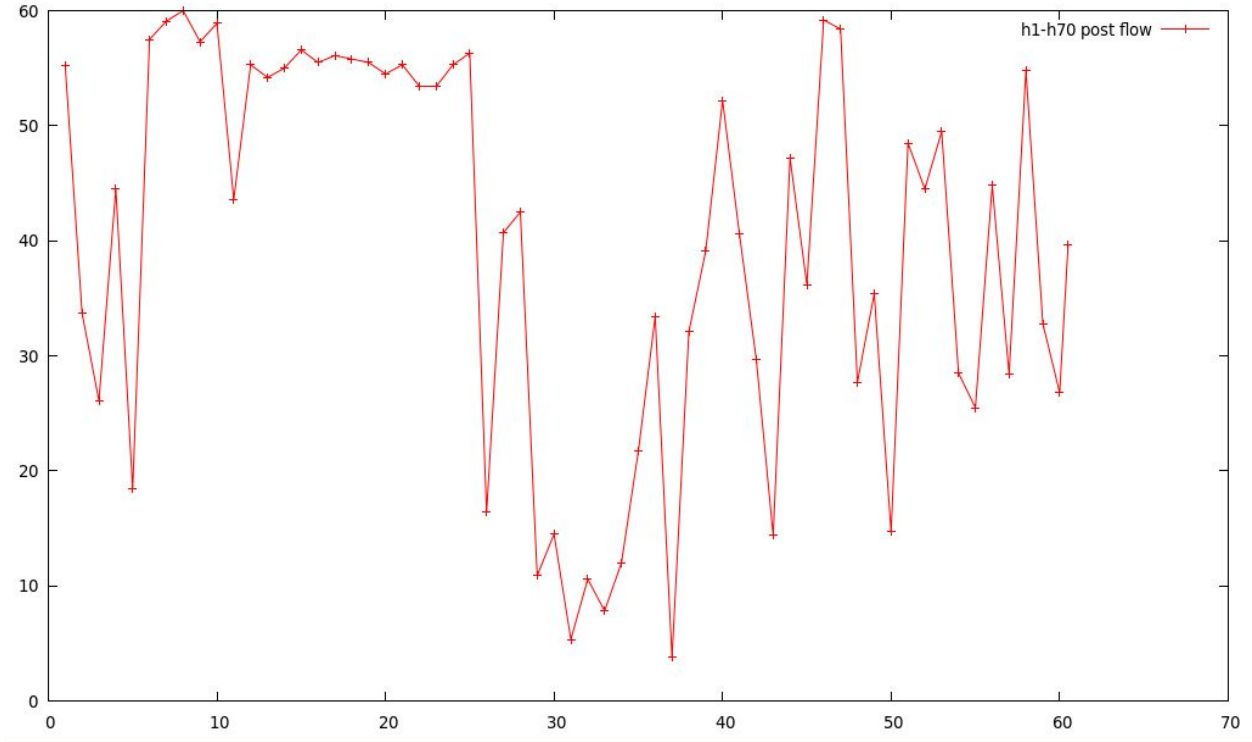
H1-H40 (Without Network Traffic)


h1-h40 flow
100
90
80
70
60
50
40
0
10
20
30
40
50
60
70

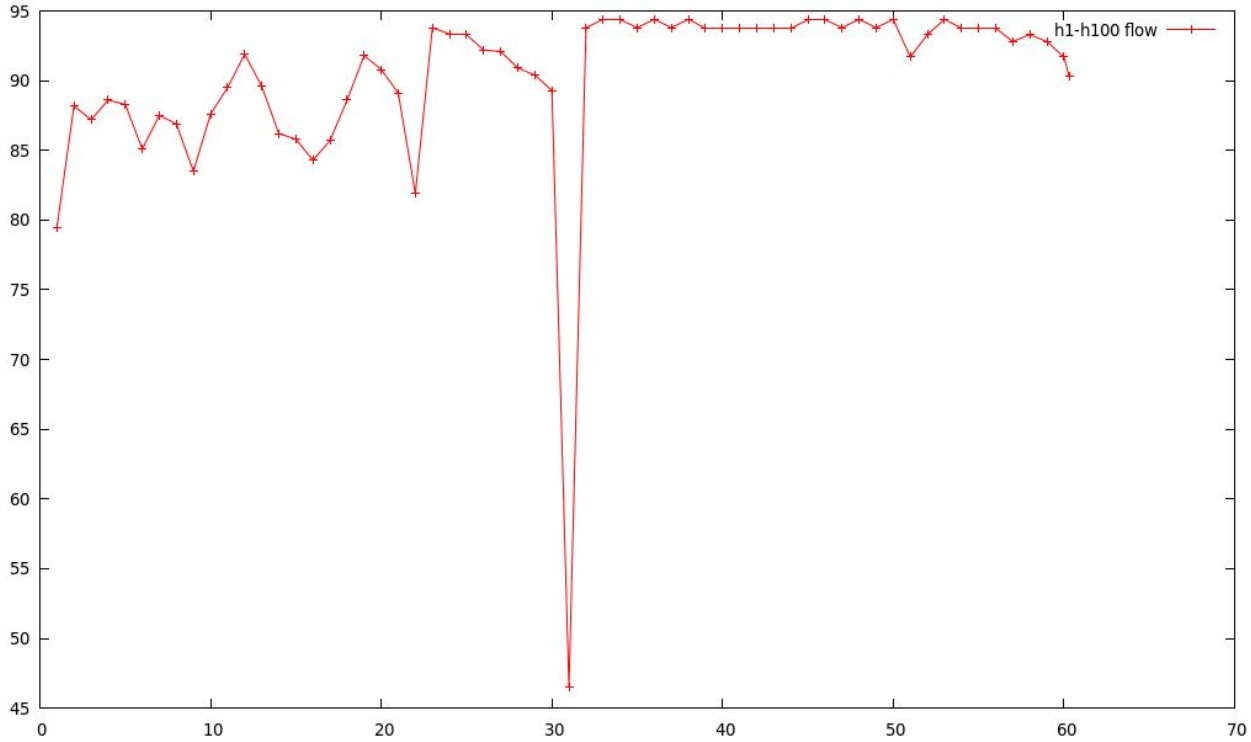

h1-h40 post flow
45
40
35
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70

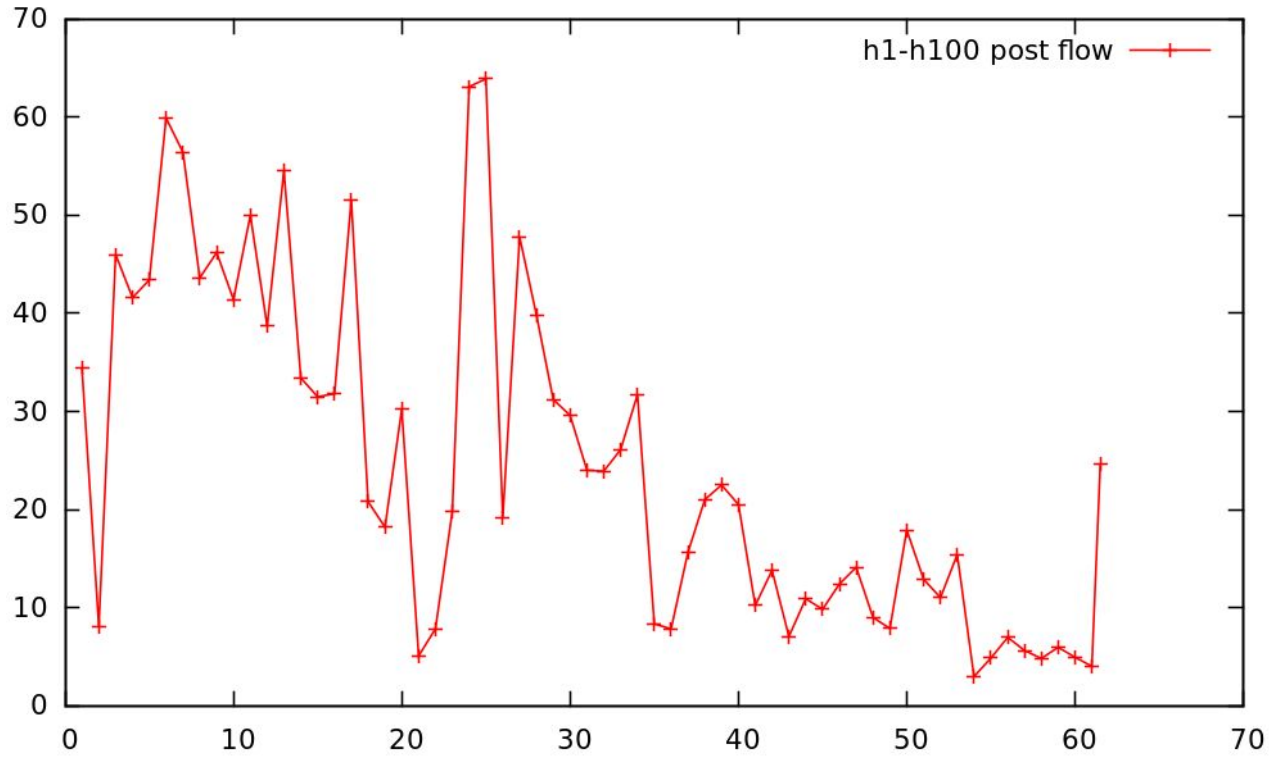
H1-H70 (Without Traffic)





H1-H100(Without Network Traffic)





Summary of Results

In the case of no network traffic involved, the results were fairly consistent. This was the result regardless of whether we were testing between nodes on the same Level 1/L2/L3 switches or different Level 1 switch, or different L2/L3 switches, or different L1/L2/L3 switches. Performance generally stayed in a range between 70-95 mbits/(s) for throughput.

In the case of network traffic involved, the results were also fairly consistent. This was the result regardless of whether we were testing between nodes on the same Level 1/L2/L3 switches or different Level 1 switch, or different L2/L3 switches, or different Level 1/L2/L3 switches. Performance generally stayed in a range between 10-60 mbits/(s) for throughout.

In conclusion, the performance was much better in every case when there was not a high network traffic simulated. This is expected given our topology of a fat tree.