



Simulation Results for QCN-FbHat and other variants of QCN

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- ECM
 - As specified
- QCN
 - As specified
- QCN-H
 - QCN using Fb-Hat, as specified
- QCN-P
 - QCN with CP-directed probes
- QCN-HP
 - QCN-H with CP-directed probes
- QCN-SP, QCN-PP
 - Sub-path probing (QCN-SP), Path probing (QCN-PP)



Simulation Parameters

Traffic

- Bernoulli
- Uniform destination distribution
- 1500 byte frames

System

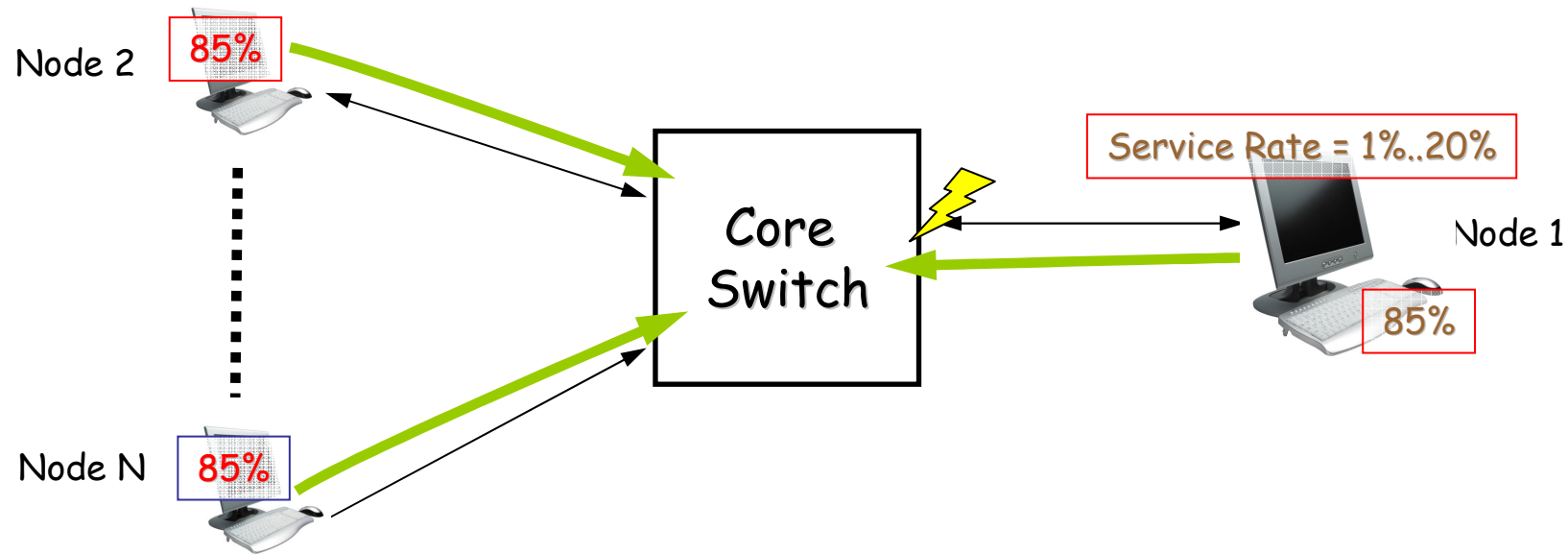
- Switch latency (processing time) = 1us
- Link latency = 500ns
- Switch frame capacity = 1 MB
- PAUSE generated by switch
- Egress buffer size 1,000 packets

QCN-xx

- Drift factor = 1.005
- Timer period = 500 uS
- Extra fast recovery enabled
- EFR MAX disabled
- A = 12 Mbit (QCN-H: 24 Mbit)
- Fast Recovery Threshold = 5
- Gd = 1/128
- TO_THRESH = 150 kBytes
- Qeq = 24kB
- QCN packet processing latency = 5uS
- Hyperactive Increase enabled/disabled
- Psample = 1% .. 10%



Test 1: Output Generated Single Hotspot, 10 nodes

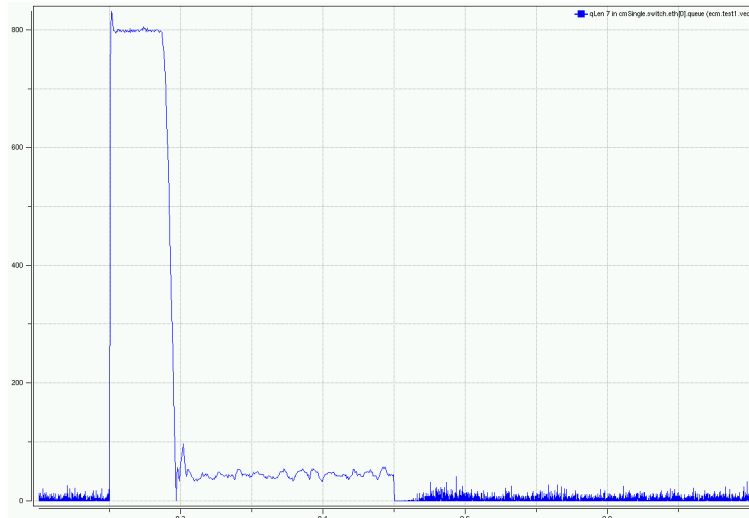


- All nodes (10): Uniform distribution, load: 8.5 Gb/s
 - From $t=0$ to 1s
- Node 1 (hotspot) service rate: 0.1Gbps, 0.5Gbps, 1Gb/s, 2Gbps
 - Duration: 400mS from $t_i=100$ ms to 500 ms



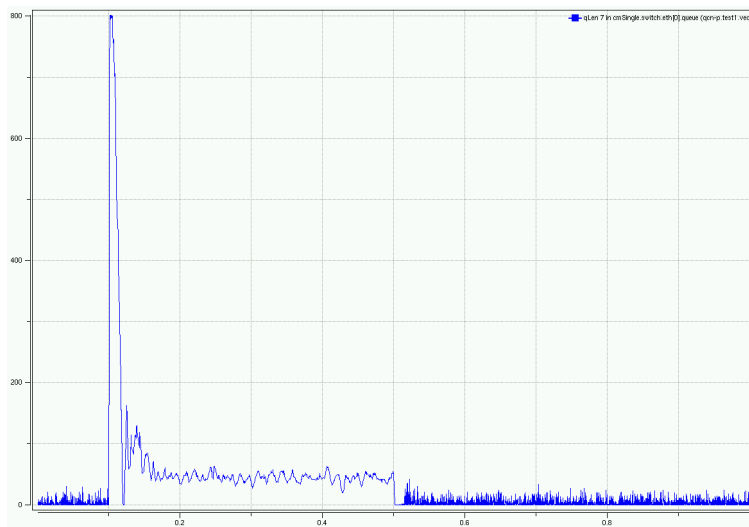
Test 1: Queue Length

ECM

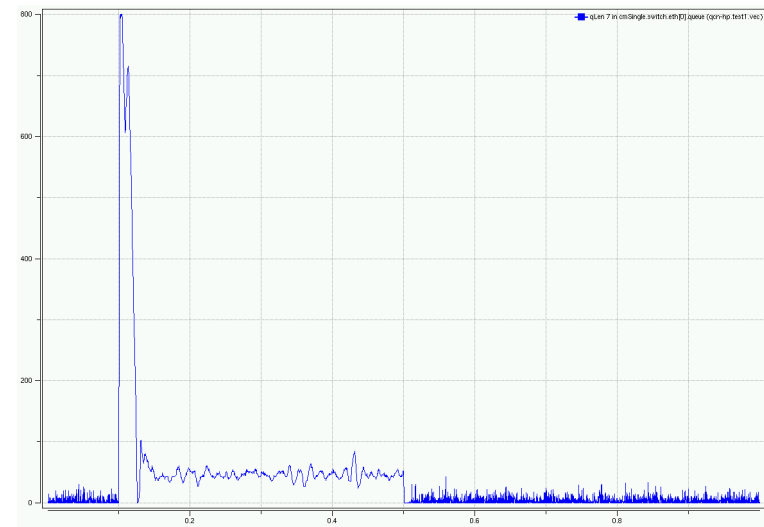


ECM result would probably be better with Oversampling

QCN-P



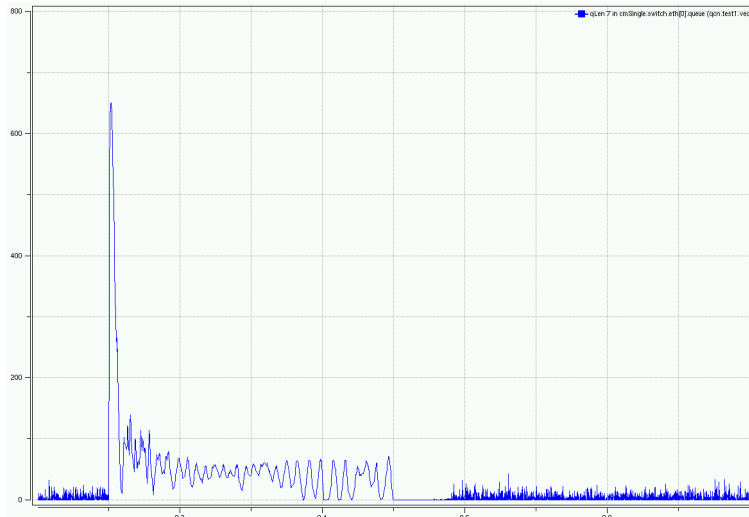
QCN-HP



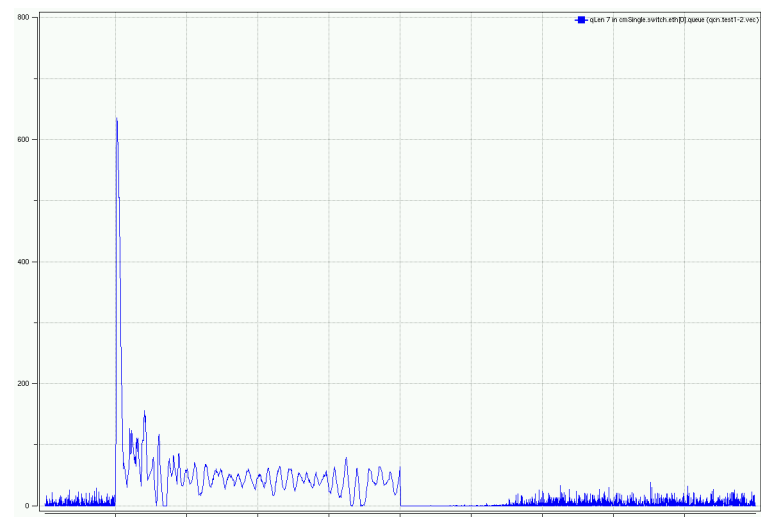


Test 1: Queue Length

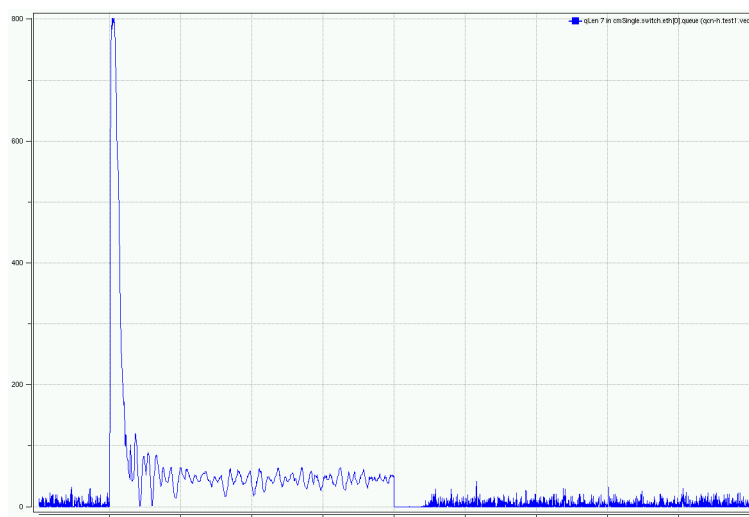
QCN (w/ Hyperactive Increase)



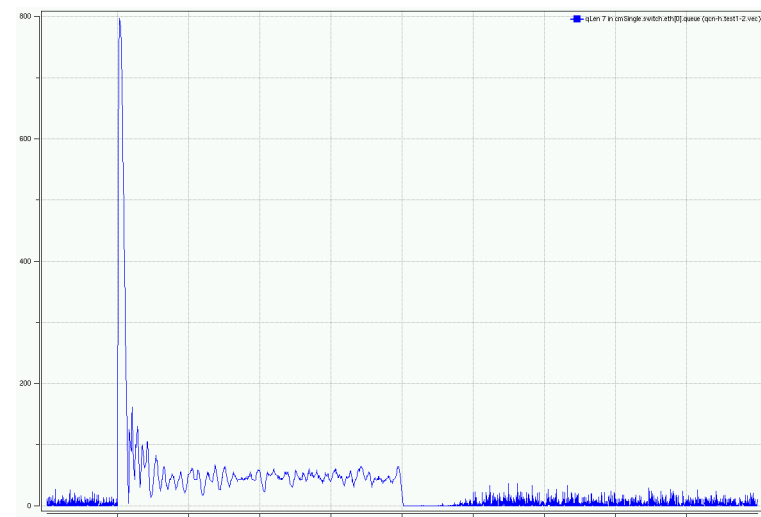
QCN (w/o Hyperactive Increase)



QCN-H (w/ Hyperactive Increase)



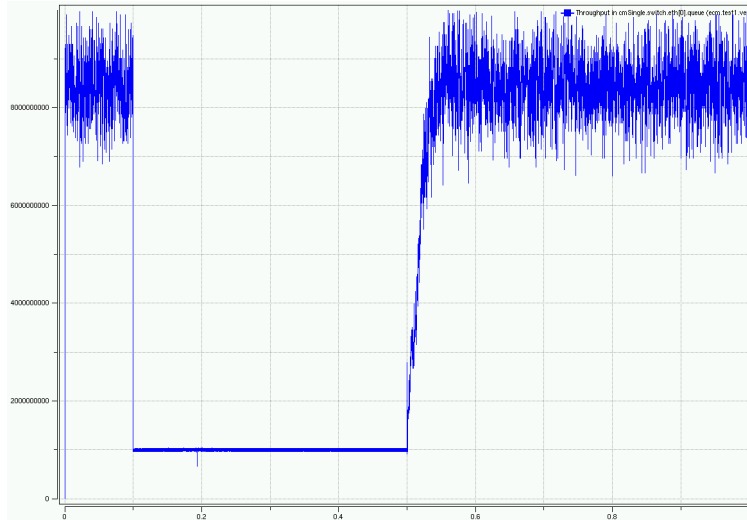
QCN-H (w/o Hyperactive Increase)



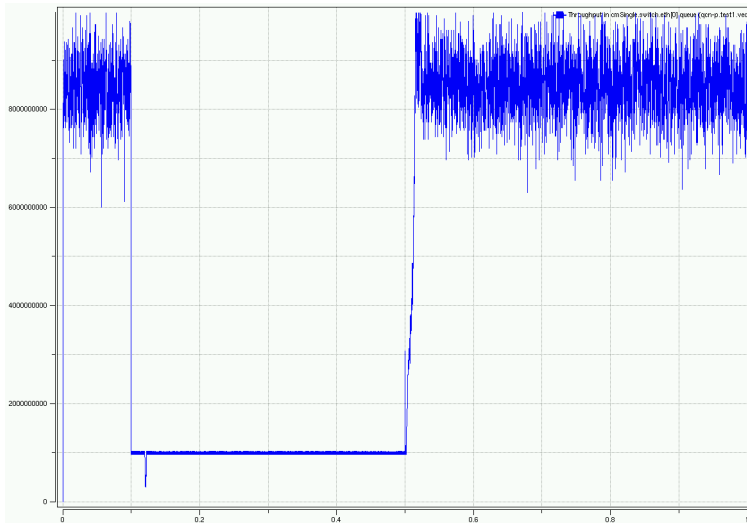


Test 1: Throughput

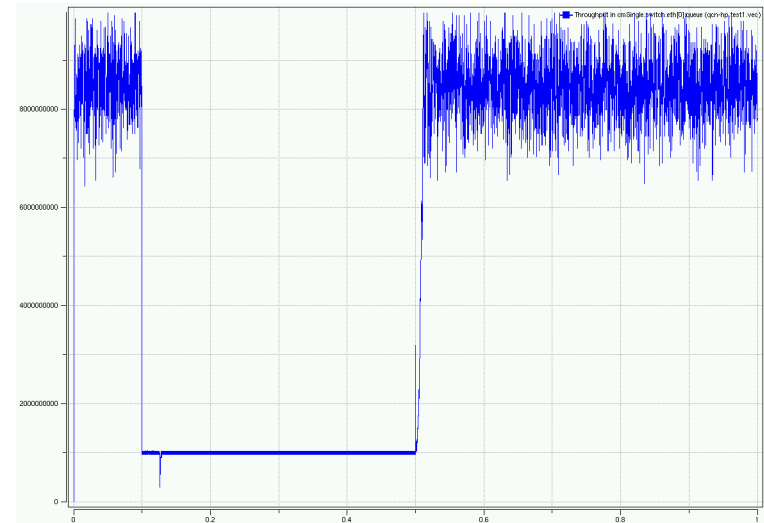
ECM



QCN-P



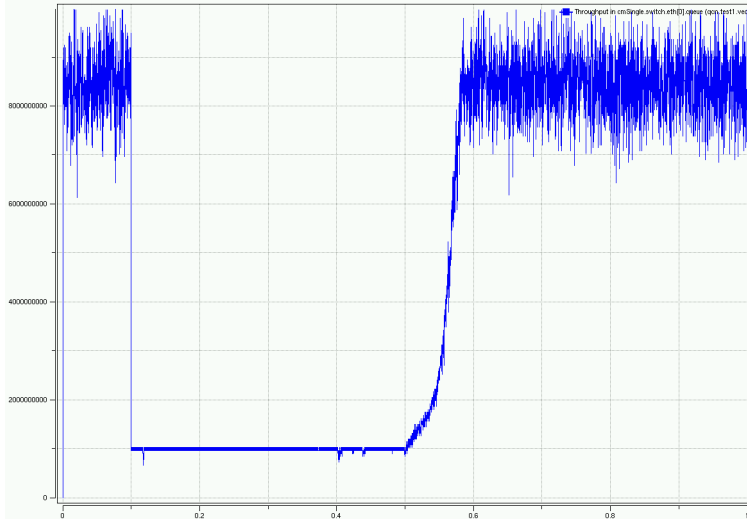
QCN-HP



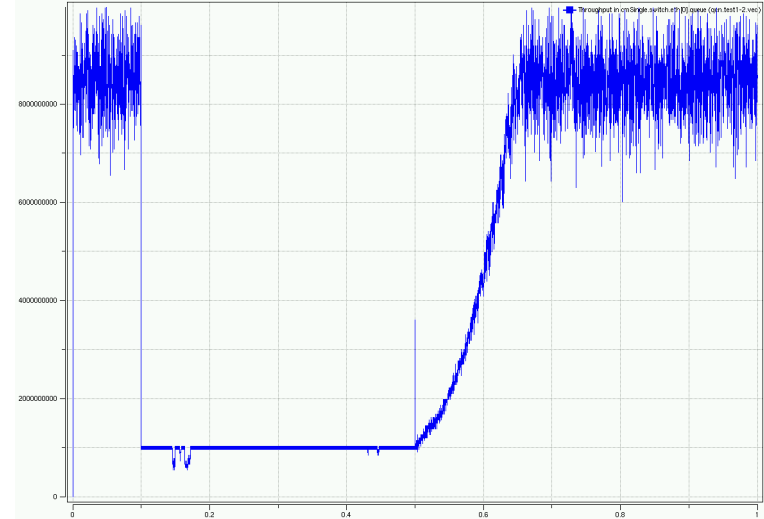


Test 1: Throughput

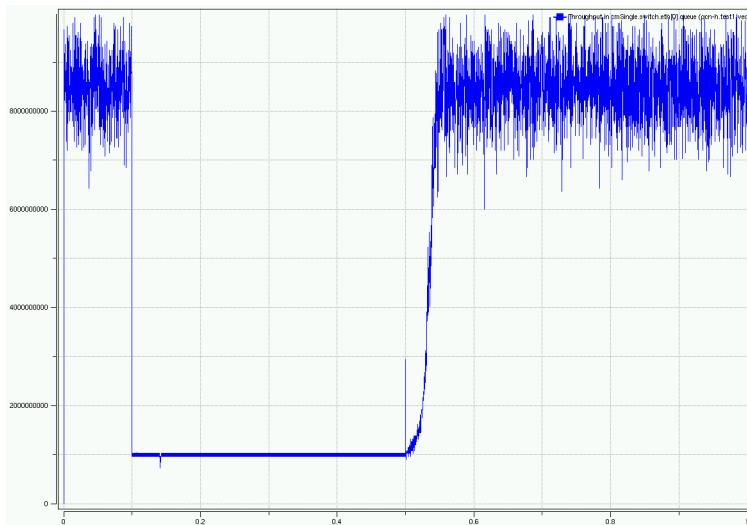
QCN (w/ Hyperactive Increase)



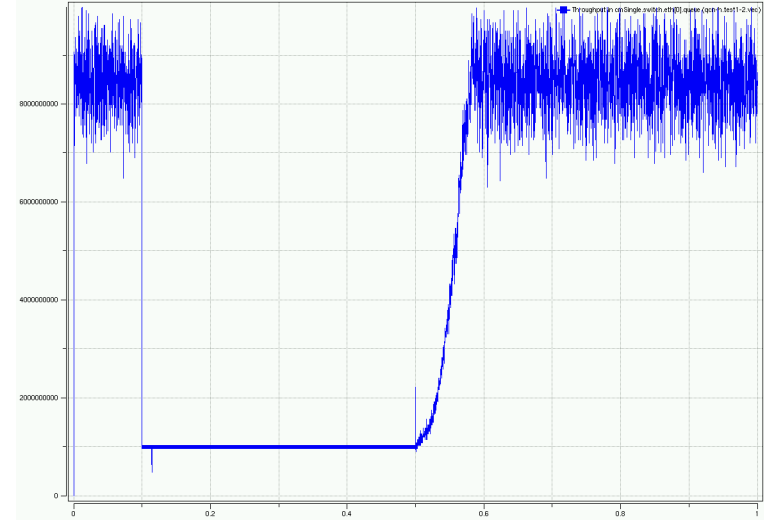
QCN (w/o Hyperactive Increase)



QCN-H (w/ Hyperactive Increase)

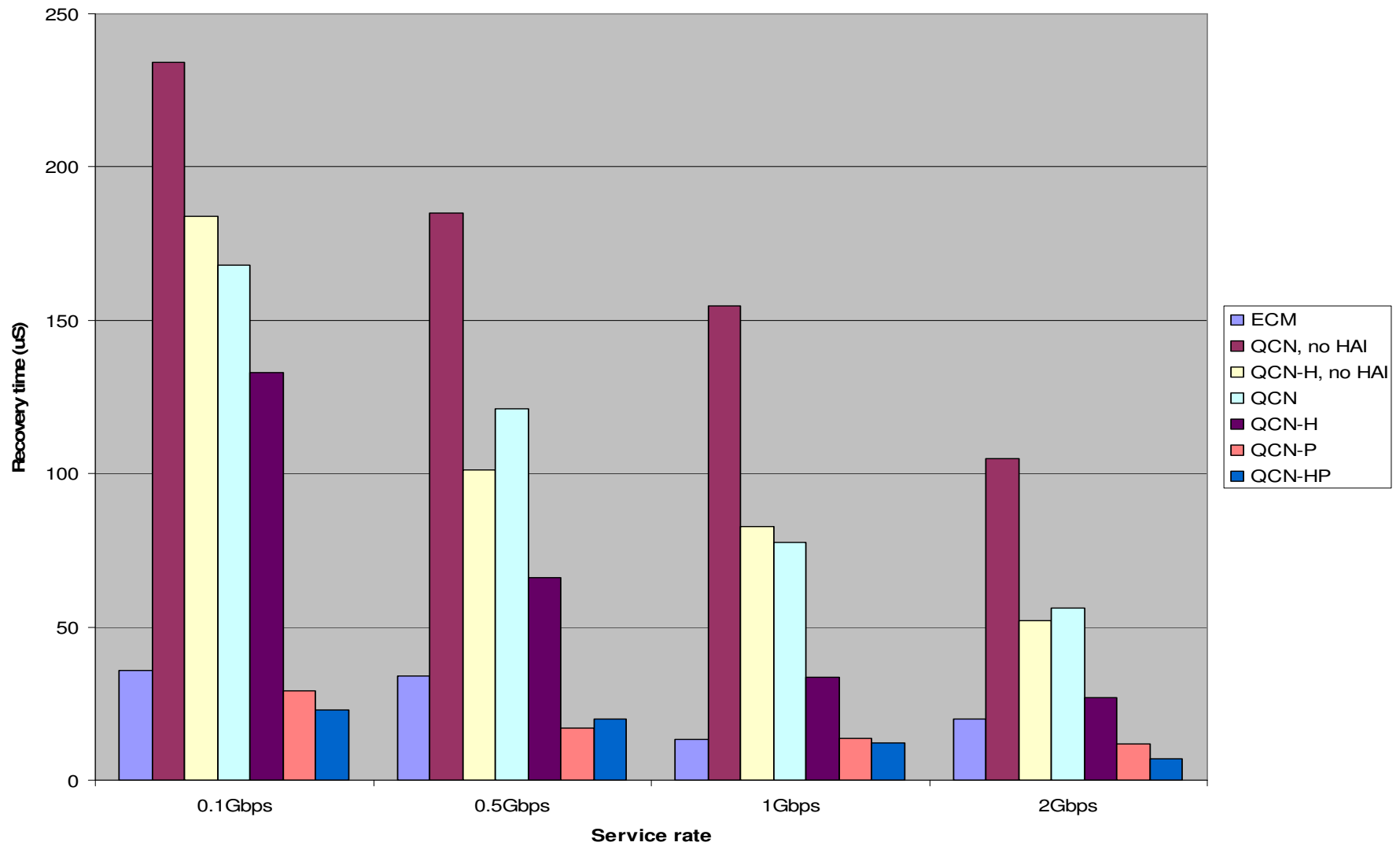


QCN-H (w/o Hyperactive Increase)



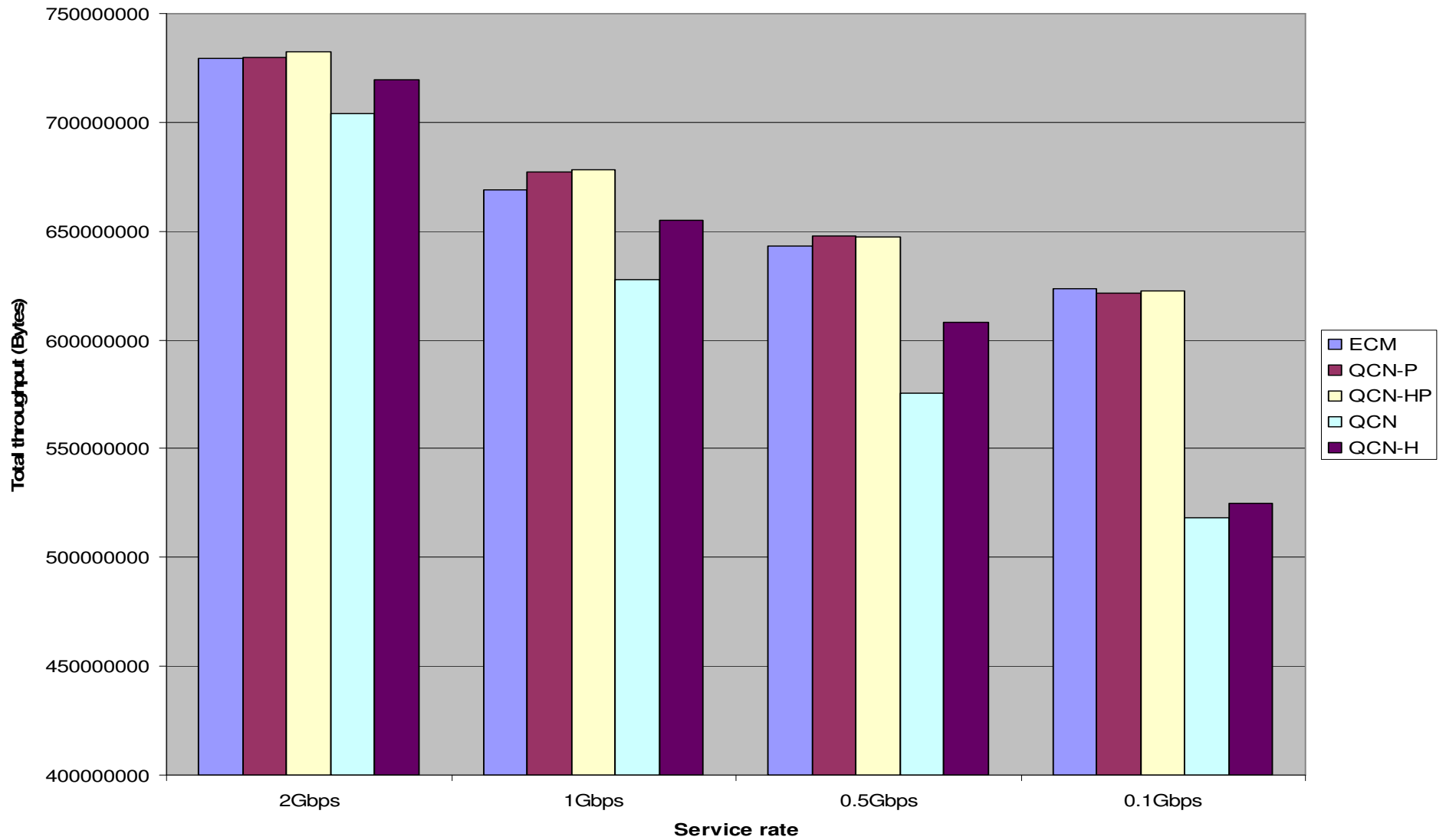


Test 1: Recovery time



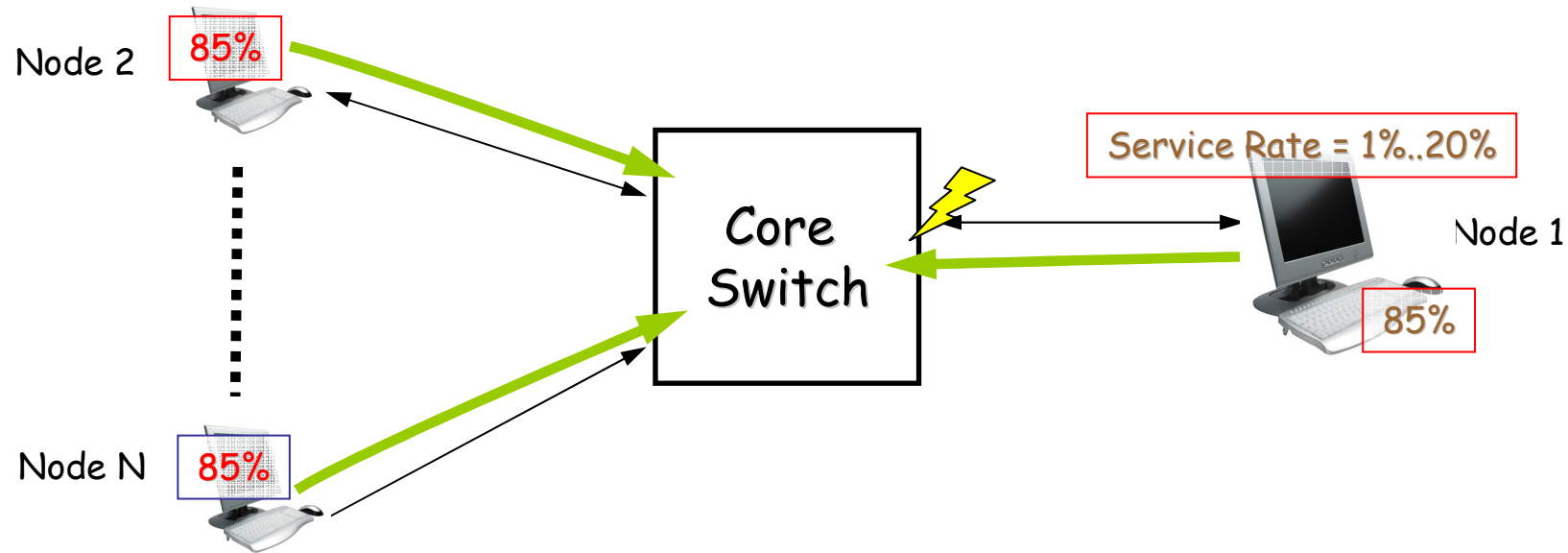


Test 1: Total Throughput





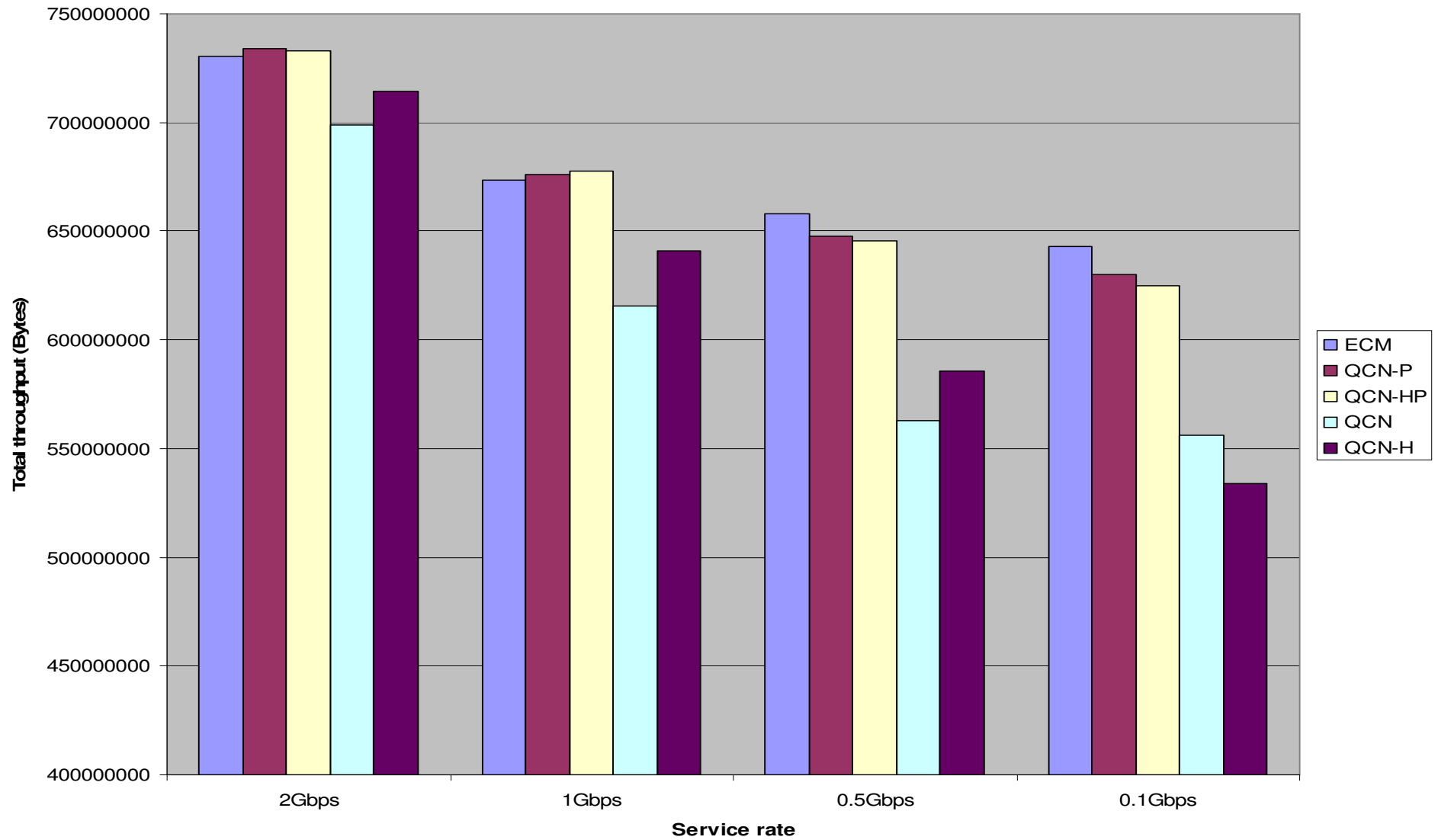
Test 1a: Output Generated Single Hotspot, 20 nodes



- All nodes (**20**): Uniform distribution, load: 8.5 Gb/s
 - From $t=0$ to 1s
- Node 1 (hotspot) service rate: 0.1Gbps, 0.5Gbps, 1Gb/s, 2Gbps
 - Duration: 400mS from $t_i=100$ ms to 500 ms



Test 1a: Total Throughput

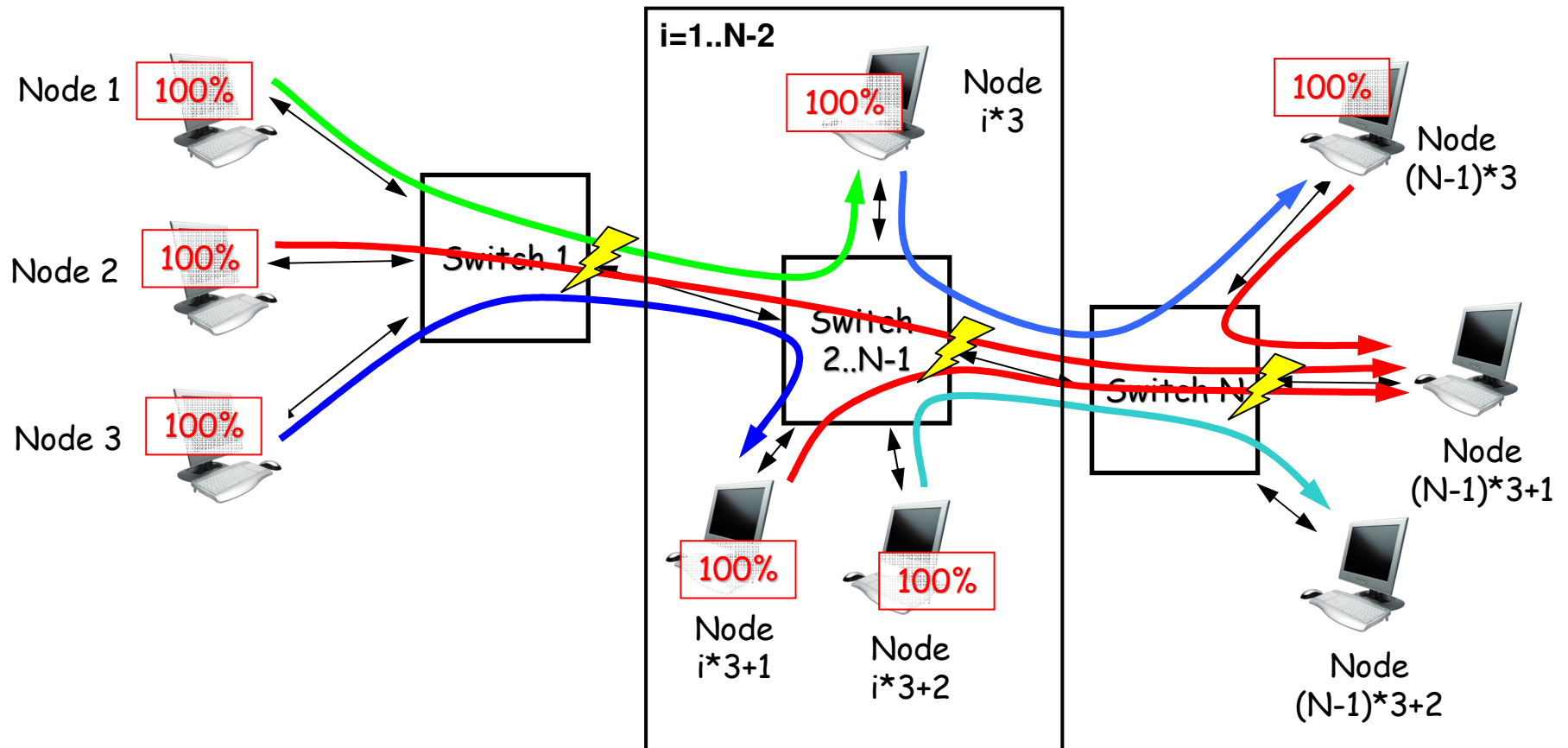




- QCN much improved with Fb-Hat
- QCN reacts (much) faster with Hyperactive Increase enabled
- QCN recovery time depends on hotspot severity
- QCN performance seems to get a little worse if more nodes are added
- Performance advantages with protocols using positive feedback



20-stage Hotspot with dynamic load

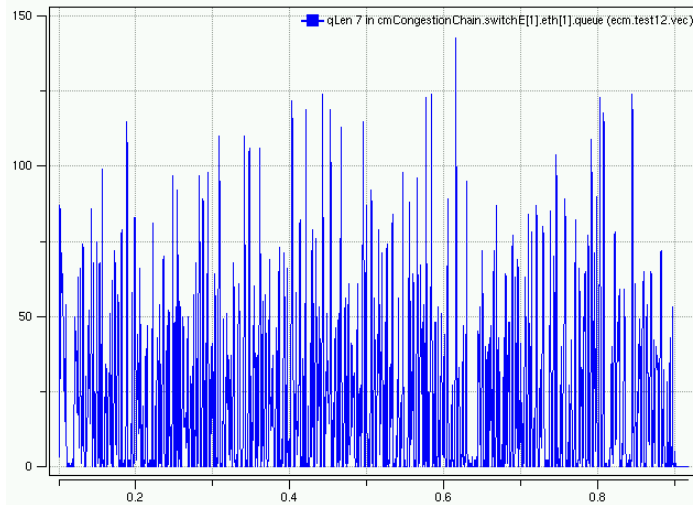


- $N=18$ switches; 3 hosts per switch
- Node $\langle i \rangle$ sends to node $\langle i+3 \rangle$; Node $\langle i+1 \rangle$ sends to node $(N-1)*3+1$; node $\langle i+2 \rangle$ sends to node $\langle i+4 \rangle$
- Node $\langle i \rangle$ sending bursty traffic with interval $1 + \langle i \rangle * 0.1$ ms
- 100% load from all nodes
- Node $(N-1)*3+1$ receives traffic from $\langle N \rangle$ sources
- N hotspots

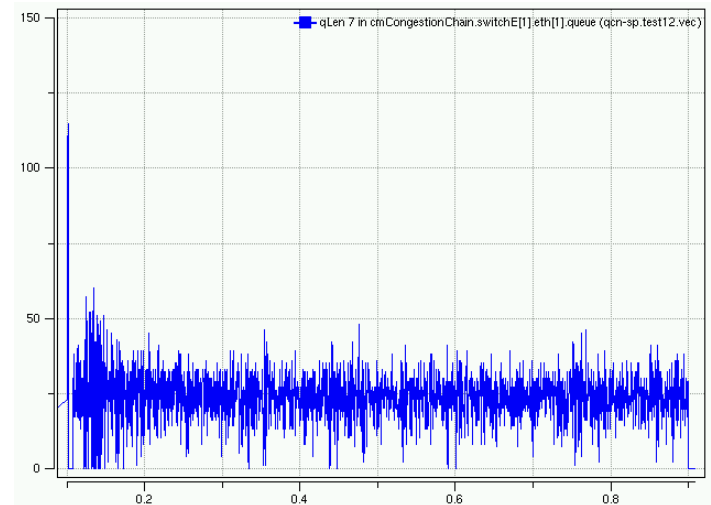


Test 20: Queue length

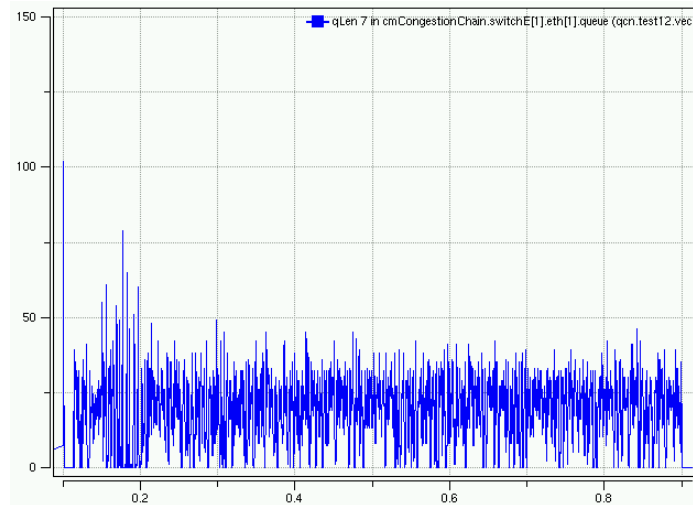
ECM



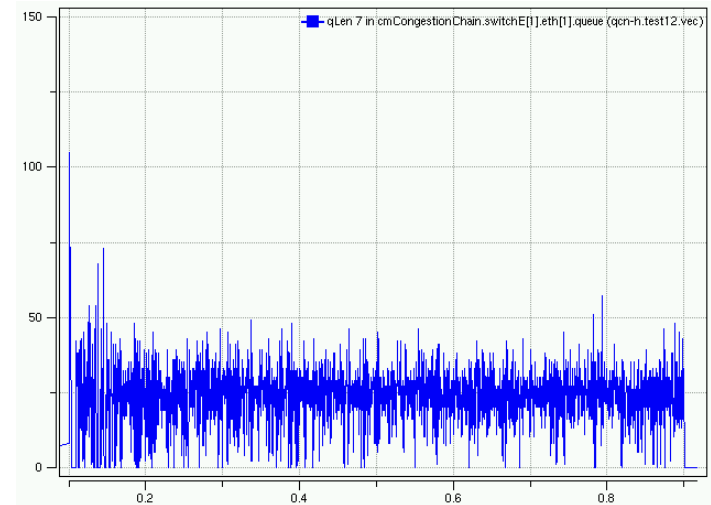
QCN-SP



QCN



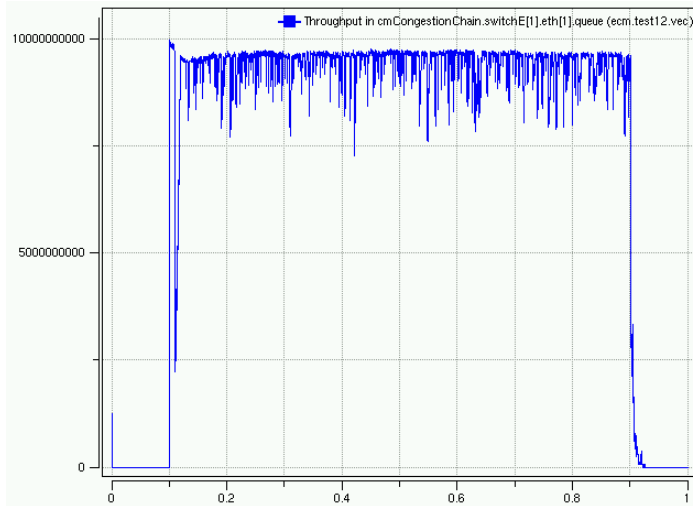
QCN-H



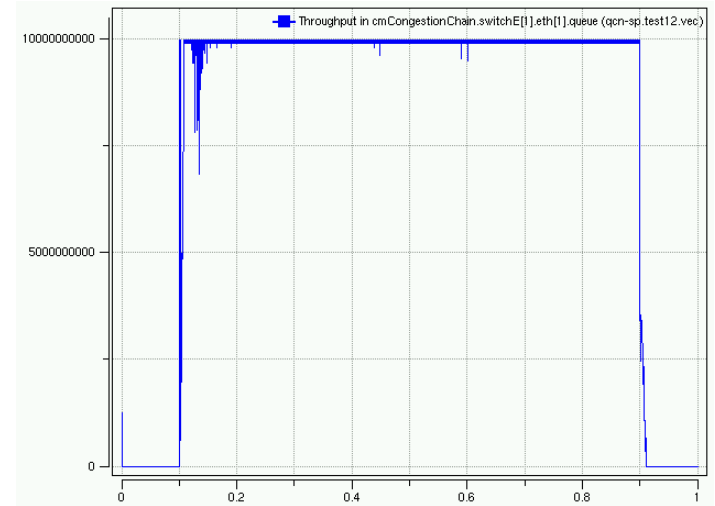


Test 20: Throughput

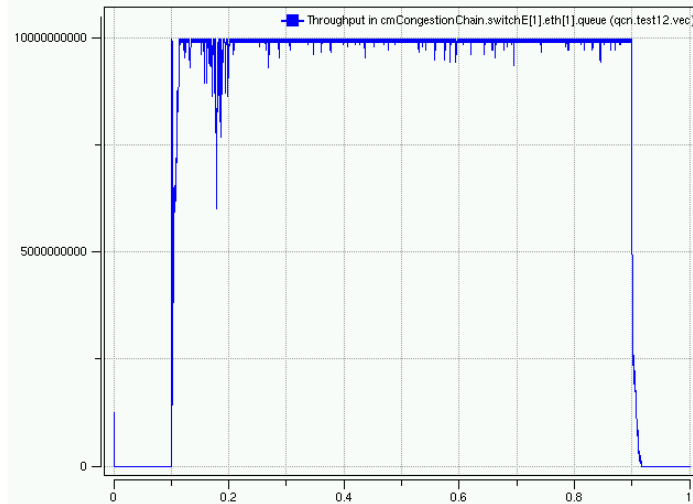
ECM



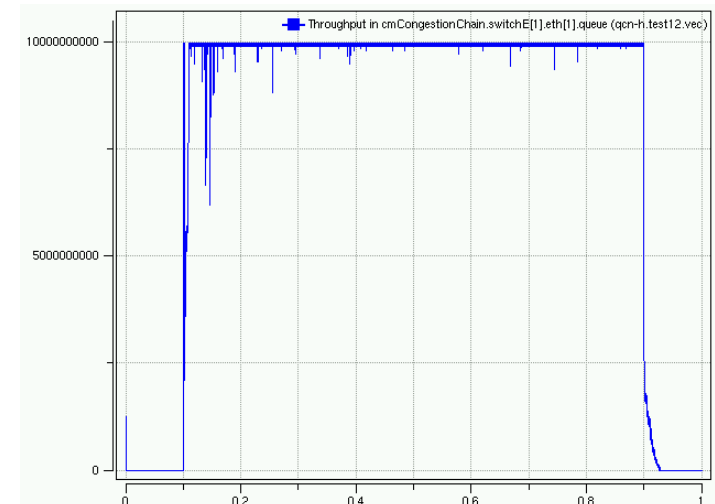
QCN-SP



QCN



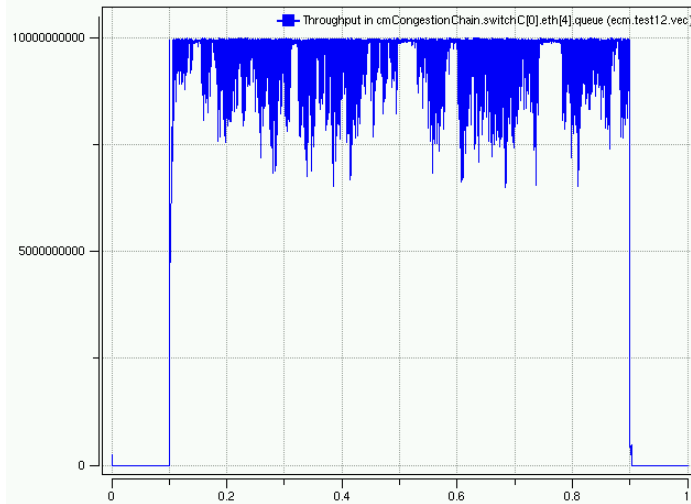
QCN-H



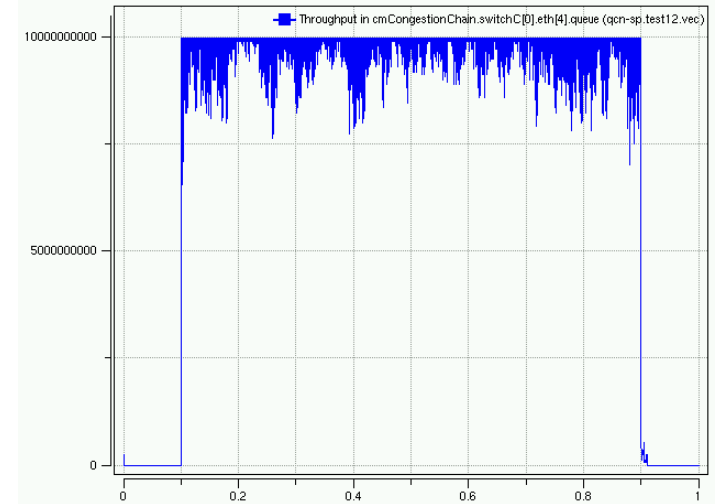


Test 20: Switch 2 Throughput

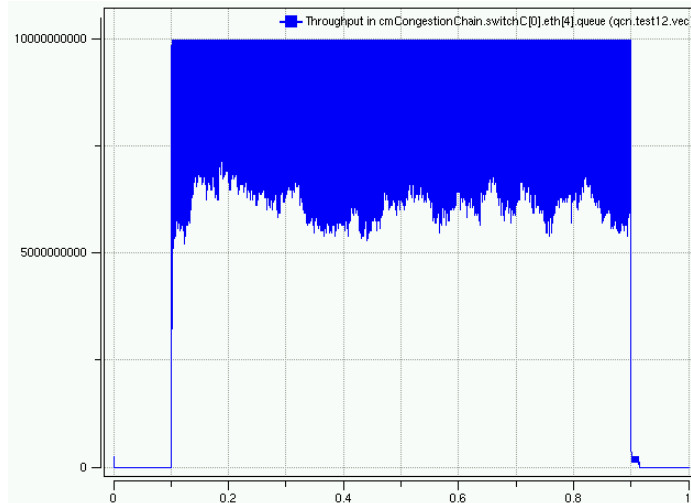
ECM



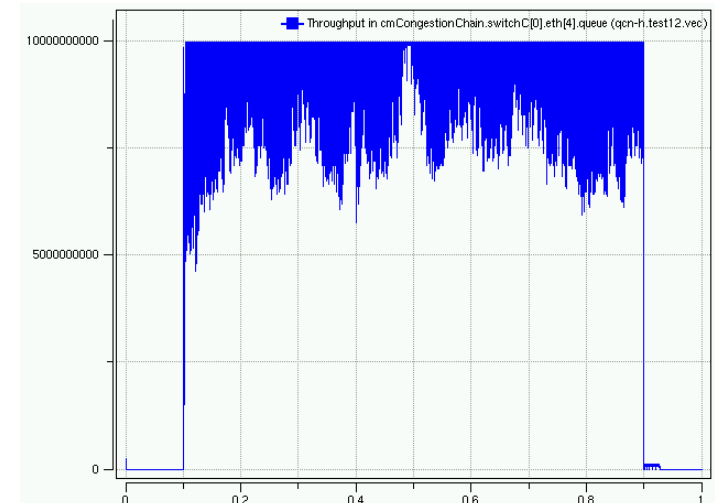
QCN-SP



QCN

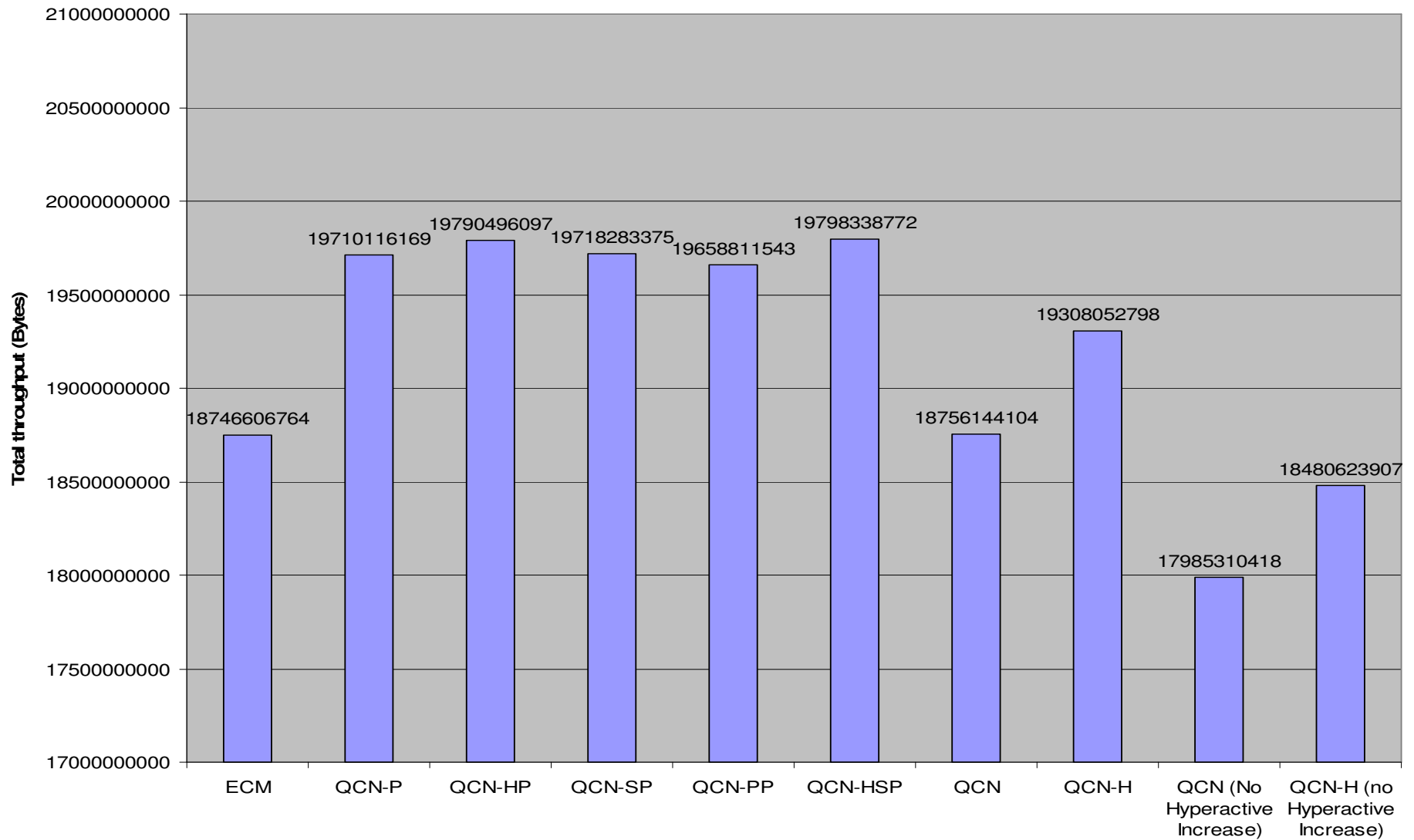


QCN-H





Test 20: Total Throughput through all hotspots





- QCN – same as before
- ECM performance suffers
 - Tagging (?)
 - Large number of false positives discarded in RP
 - CPID thrashing (?)
- No CPID thrashing effects seen for QCN based protocols using probes (QCN-*P)
- Best performance with Sub-path probing (RP<->CP)
 - QCN-SP, QCN-HSP
 - Even better than with full path probing
 - Only marginally better than direct CP probing