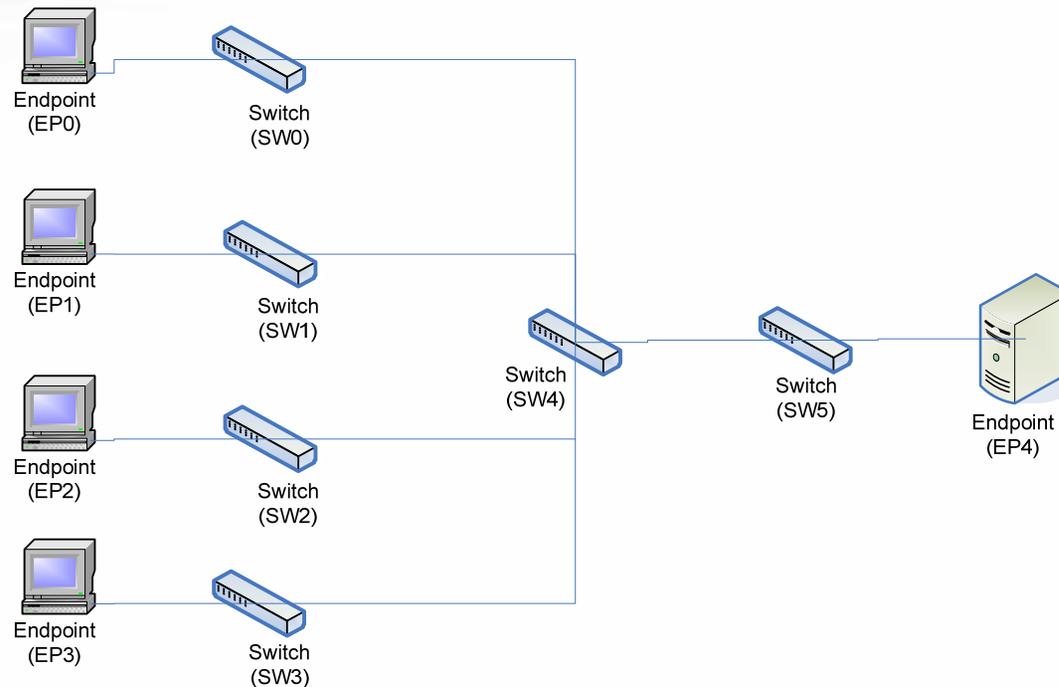




BCN Calibration Simulation Results

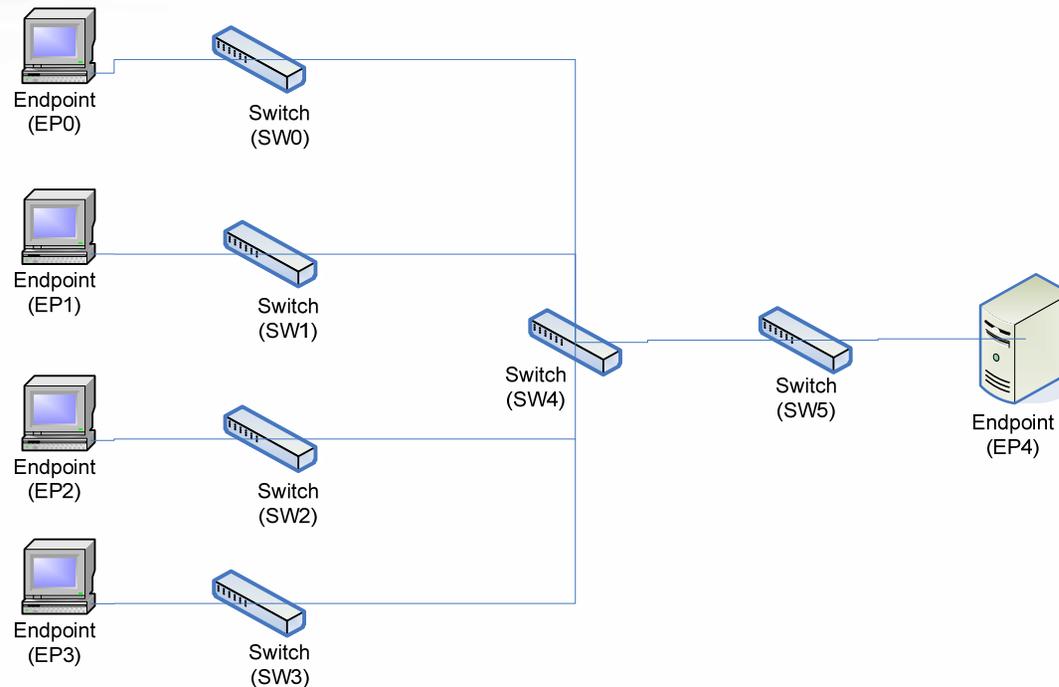
Bruce Kwan (bkwan@broadcom.com)
September 14, 2006

Topology



- Short Range, High-Speed Datacenter-like Network
 - Link Capacity = 10 Gbps
 - Egress Port Buffer Size = 150KBytes
 - Switch Latency = 1 us
 - Link Length = 100 m (.5 us propagation delay)
 - Endpoint response time = 1 us
 - Loop latency = 8us

Workload



- Traffic Type: 100% UDP (or Raw Ethernet) Traffic
- Destination Distribution: EP0-EP3 send to EP4
- Frame Size Distribution: Fixed length (1500 bytes) frames
- Arrival Distribution: Bernoulli temporal distribution
- Offered Load/Endpoint = 49%

BCN Parameters

- Qeq
 - 375 * 64 byte pages (or 16 * 1500-byte frames)
- Frame Sampling
 - Frames are sampled on average 150 KB received to the egress queue
 - Sampling Jitter: +/- 20KB
- $W = 2$
- $G_i = 12.42$
 - Computed as $(\text{Linerate}/10) * [1/((1+2*W)*Q_{eq})]$
 - $G_i = 5.3 \times 10^{-1} * (1500/64) = 12.42$
- $G_d = 6.09 \times 10^{-3}$
 - Computed as $1/2 * [1/((1+2*W)*Q_{eq})]$
 - $G_d = 2.6 \times 10^{-4} * (1500/64) = 6.09 \times 10^{-3}$
- $R_u = 1 \text{ Mbps}$

Simulation Setup & Metrics

- Simulation Setup

- Initial Transient @ $t = 5\text{ms}$ (All 4 sources start transmitting)
- 2 flows stop @ $t=80\text{ms}$
- Simulation ends @ $t = 95\text{ms}$

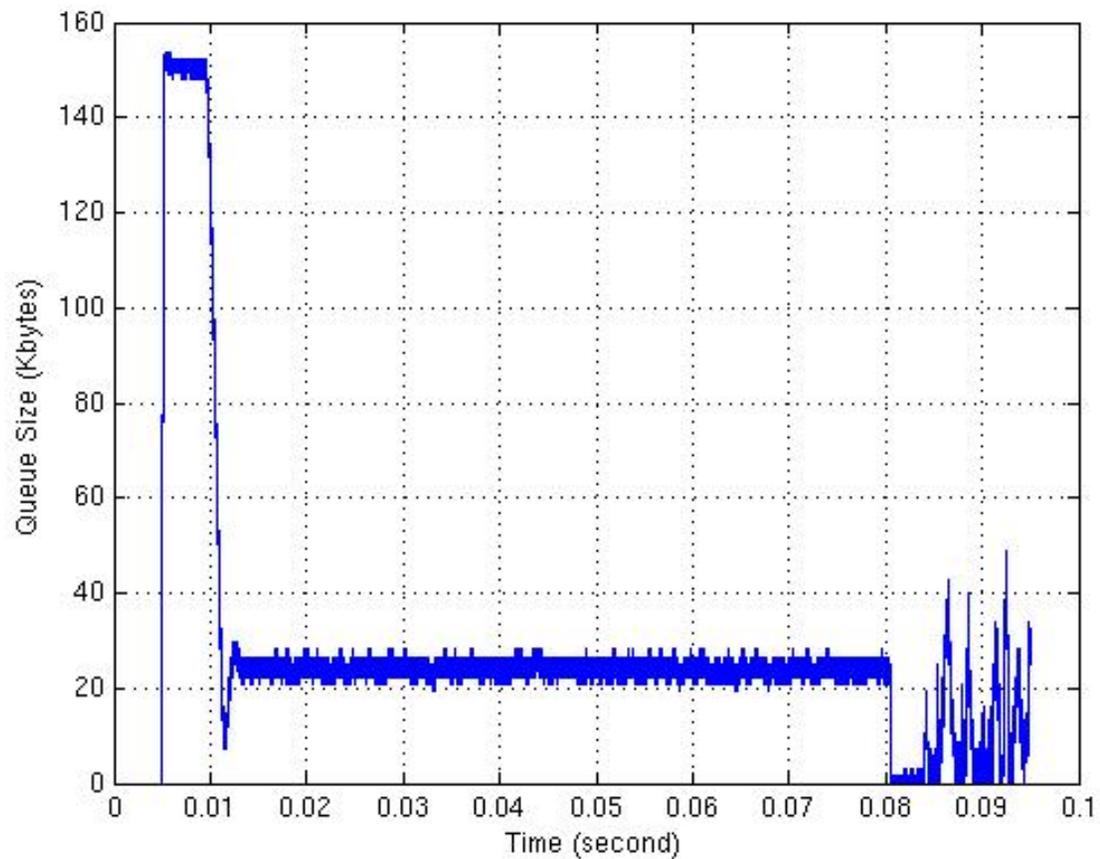
- Metrics

- Switch Buffer Utilization v.s. Time
- Throughput
 - Packets transmitted, received, & dropped
 - Compute throughput for each of the 4 flows during 78ms – 80ms
- Fairness Metrics
 - % Error from expected BW for each flow = $|(\text{Observed_Tput} - 2.5\text{G})/2.5\text{G}|$
 - Jain's Fairness Index
- Statistics of fairness metrics collected across 10 simulation trials
 - Take note of (Min, Mean, Max) across the trials.

Throughput Results

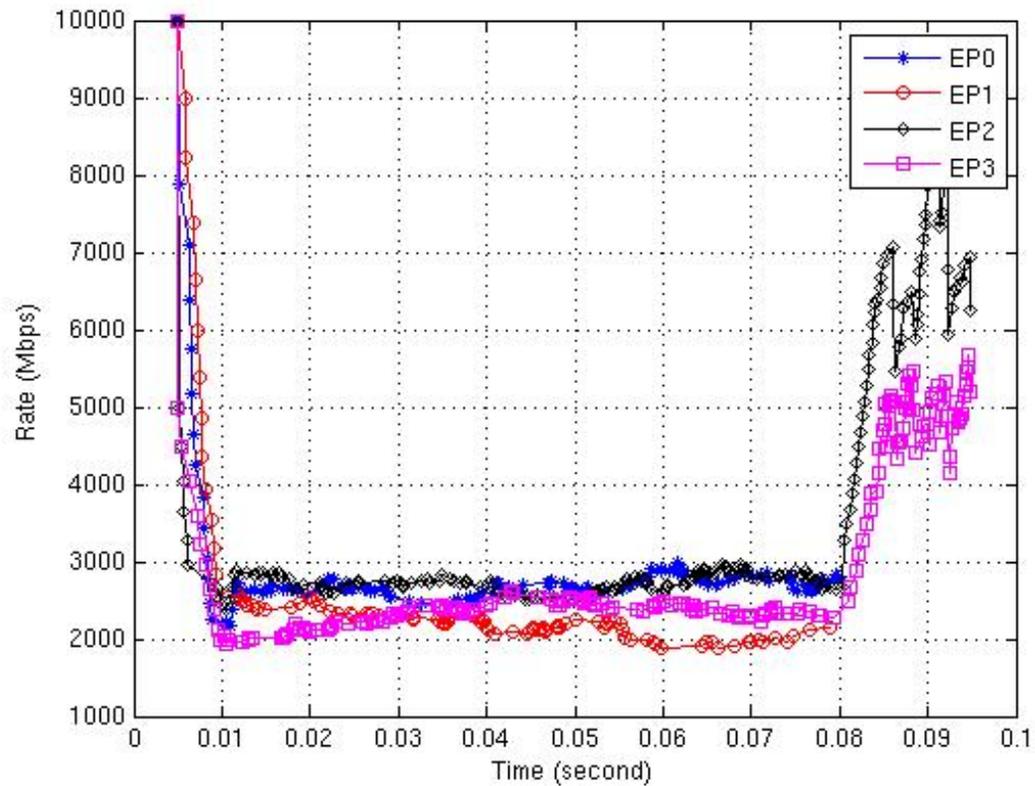
- Observed Aggregate Throughput [during 78ms - 80ms] = 10Gbps
- Best Case (based on Fairness Index) across 10 trials
 - Packets Transmitted: 122740
 - Packets Received: 61832
 - Packets Dropped
 - @ Core Switch: 1964
 - @ Reaction Points: 58536

Core Switch Buffer Utilization Best Case (based on Fairness Index)



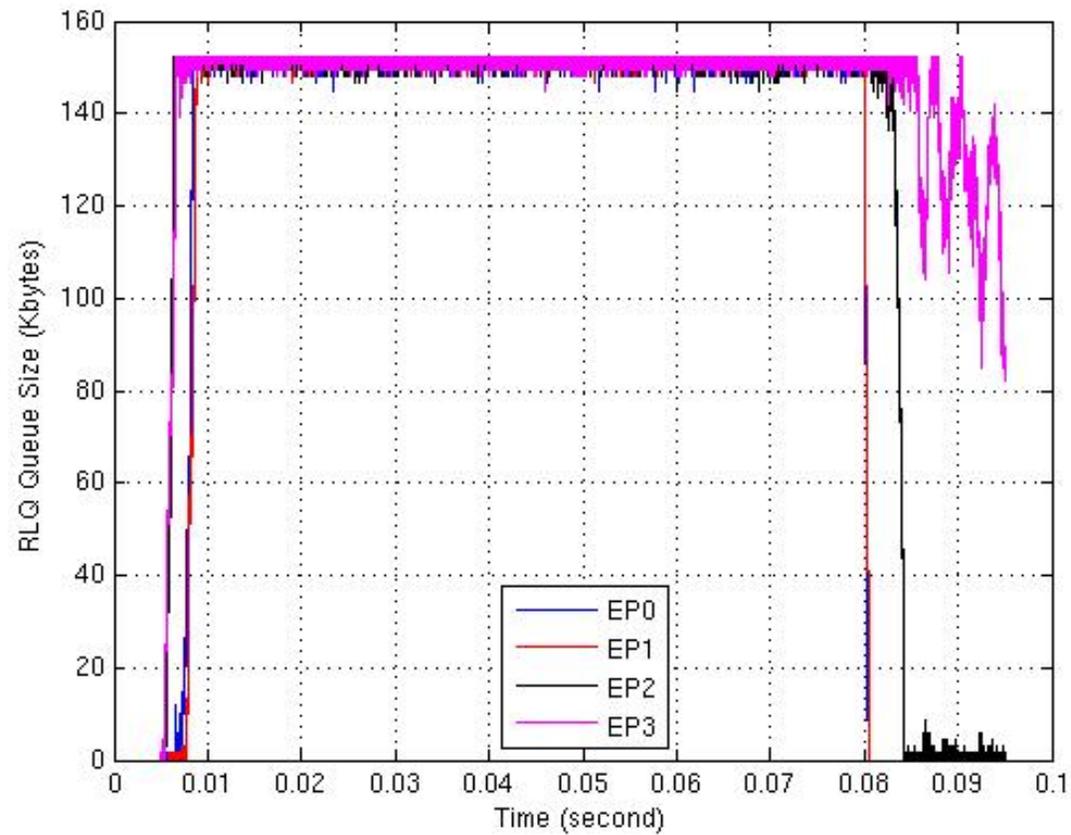
RLQ Rates

Best Case (based on Fairness Index)

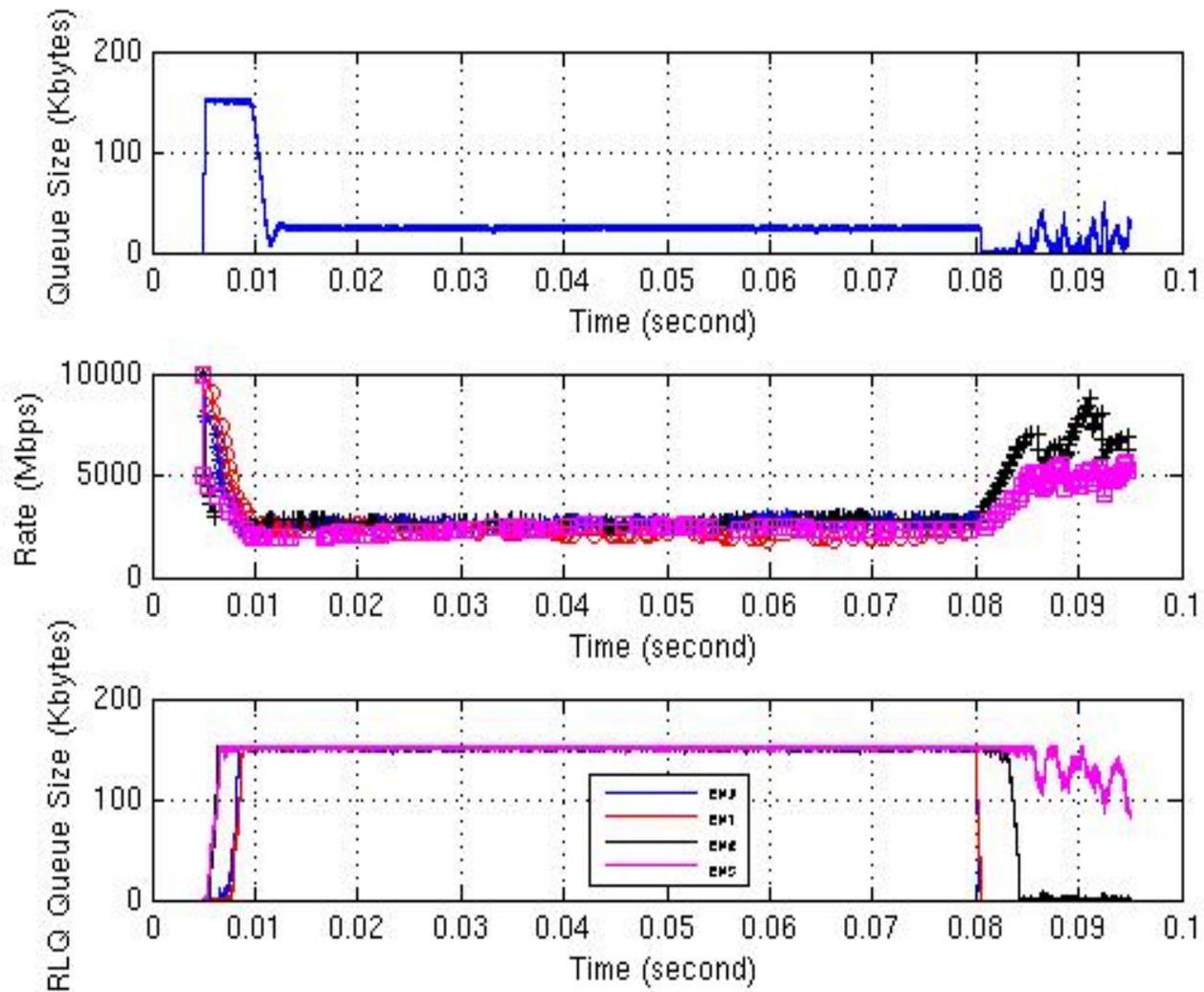


Fairness Index = 0.99

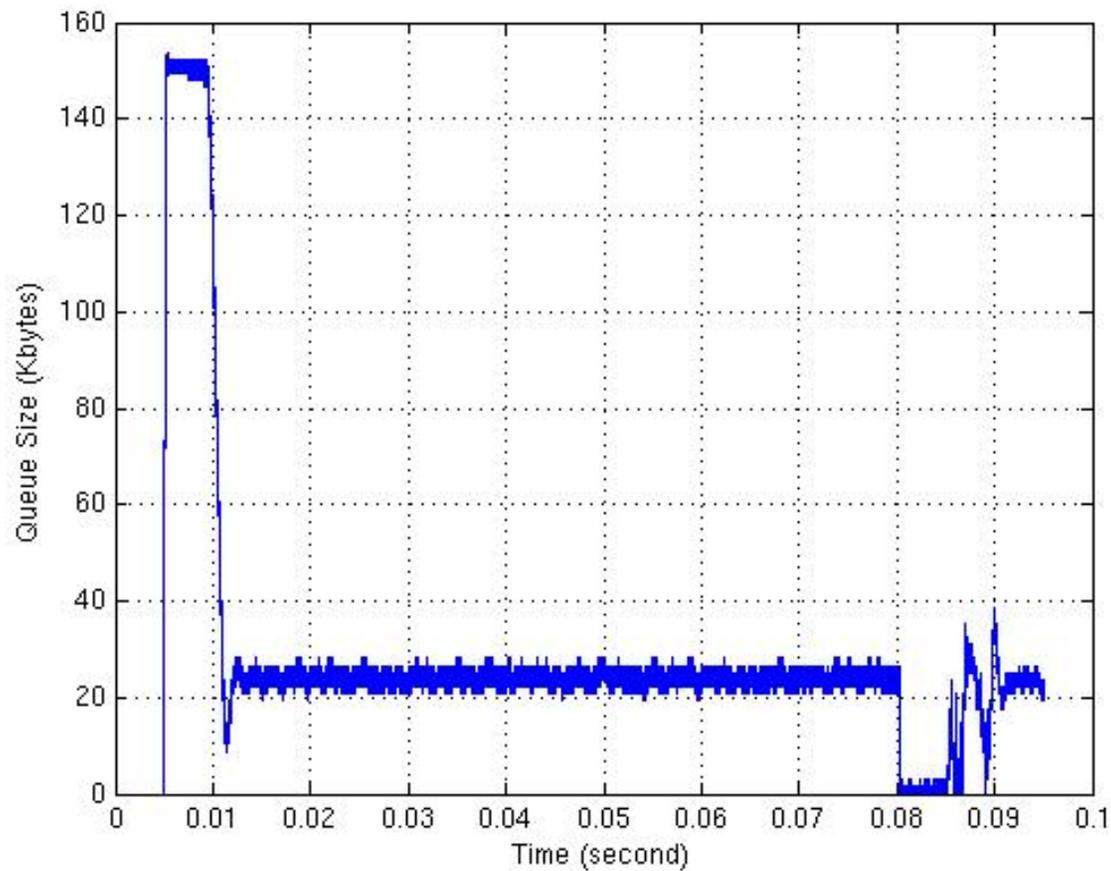
RLQ Buffer Utilization Best Case (based on Fairness Index)



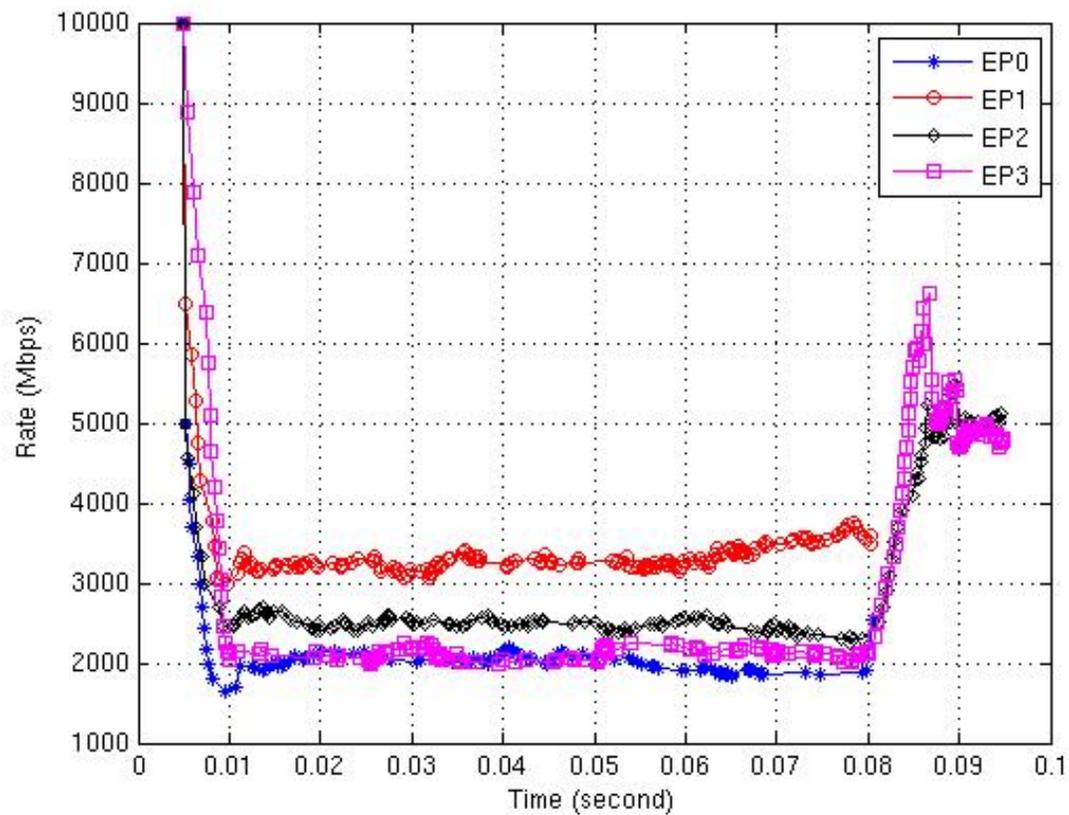
Summary (Best Case)



Core Switch Buffer Utilization Worst Case (based on Fairness Index)

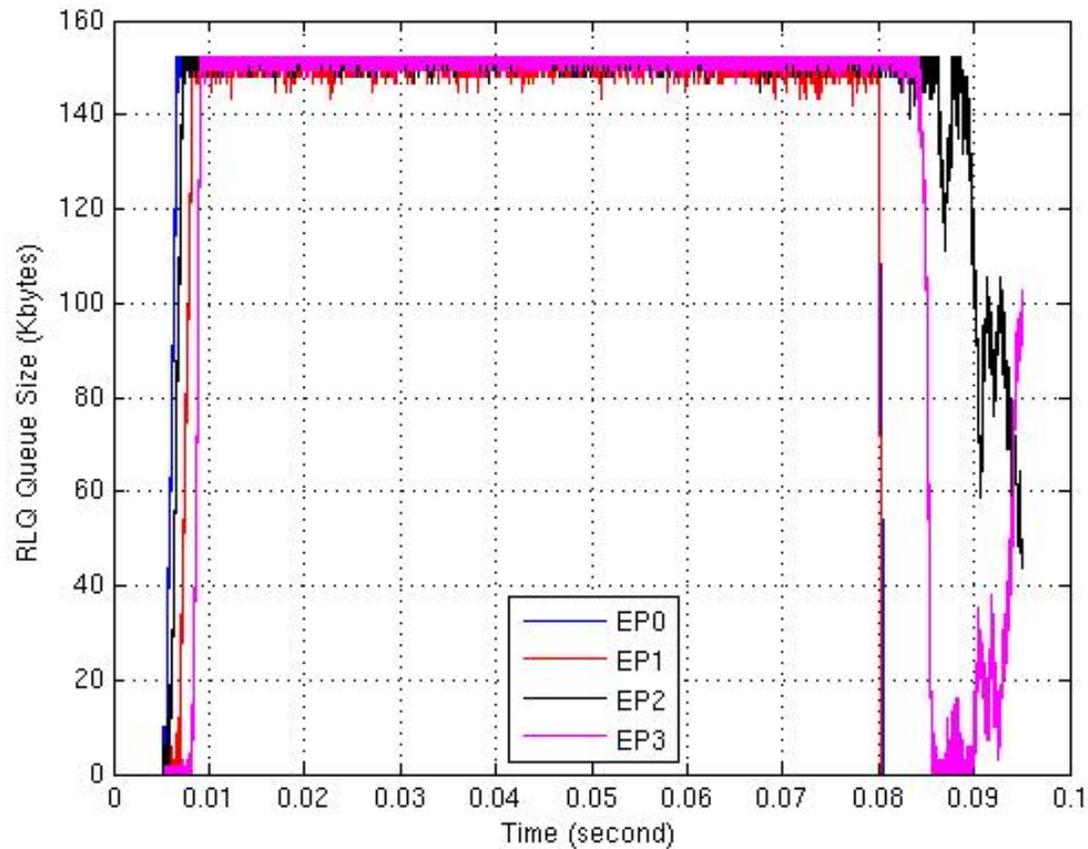


RLQ Rates Worst Case (based on Fairness Index)

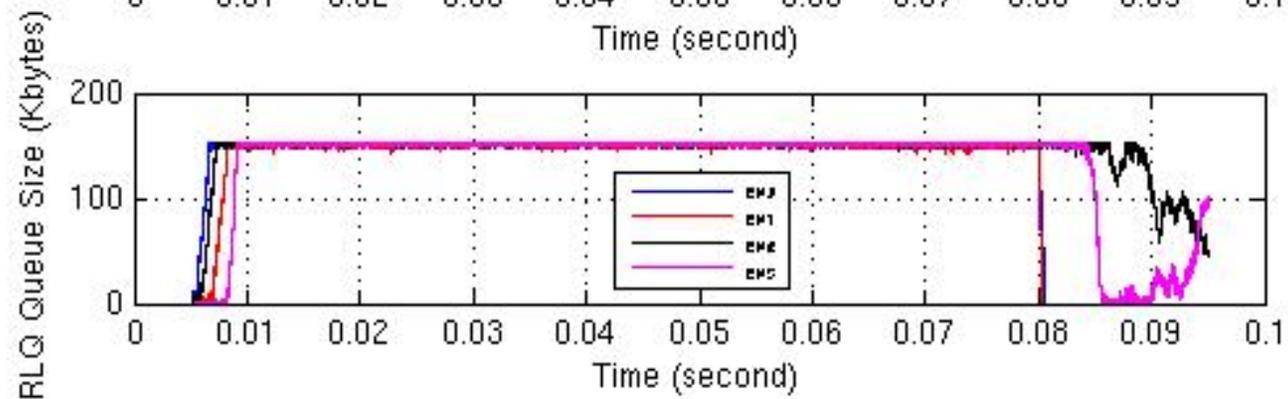
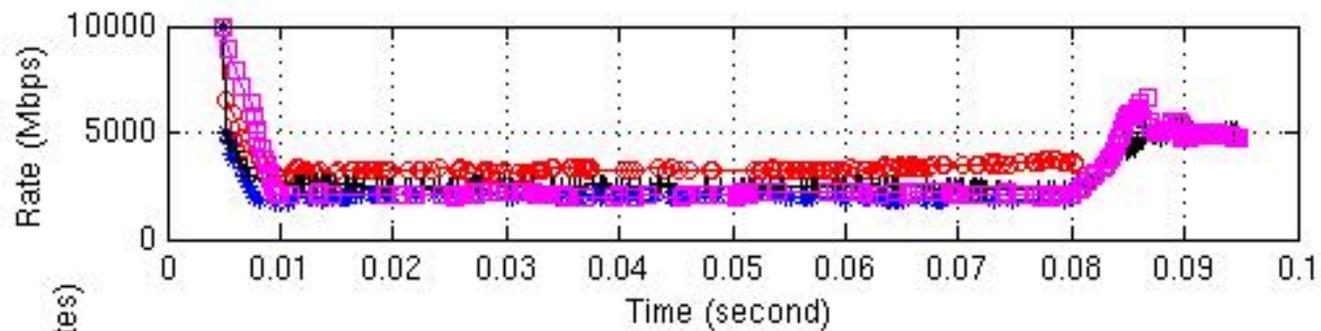
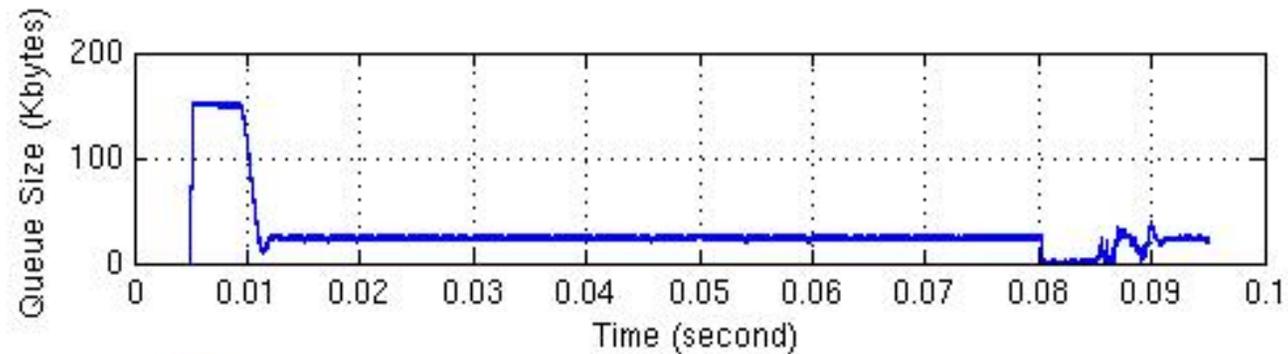


Fairness Index = 0.92

RLQ Buffer Utilization Worst Case (based on Fairness Index)



Worst Case Summary



Fairness Results

- Throughput metric computed based on bytes received over a 2ms period from 78ms to 80ms
- 10 Simulation Trials
- Fairness Metrics
 - Fairness Index [1.0 is ideal]
 - Max Error from Expected throughput of 2.5Gbps per flow
- Statistics of fairness metrics collected across the 10 trials

Fairness Index Statistics (Min, Mean, Max)	Max Error Statistics (Min, Mean, Max)
(0.92, 0.96, 0.99)	(0.04, 0.30, 0.48)