



Preliminary Simulation Results on FECN In Symmetric Topology w/Single Hot Spot Scenario (Revised)

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Overview

- Purpose
- Key Observations
- System Parameters & Work Load
- Validating FECN Simulation
- Sensitivity Analysis (N0 and Qeq)
- Conclusion

Purpose

- Goal

- Provide revision of simulation results presented for FECN as shown at Orlando plenary taking into account the below modifications.

- Obsoletes:

- <http://www.ieee802.org/1/files/public/docs2007/au-sim-kwan-ding-prelim-fecn-orlando-20070314.pdf>

- Correction

- Fixed the simulation error in exponential averaging function.

- In previous results, oscillations occurred under long delay conditions with a small Q_{eq}
- Given correction, oscillations no longer occur under the same conditions

- Enhancements

- Limited Rate Increase

- Include the modification as described in Orlando Interim meeting (3/14) specified in
 - <http://www.ieee802.org/1/files/public/docs2007/au-jain-fecn-20070314.pdf>

- Queue at the reaction point is rated limited to C/N0 initially.

- Requires rate limiters during startup at the reaction point.

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Key Observations

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- Sensitivity to N_0
 - New limited rate increase algorithm (logarithmic rise) improves the system sensitivity to N_0
 - When N_0 is too low (i.e. 1), effectively removes the “slow start” effect of having a rate limited queue from the start and results in some amount of dropping
- Even with long delays for the single hop scenario, behavior appears stable.

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FECN Overview

- Source

- Tagging Frames

- After time τ , subsequent outgoing frame is tagged with two RD tags with rate field initialized to -1.

- Response to Rate Adjustments

- When receiving returning RD tag, adjust rate based on information carried in RD tag

- Switch

- Rate Computation

- After measurement interval, T , compute advertised rate to be included in forward RD tag

- Congestion Notification

- If incoming frame has forward RD tag, include advertised rate if lower than rate included in forward RD tag of the frame.

- Receiver

- Reflecting Rate Information Back to Source

- Copy forward RD tag into returning RD tag.

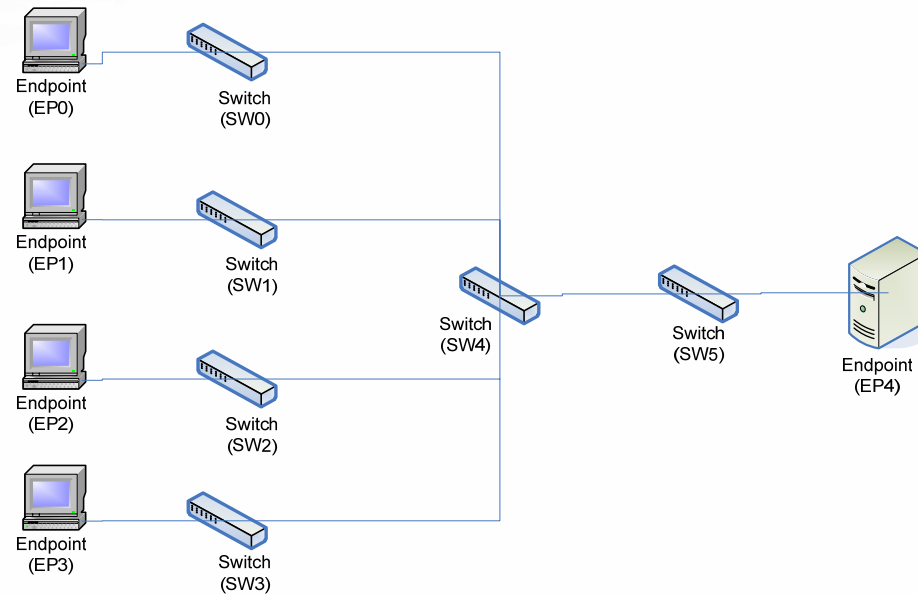
More details, see <http://www.ieee802.org/1/files/public/docs2007/au-jain-fecn-20070124.pdf>

Basic System Parameters

- No PAUSE
- Switch Parameters
 - Buffer Size (B)
 - 600Kbytes/Port.
 - Discard Threshold:
 - 600 Kbytes / Port
- FECN Parameters
 - Queue Control Function
 - Hyperbolic Function
 - $a = 1.1$
 - $b = 1.002$
 - $c = 0.1$
 - Measurement Interval
 - $T = 1\text{ms}$
 - Q_{eq}
 - $B / 4$ or
 - $16 * 1500$ byte packets
 - FECN Enhancements
 - Exponential Averaging of Computed Weight
 - $\alpha = 0.5$
 - **Limited Rate Increase in Switch***
 - Time Based Sampling at the Source
 - $\tau = 1\text{ms}$

*Based on algorithm specified on slide #13 in <http://www.ieee802.org/1/files/public/docs2007/au-jain-fecn-20070314.pdf>

Symmetric Topology Single HS – Non Bursty (Similar to Required Scenario #5)



- Symmetric Topology Single HS
 - Link speed : 10Gbps for all links
- Traffic Pattern
 - Traffic Type: 100% UDP (or Raw Ethernet) Traffic
 - Destination Distribution: EP0-EP3 send to EP4 @ 5ms, EP0 and EP1 stop @80ms
 - Frame Size Distribution: Fixed length (1500 bytes) frames
 - Arrival Distribution: Bernoulli temporal distribution
 - Offered Load/Endpoint = 50%

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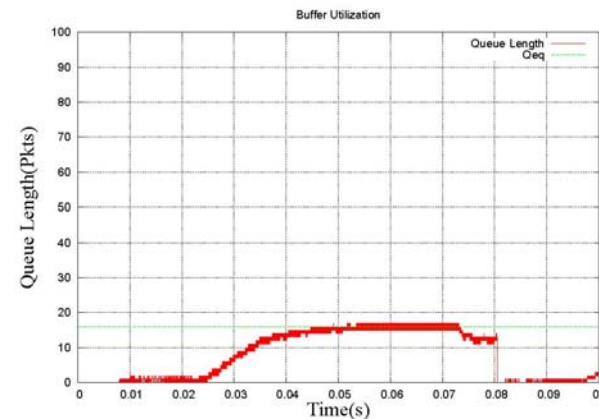
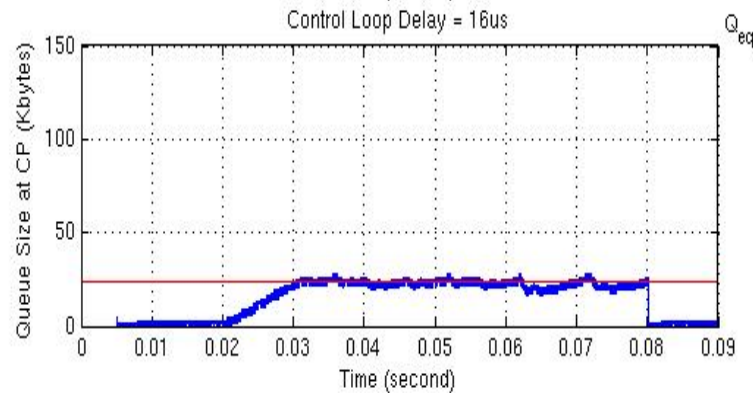
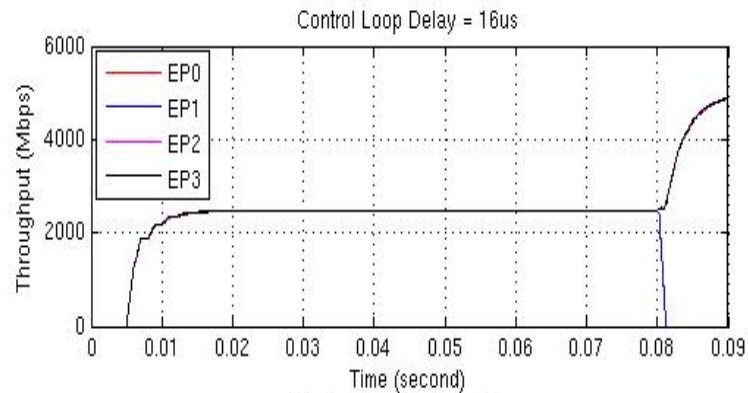
Validation of FECN

- Setup:

- One flow per end point
- $N_0 = 8$
- $T = 1\text{ms}$
- $Q_{eq} = 16\text{packets}$

- Observations:

- Generally lines up with existing FECN simulation results*



*<http://www.ieee802.org/1/files/public/docs2007/au-jain-fecn-20070124.pdf>

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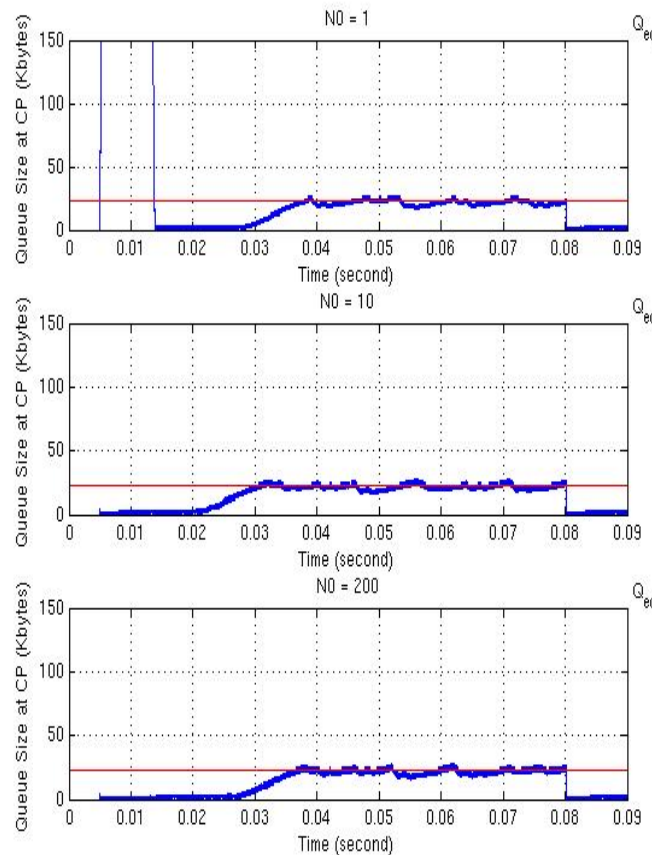
Sensitivity Analysis of N0 Queue Size @ CP

- Setup:

- One flow per end point
- T = 1ms
- Qeq = 16 packets

- Observations:

- N0 is the estimated number of flows



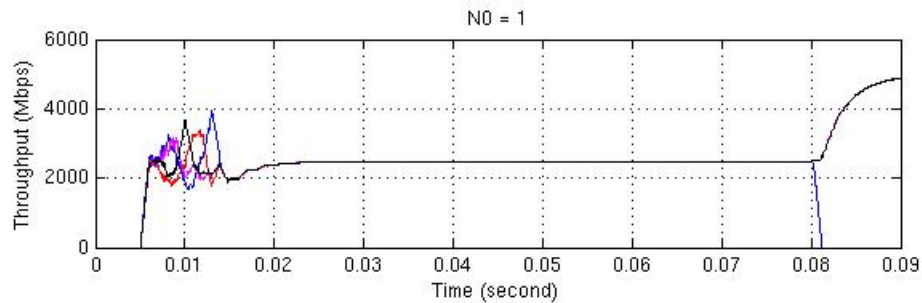
N0	#drops	Throughput
1	4055	9.887Gbps
10	0	9.766Gbps
200	0	9.098Gbps

The effects of N0 are minimized now given the new limited rate increase function. Some amount of frame discards can occur when N0 is too low.

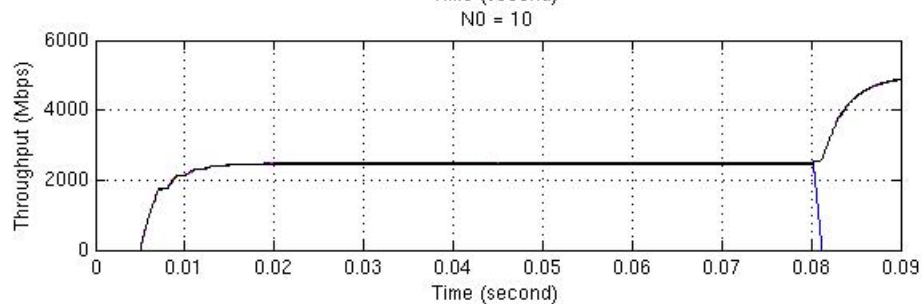
Sensitivity Analysis of N0 Throughput per Flow

N0

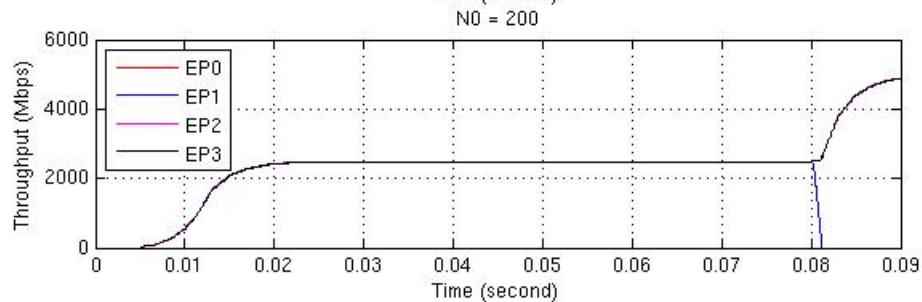
1



10



200



Impact of Delay Queue Size @ CP

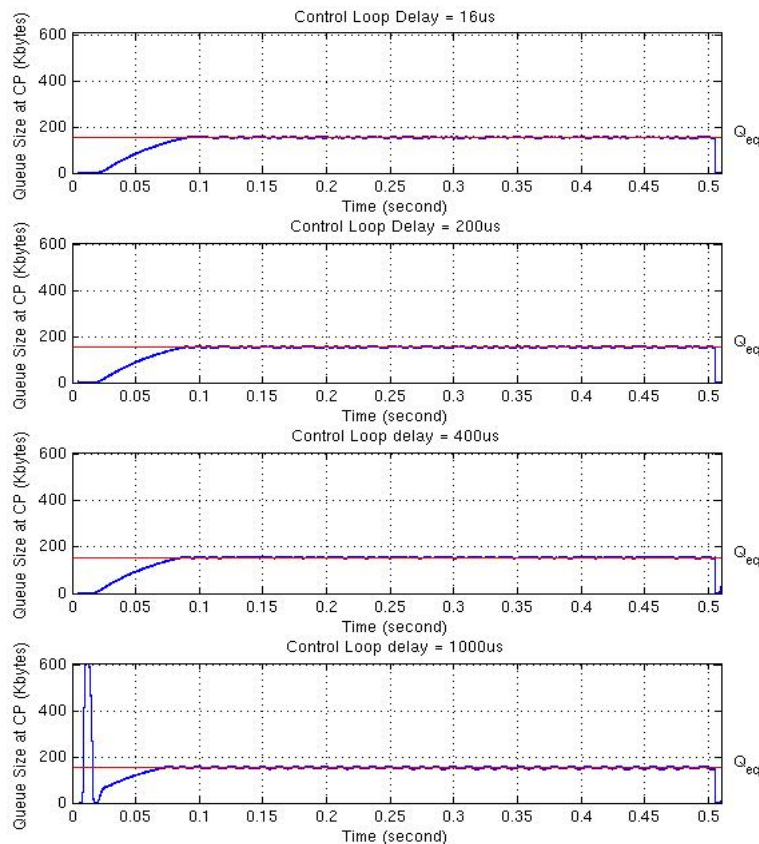
- Setup

- Buffer Size = 600Kbytes

- N0 = 10

- Qeq = 150Kbytes (B/4)

Effects of Qeq Queue Size @ CP



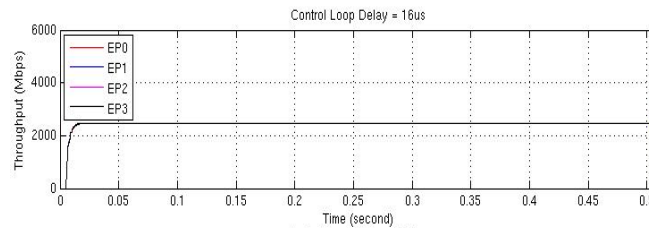
Ctrl Loop Delay	# of drops	Throughput
16us	0	9.965Gbps
200us	0	9.965Gbps
400us	0	9.967Gbps
1000us	328	9.957Gbps

Given a Qeq of 150kbytes, FECN performs well despite increase in control loop delay. Some frame discards do occur as the delay increases to 1000us.

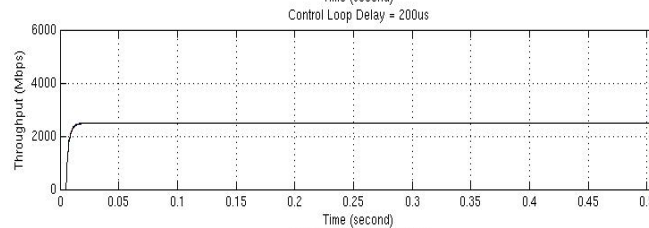
Effects of Q_{eq} Throughput

Control Loop Delay

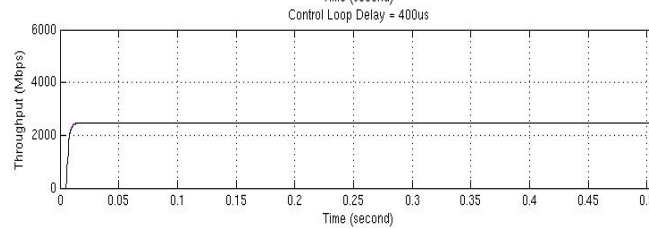
16us



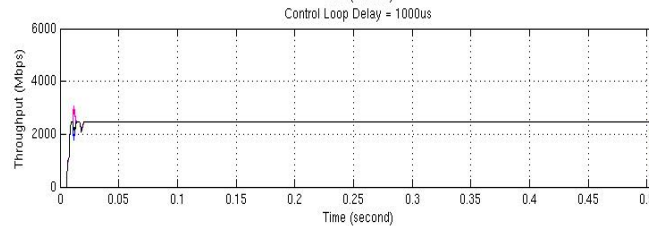
200us



400us



1000us



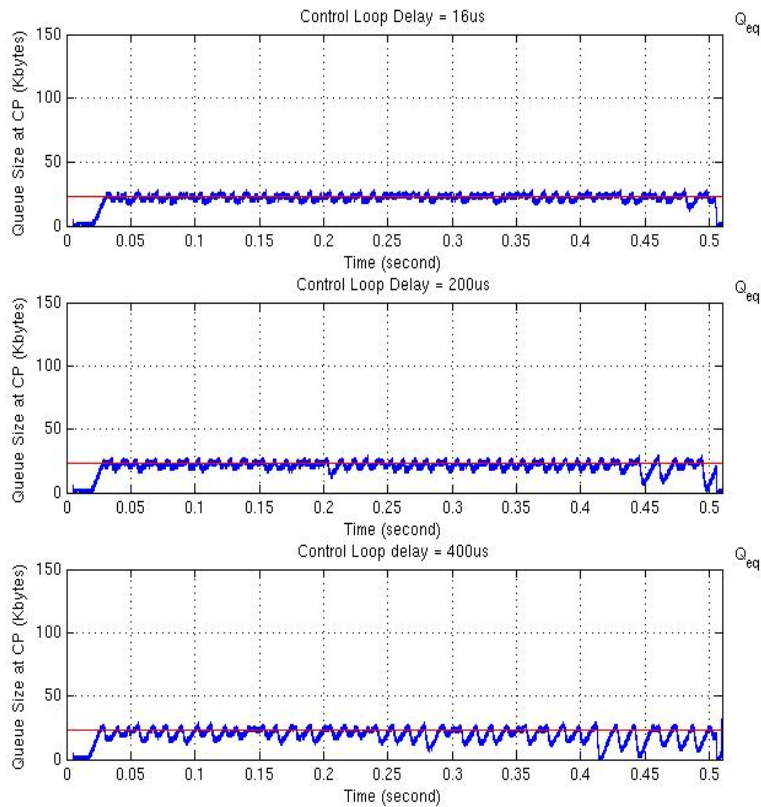
Good fairness can be achieved, even with large control loop delay

Effects of Low Qeq Queue Size @ CP

- Setup

- Buffer Size = 600Kbytes
- N0 = 10
- Qeq = 24K (16 Packets)

Effects of Q_{eq} Queue Size @ CP



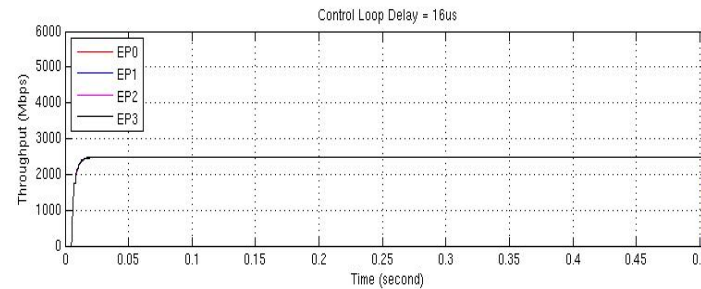
Ctrl Loop Delay	# of drops	Throughput
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Given current FECN settings, well behaved even under large delay conditions.

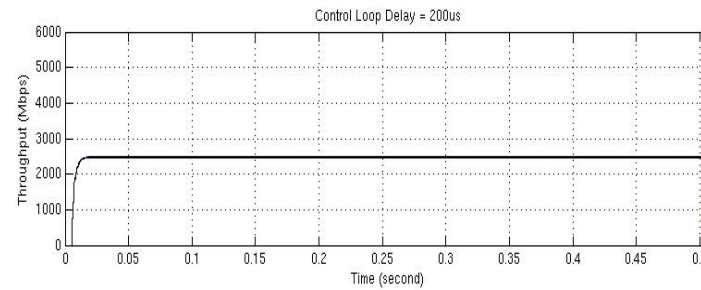
Effects of Q_{eq} Throughput

Control Loop Delay

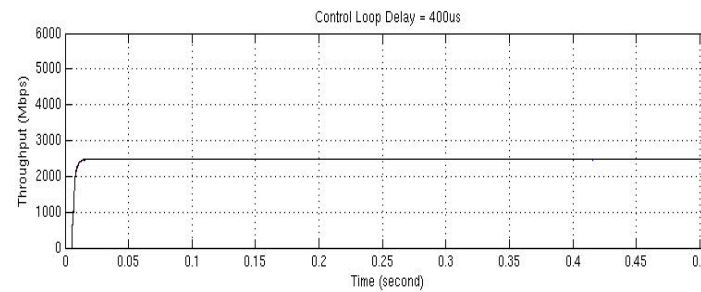
16us



200us



400us



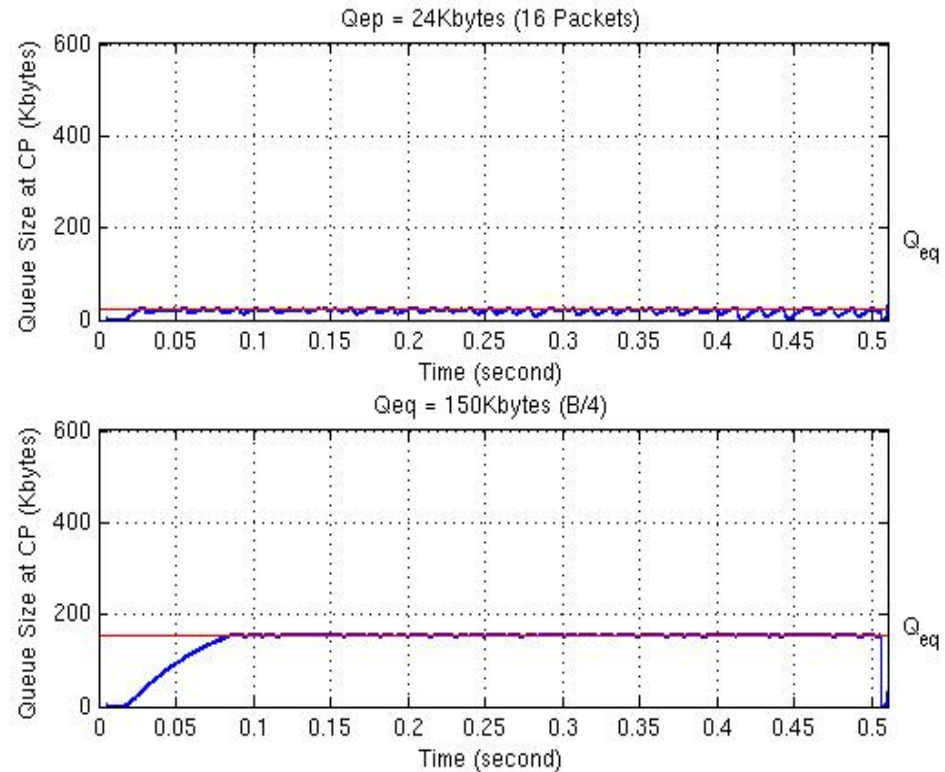
Comparison of Queue Behavior for Different Qeq

- Setup

- Control Loop Delay = 400us
- Qeq
 - 24 kbytes
 - 150 kbytes

- Observations

- Despite reduction in the Qeq, remains stable under these conditions.



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