



CN-SIM: Single-Hop Output- Generated Hotspot Scenario



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Objective

- Evaluate performance of ECM and FECN in the Single-Hop Output-Generated Hotspot Scenario

Required Scenario #1 from “*Topologies & Workloads*” ¹

- Metrics

Tier 1 Performance metrics from “*Discussion About Metrics*” ²

Aggregate throughput

Flow completion time (Max, Avg, Min, Stddev)

Packets dropped

% time paused

Signaling overhead

Queue length

Bottleneck link utilization

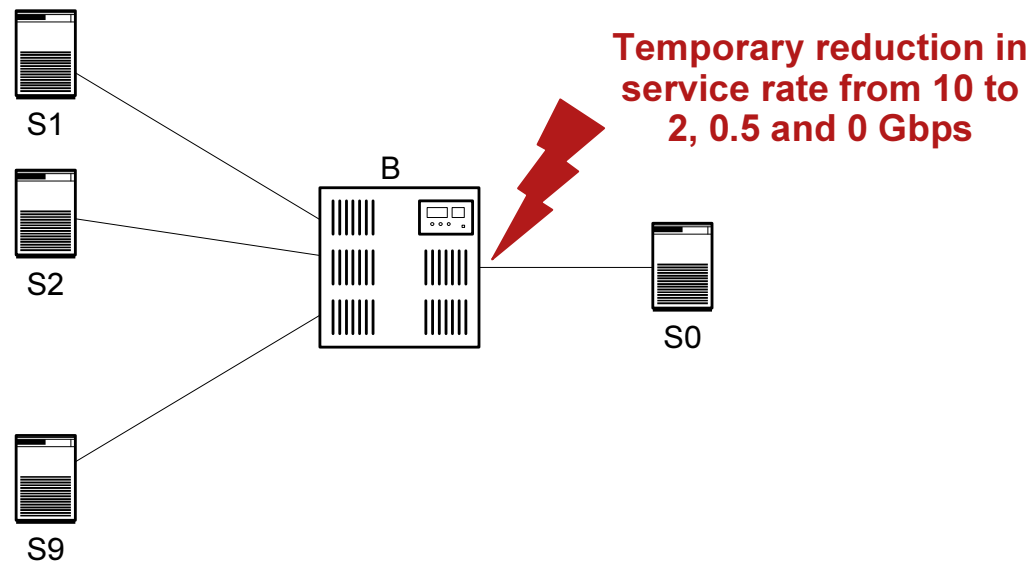
Tier 2 Performance metrics to follow

¹ <http://www.ieee802.org/1/files/public/docs2007/au-sim-wadekar-reqd-extended-sim-list020807.pdf>

² <http://www.ieee802.org/1/files/public/docs2007/au-sim-bergamasco-on-metrics-070314.pdf>

Simulation Environment

- Topology & Workload



- Traffic pattern

- Load 75%
- Spatially Uniform (except self)
- Temporally Bursty:
 - On Time \rightarrow Pareto $\mu = 45 \mu\text{s}$
 - Off Time \rightarrow Exponential $\mu = 15 \mu\text{s}$

- Hotspot

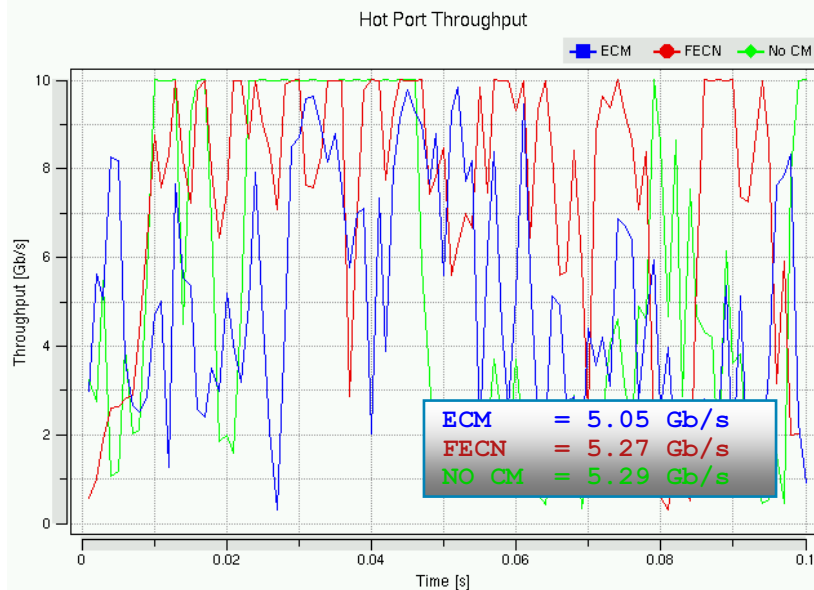
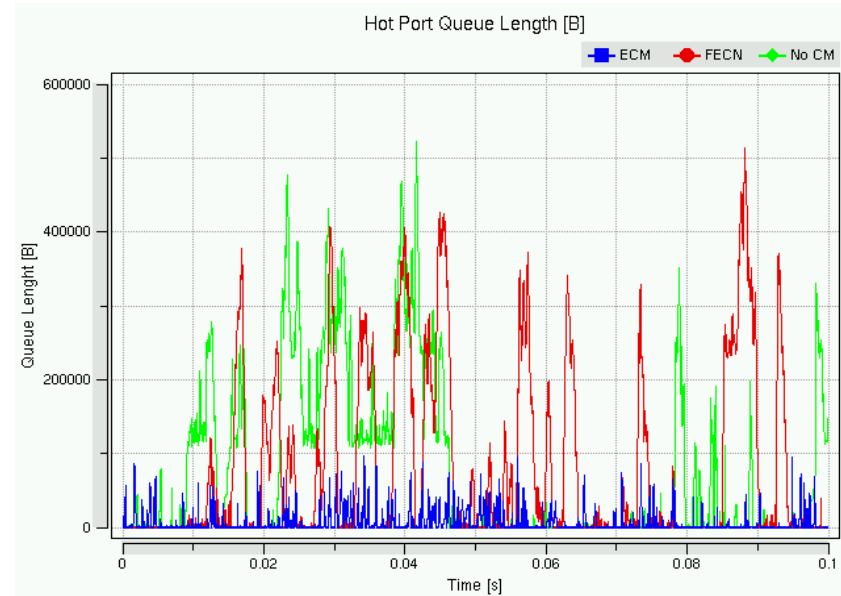
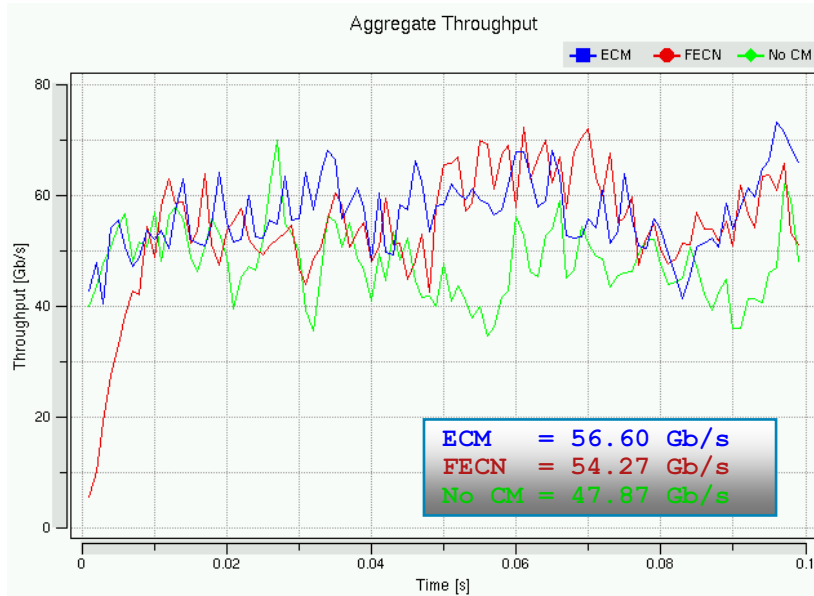
- Duration: 80 ms, from $t_i = 10$ to $t_f = 90$ ms
- HS degree = 9
- HS severity = 3.25 / 15 / ∞ : 1

Simulation Environment

- Selective Pause enabled as per “*CN-SIM: A common Bridge Model*”¹
- Switch output buffer partitioned per input port
150 KB of space for each input → 2.4 MB for 16 ports
Pause Enabled
High watermark = 130 KB
Low watermark = 120 KB
- ECM parameters
 - W = 2
 - Gi = $5.333333333 \times 10^{-1}$
 - Gd = $2.666666667 \times 10^{-4}$
 - Qeq = 375
 - Qmc = 1300
 - FixedSamplingInt = 75000 B
 - RandomSamplingInt = uniform(-5000, 5000) B
 - BCN-Max used in lieu of BCN(0,0)
 - RL Timeout = 2 ms
- FECN parameters
 - T = 1 ms
 - a = 1.1
 - b = 1.02
 - c = 0.1
 - Qeq = 375
 - Qsc = 1300
 - N0 = 200 → R0 = 50 Mb/s
 - RL Timeout = 2ms
- Simulation duration 100 ms

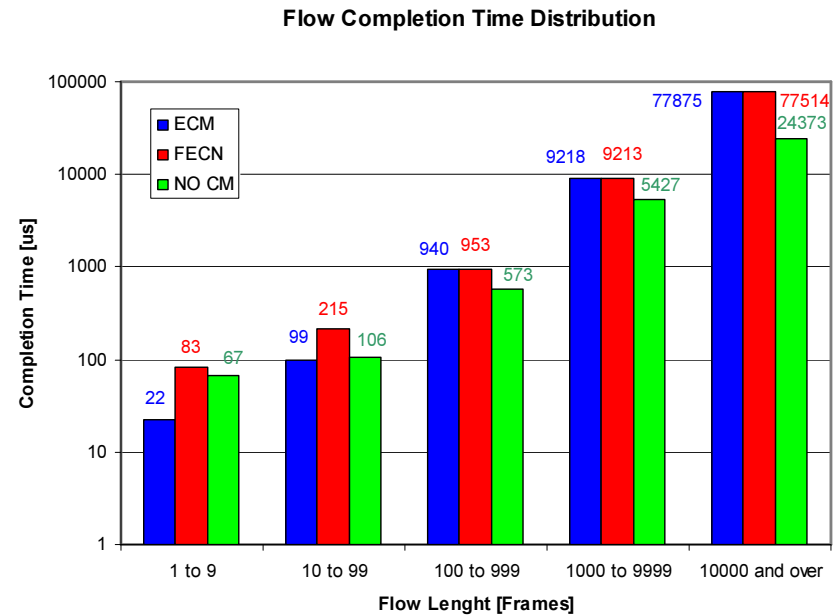
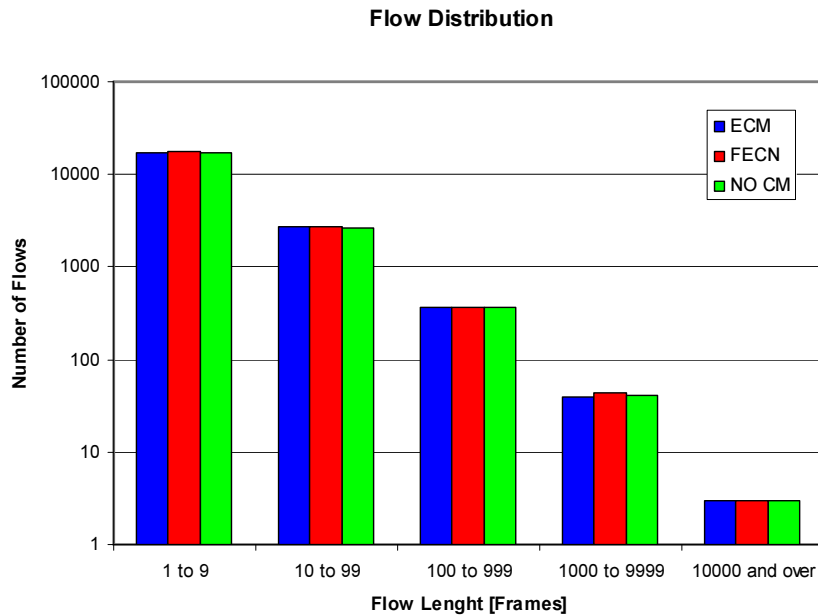
¹ <http://www.ieee802.org/1/files/public/docs2006/au-sim-bergamasco-common-bridge-model-101206v2.pdf>

No Hotspot (Baseline)



	Flow Completion Time					Avg Time Paused [%]	Dropps Frames [#]	Over-head [Mb/s]
	Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	22413	3.5	66.4	69,880	718	0	0	28.2
FECN	21916	3.5	137.7	77,514	813	8.1	0	2.5
No CM	20132	3.5	97.2	25,156	477	19.7	0	0

No Hotspot (Baseline)

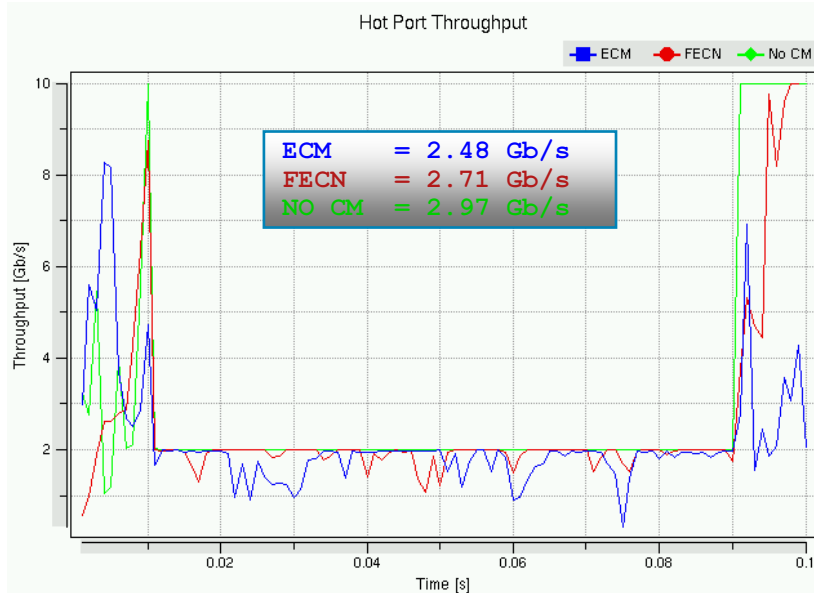
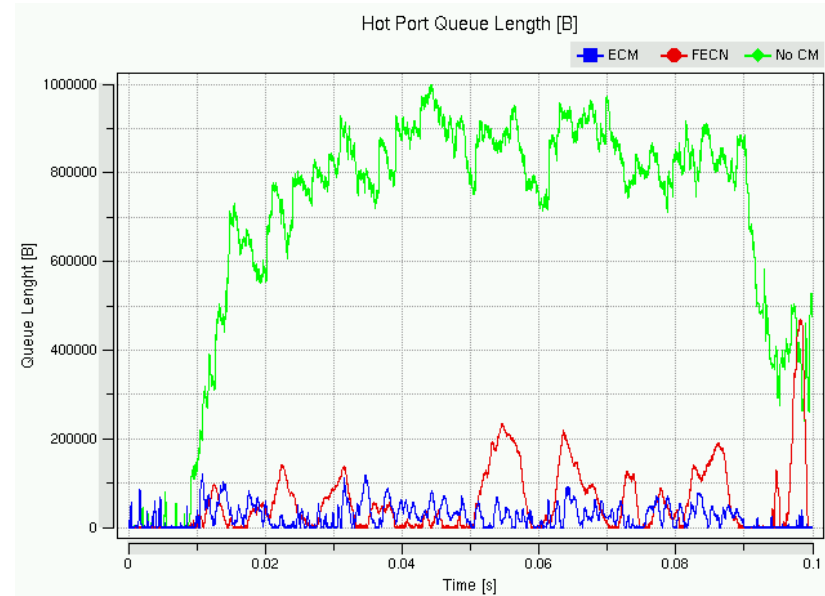
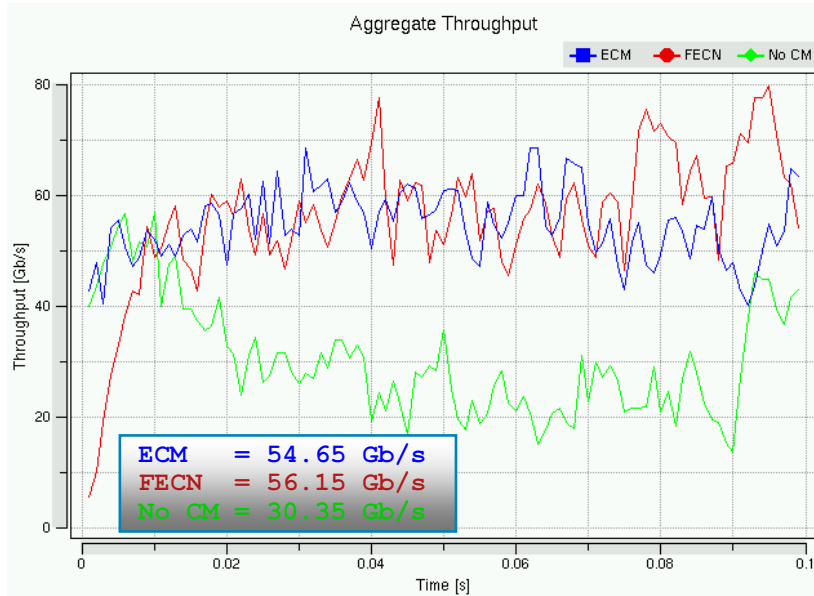


■ Observations

FECN seems to increase FCT for short-lived flows because all flows are treated equally, irrespective of their size

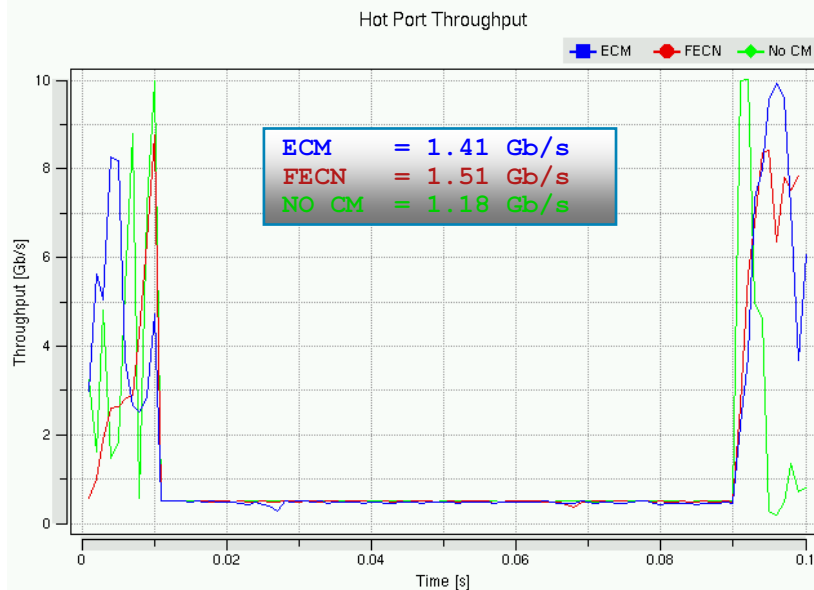
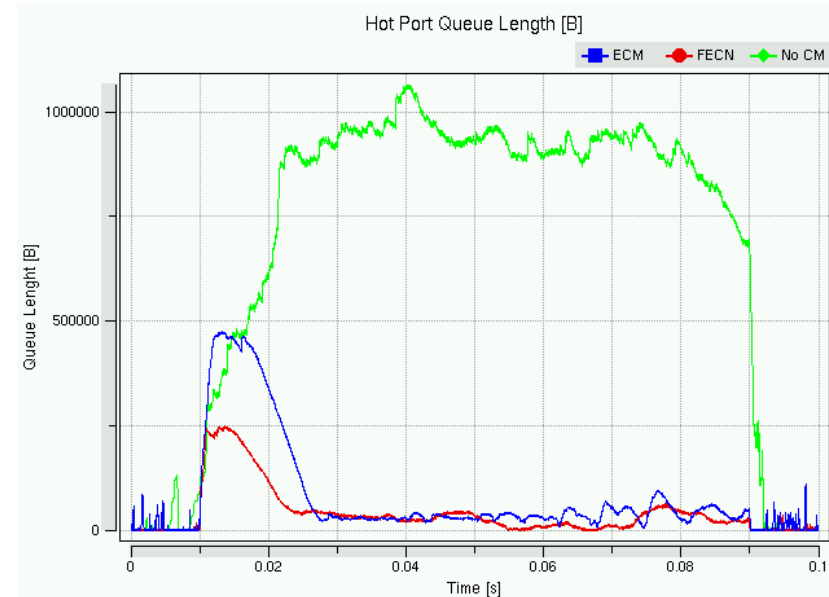
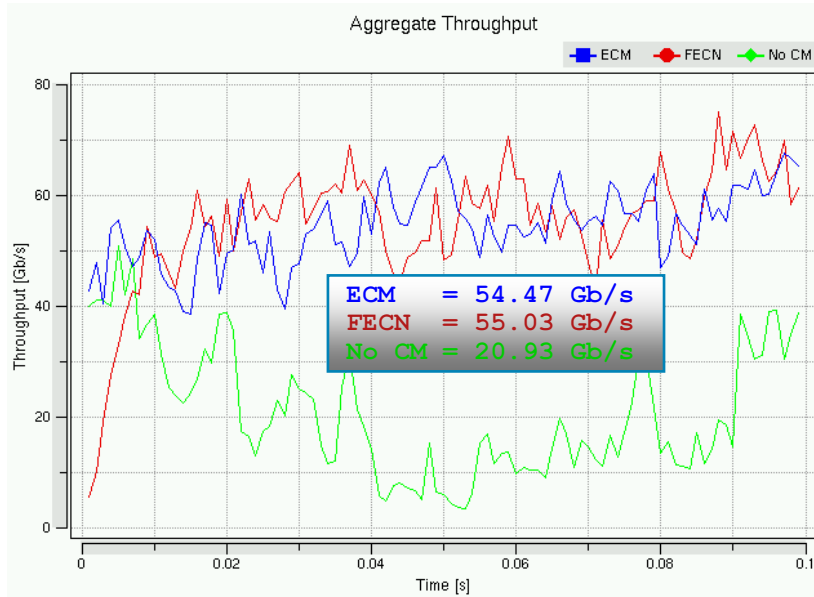
ECM shows a bias towards long-lived flows

2 Gb/s Hotspot



	Flow Completion Time					Avg Time Paused [%]	Dropps Frames [#]	Over-head [Mb/s]
	Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	20,386	3.5	80.4	51,297	750	0	0	26.7
FECN	22,428	3.5	188.7	69,933	1122	12.1	0	3.5
No CM	15,032	3.5	377.2	79,113	1411	65.2	0	0

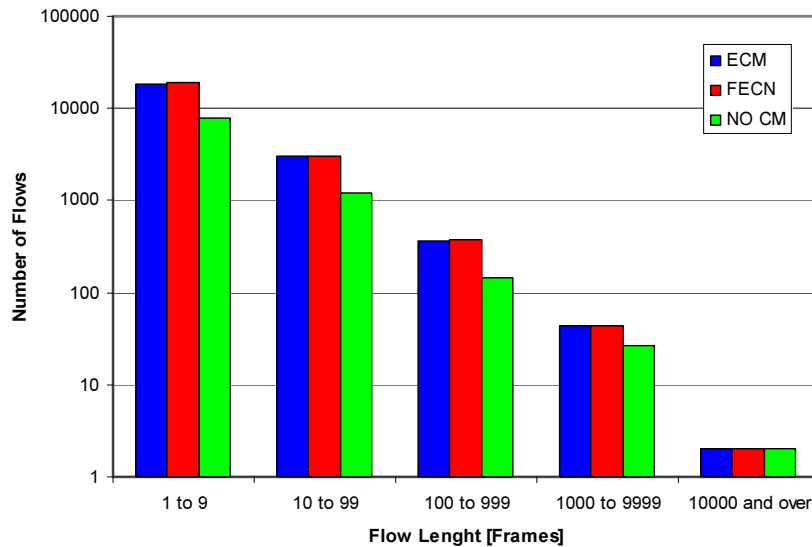
0.5 Gb/s Hotspot



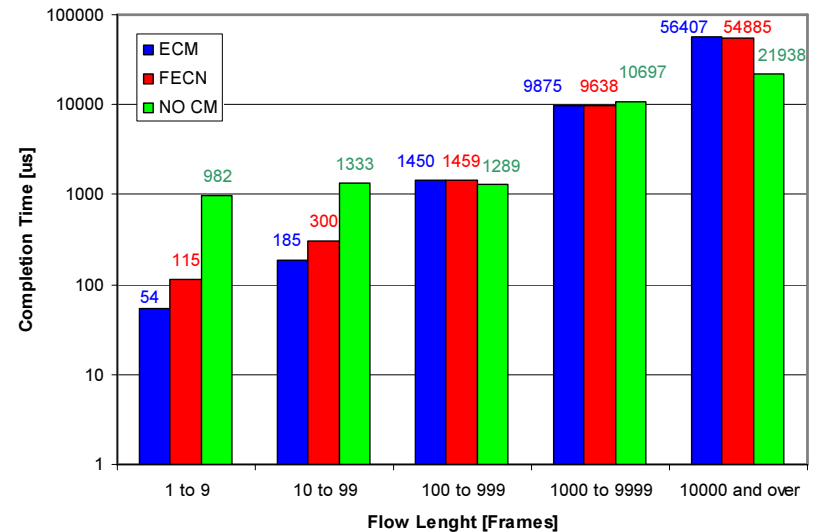
	Flow Completion Time					Avg Time Paused [%]	Dropps Frames [#]	Over-head [Mb/s]
	Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	21104	3.5	114.4	86,295	1268	11.1	0	29.3
FECN	22646	3.5	185.8	91688	1203	1.2	0	3.6
No CM	9232	3.5	1062	81127	3744	52.2	0	0

0.5 Gb/s Hotspot

Flow Distribution



Flow Completion Time Distribution

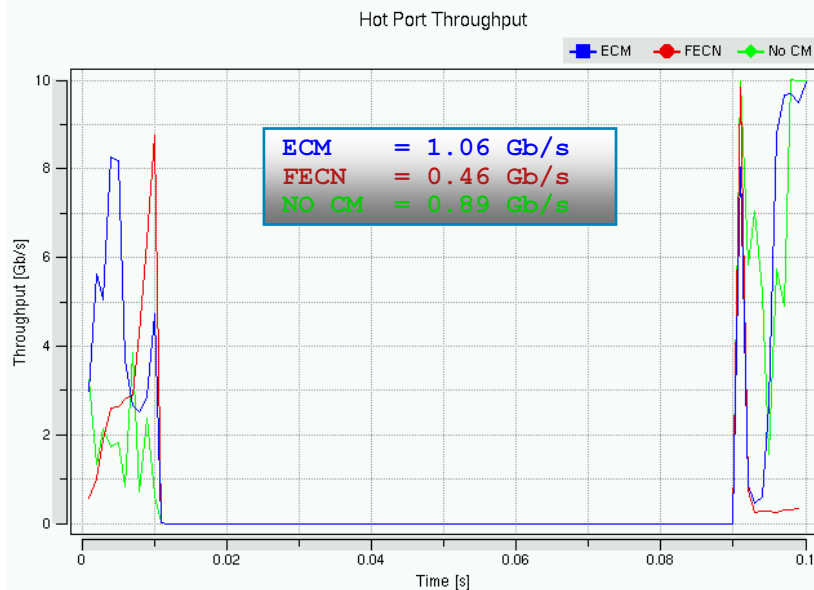
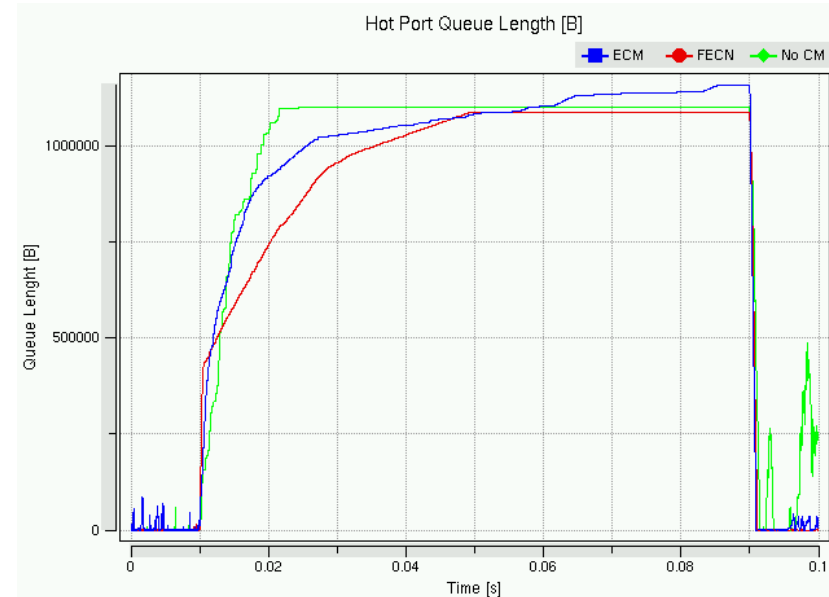
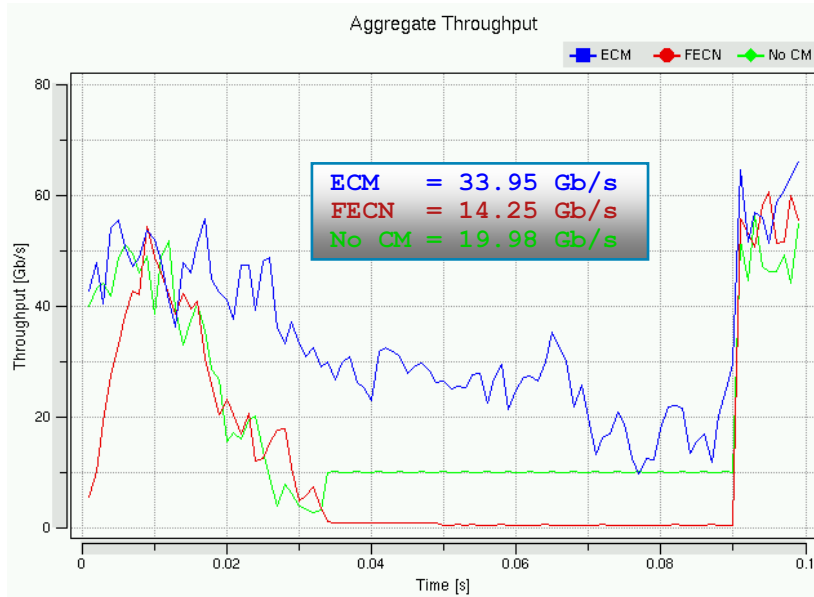


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	Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	15123	3.5	784	72,467	7309	50.2	0	15.2
FECN	7186	3.5	2618	82,890	13490	72.8	0	1.7
No CM	8636	3.5	2002	79,890	10643	75.3	0	0

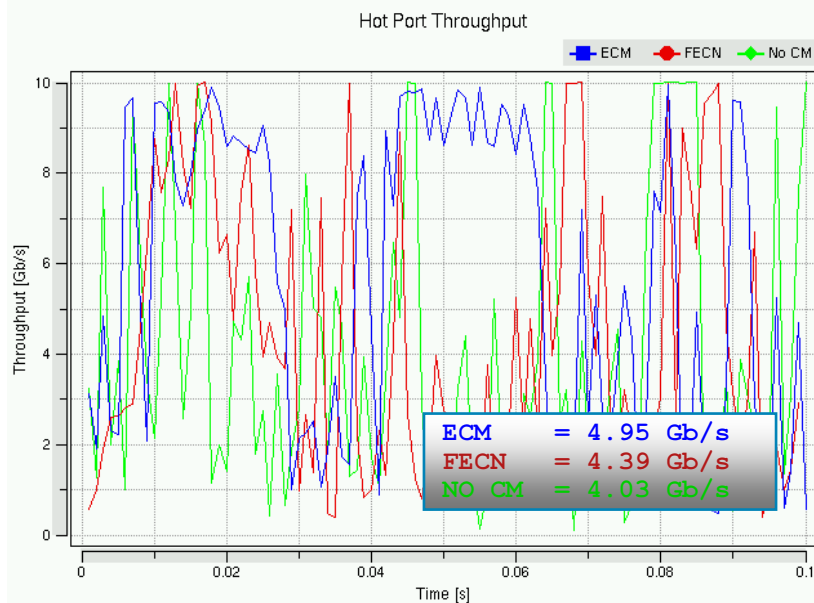
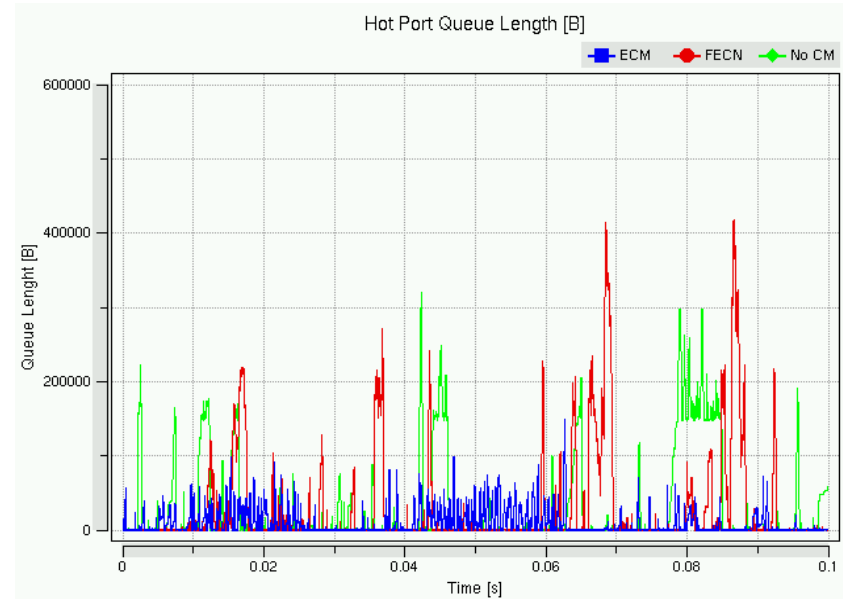
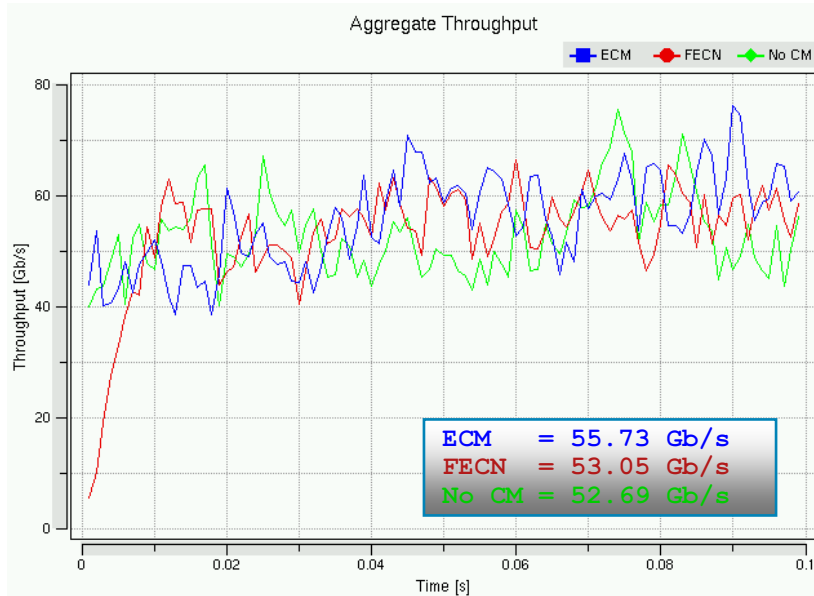
Observations

- CM beneficial even in absence of hotspots
 - However, throughput is increased at the expense of latency
- ECM and FECN perform similarly in this scenario
 - However, FECN seems to show a slightly higher FCT because RLs are “always-on”
- Exception: 0 Gb/s hotspot
 - When the link is stopped, FECN performance degrades significantly because of loss of communication b/w CP and RP

Pause Disabled

- Same scenario and workloads run with pause disabled
- Results may not be representative of reality
 - There is no reliable transport layer (no retransmissions)
 - Throughput is higher
 - FCT is lower
 - Topology too simple
 - Does not show blocking due to frame loss

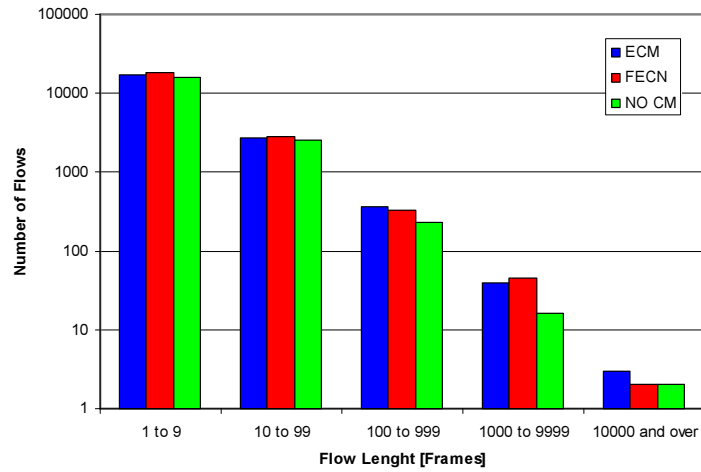
No Hotspot (Baseline)



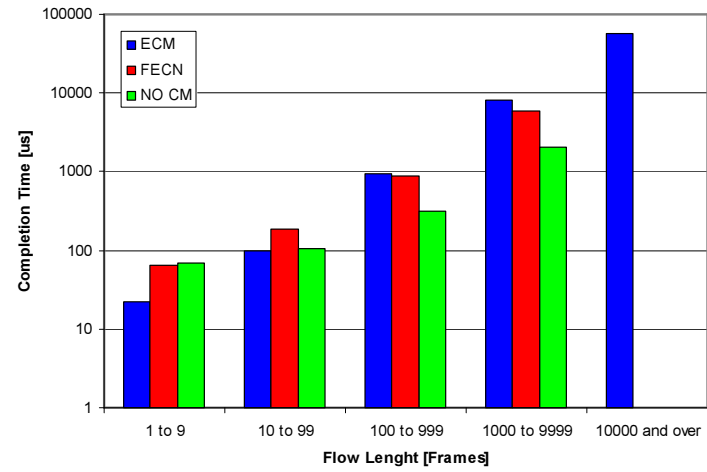
	Flow Completion Time					Avg Time Paused [%]	Droppd Frames [#]	Over-head [Mb/s]
	Tot Flows / Bad Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	20399 / 0	3.5	70.3	76210	925	0	0	29.11
FECN	21976 / 192	3.5	94.73	13512	942	0	19055	3.0
No CM	18821 / 200	3.5	77.41	32310	1035	0	158747	0

No Hotspot (Baseline)

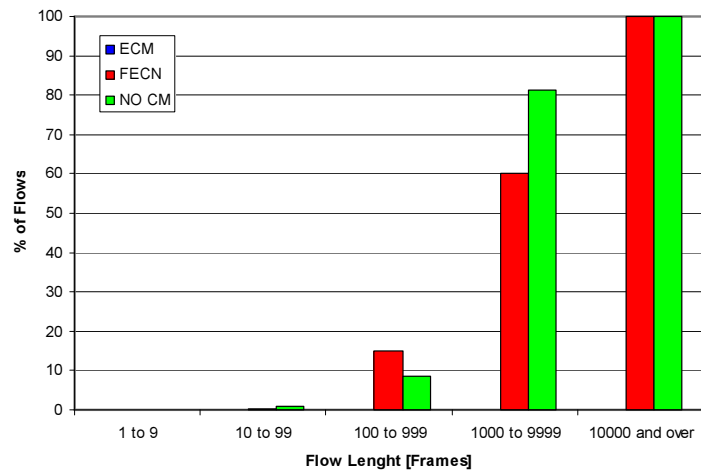
Flows Distribution



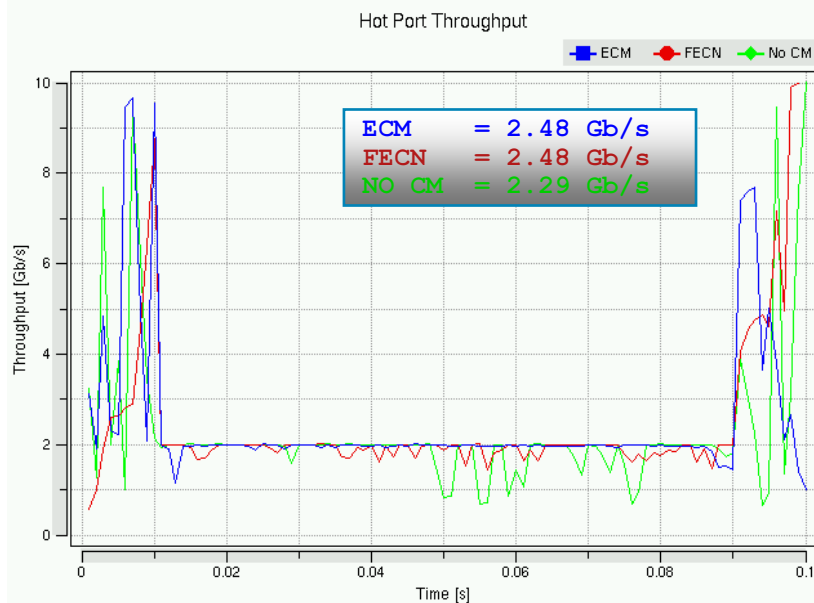
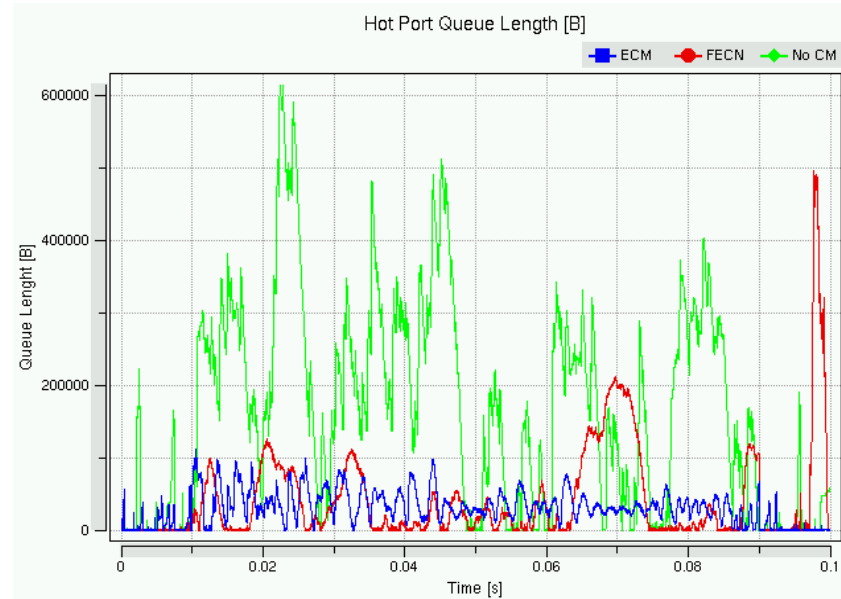
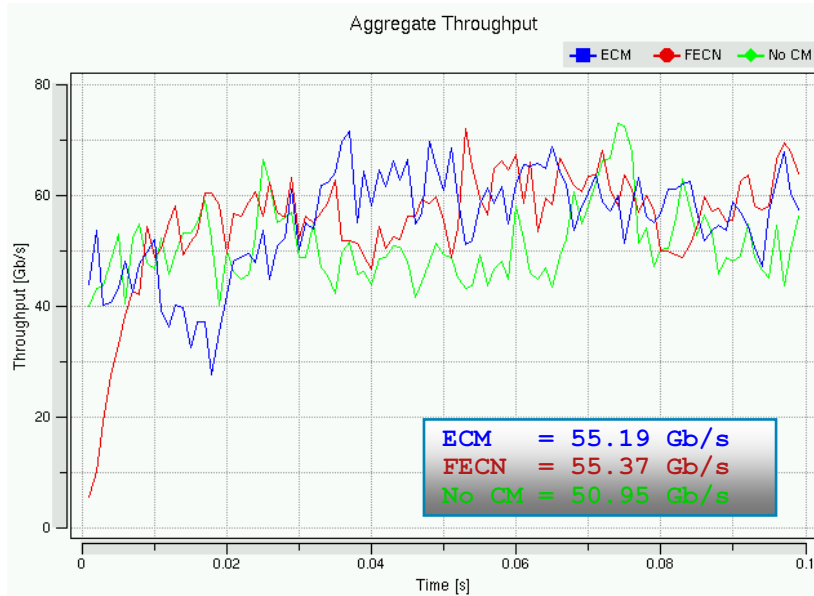
Flow Completion Time Distribution



Bad Flows Distribution

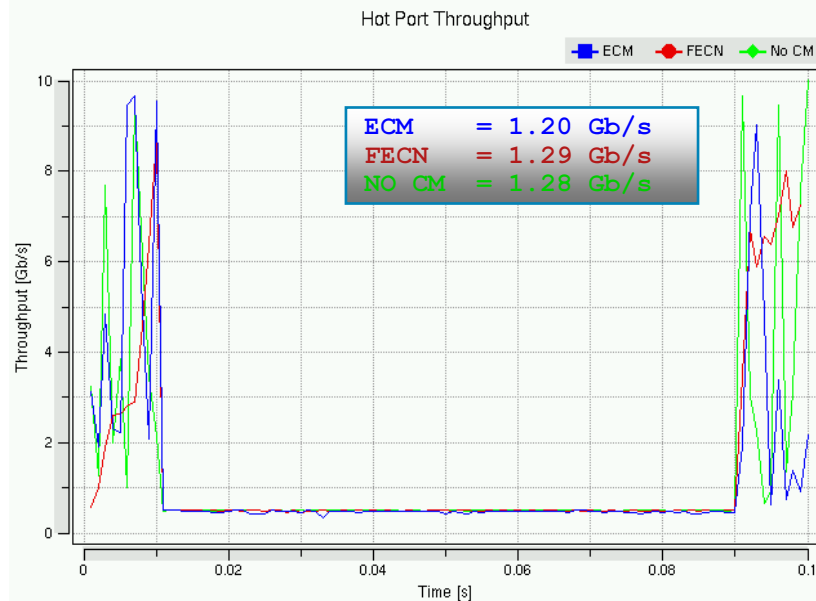
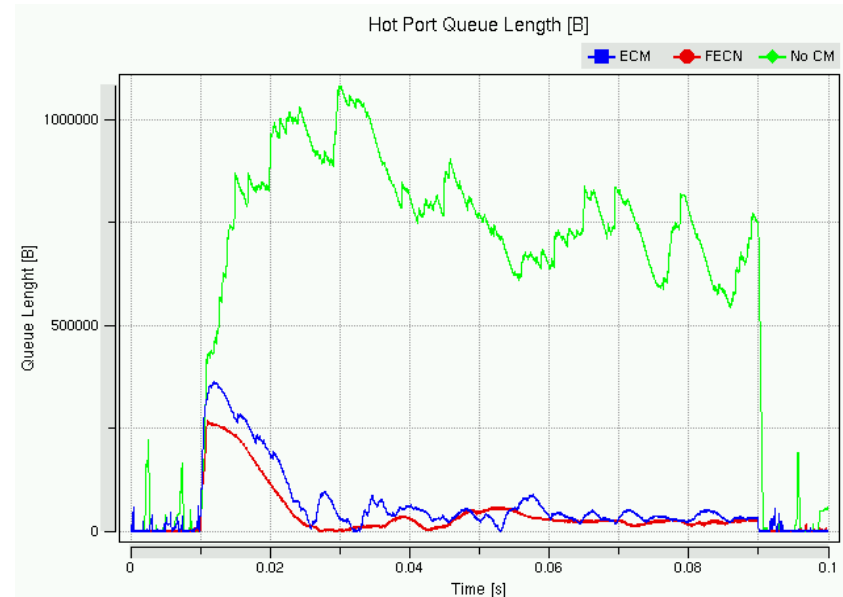
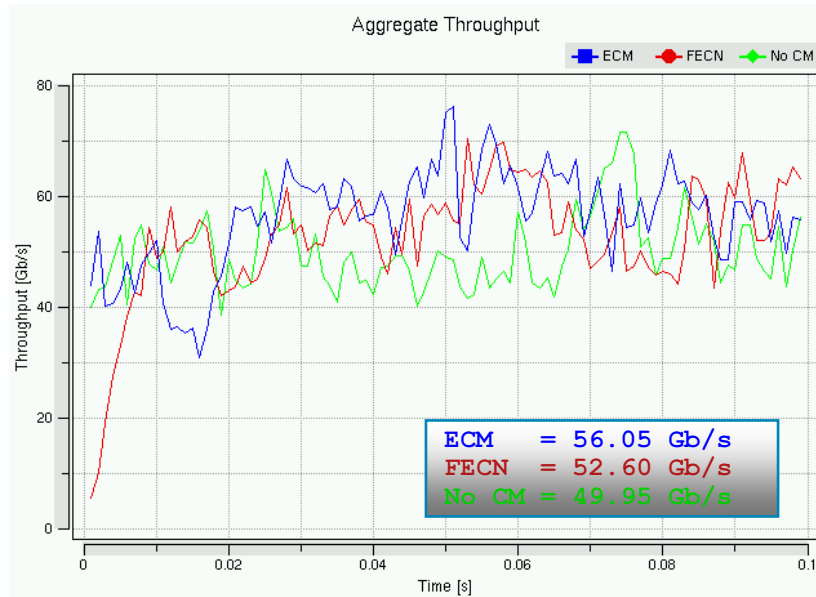


2 Gb/s Hotspot



	Flow Completion Time					Avg Time Paused [%]	Dropps Frames [#]	Over-head [Mb/s]
	Tot Flows / Bad Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	18760 / 7	3.5	113.4	80024	1590	0	11	30.6
FECN	22060 / 139	3.5	129.6	64456	753	0	21634	3.1
No CM	18821 / 286	3.5	132.3	32231	257	0	173277	0

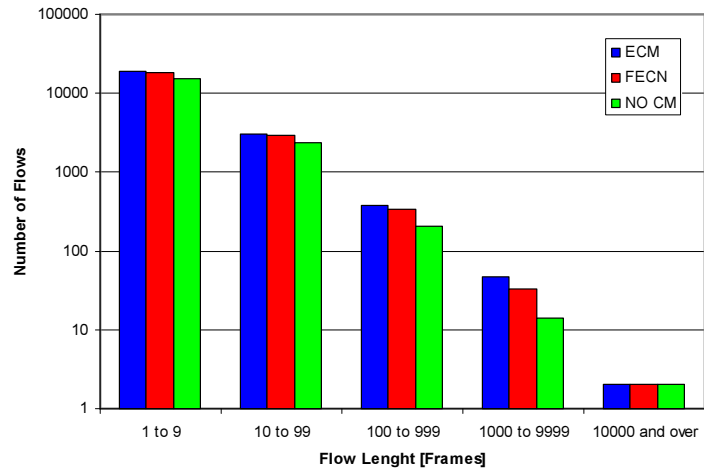
0.5 Gb/s Hotspot



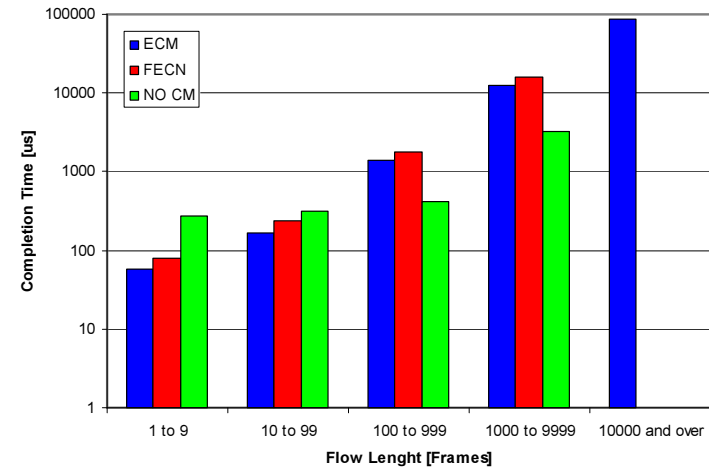
	Flow Completion Time					Avg Time Paused [%]	Droppd Frames [#]	Over-head [Mb/s]
	Tot Flows / Bad Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	22654 / 6	3.5	126.4	86278	1484	0	484	30.5
FECN	22025 / 115	3.5	137.3	91704	950	0	13369	3.1
No CM	18821 / 1030	3.5	401.2	17356	1943	0	182056	0

0.5 Gb/s Hotspot

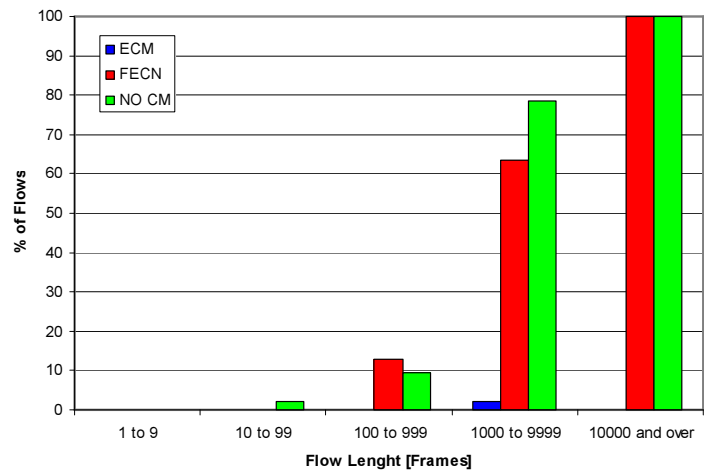
Flows Distribution



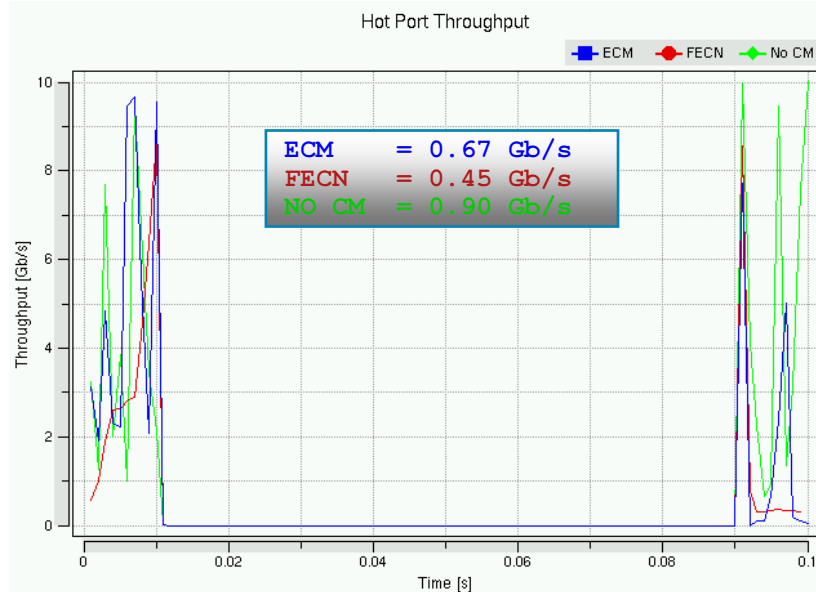
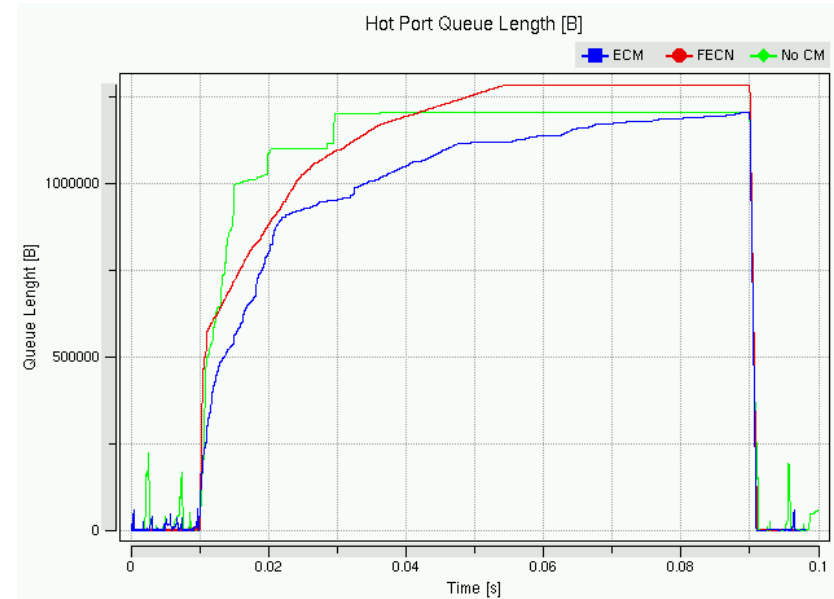
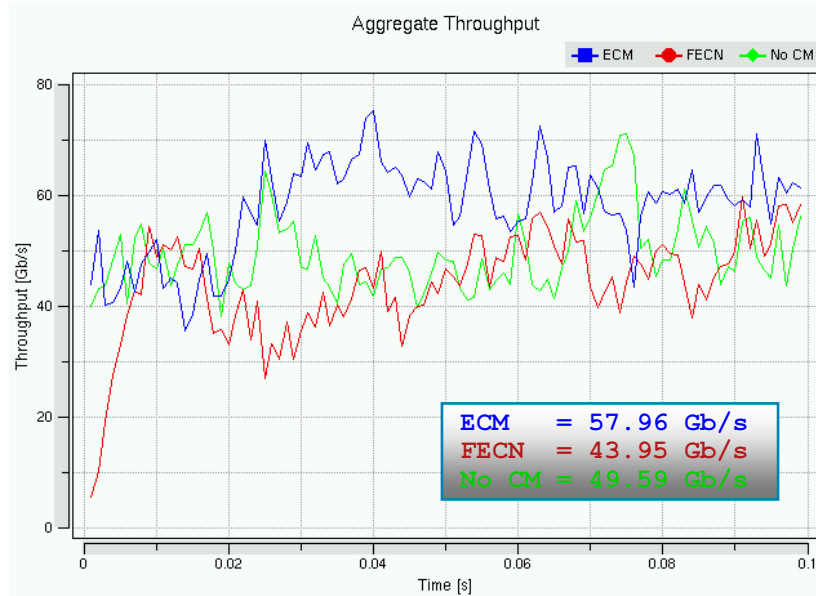
Flow Completion Time Distribution



Bad Flows Distribution



0 Gb/s Hotspot



	Flow Completion Time					Avg Time Paused [%]	Droppd Frames [#]	Over-head [Mb/s]
	Tot Flows / Bad Flows [#]	MIN [us]	AVG [us]	MAX [us]	Std-Dev [us]			
ECM	21191 / 31	3.5	293	83,983	3726	0	4917	31.1
FECN	20792 / 345	3.5	413	90,149	4985	0	14697	2.6
No CM	18821 / 1550	3.5	553	79,981	6002	0	185568	0

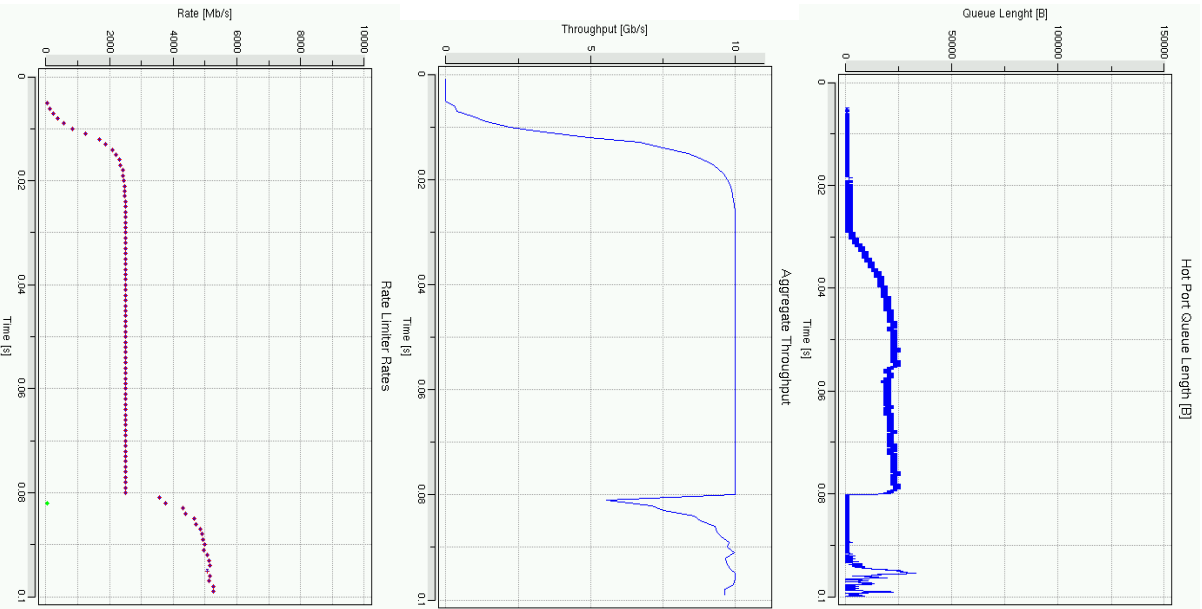


Backup



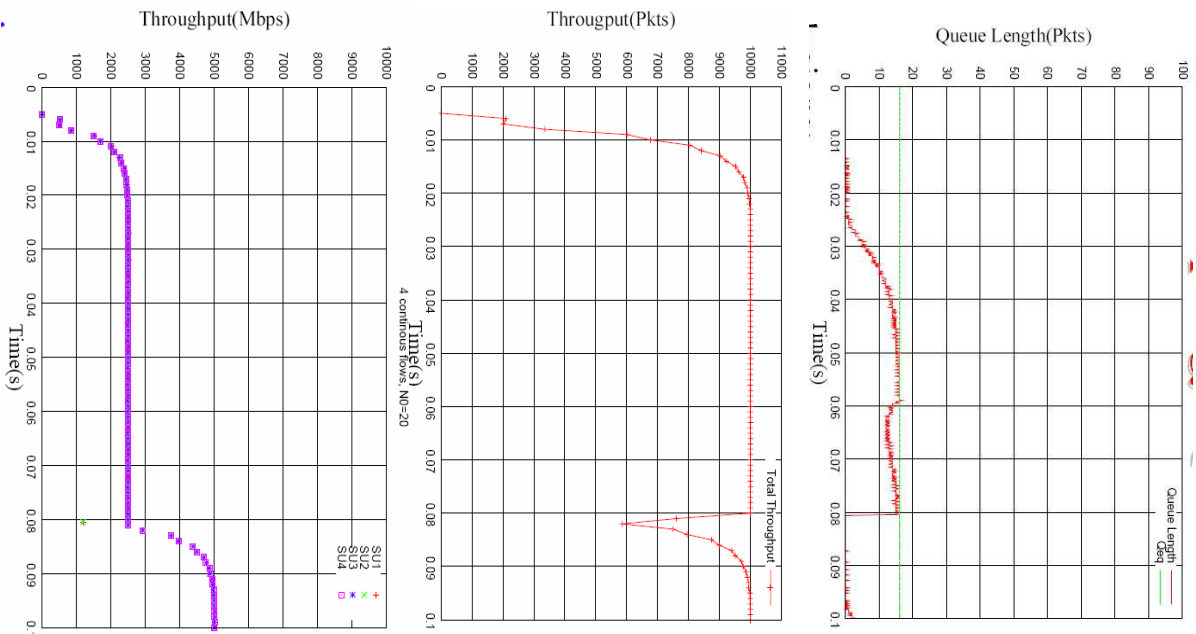
FECN Validation

Cisco simulations



EDCS-586838

Cisco Public



Prof Jain's simulations from

<http://www.ieee802.org/1/files/public/docs2007/au-jain-fecn-20070314.pdf>

