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

Davide Bergamasco

April 5th, 2007

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

Temporary reduction in service rate from 10 to 2, 0.5 and 0 Gbps
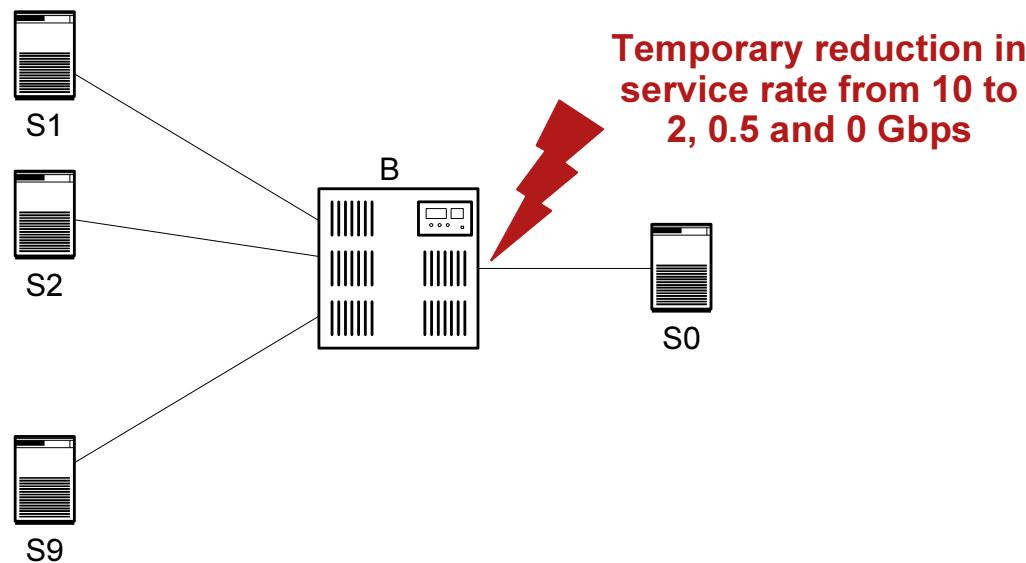
- Traffic pattern

  - Load 75%

  - Spatially Uniform (except self)

  - Temporally Bursty:

    - On Time → Pareto μ = 45 μs

   - Off Time → Exponential μ = 15 μs

- 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)

- FECN parameters
    - T = 1 ms
    - a = 1.1
    - b = 1.02
    - c = 0.1
    - Qeq = 375
   - Qsc = 1300

- Simulation duration 100 ms

[1] http://www.ieee802.org/1/files/public/docs2006/au-sim-bergamasco-common-bridge-model-101206v2.pdf
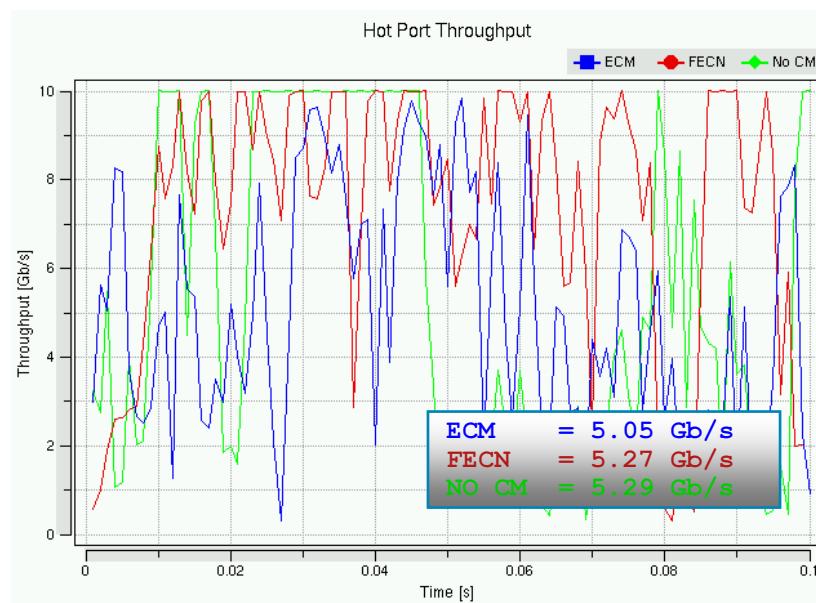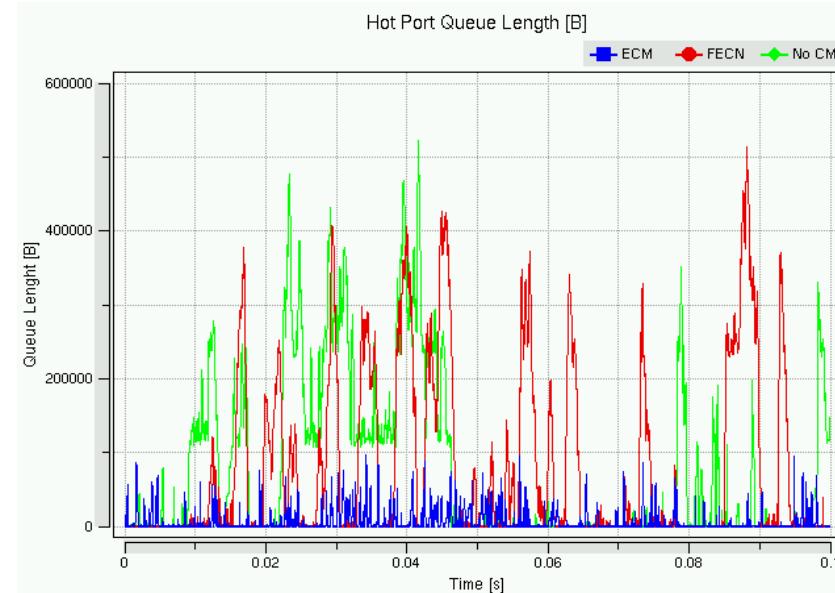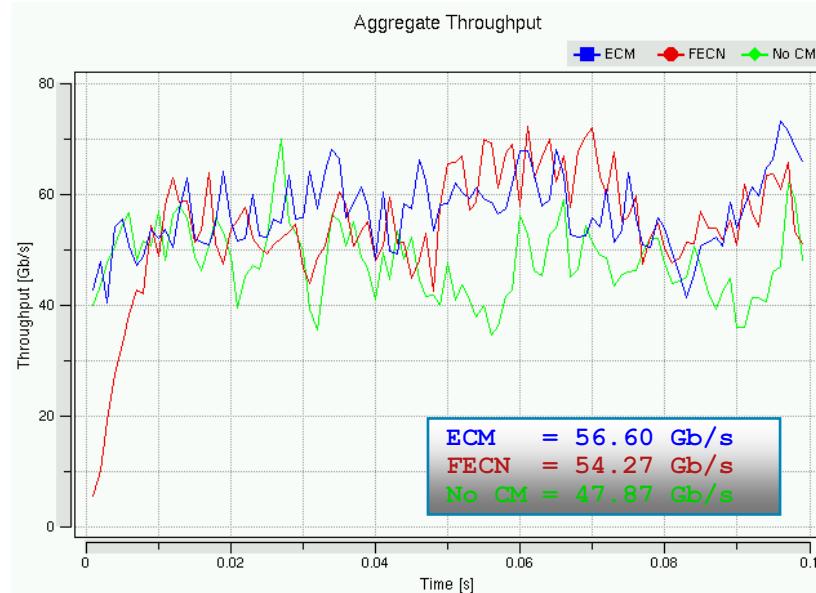
No Hotspot (Baseline)

Aggregate Throughput

ECM   = 56.60 Gb/s
FECN   = 54.27 Gb/s
No CM = 47.87 Gb/s

Hot Port Queue Length [B]

Hot Port Throughput

ECM   = 5.05 Gb/s
FECN   = 5.27 Gb/s
NO CM = 5.29 Gb/s

	Flow Completion Time					Avg Time Paused [%]	Droppd 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	25,16	477	19.7	0	0
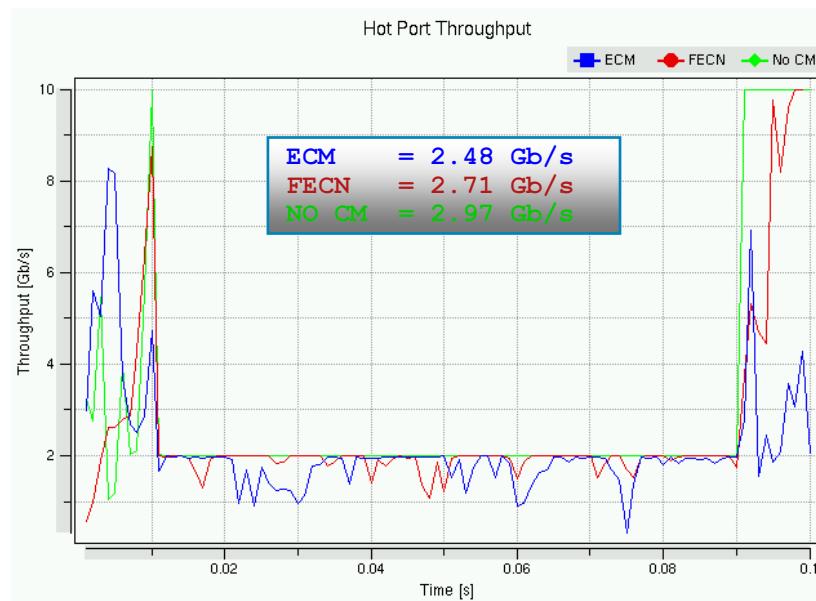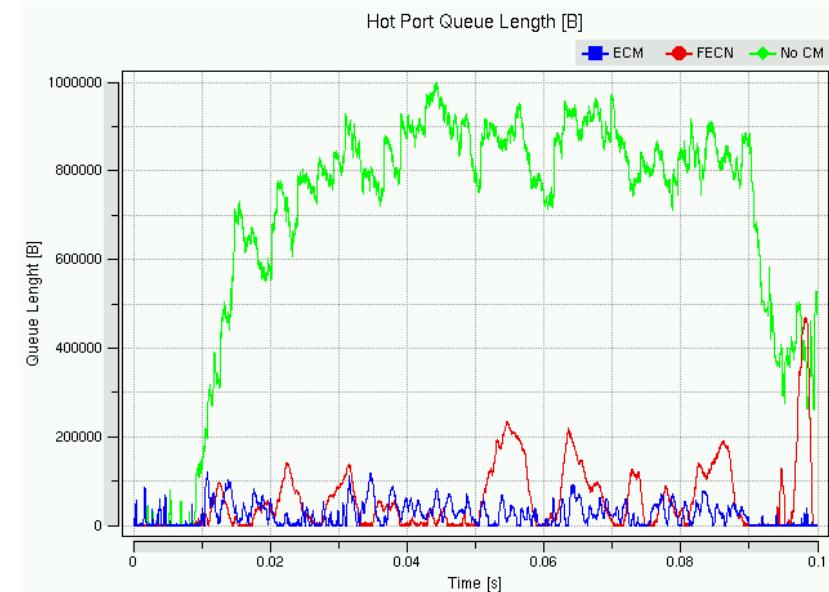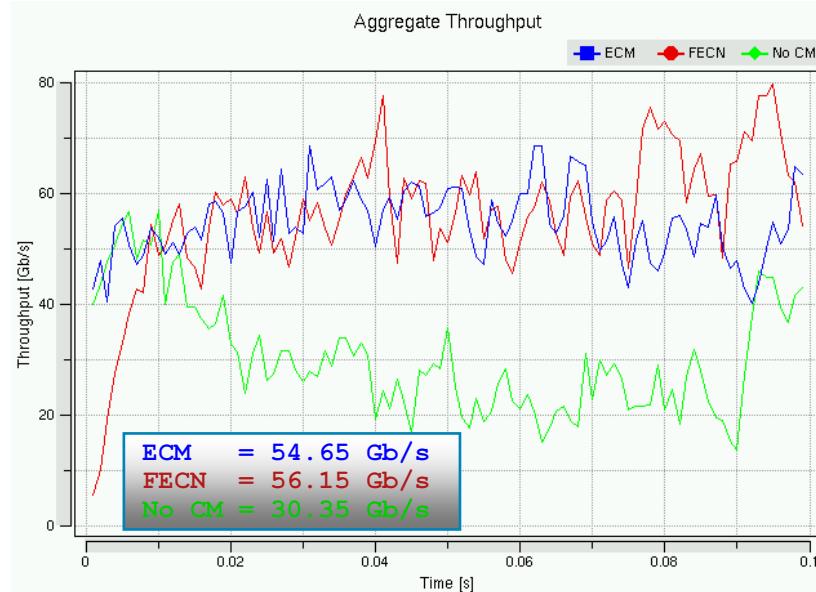
5

2 Gb/s Hotspot

Aggregate Throughput

ECM   = 54.65 Gb/s
FECN   = 56.15 Gb/s
No CM = 30.35 Gb/s

Hot Port Queue Length [B]

Hot Port Throughput

ECM   = 2.48 Gb/s
FECN   = 2.71 Gb/s
NO CM = 2.97 Gb/s

	Flow Completion Time					Avg Time Paused [%]	Droppd 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
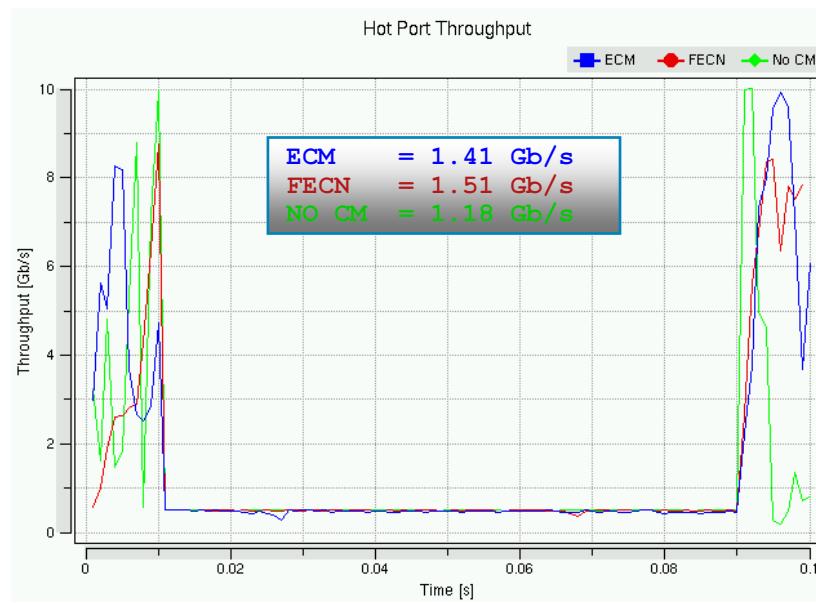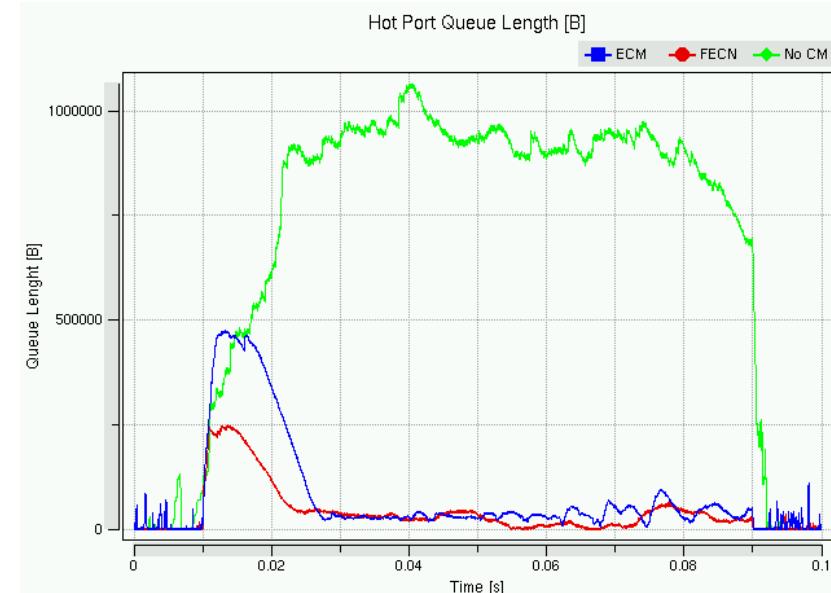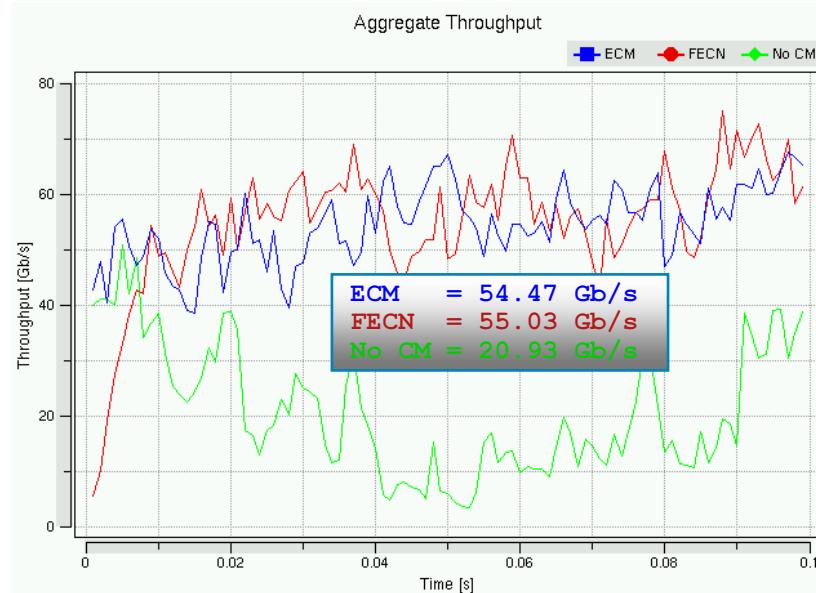
6

0.5 Gb/s Hotspot

Aggregate Throughput

ECM = 54.47 Gb/s
FECN = 55.03 Gb/s
No CM = 20.93 Gb/s

Hot Port Queue Length [B]

Hot Port Throughput

ECM = 1.41 Gb/s
FECN = 1.51 Gb/s
NO CM = 1.18 Gb/s

	Flow Completion Time					Avg Time Paused [%]	Droppd 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 Gb/s Hotspot
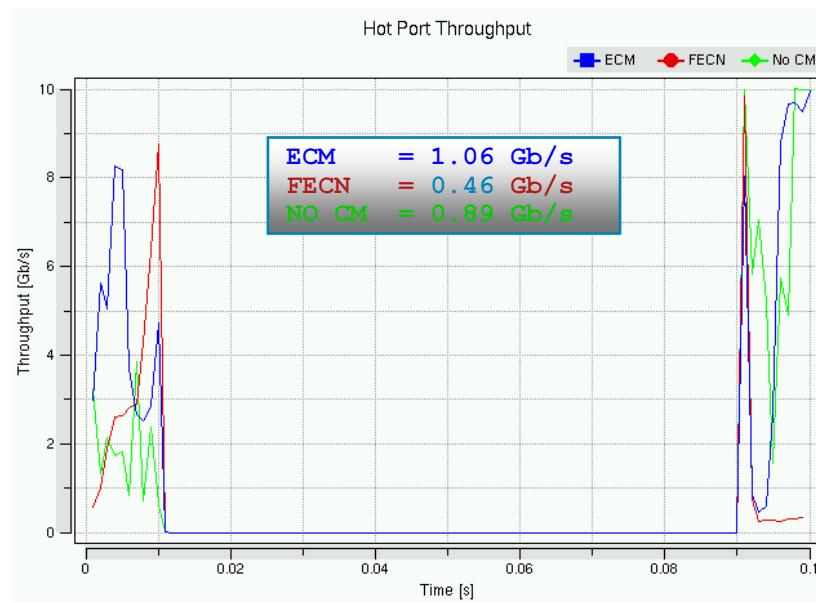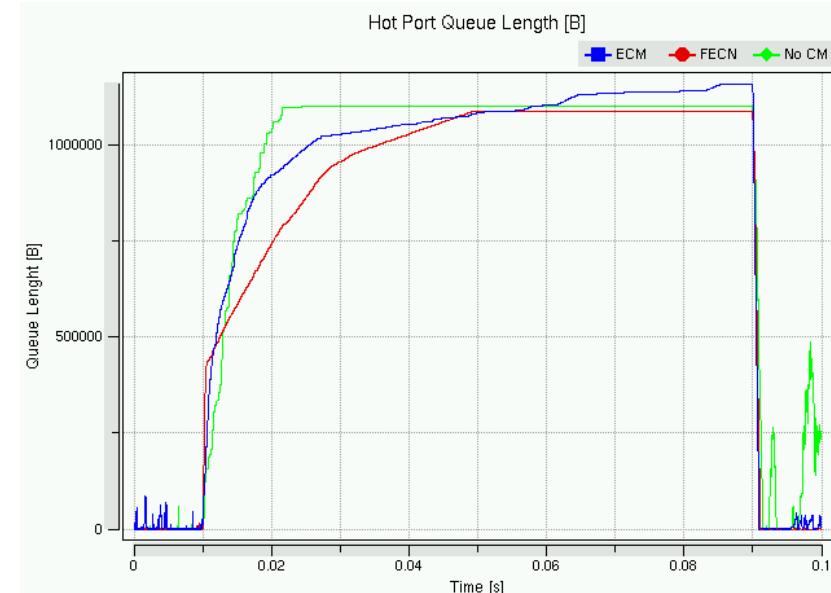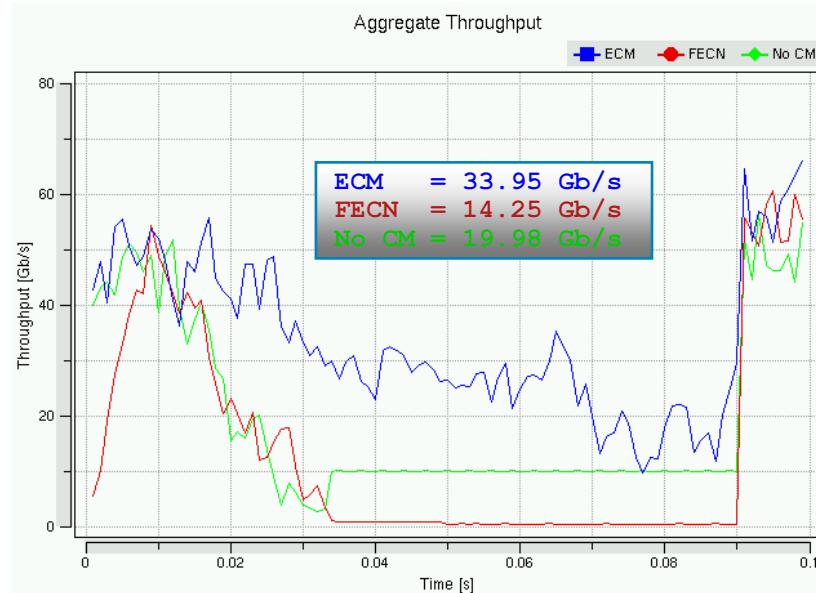
Aggregate Throughput

ECM   = 33.95 Gb/s
FECN = 14.25 Gb/s
No CM = 19.98 Gb/s

Hot Port Queue Length [B]

Hot Port Throughput

ECM   = 1.06 Gb/s
FECN = 0.46 Gb/s
NO CM = 0.89 Gb/s

	Flow Completion Time					Avg Time Paused [%]	Droppd Frames [#]	Over-head [Mb/s]
	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

  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

Next Steps

- Have a look at Tier 2 metrics

- Analyze same scenario with Pause disabled

Backup

FECN Validation