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

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April 5th and 12th, 2007
Objective

- Evaluate performance of ECM and FECN in the Single-Hop Output-Generated Hotspot Scenario
  - Required Scenario #1 from “Topologies & Workloads”

- Metrics
  - Tier 1 Performance metrics from “Discussion About Metrics”
    - 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

Simulation Environment

- **Topology & Workload**

  ![Network Diagram]

  - 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 $\rightarrow$ Pareto $\mu = 45$ $\mu$s
    - Off Time $\rightarrow$ Exponential $\mu = 15$ $\mu$s

- **Hotspot**
  - Duration: 80 ms, from $t_{i} = 10$ to $t_{f} = 90$ ms
  - HS degree = 9
  - HS severity = 3.25 / 15 / $\infty : 1$
Simulation Environment

- Selective Pause enabled as per “CN-SIM: A common Bridge Model”
- 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
  - $W = 2$
  - $G_i = 5.333333333 \times 10^{-1}$
  - $G_d = 2.666666667 \times 10^{-4}$
  - $Q_{eq} = 375$
  - $Q_{mc} = 1300$
  - $FixedSamplingInt = 75000 \text{ B}$
  - $RandomSamplingInt = \text{uniform(-5000, 5000) B}$
  - $BCN$-Max used in lieu of $BCN(0,0)$
  - $RL$ Timeout = 2 ms
- FECN parameters
  - $T = 1 \text{ ms}$
  - $a = 1.1$
  - $b = 1.02$
  - $c = 0.1$
  - $Q_{eq} = 375$
  - $Q_{sc} = 1300$
  - $N_0 = 200 \rightarrow R_0 = 50 \text{ Mb/s}$
  - $RL$ Timeout = 2 ms
- Simulation duration 100 ms

No Hotspot (Baseline)

Aggregate Throughput

热点端口通过量

平均时延

流量完成时间

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</table>
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

Aggregate Throughput

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

Hot Port Throughput

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

Flow Completion Time

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</table>
0.5 Gb/s Hotspot

Aggregate Throughput

Throughput (Gb/s)

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

Hot Port Queue Length [B]

Queue Length [B]

- ECM
- FECN
- No CM

Hot Port Throughput

Throughput (Gb/s)

- ECM = 1.41 Gb/s
- FECN = 1.51 Gb/s
- No CM = 1.18 Gb/s

Flow Completion Time

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0.5 Gb/s Hotspot

- 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
0 Gb/s Hotspot

**Aggregate Throughput**

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

**Hot Port Throughput**

- **ECM** = 1.06 Gb/s
- **FECN** = 0.46 Gb/s
- **No CM** = 0.89 Gb/s

**Flow Completion Time**

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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)

**Aggregate Throughput**

- ECM = 55.73 Gb/s
- FECN = 53.05 Gb/s
- No CM = 52.69 Gb/s

**Hot Port Queue Length [B]**

**Flow Completion Time**

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No Hotspot (Baseline)

Flows Distribution

Flow Completion Time Distribution

Bad Flows Distribution
2 Gb/s Hotspot

Aggregate Throughput

- ECM = 55.19 Gb/s
- FECN = 55.37 Gb/s
- No CM = 50.95 Gb/s

Hot Port Throughput

- ECM = 2.48 Gb/s
- FECN = 2.48 Gb/s
- No CM = 2.29 Gb/s

Flow Completion Time

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0.5 Gb/s Hotspot

**Aggregate Throughput**

- ECM = 56.05 Gb/s
- FECN = 52.60 Gb/s
- No CM = 49.95 Gb/s

**Hot Port Throughput**

- ECM = 1.20 Gb/s
- FECN = 1.29 Gb/s
- No CM = 1.28 Gb/s

**Hot Port Queue Length [B]**

**Flow Completion Time**

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</table>
0.5 Gb/s Hotspot

Flows Distribution

Flow Completion Time Distribution

Bad Flows Distribution
0 Gb/s Hotspot

Aggregate Throughput

- ECM = 57.96 Gb/s
- FECN = 43.95 Gb/s
- No CM = 49.59 Gb/s

Hot Port Queue Length

Flow Completion Time

|----------------|---------------------------|----------|----------|----------|--------------|--------------------|-------------------|----------------|
Backup
Cisco simulations

Prof Jain’s simulations from