CN-SIM: A Baseline Simulation Scenario

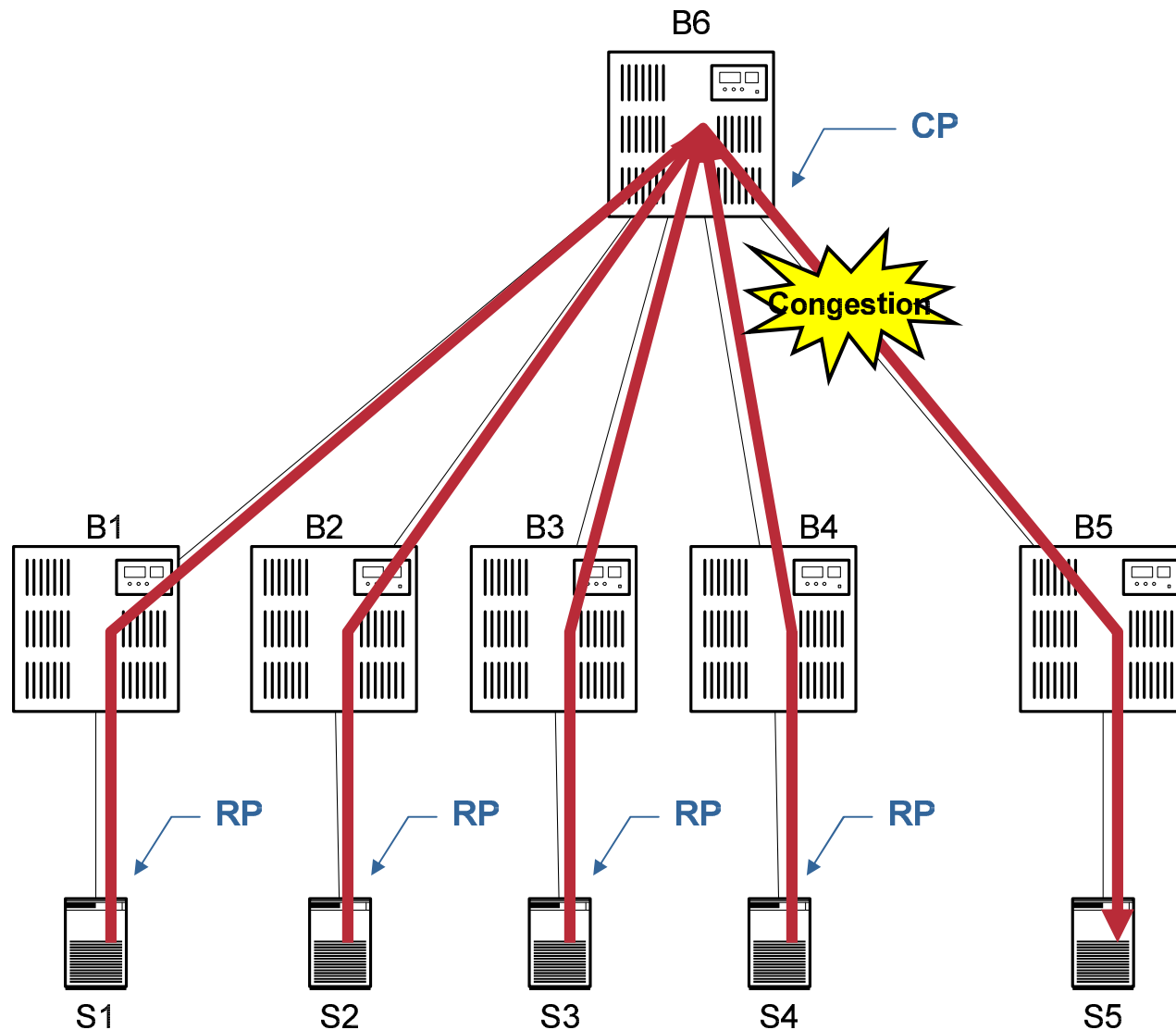Davide Bergamasco (davide@cisco.com)

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Ver. 5

Motivation

- **So far we have defined a set of common**
  - **Topologies**
  - **Traffic Patterns**
  - **Metrics**
  - **Bridge Model**

- **To ensure comparability of results, we also need to make sure our models and simulation tools are properly calibrated**

- **The baseline simulation scenario should allow us to achieve a reasonable alignment quickly and easily**

Topology & Traffic Pattern
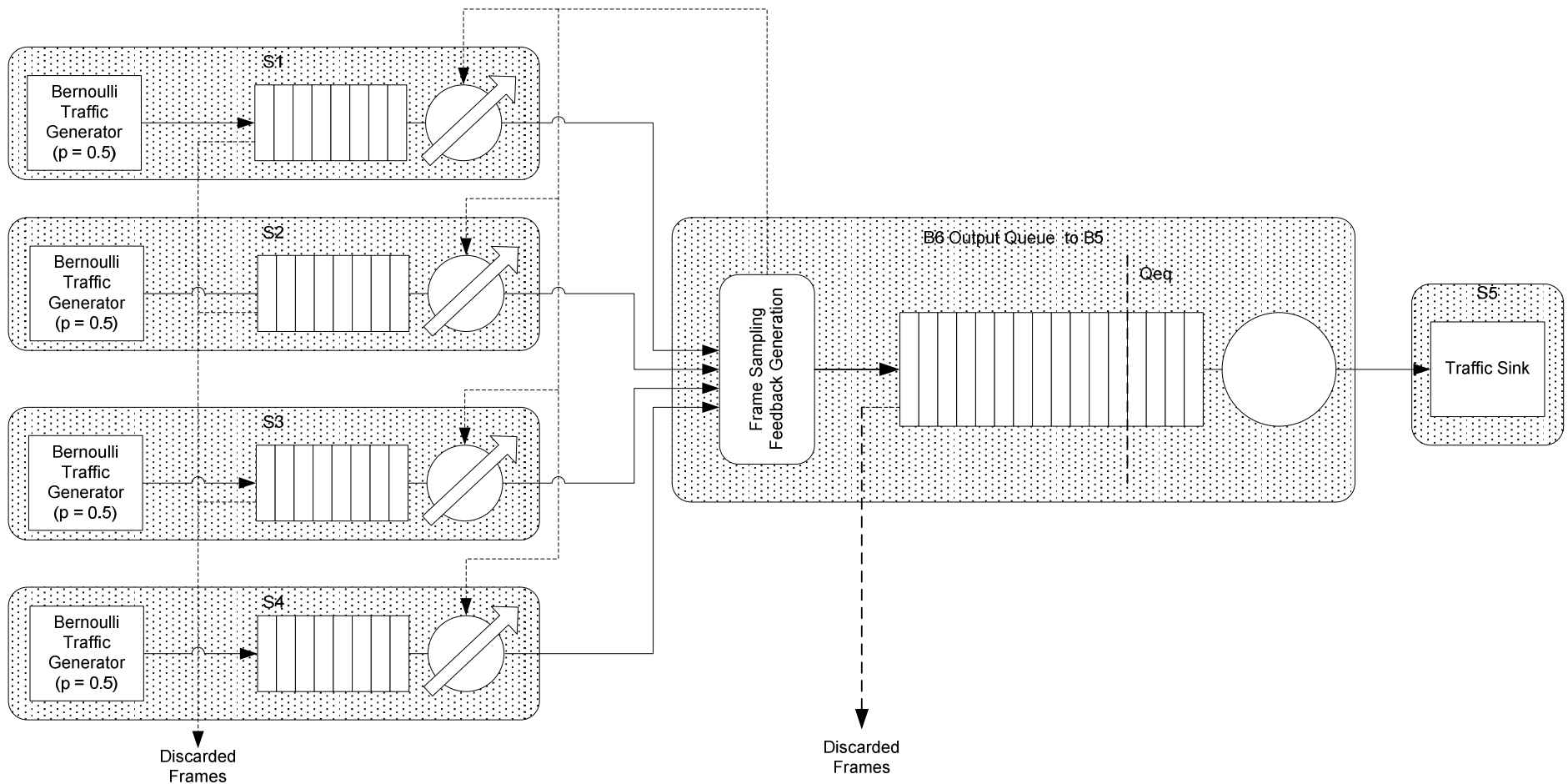
Configuration, Parameters & Workload

- **Short Range, High-Speed Datacenter-like Network**

    Link Capacity (C) = 10 Gbps

    Buffer Size (B) = 150 KB (both CP and RP)

    Switch latency = 1 μs

    Link Length = 100 m (.5 μs propagation delay)

    Station processing time = 2 μs

    Loop Latency = 8 μs

- **BCN Control Loop Parameters**

    Qeq = 375 64-byte pages (or 16 1500-byte frames or approx 24 KB)

    S = 150 KB (frames are sampled on average every 150 KB received)

    W = 2

    Gi = 5.3 x 10^{-1} (Max rate increase: C/10 when Max Fb^+ = (1 + 2 * W) * Qeq is received)

    Gd = 2.6 x 10^{-4} (Max rate decrease: 1/2   when Max Fb^- = (1 + 2 * W) * Qeq is received)

    Ru = 1 Mbps

- **Workload: 100% UDP (or Raw Ethernet) Traffic**

    S1-S4: fixed-length (1500 bytes) frames, Bernoulli temporal distribution with parameter p = 0.5
    (i.e., offered load = 50%)

Simulation Run & Measurements

- **Simulation**
  - **Runs: 25**
  - **Duration: 100 ms**
  - **Initial Transient: t = 5 ms (all sources start)**
  - **Final Transient: t = 80 ms (2 sources stop)**

- **Measurements**
  - **Throughput (Slide 7 & 8)**
    - **On congested downlink: 10 Gbps (100%, from 5 to 100 ms)**
    - **On uplinks: 2.5 Gbps (25%, from 20 to 80 ms)**

  - **Fairness (Slide 9)**
    - **Jain's Index**

$$RJFI = \frac{\left(\sum_{i=1}^{N} R_i / T\right)^2}{N \sum_{i=1}^{N} (R_i / T)^2}$$

  - **Alternate Index:**

$$ALFI = \frac{\sum_{i=1}^{N} (R_i - T)^2}{N} \cdot \frac{1}{T}$$

  - **Where:**
    - **N = 4 number of flows**
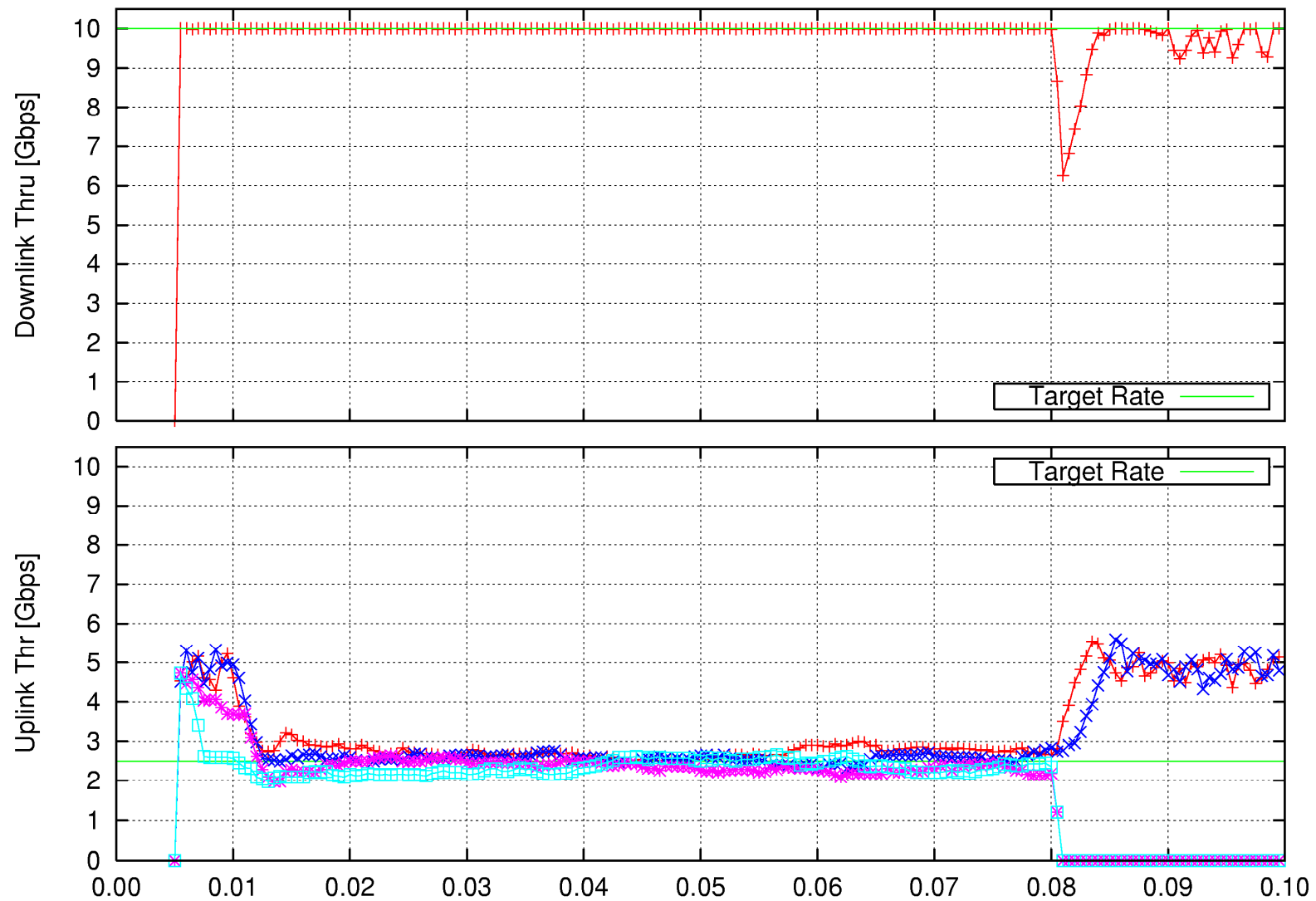   - **Ri = rate of each flow measured between 20 and 80 ms**
    - **T = 2.5 Gbps Targe rate**
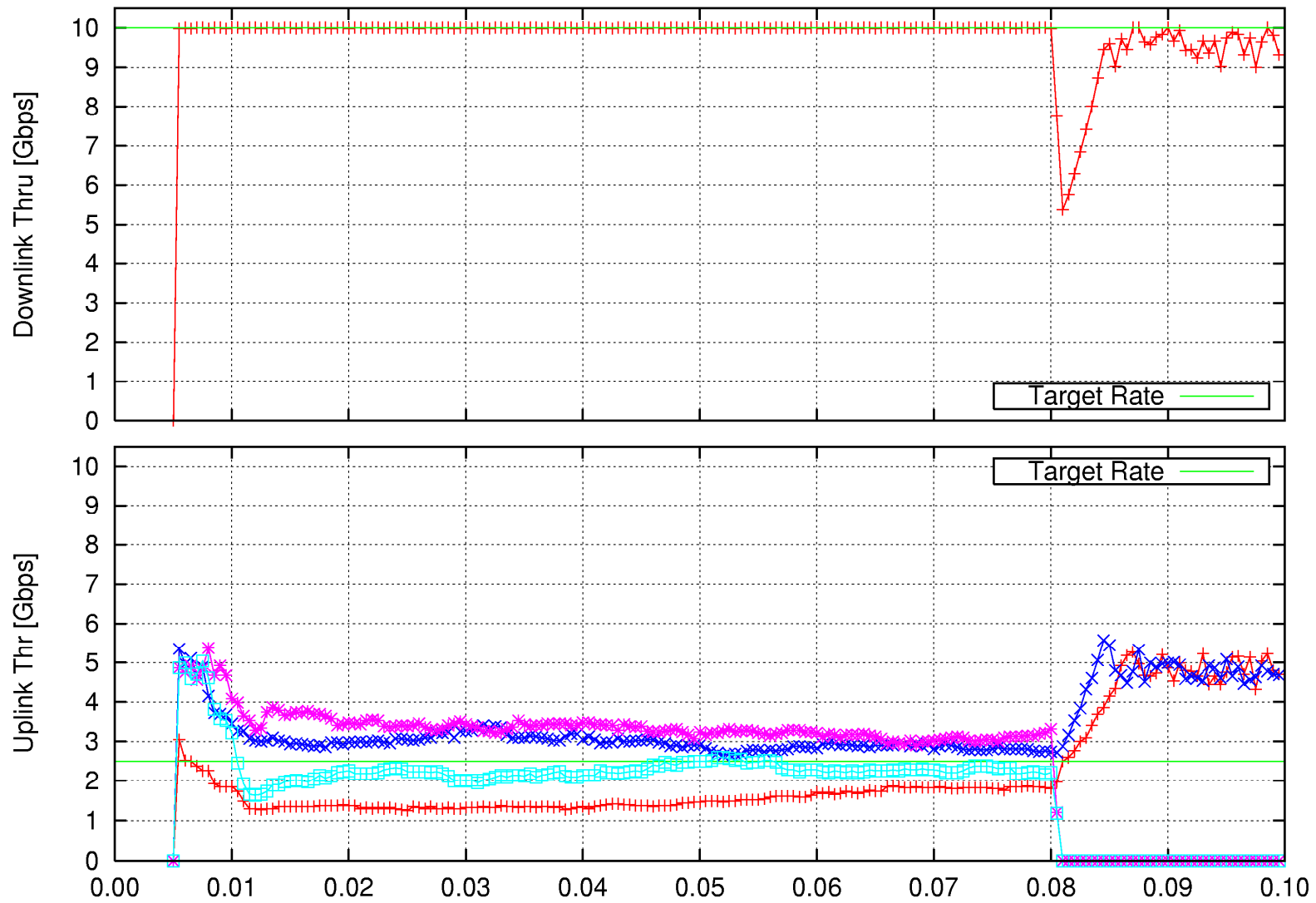 - **Buffer utilization (Slide 10 & 11)**
    - **Congested link**
    - **Rate limiter queues**

Throughput (best)

Throughput (worst)

Fairness: Normalized Deviation & FI

```
Run     Max     Min     Mean    AL-FI   RJ-FI

-------------------------------------------
19812   0.383   0.048   0.193   0.229   0.950
19639   0.252   0.001   0.126   0.177   0.970
19460   0.150   0.009   0.072   0.093   0.992
19285   0.143   0.035   0.078   0.088   0.992
19105   0.353   0.044   0.178   0.212   0.957
18924   0.215   0.017   0.124   0.144   0.980
18741   0.247   0.006   0.129   0.157   0.976
18578   0.103   0.032   0.064   0.069   0.995
18411   0.181   0.022   0.087   0.106   0.989
18240   0.189   0.019   0.096   0.113   0.987
18068   0.100   0.050   0.066   0.069   0.995
17790   0.138   0.041   0.089   0.096   0.991
17619   0.271   0.024   0.148   0.172   0.971
17452   0.216   0.059   0.135   0.147   0.979
17281   0.306   0.044   0.155   0.188   0.966
17112   0.083   0.027   0.057   0.061   0.996
16945   0.311   0.103   0.196   0.211   0.958
16800   0.372   0.093   0.237   0.261   0.937
16629   0.287   0.033   0.147   0.180   0.969
16462   0.249   0.021   0.128   0.163   0.974
16291   0.183   0.071   0.127   0.134   0.982
16120   0.200   0.135   0.168   0.170   0.972
15949   0.220   0.202   0.213   0.213   0.957
15794   0.089   0.009   0.048   0.057   0.997
15625   0.152   0.041   0.095   0.103   0.990
```

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Max Dev stats:
   min  = 0.083
   mean = 0.216
   max  = 0.383

AL-FI stats:
   min  = 0.057
   mean = 0.144
   max  = 0.261

RJ-FI stats:
   min  = 0.937
   mean = 0.977
   max  = 0.997
```
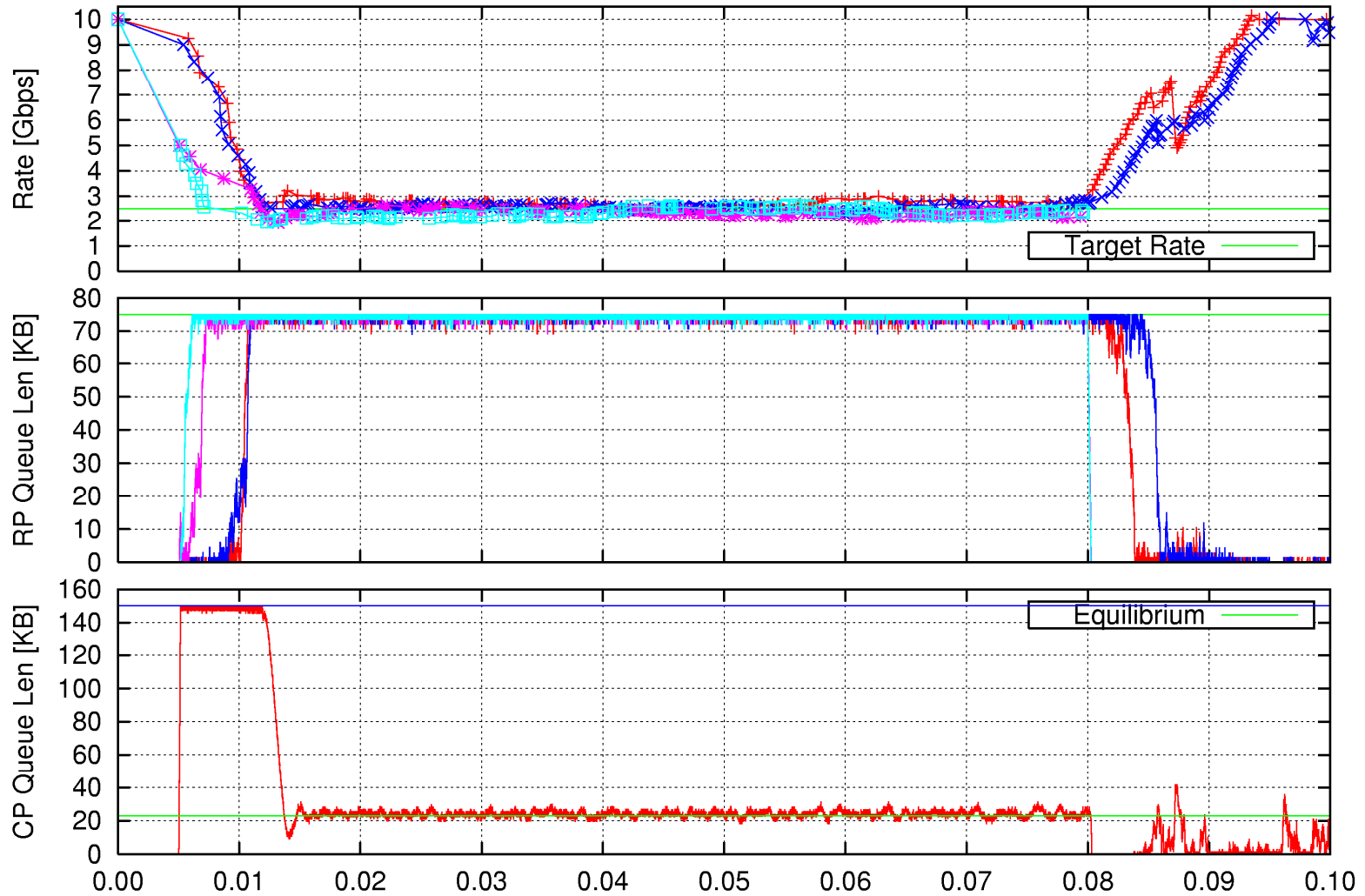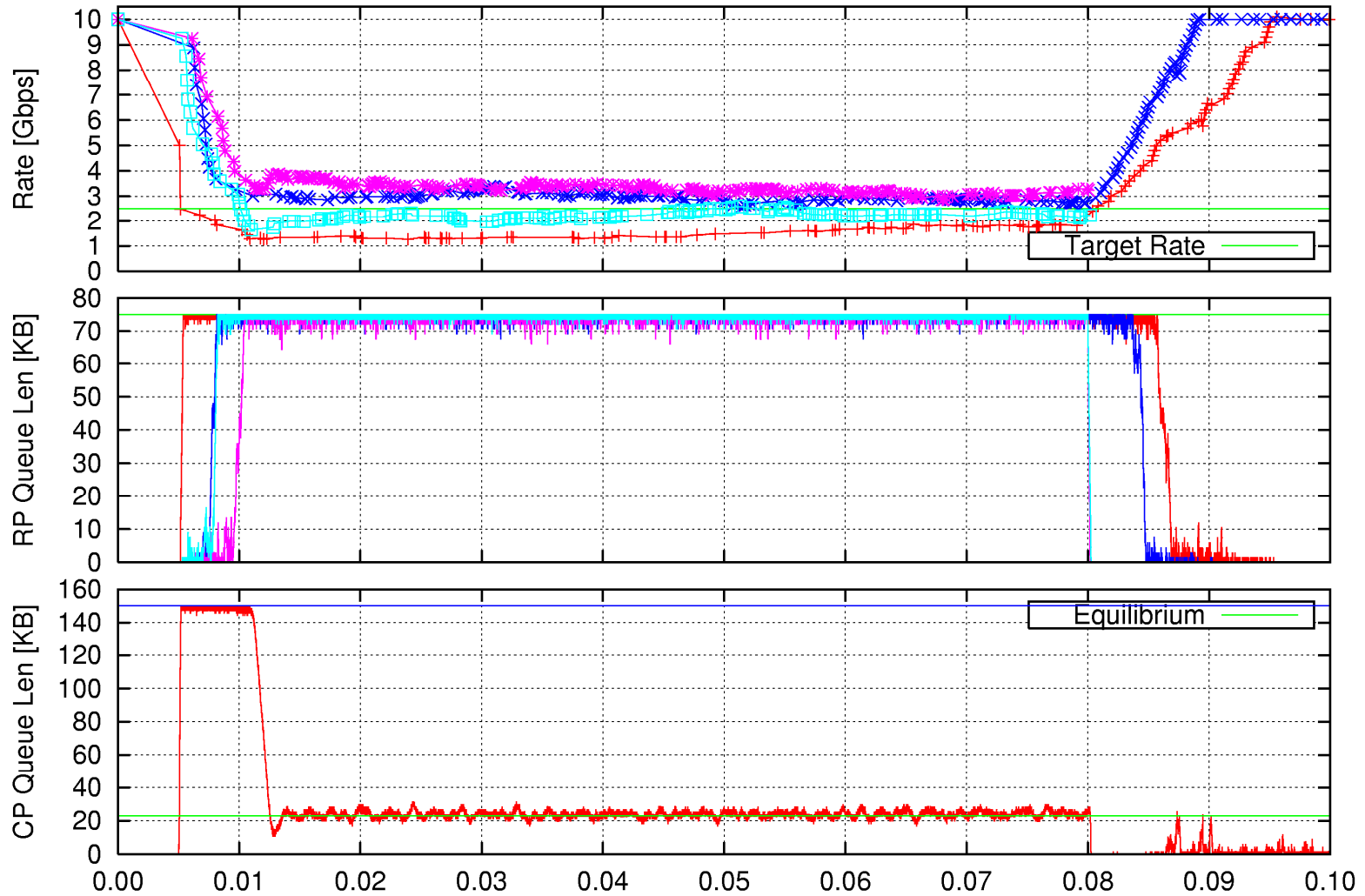
Buffer Utilization (best)

Buffer Utilization (worst)
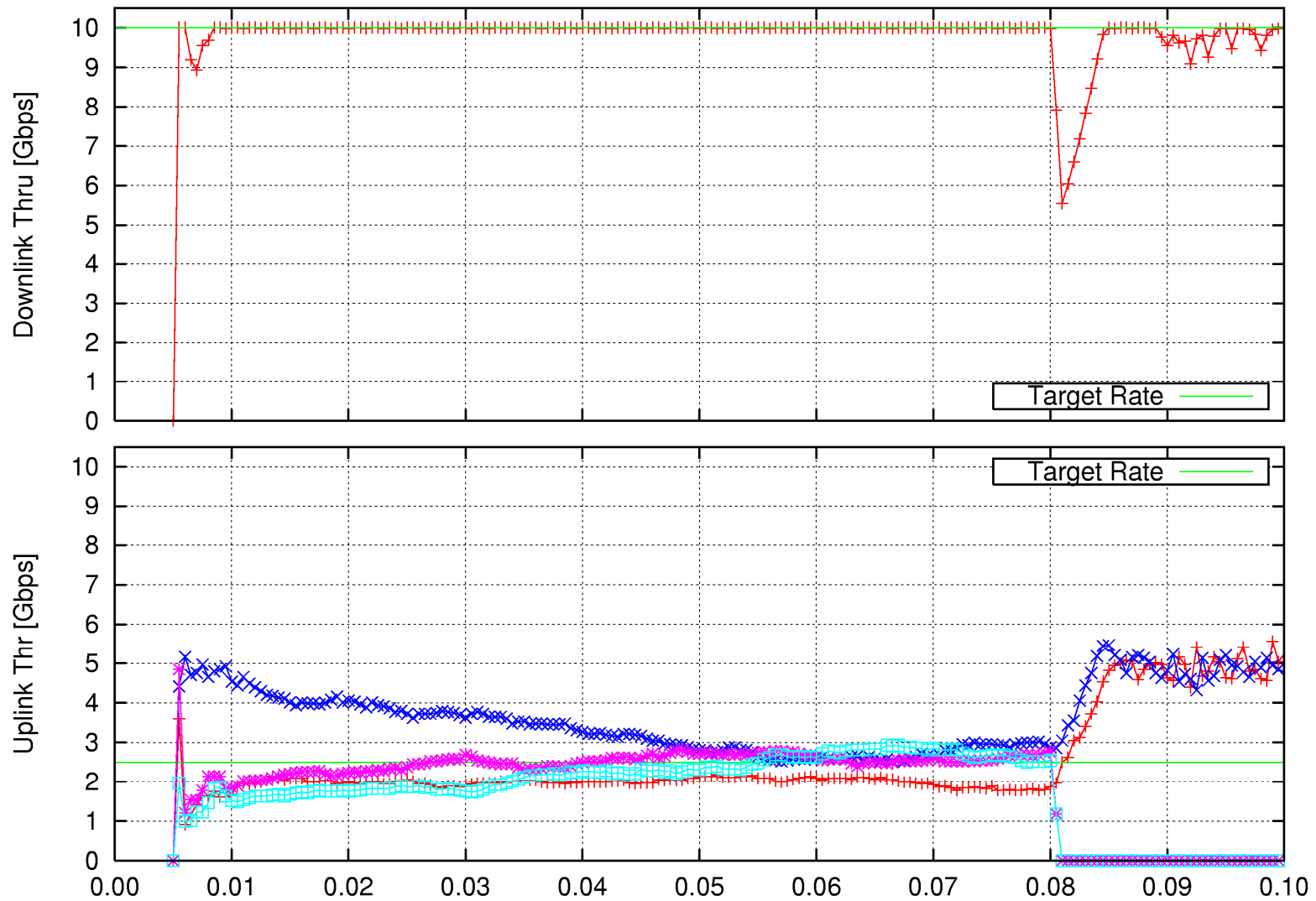
What happens with BCN(0,0)?

- **Settings**

    Qsc = 112.5 KB (75% buffer)

    Tmax = 100 us

    Rmin = 1 Gbps (10% max rate)

    Drift = 10 Gbps / s^2 (1 Mbps every 100 us)

Throughput

Buffer Utilization