BCN Calibration Simulation Results
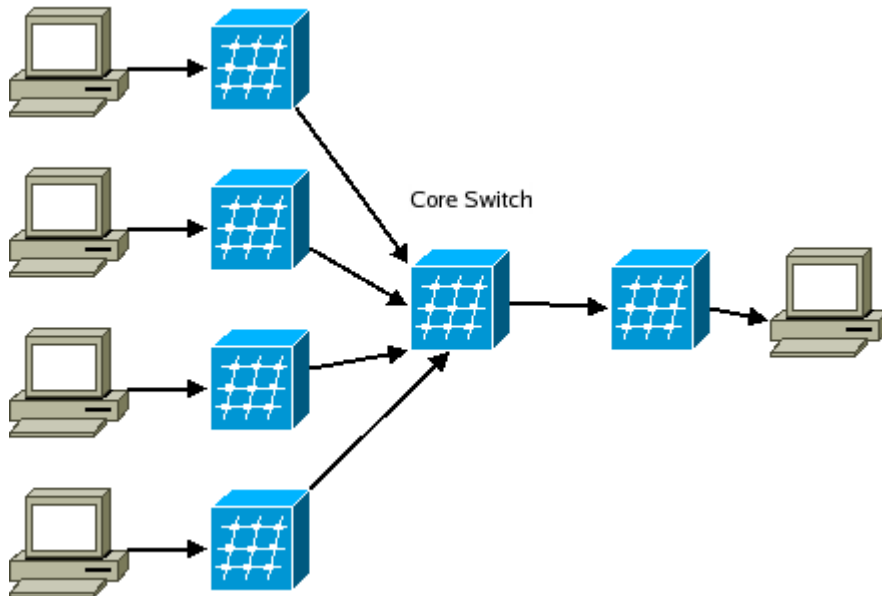
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Workload

- **Traffic Type: 100% UDP (or raw Ethernet) Traffic**

- **Destination: EP0-EP3 sending to EP4**

- **Frame Size Distribution: 1500 byte fixed**

- **Arrival Distribution: Bernoulli temporal distribution**

- **Offered load at endpoint = 50%**

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Topology

Core Switch

- Link capacity 10Gbps
- Core switch egress port buffer size (varies from unlimited to 150 KB)
- Rate limiter queue buffer size 150KB
- Switch latency (1 us)
- Link length (not modelled, 0 latency)
- Endpoint response time (not modelled, 0 latency)

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BCN Parameters

- **Qeq 375 * 64 byte pages**

- **Frame Sampling 150KB +- 5KB (random jitter)**

- **W = 2**

- **$G_i = 5.3 \times 10^{-1}$**

- **$G_d = 2.6 \times 10^{-4}$**

- **R_u = 1 Mbps**

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Fairness Index Definitions

- Measured Throughput $R_1\ R_2\ ...\ R_n$

- Optimal Throughput $\quad T_1\ T_2\ ...\ T_n \qquad$ (2.5Gbps for baseline topology)

- Jain Fairness Index

  - Jain's normalized throughput $X_i\ = R_i\ / T_i$

  - $FI = (sum(X_i))^2 / (N * sum(X_i^2))$

- Alternate Fairness Index

  - $FI = (1/T) * sqrt(\ (1/N) * sum_{i=1}^{N}(\ (R_i\text{-}T)^2\ )\ )$

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Metrics

- **Normalized Deviation**

  - Measures deviation from target rate

  - Rates, R_i = mean measured rate over sample interval (78-80ms)

  - Normalized deviation, $ND_i = (R_i - T) / T$

  - Max = maximum ND_i over all i, Min = minimum ND_i over all i, Mean = mean

    ND_i over all i.

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Setup

- **Congested Queue size = 150KB**

- **150 Trials**

- **Rate measurement interval (20-80ms)**
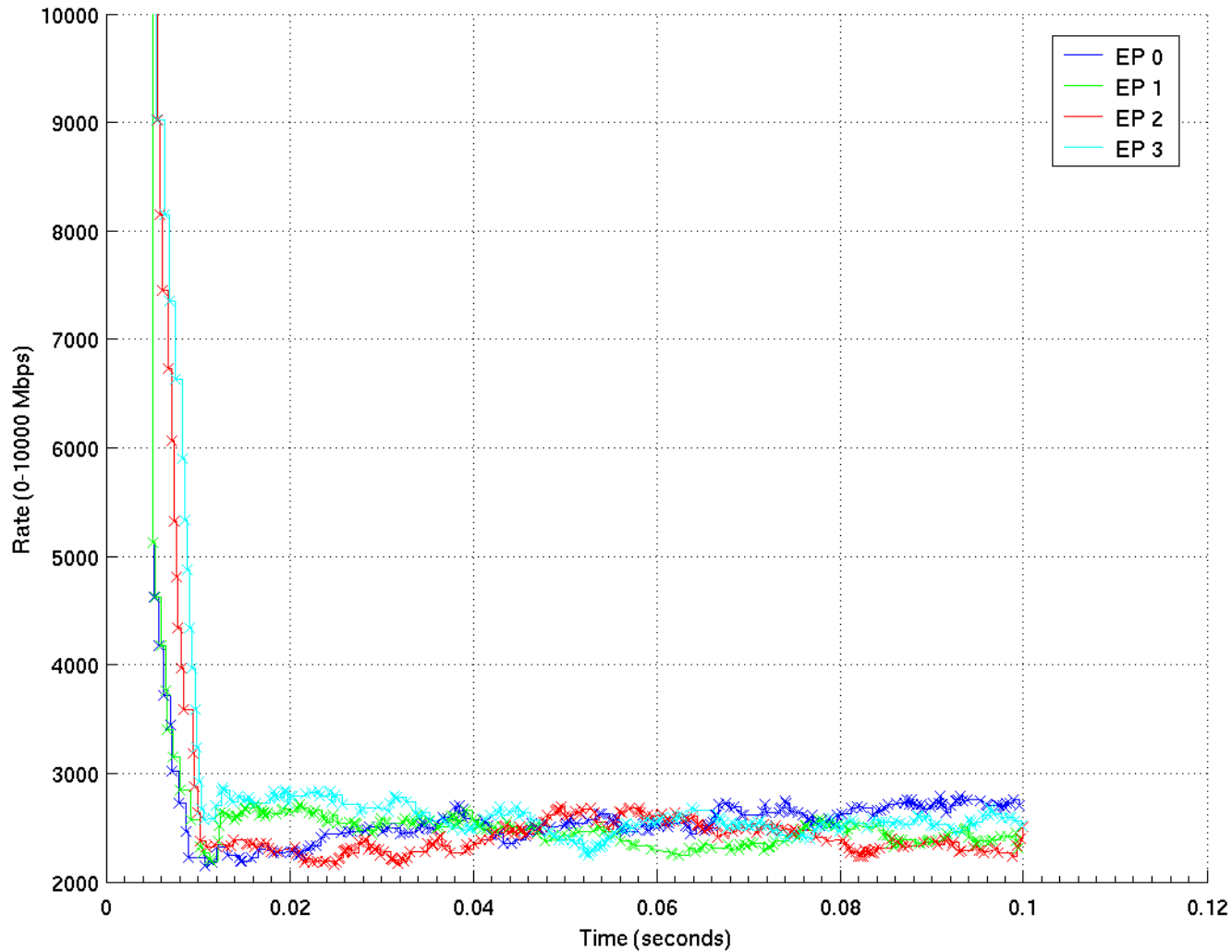
  - Measurement interval for normalized deviation, fairness index

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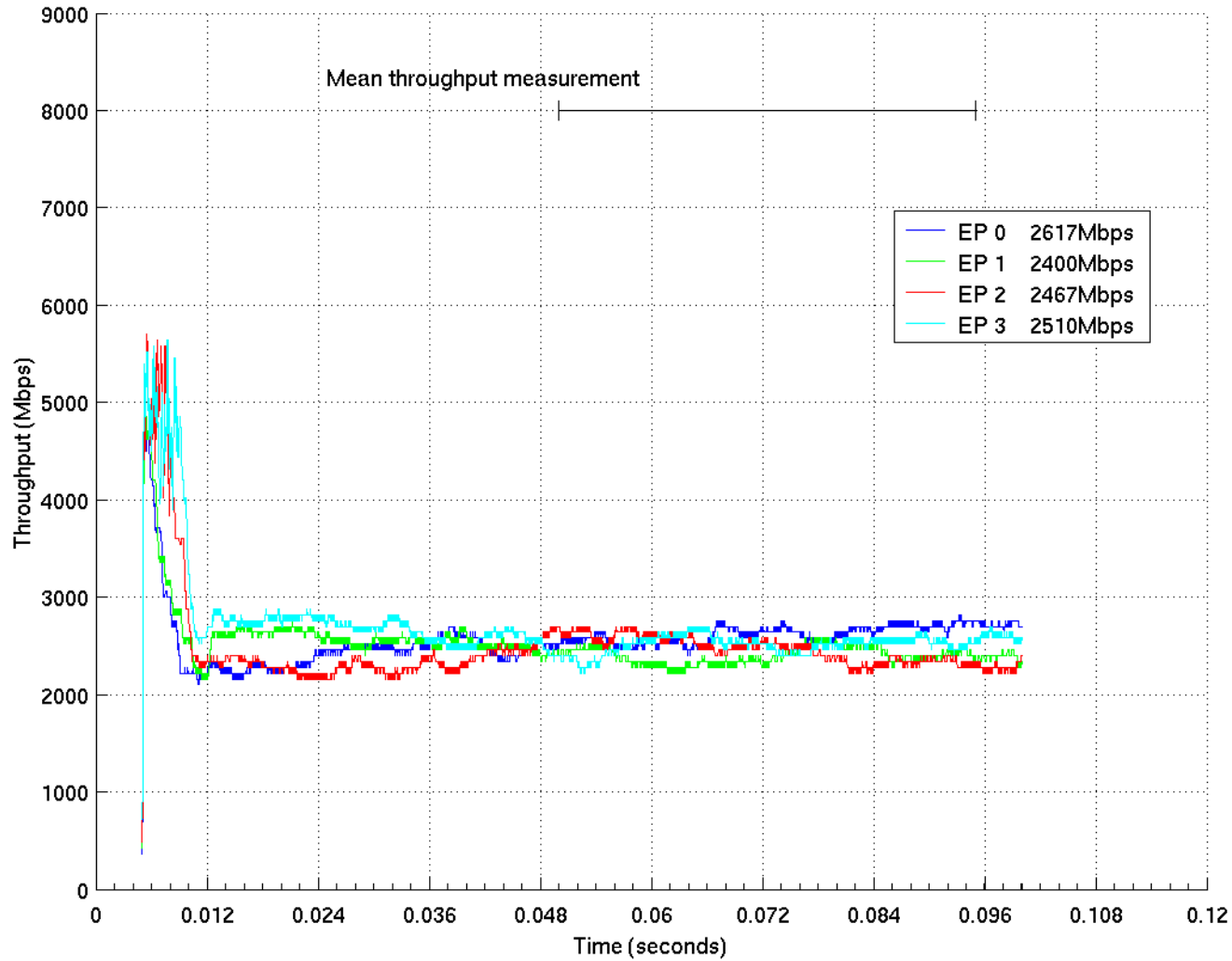# Best Case FI: Buffer Utilization

Buffer Utilization at Core Switch

Alt | FI 0.021

RJ | FI 1.000

Min | ND 0.009

Max | ND 0.028

Mean | ND 0.019

RLQ Rate vs Time

Best Case FI: Accepted Load

Accepted Throughput

Worst Case FI: Buffer Utilization

Buffer Utilization at Core Switch

Alt FI 0.446

RJ   FI 0.834

Min ND 0.130

Max ND 0.671

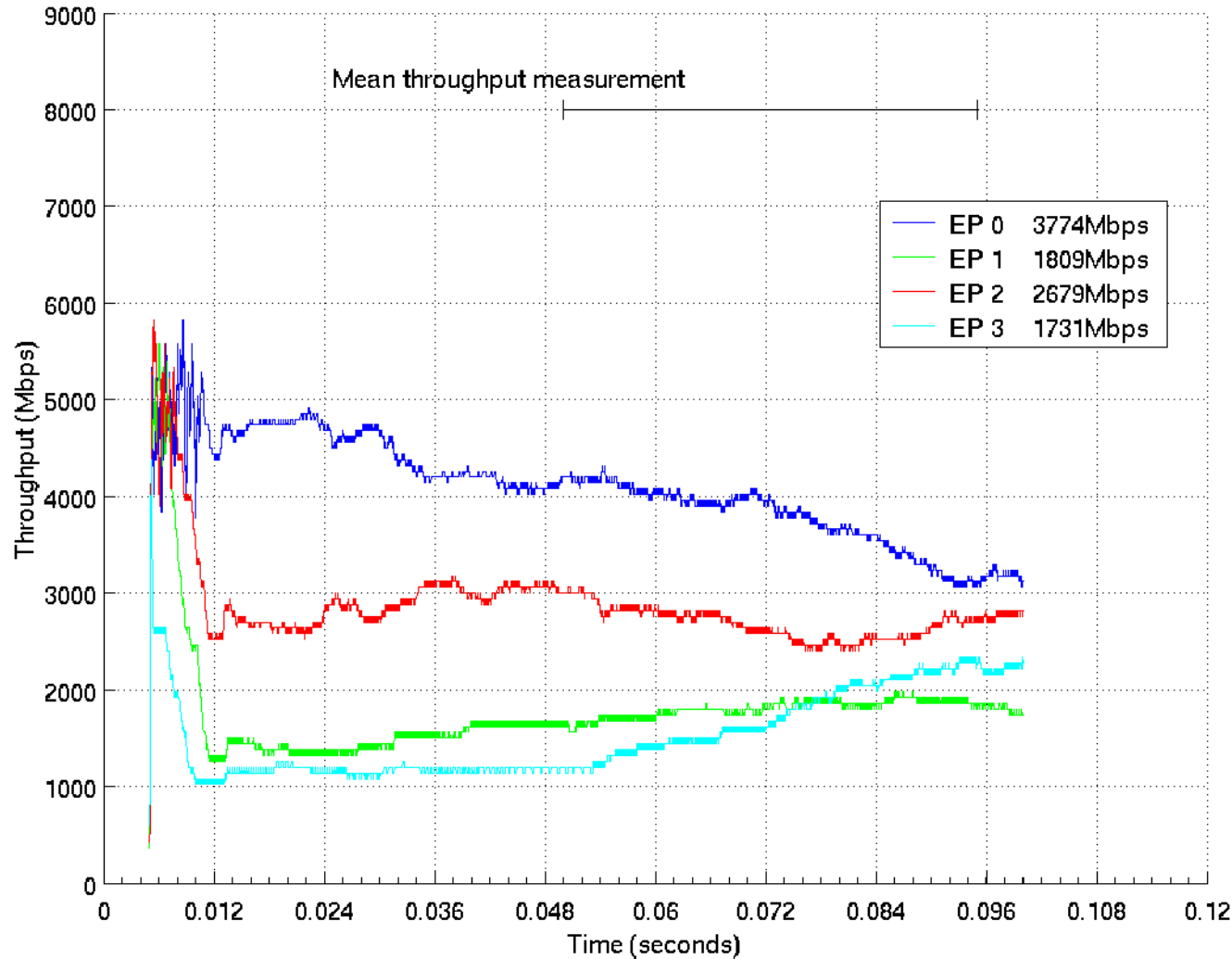Mean ND 0.401

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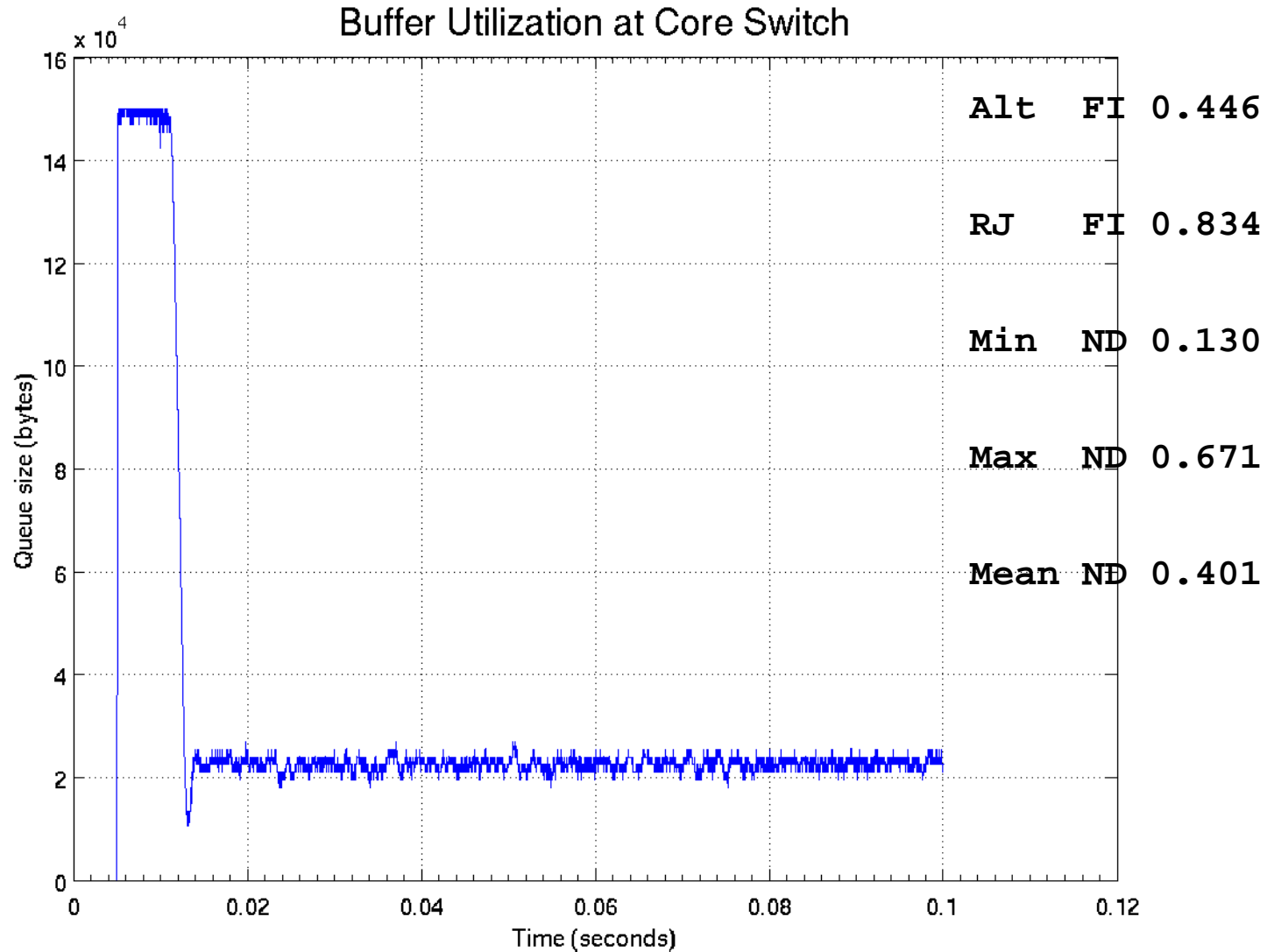
Worst Case FI: RLQ Rates

RLQ Rate vs Time
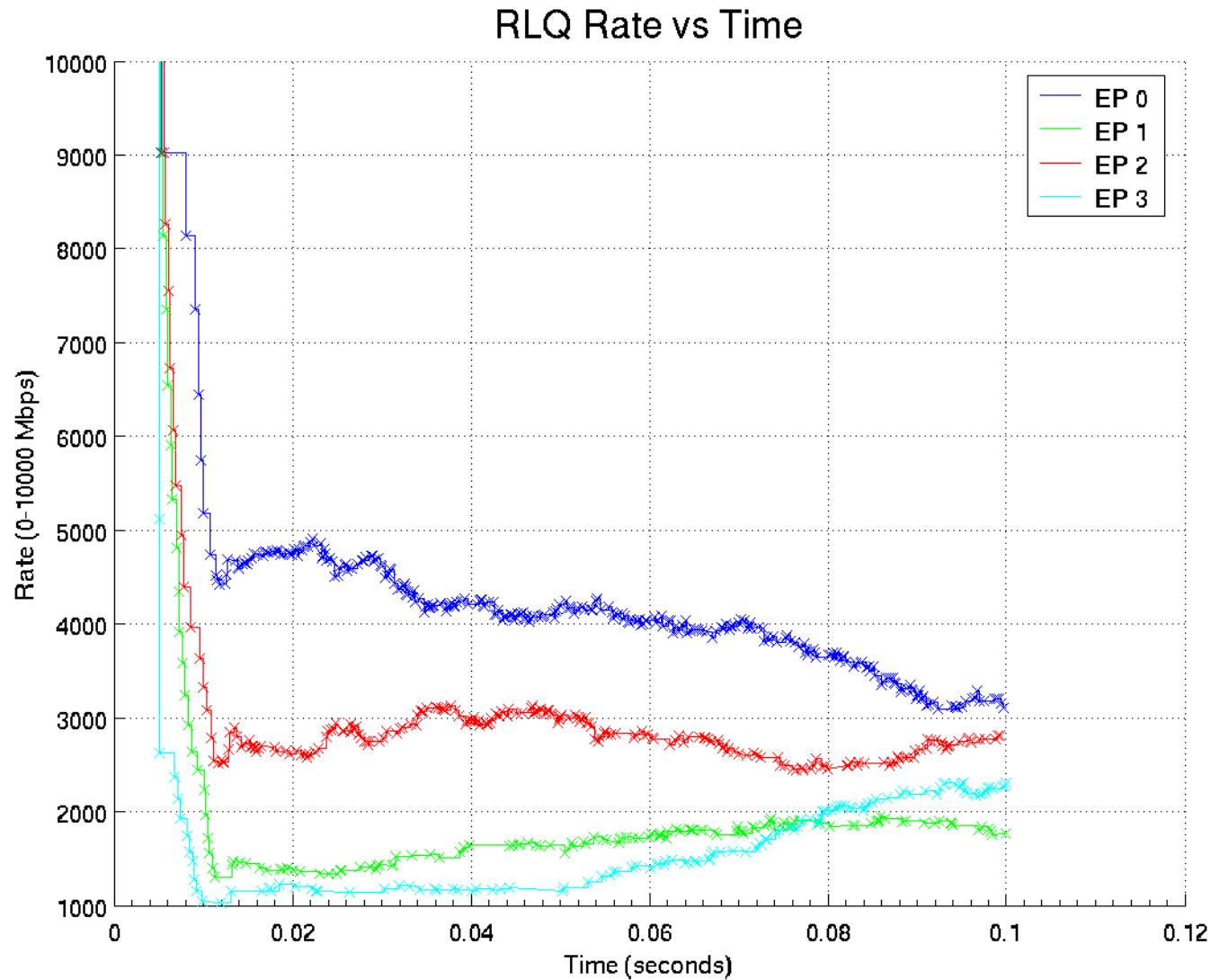
Worst Case FI: Accepted Load

Accepted Throughput

Statistics Convergence

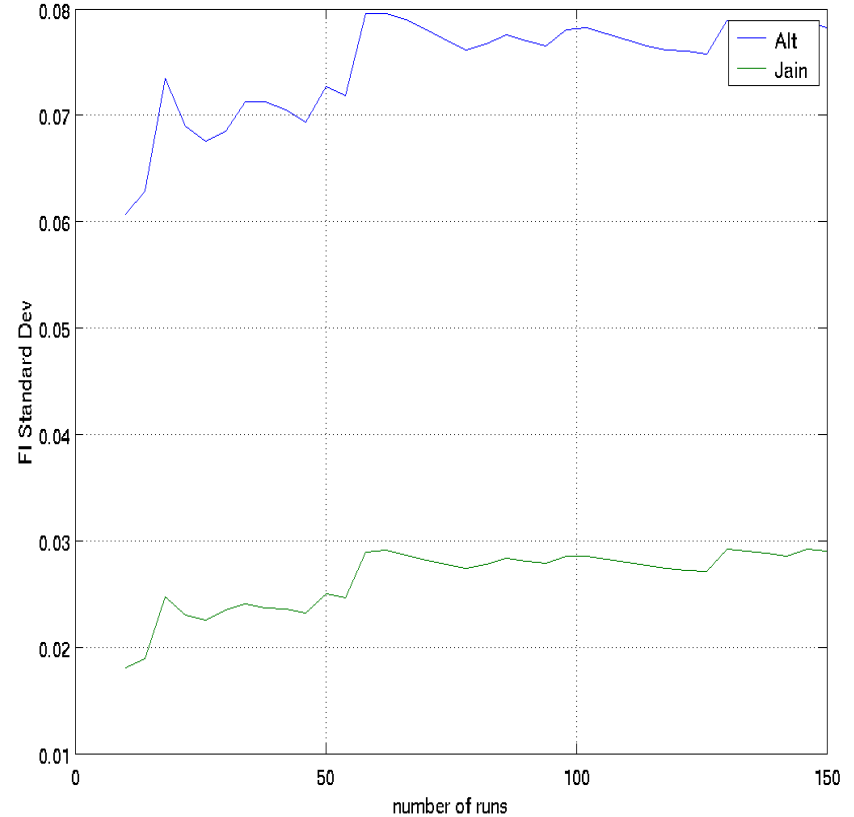- **How can we be sure that we are running enough trials?**
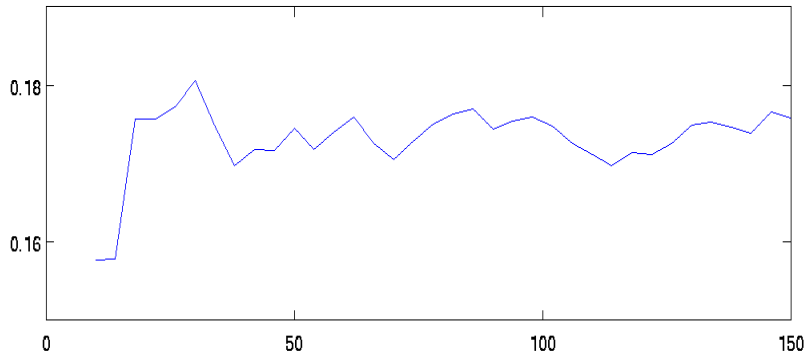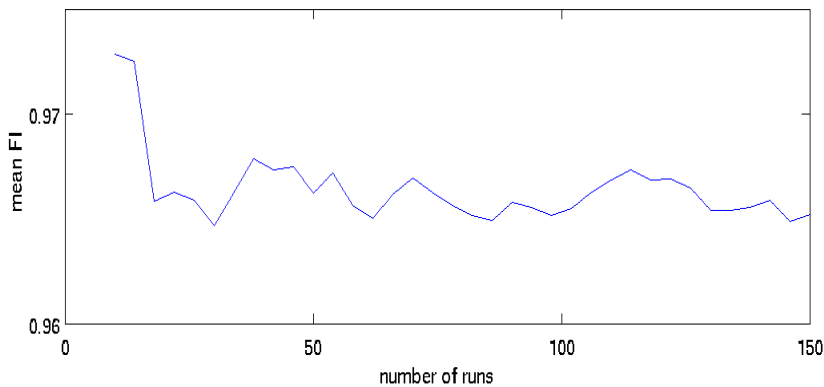
Time To Fairness

- **BCN attains fairness to the different flows but how long does that take?**

- **Measure mean FI over time windows**

    - Measurement window = [0.02 0.04 0.08 0.10 0.20 0.50 1.0 2.0];

- **4 Flows continous (2 seconds)**

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FI vs Time
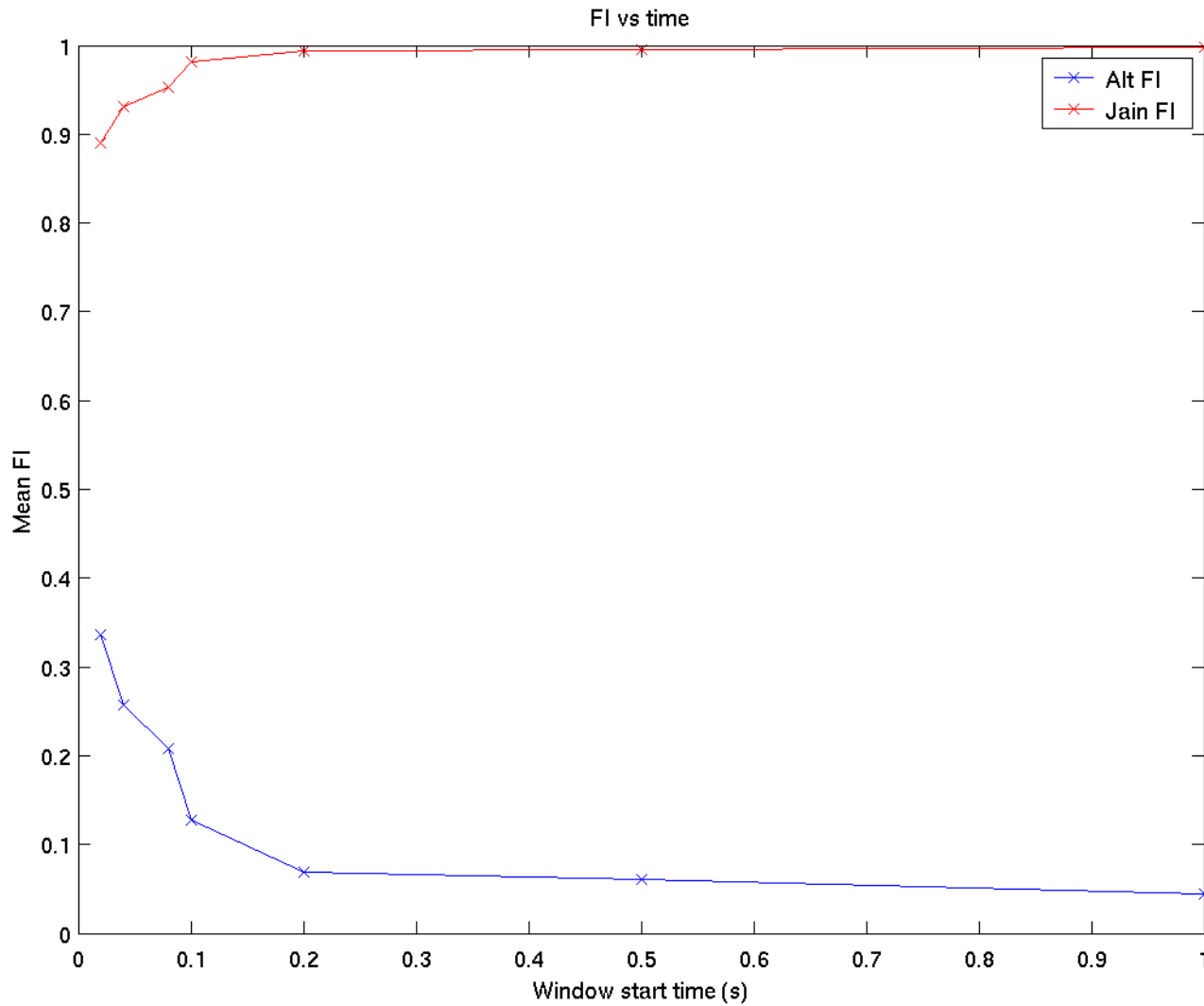
Queue Size Effects On Fairness

- **The size of the congested queue has an effect on the fairness of the system**

- **Vary max queue size**

    - [150, 200, 250, 300, 350, 400, 450, 500, 550] KB

- **4 Flows continous**

- **FI measurement interval (20 – 80 ms)**

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Mean FI vs Max Queue Size