Multi-link topology: Recent results

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Outline

- Study flow-level performance.
- Description of the Simulations
- Interpretation of the results
- Conclusions

Introduction

- So far.....
  - Study of N long-lived flows:
  - First step in the analysis of a protocol.
  - Model amenable to control theoretic analysis.
  - Deterministic analysis: Helpful in tuning parameters.
  - Link utilization $\Longleftrightarrow$ per-flow throughput
  - Fairness properties: Can be studied by comparing the throughput achieved by various flows.
- Real network-like situation:
  - Flows arrive and depart.
  - Finite (but random) file sizes.
  - Number of flows in the network random.
  - Use flow completion time as a metric to evaluate network performance and fairness.

$$bandwidth = \frac{flowsize}{FCT}$$

Introduction

- Flow completion time:
  - Time taken for a flow to transmit the entire file.
  - Depends on network load.
  - Good metric to measure end user performance.
  - Fairness??
    - Has to be qualified indirectly.
    - Ex: Measure the variance in the completion times of the same file at various times.
    - Ex: Measure flow completion times of flows on different paths, but same congestion point.
- Good network performance :
  - Number of flows in the network is bounded.
  - Flows face a finite delay.

Simulation: Goals

- Study the effect of congestion spreading in multi-link topology.
- Study the ***robustness*** of BCN protocol
  - To changes in
    - flow sizes
    - starting transmission rate
    - turning off switch-signalled rate increases
  - Using
    - flow completion time
    - fairness (variance of FCT)

Network Topology

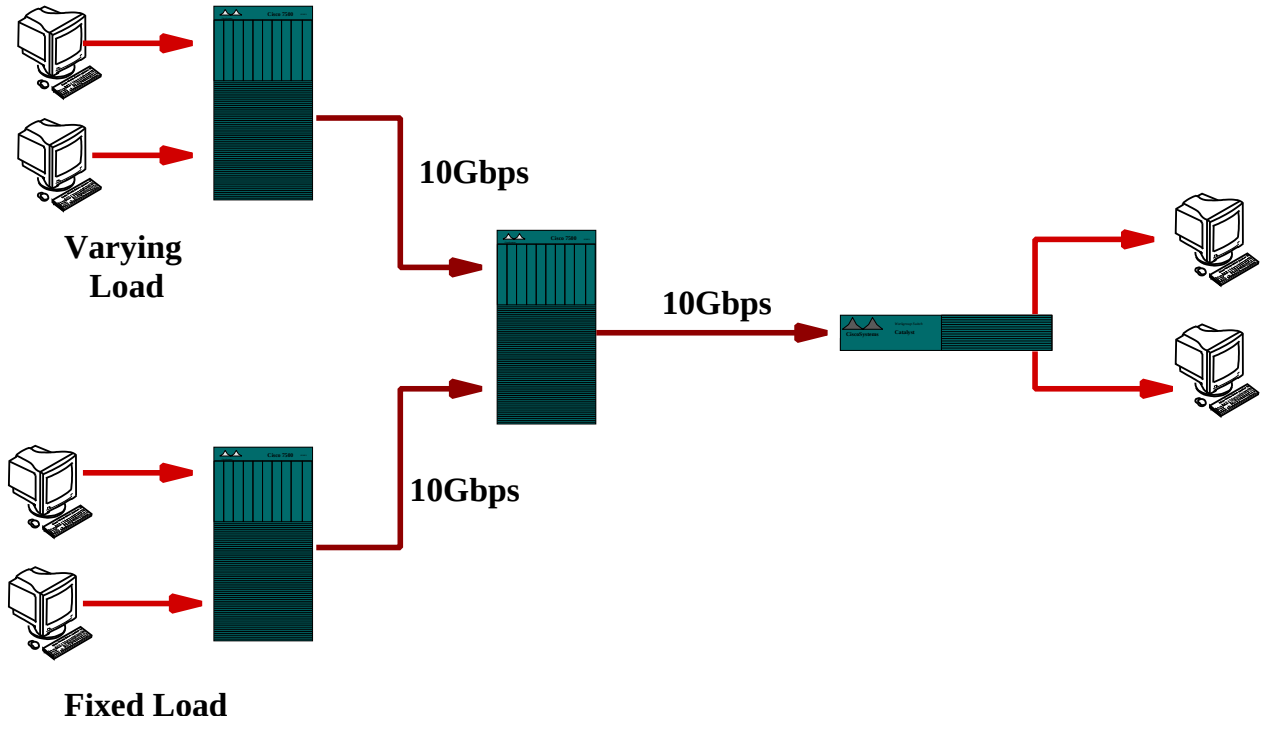


Figure 1: Topology

Simulation parameters

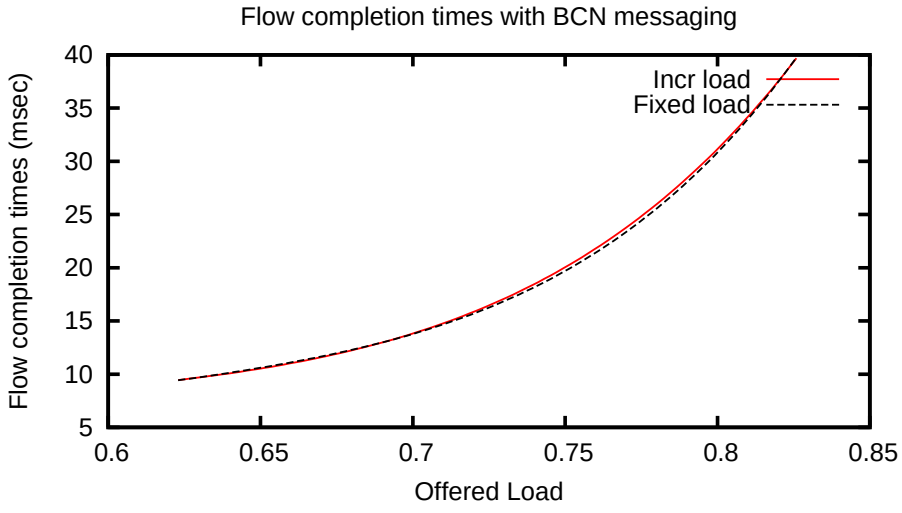
Traffic parameters:

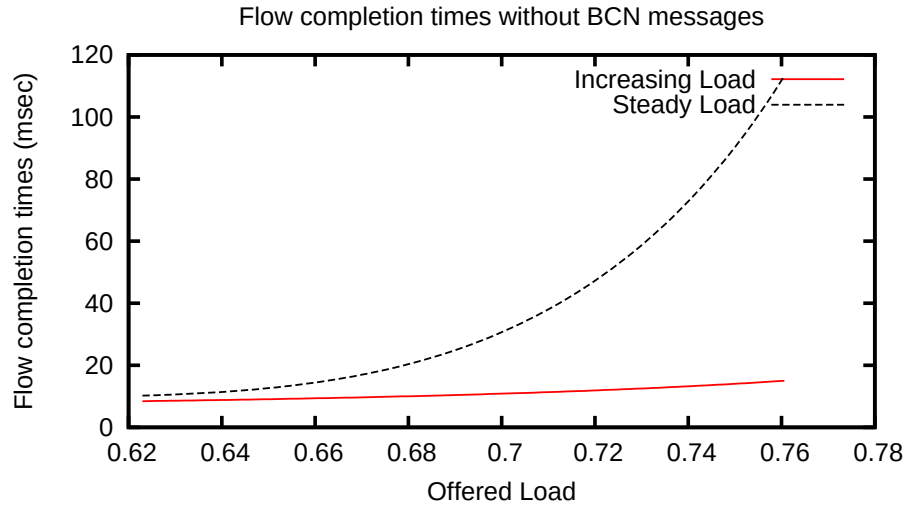
Arrival process	Poisson
File size distribution	Exponential
Mean file size	1MB
RTT	100μs
Total load	$50\% - 80\%$

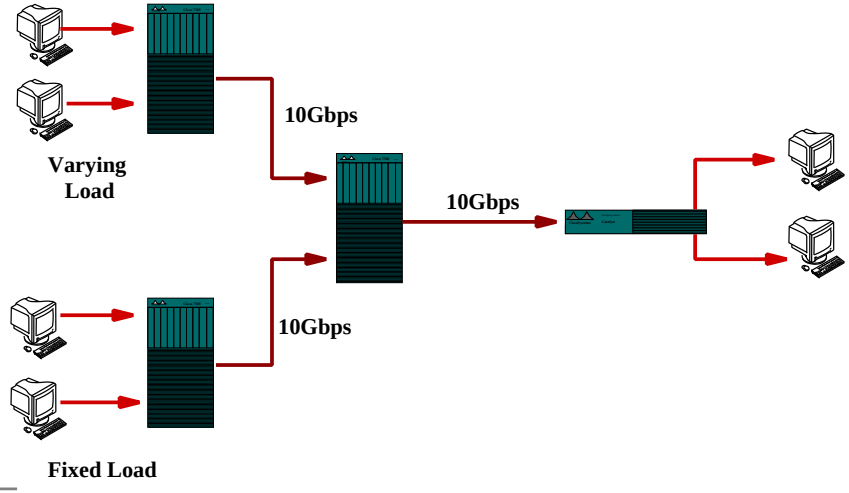
BCN parameters:

W	4
G_i	2
G_d	$\frac{1}{128}$
Starting rate	1Gbps
Drift	Multiplicative
a	$10/sec$
Buffer size	100pkts = 150KB
X_{0FF}	75pkts
X_{ON}	25pkts
sampling probability	0.03
Q_e	16pkts (24KB)

Effect of BCN







Effect of mean flow size and flow size distribution

Traffic parameters:

Arrival process	Poisson
File size distribution	Hyper-exponential
Short-flow size	20pkts
Short-flows percentage	90%
Long-flow size	320pkts
Long-flow percentage	10%
Mean file size	50KB
RTT	100μs
Total load	$50\% - 80\%$

BCN parameters:

W	4
G_i	2
G_d	$\frac{1}{128}$
Starting rate	1Gbps
Drift	Multiplicative
a	$10/sec$
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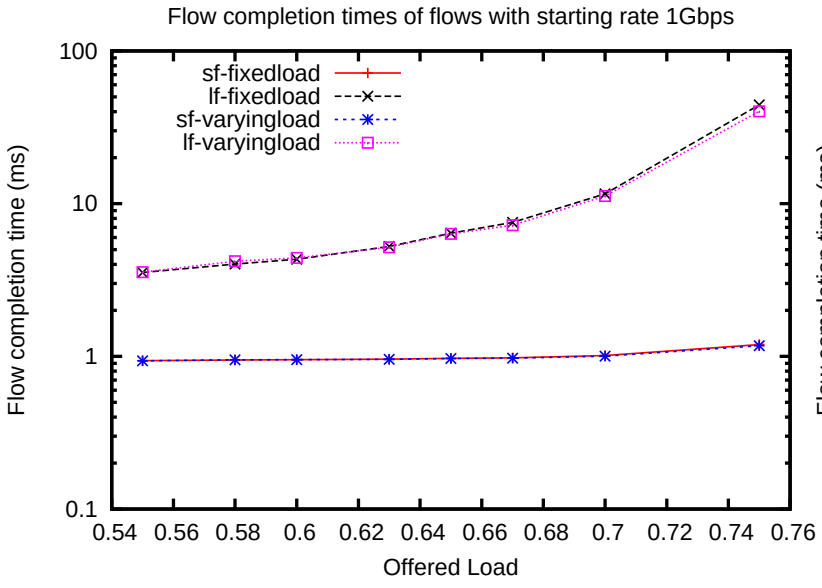
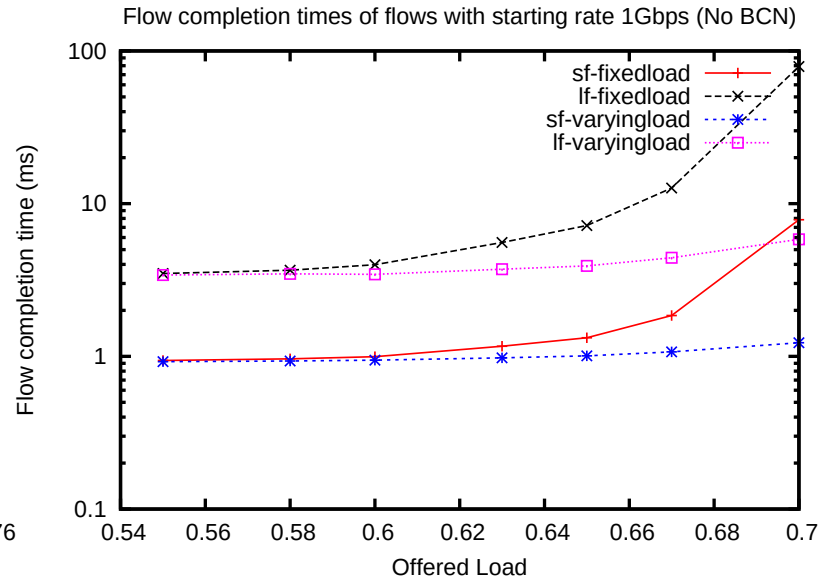
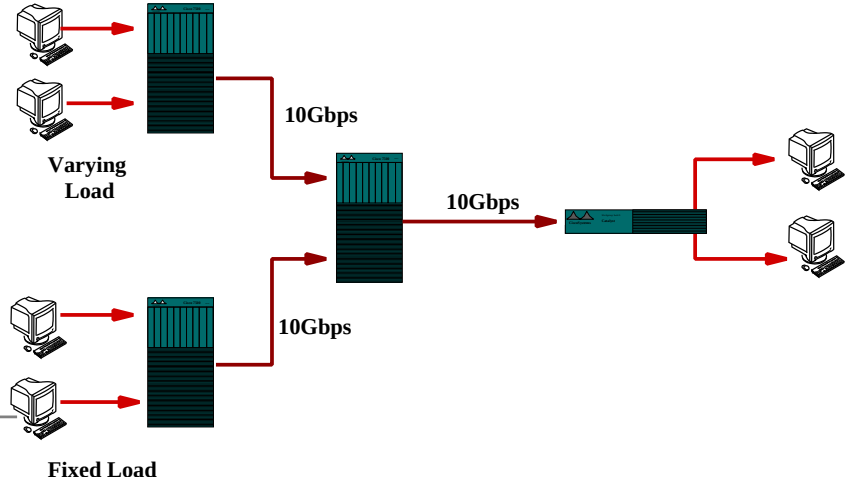
Effect of BCN



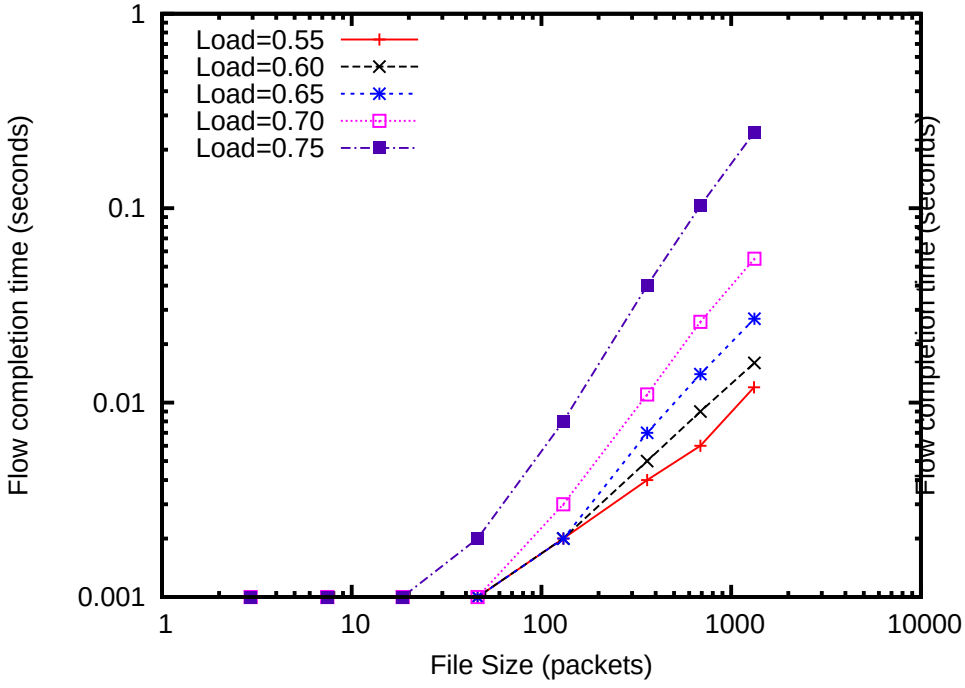


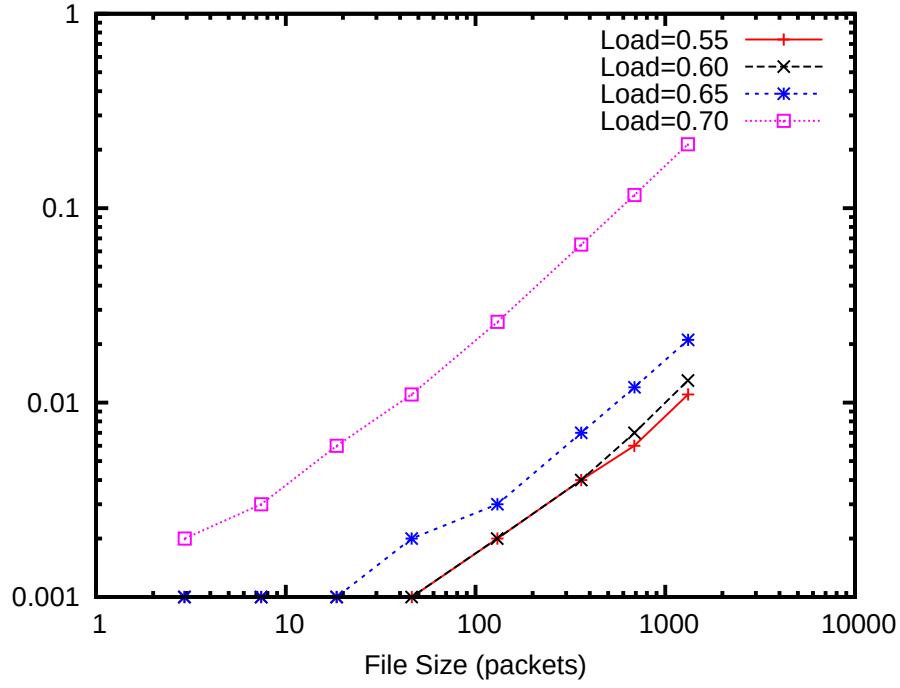


Interpretation of the results

- Mean flow size = $1MB$: gain in throughput is about 10%.
- Mean flow size = $50KB$: gain in throughput is about 5%.
- Flow completion time: Using BCN messages improves the overall FCT.
- Fairness:
  - Without BCN, FCT depends on the loading of uncongested links too !
  - With BCN, FCT depends on most congested links.
  - BCN messages, helps improve the fairness.

Effect of BCN on the FCT

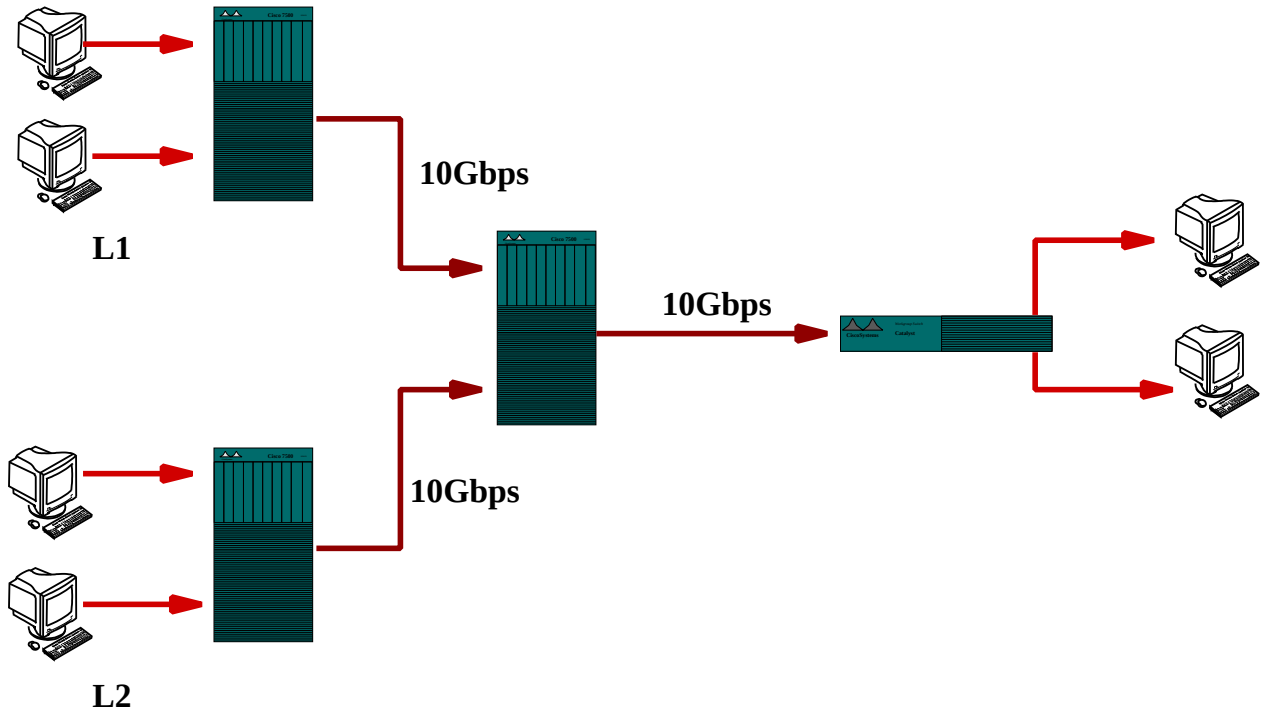




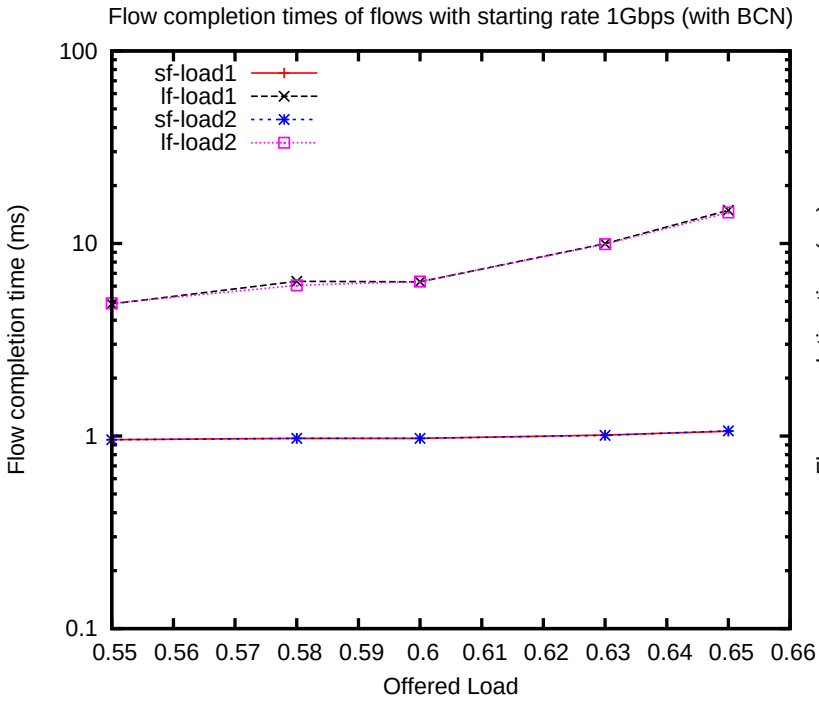
Interpretation of the results

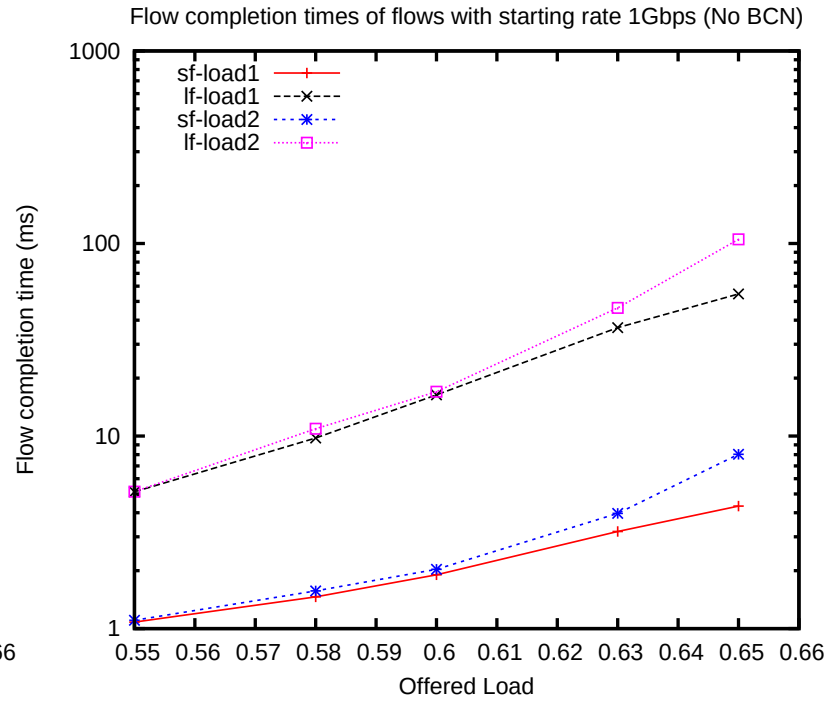
- Without BCN, no priority for short-flows. All flows are worse off equally.
- With BCN, the short-flows completion time remain same irrespective of the loading.
- At 70% loading FCT of 80% of the flows remain unchanged.

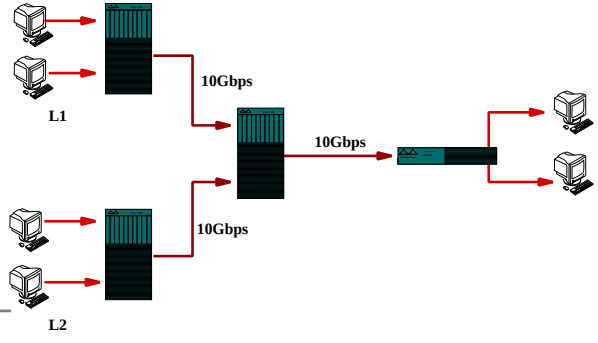
Bursty loading



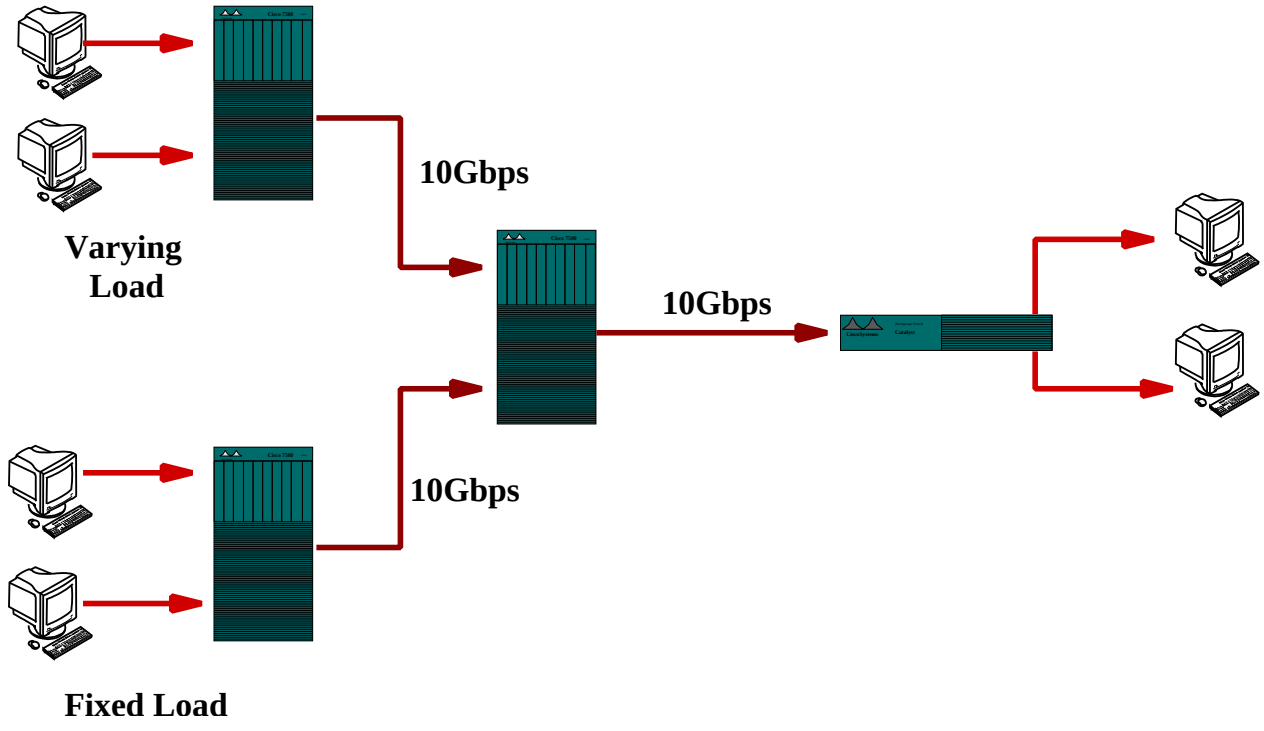
Effect of BCN on the FCT





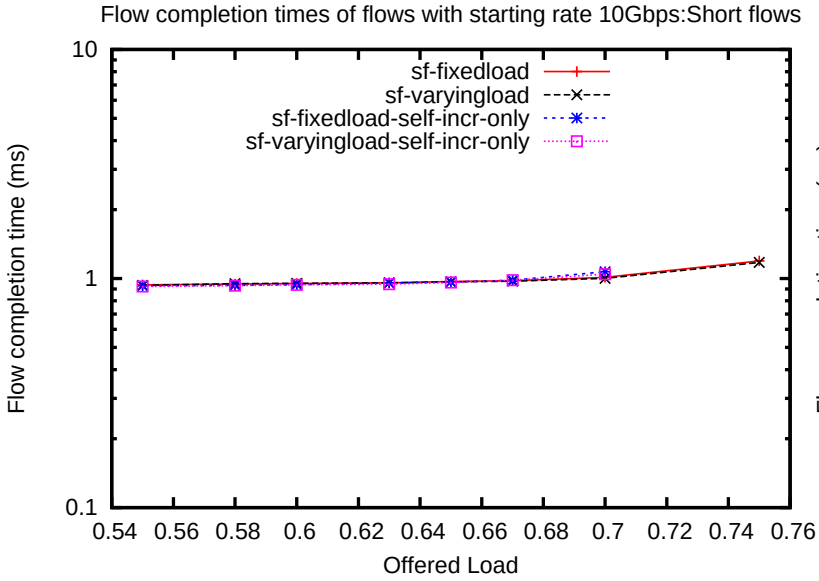


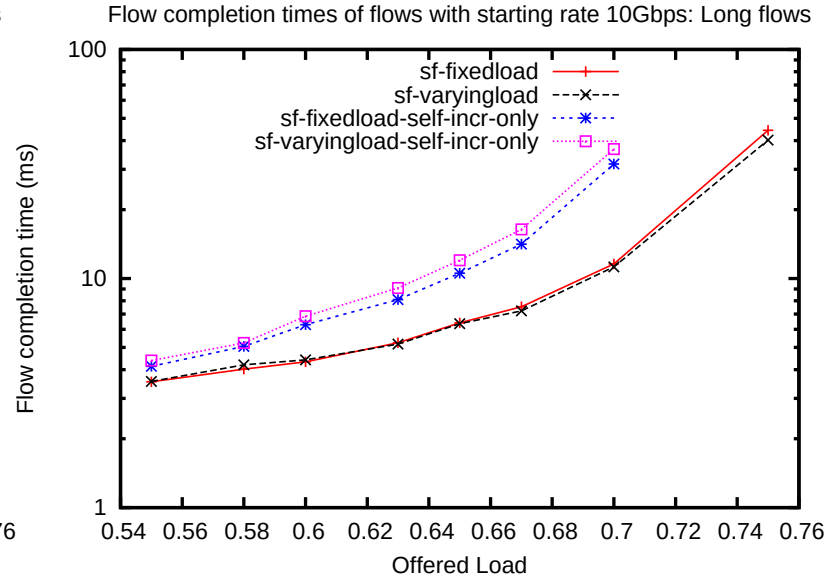
Effect of switch-signalled rate increase



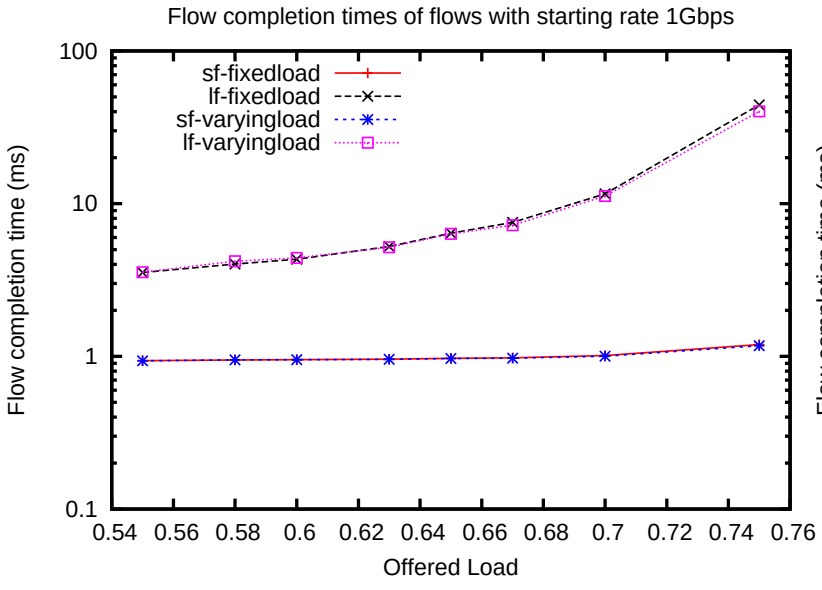
Effect of switch-signalled rate increase

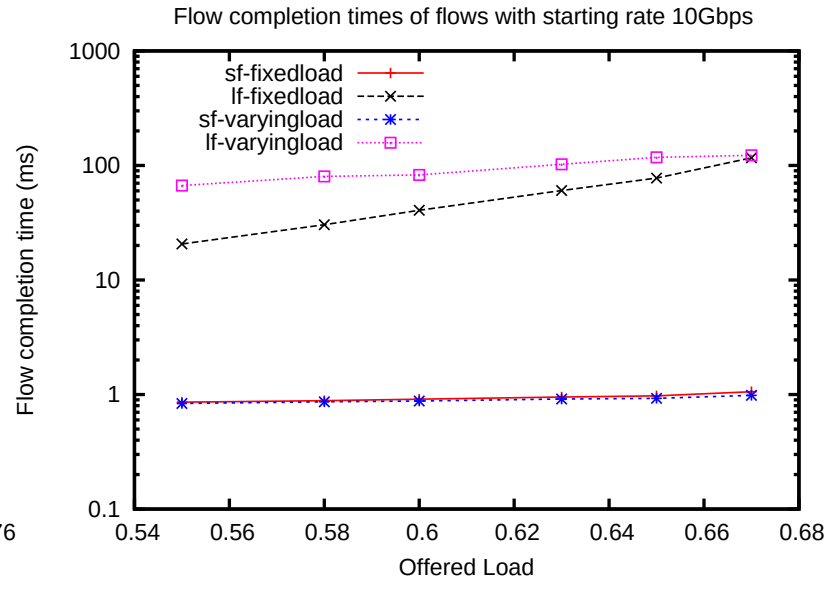
- Switch increase is turned off. RPs respond only to switch decrease messages.

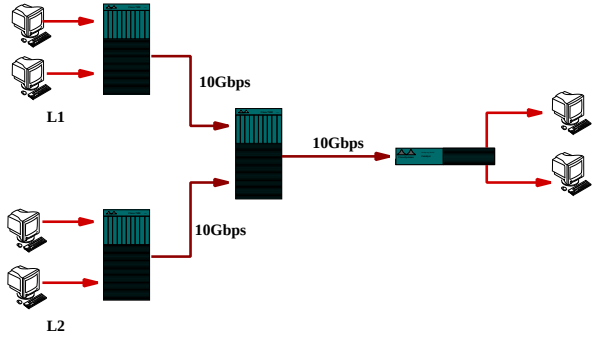




Effect of starting rate







Conclusions

- Studied the effect of BCN system in a multi-link topology.
- Studied the performance of BCN under flow arrivals and departures.
- Studied the effect of
  - Flow size distribution.
  - Mean flow size.
  - BCN increase messages.
  - Link pauses.

  on the performance of BCN.
- Qualitatively studied the fairness properties of BCN.