Performance Simulation of Nortel OPE-RPR Ring (II)

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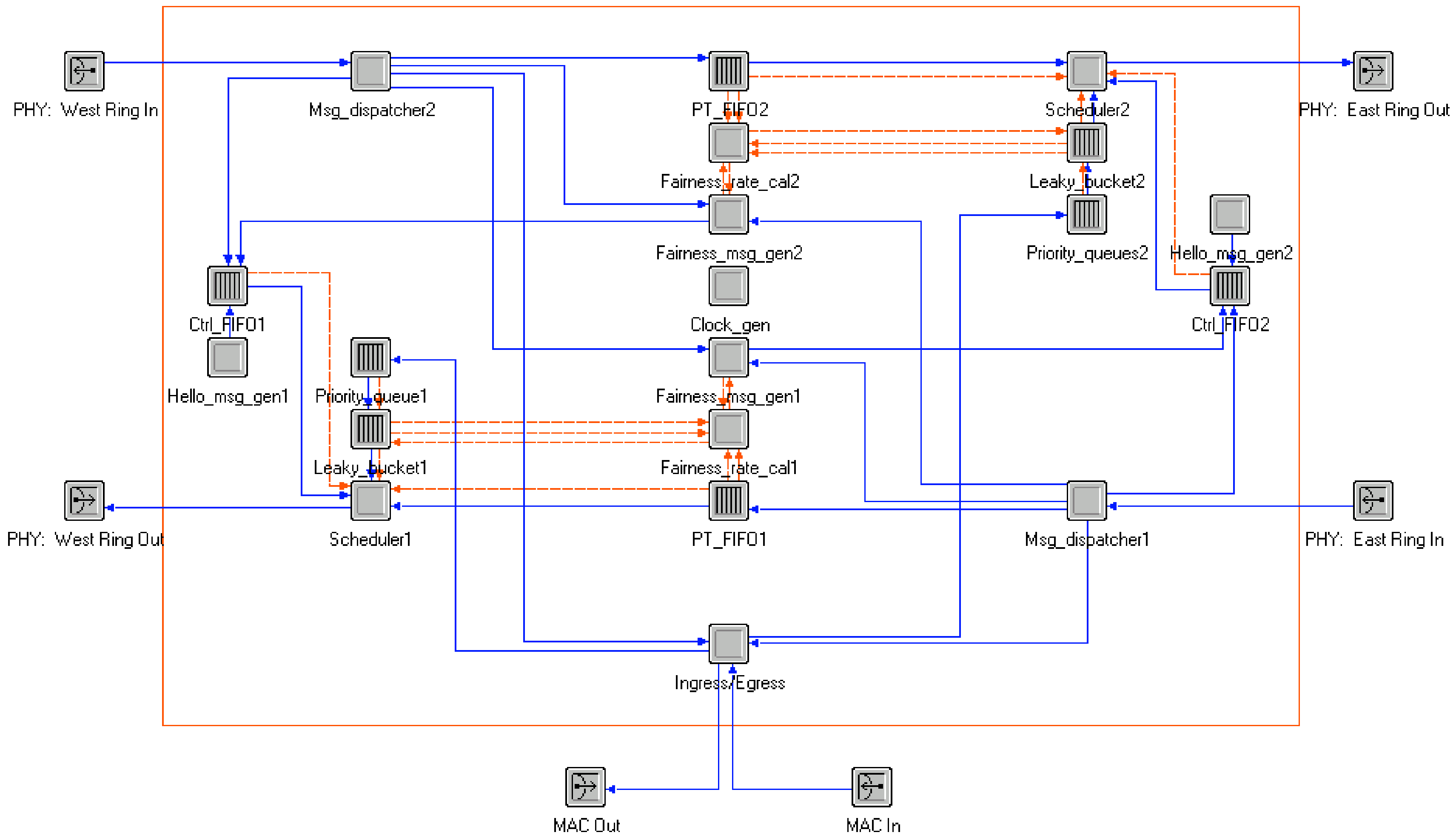
Agenda

- Objectives
- Simulation setup
- Transient simulation results
- Steady-State simulation results
- Conclusions
- What's next

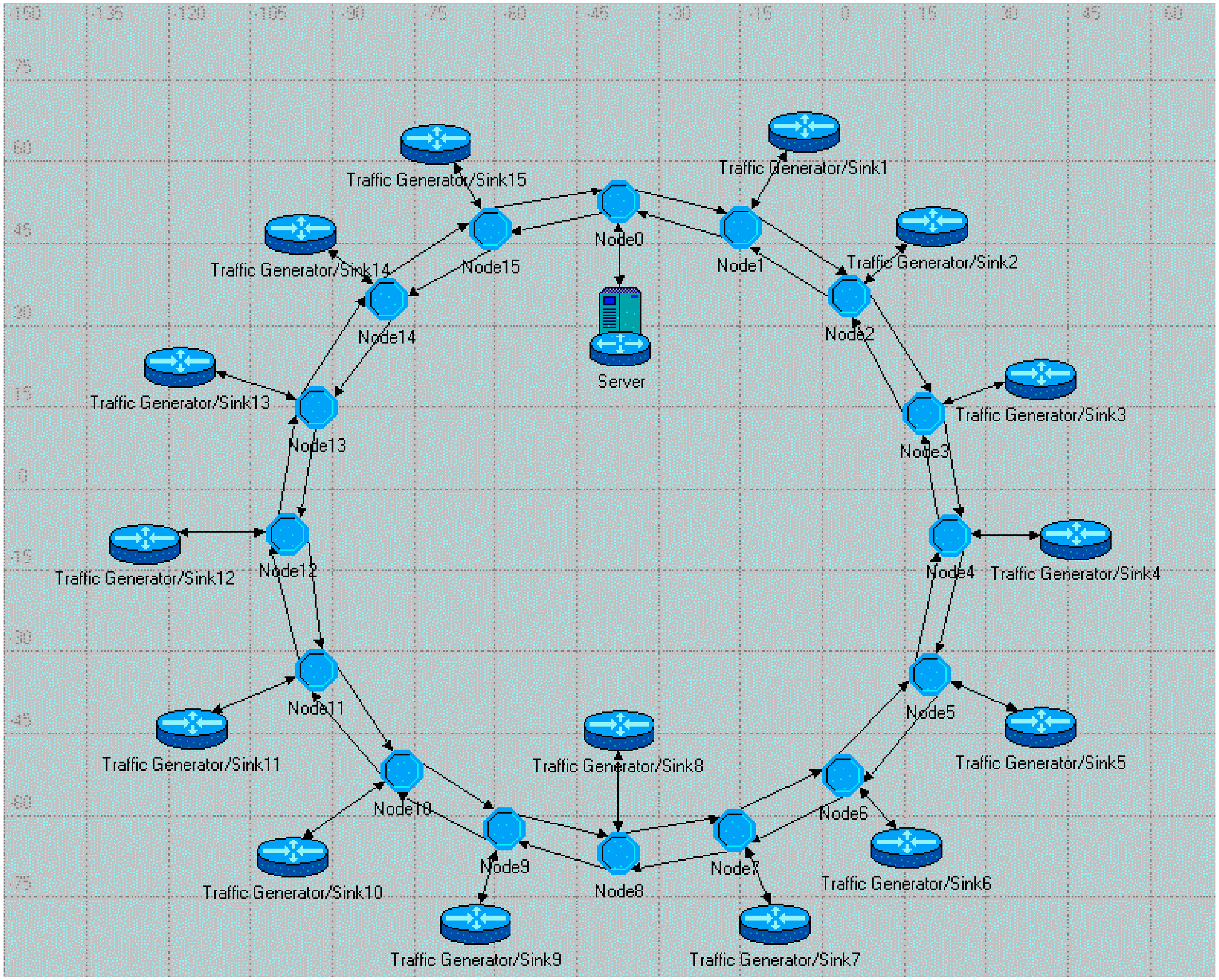
Objectives

- Phase II
  - Examine the transient performance of OPE-RPR ring under raw traffic model with priority
  - Examine the steady-state performance of OPE-RPR ring under bursty raw traffic model with priority

Simulation setup: Node model



Simulation setup: Ring model



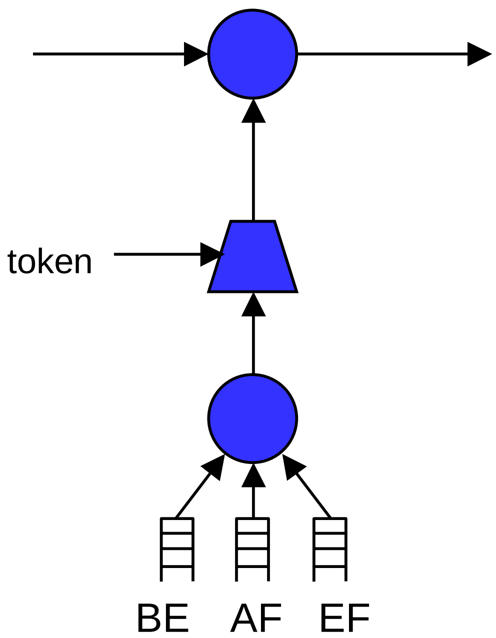
Definitions

- **MAC end-to-end delay:** Time between the arrival of an end of packet at the MAC transmit buffer of the source node and the time that this packet is completely delivered to the next protocol layer of the destination node on the same ring.
- **Medium access delay:** Time required for a head-of-the-line packet in the MAC transmit buffer to gain access to the medium. This delay is only caused by the medium competition and the fairness mechanism, not by the node's own traffic. This delay does not include the packet transmission time.
- **User end-to-end delay:** MAC end-to-end delay plus higher layer ingress and egress queue delay

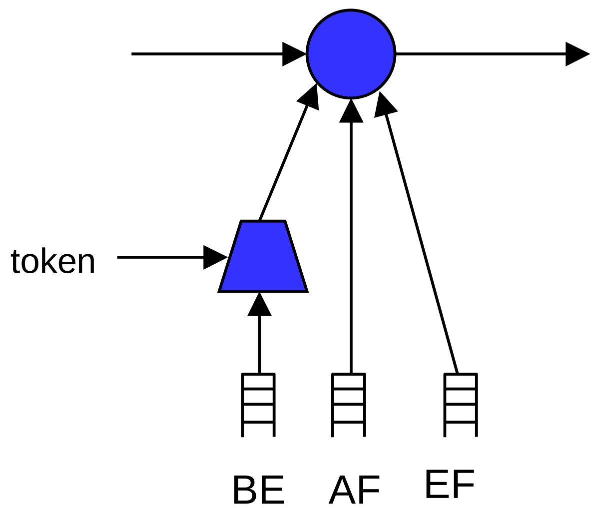
Traffic description

- AF and BE: the packet interarrival distribution is exponential (Poisson traffic)
- EF: the packet interarrival distribution is constant
- Packet size distribution is trimodal (60% 64B, 20% 512B, 20% 1518B)
- The mean packet size is 444.4B
- Hub application
  - Node 0 is the hub node
  - Node 1 to 15 send traffic to node 0 along counter clockwise direction

Two Scenarios for ingress priority traffic



1-add

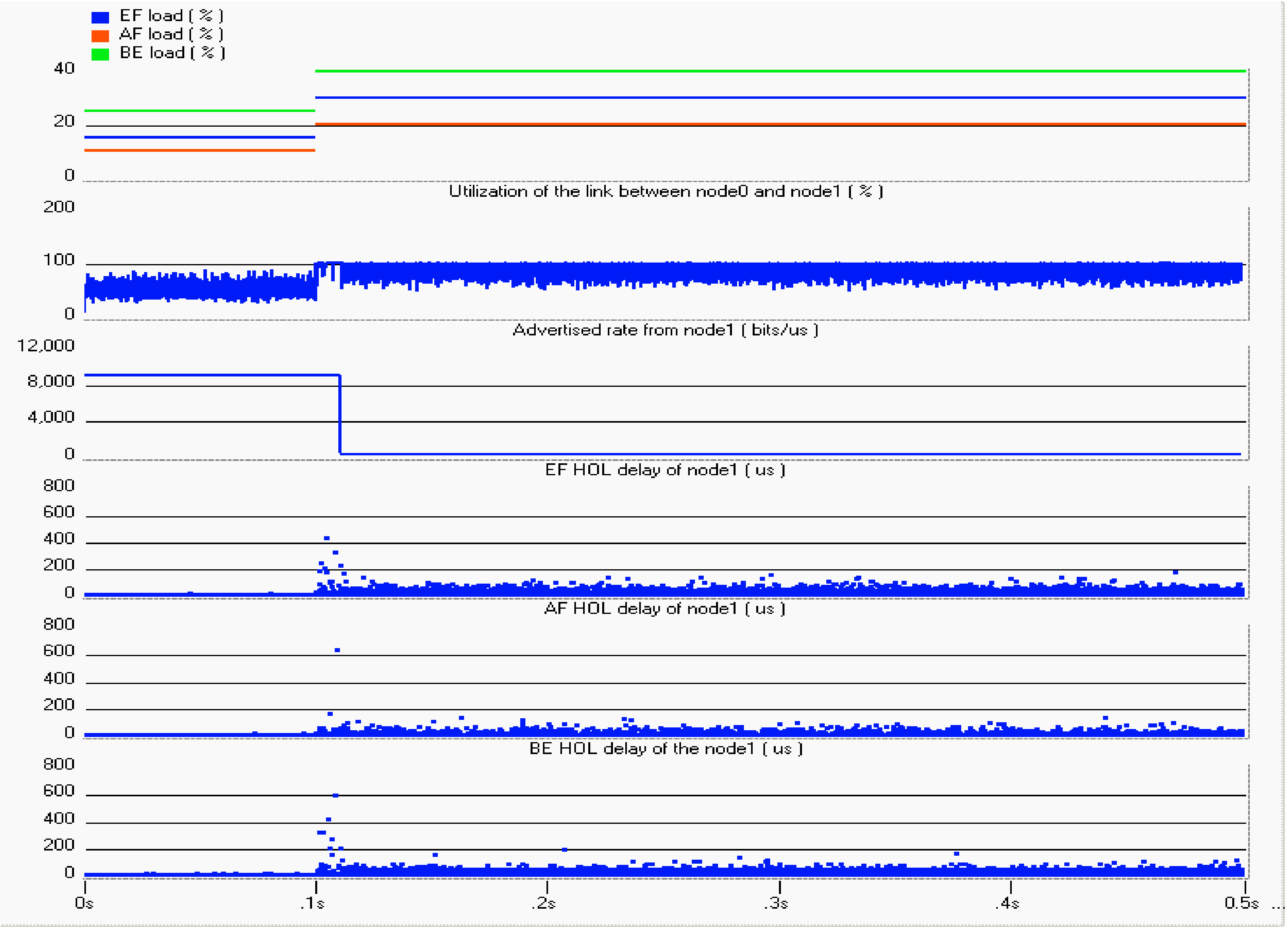


3-add

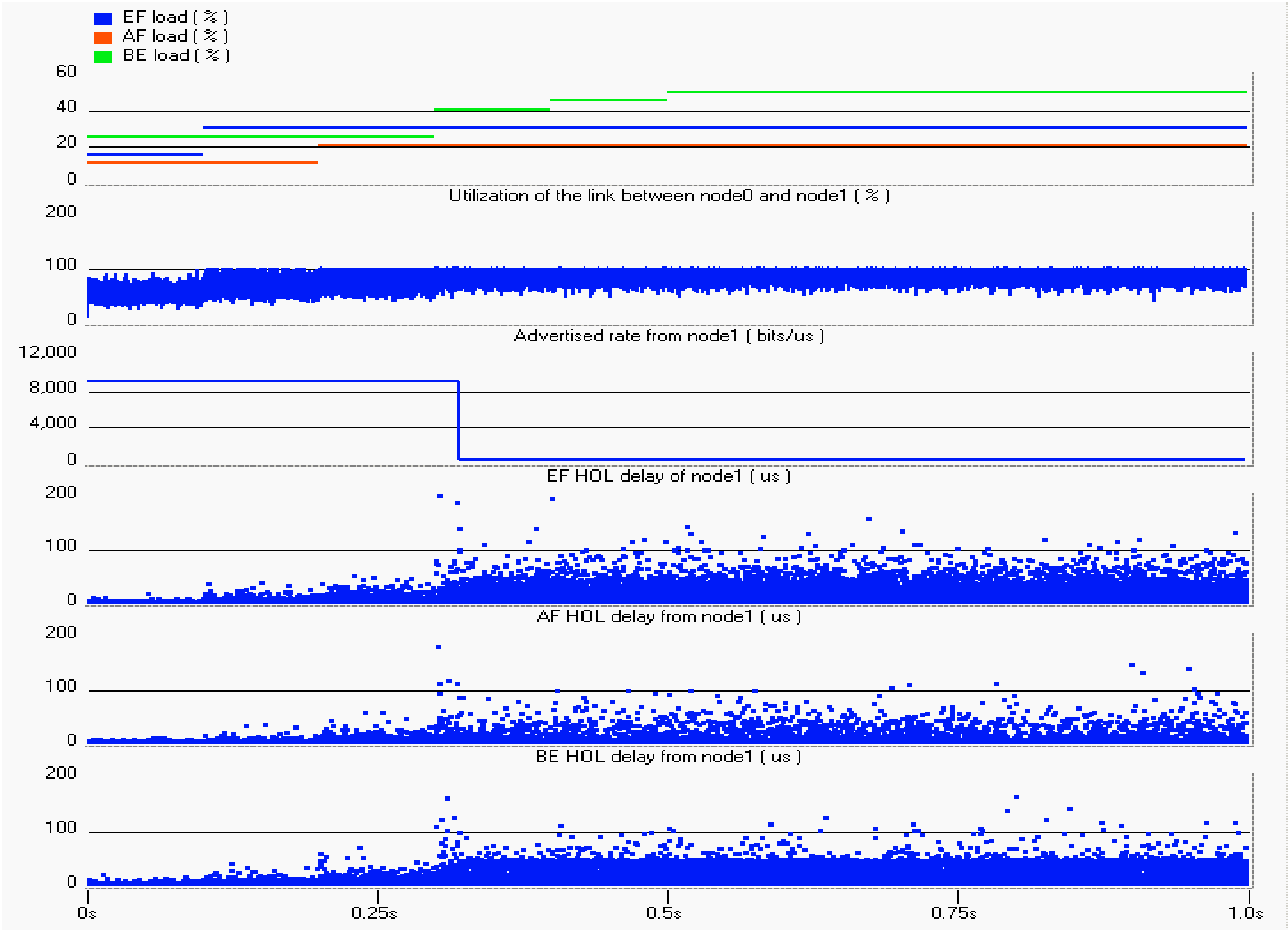
Simulation scenarios for transient performance study

- Two types of scenarios:
  - Step Respose
  - piecewise linear (emulate LRD)
- Common parameters:
  - Link Utilization Max Threshold : 0.95
  - HOL Delay Threshold: 1,000us
  - Sample Window: 200 us
  - Token Size: 1,000 bits
  - Token Bucket Size: 15,000 bits
  - Tandem Rate Min Threshold : 0.0001
  - Add Rate Min Threshold: 0.0001
  - Packet Size 12,000 bits
  - Link rate : 10 G bps
  - Propagation delay: 70 us (20 KM)

Step Response results



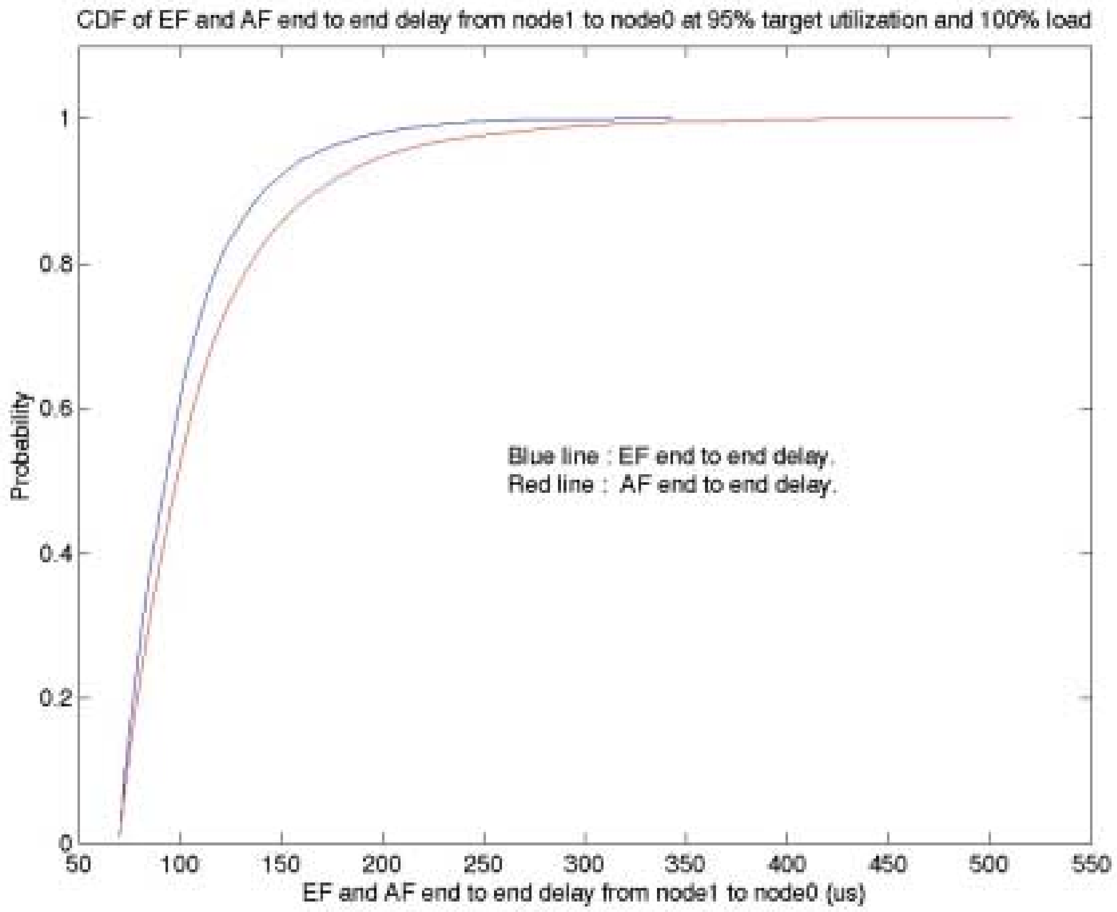
Piecewise linear



Steady state performance results

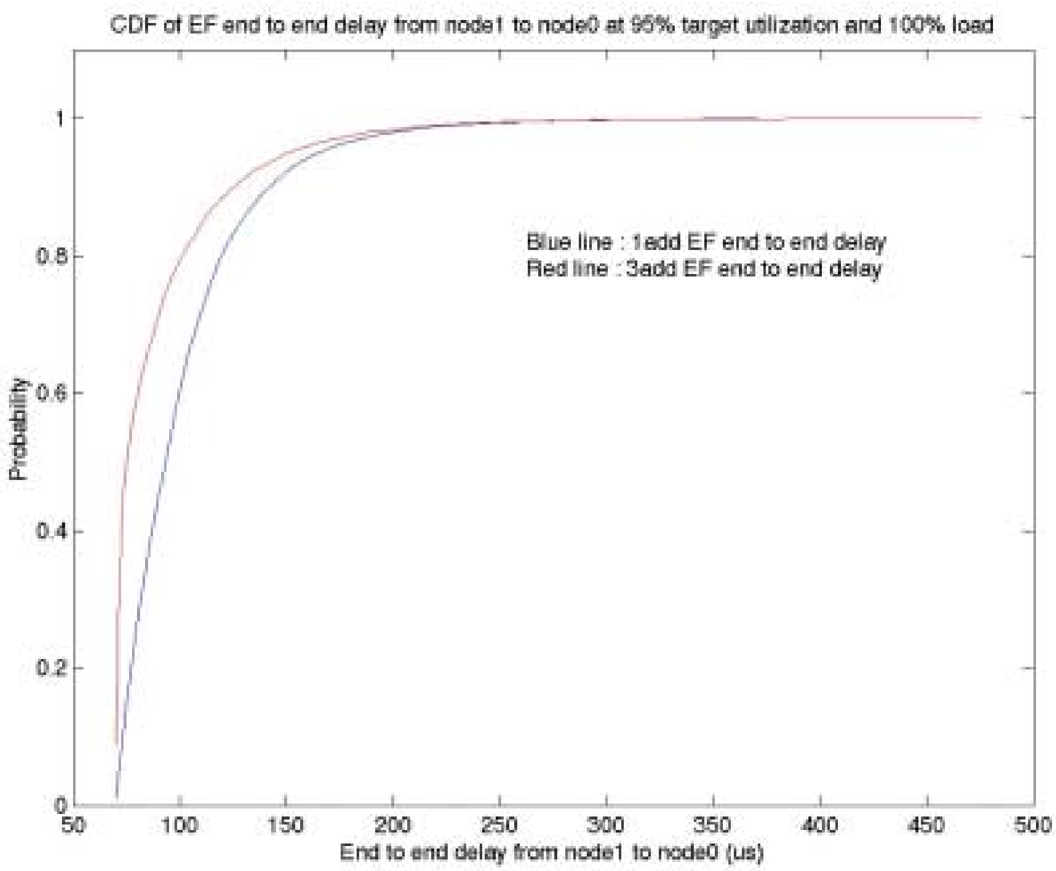
- EF vs. AF
- 1-add vs. 3-add
- Delay vs. utilization
- Throughput vs. node id.
- HOL delay vs. bucket size
- Default configuration
  - bucket size: 150K bits
  - 1-add solution
  - 95% target utilization
  - 100% total load (30% EF 20% AF 50% BE)

EF vs. AF User ETE delay results



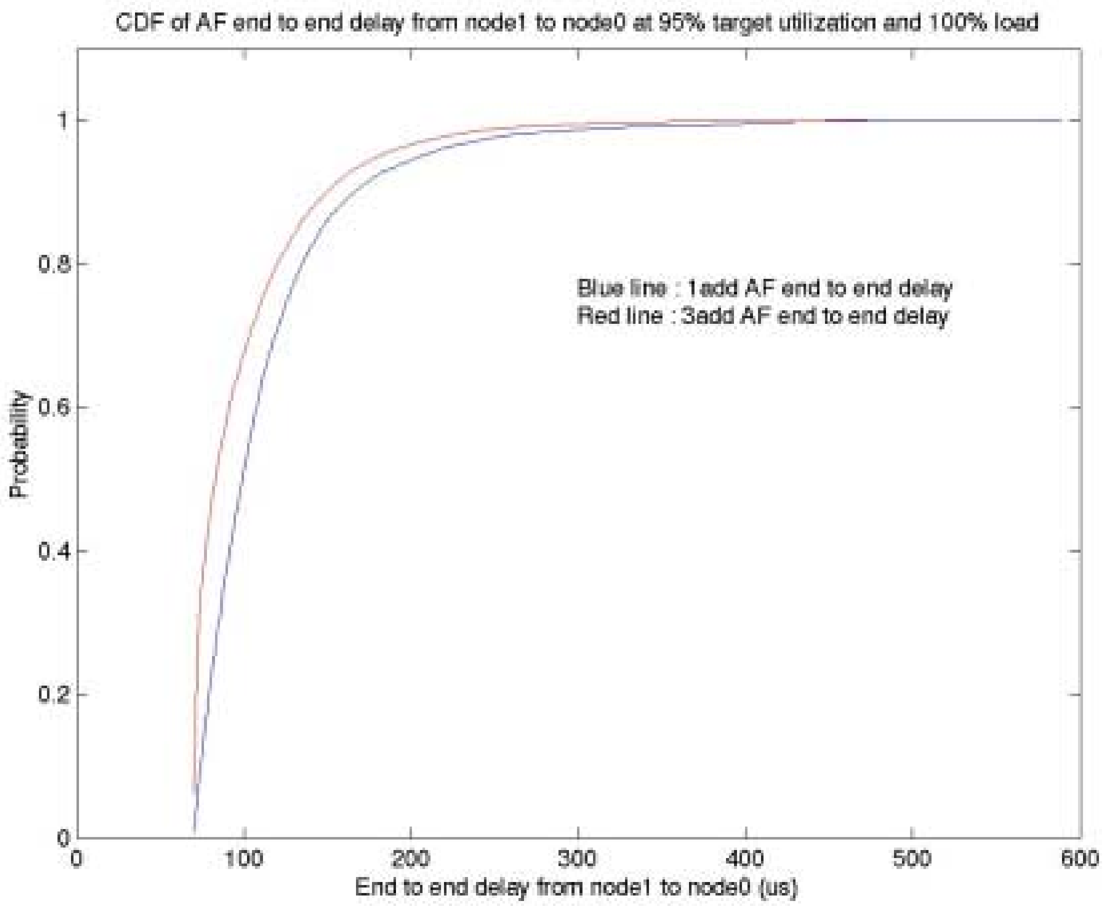
EF has better delay results than AF

1-add vs. 3-add EF User ETE delay results



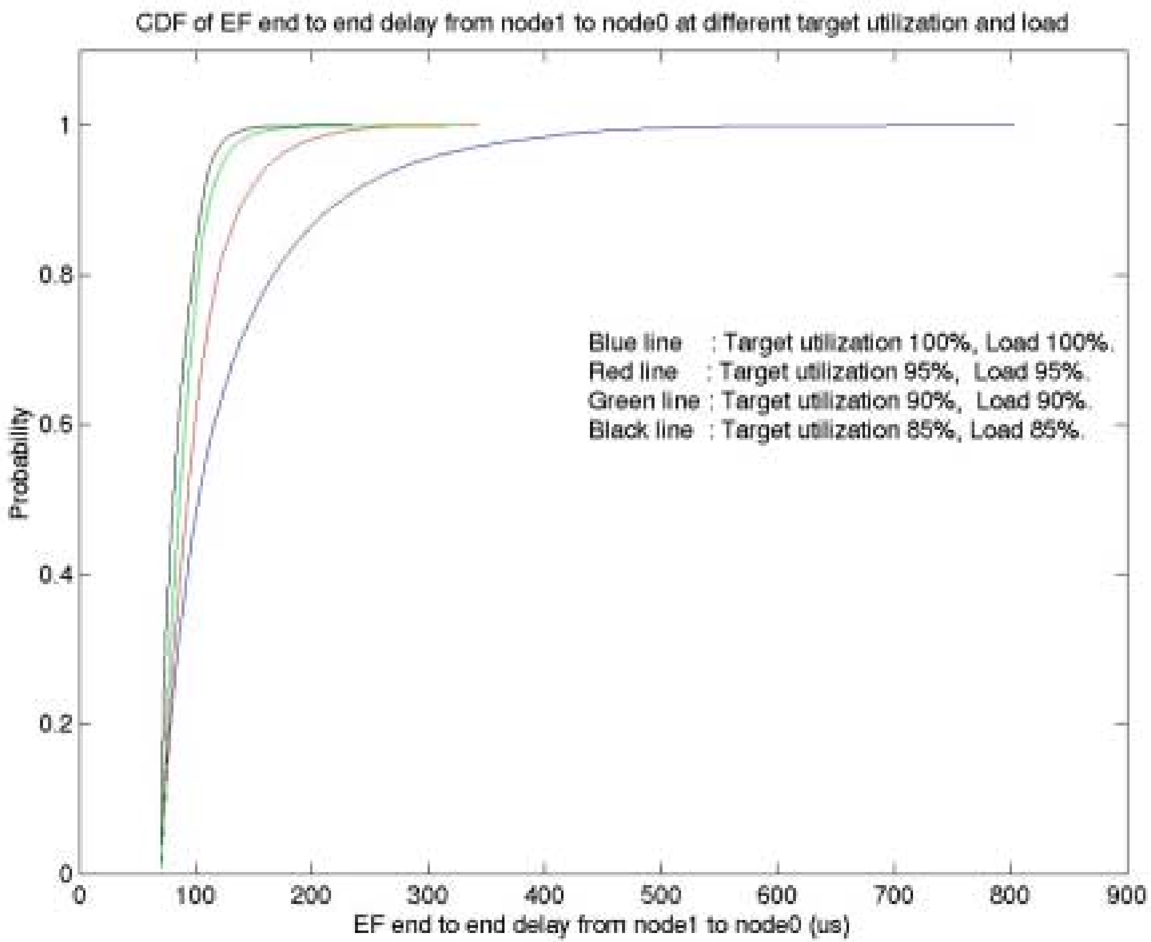
3-add has better EF delay results than 1-add

1-add vs. 3-add AF User ETE delay results



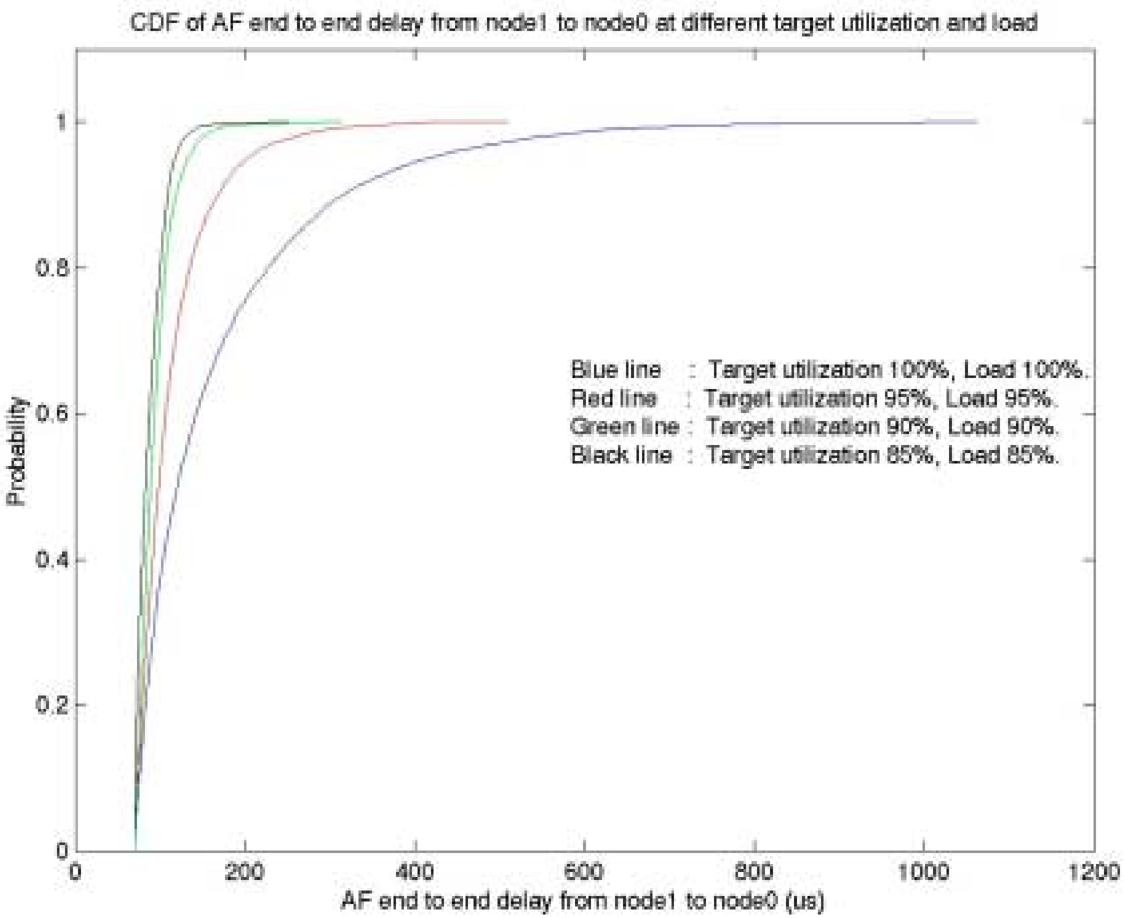
3-add has better AF delay results than 1-add

Delay vs. utilization EF User ETE delay results



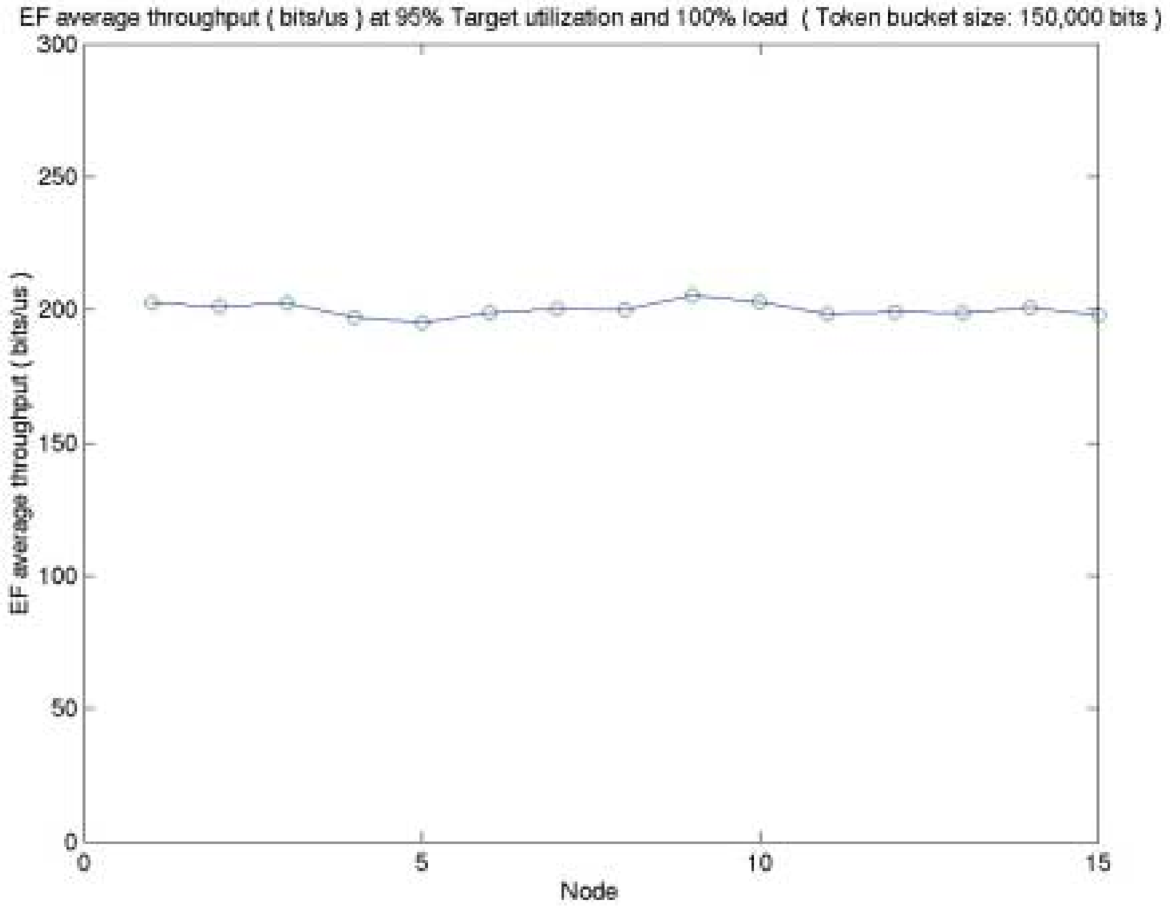
High utilization can be achieved with very small delay for EF

Delay vs. utilization AF User ETE delay results



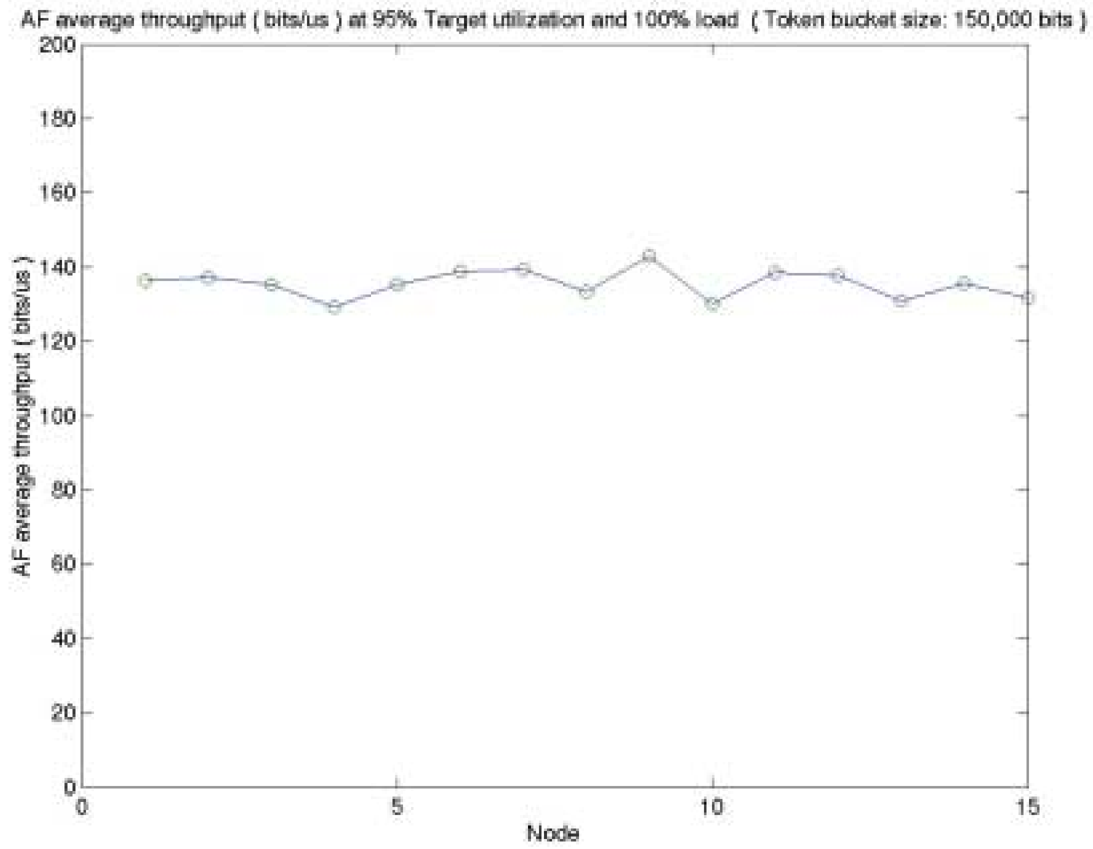
High utilization can be achieved with small AF delay

Throughputs vs. node id EF results



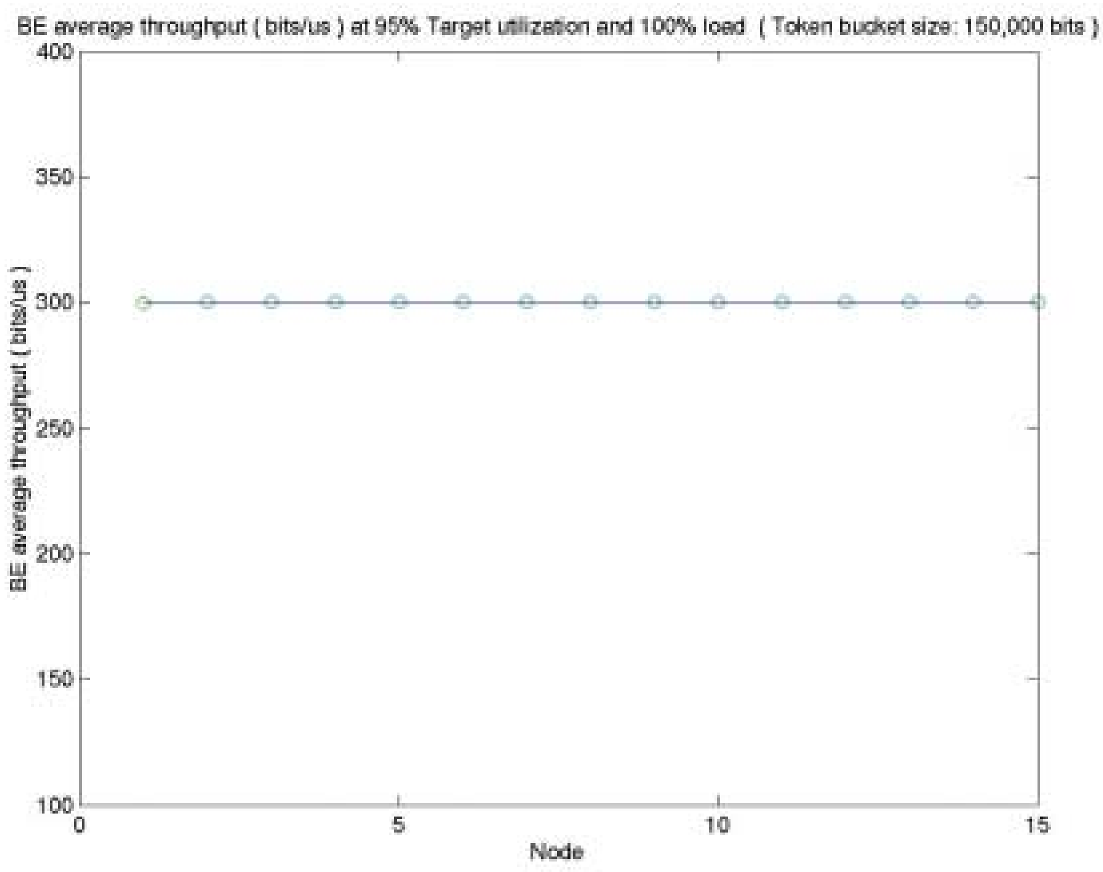
Fairness is achieved for EF

Throughput vs. node id. AF results



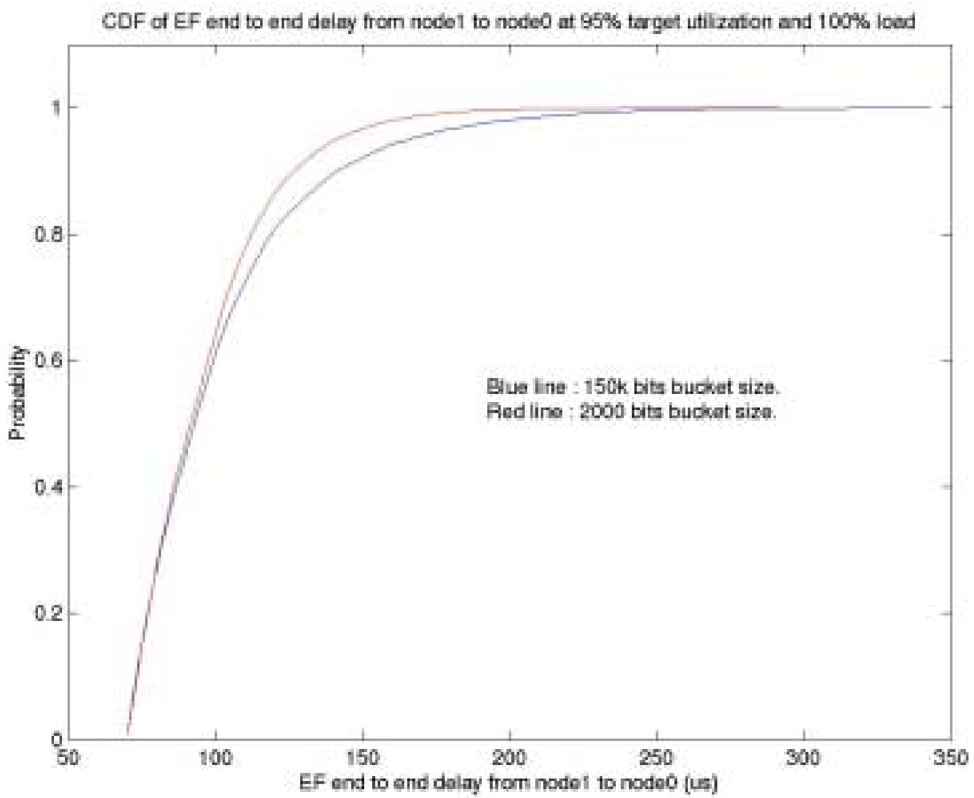
Fairness is achieved for AF

Throughput vs. node id. BE results



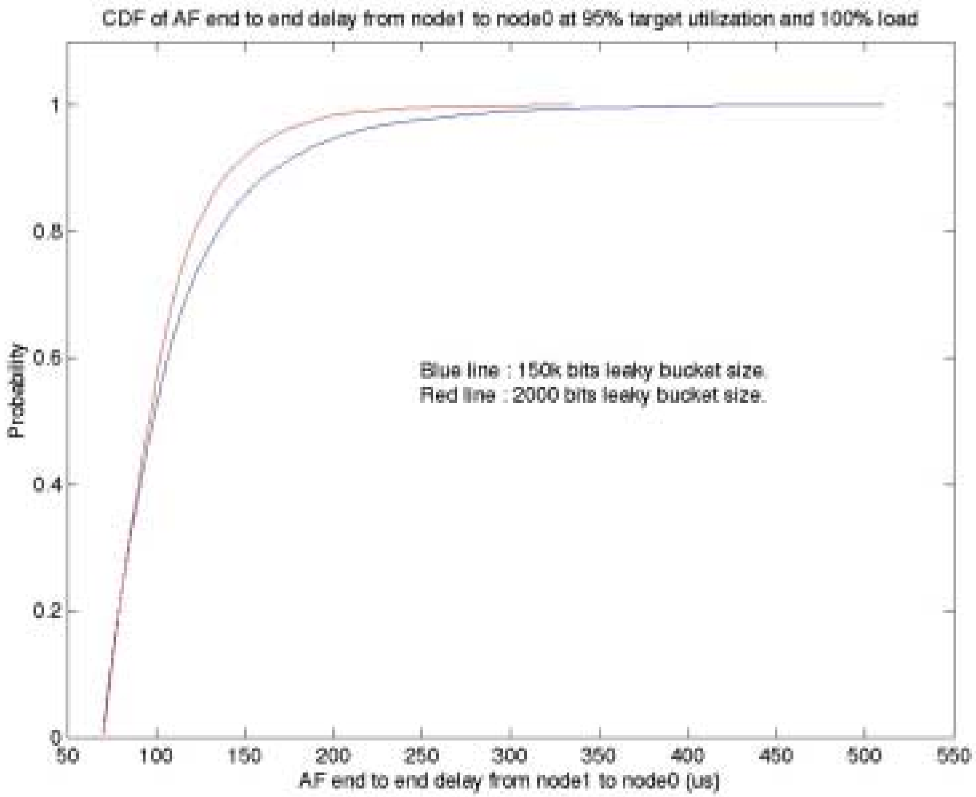
Fairness is achieved for BE

EF ETE delay vs. bucket size



Smaller bucket size can reduce EF delay

AF ETE delay vs. bucket size



Smaller bucket size can reduce AF delay

Conclusions

- OPE-RPR ring achieves more than 95% utilization and low MAC User end-to-end delay with single insertion buffer
- OPE-RPR fairness algorithm is stable under steady and bursty traffic
- OPE-RPR fairness algorithm is fair to all nodes under congestion
- OPE-RPR fairness algorithm works effectively as predicted
- In terms of handling priority traffic 1-add has no significant differences from 3-add solution

What’s next

- Distributed applications (multiple servers)
- BW unfairness services
- TCP applications