Performance Simulation of Nortel OPE-RPR Ring

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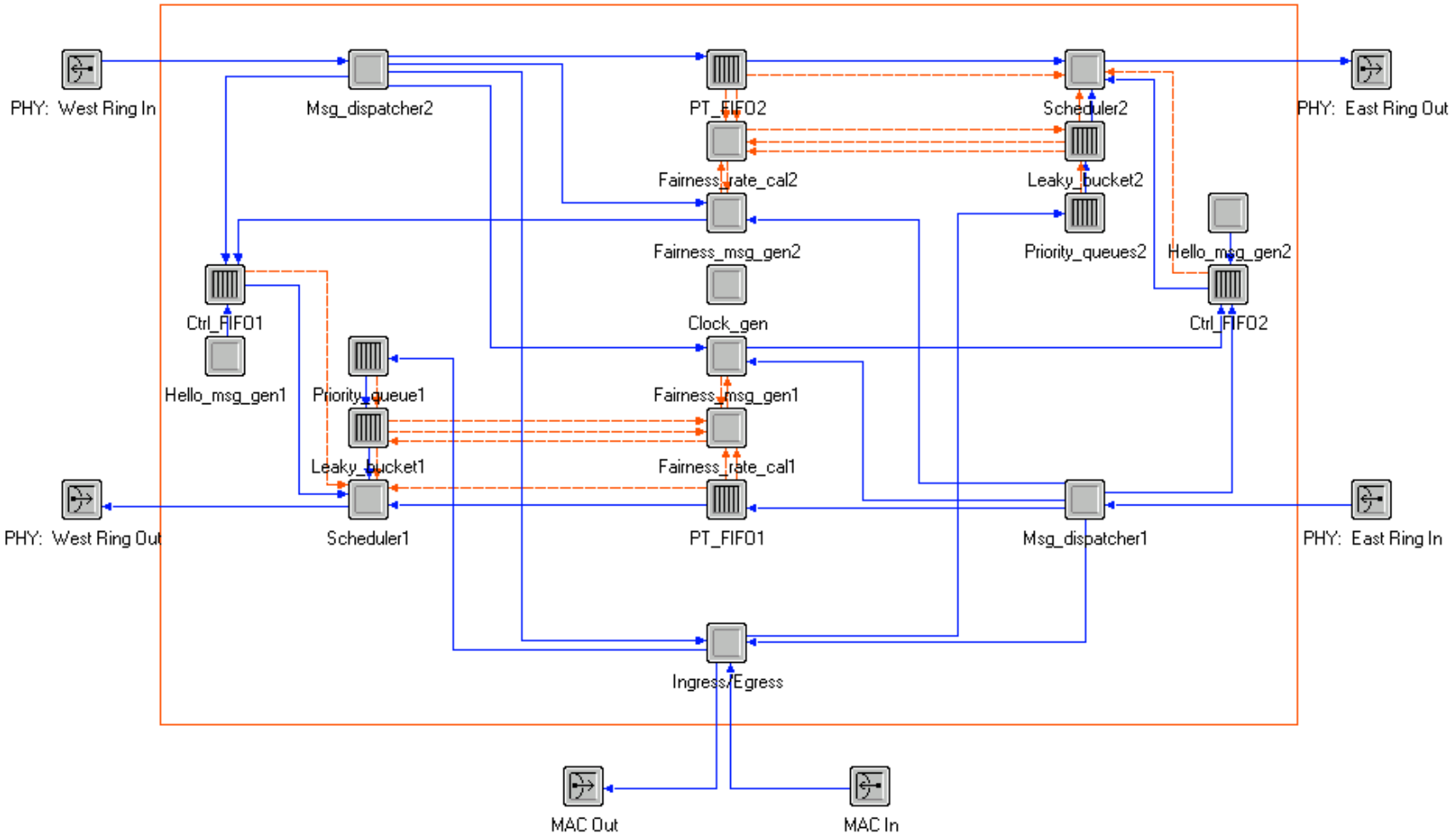
Agenda

- Objectives
- Simulation setup
- Transient simulation results
- Steady-State simulation results (to be added)
- Conclusions
- What’s next

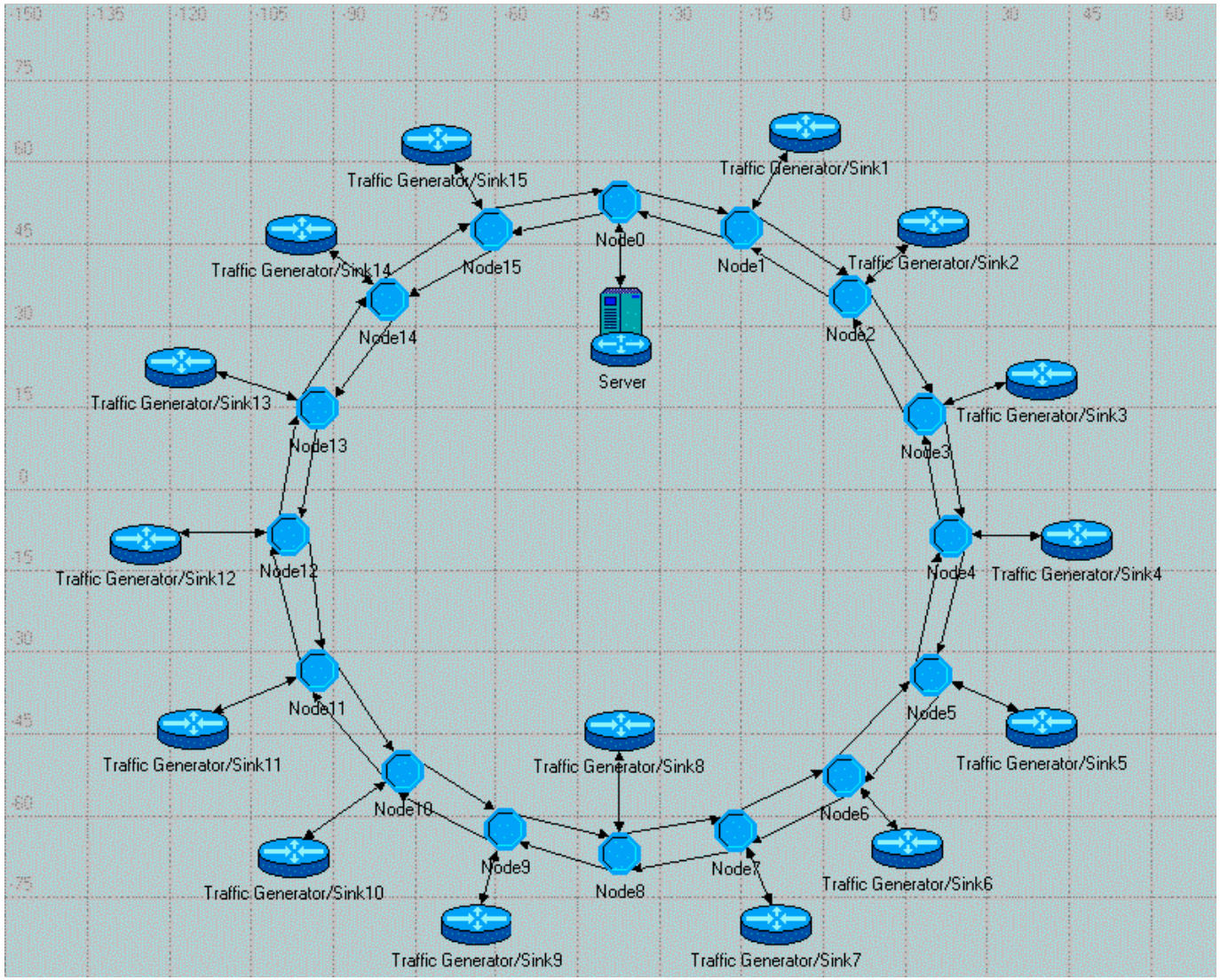
Objectives

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

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.

Trigger conditions of fairness algorithm

- Two trigger conditions:
  - triggered by high utilization
    - controlled by target utilization and weights
    - tandem and add-in rate estimator
      - *ESTIMATEDrate(t) = ESTIMATEDrate(t-1) - (ESTIMATEDrate(t-1))/WEIGHT1 + (CURRENTrate)/WEIGHT2*
  - triggered by high HOL delay
    - controlled by HOL timer

Traffic description

- The packet interarrival distribution is exponential (Poisson traffic)
- 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-clock direction

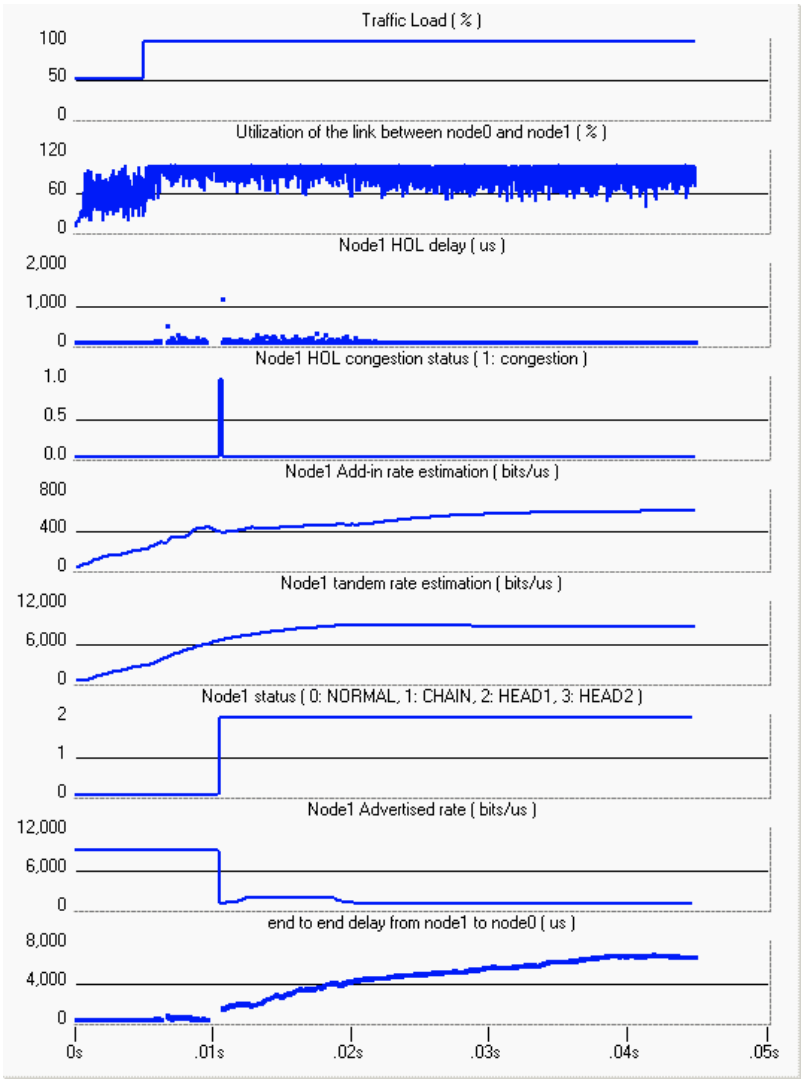
Simulation scenarios for transient performance study

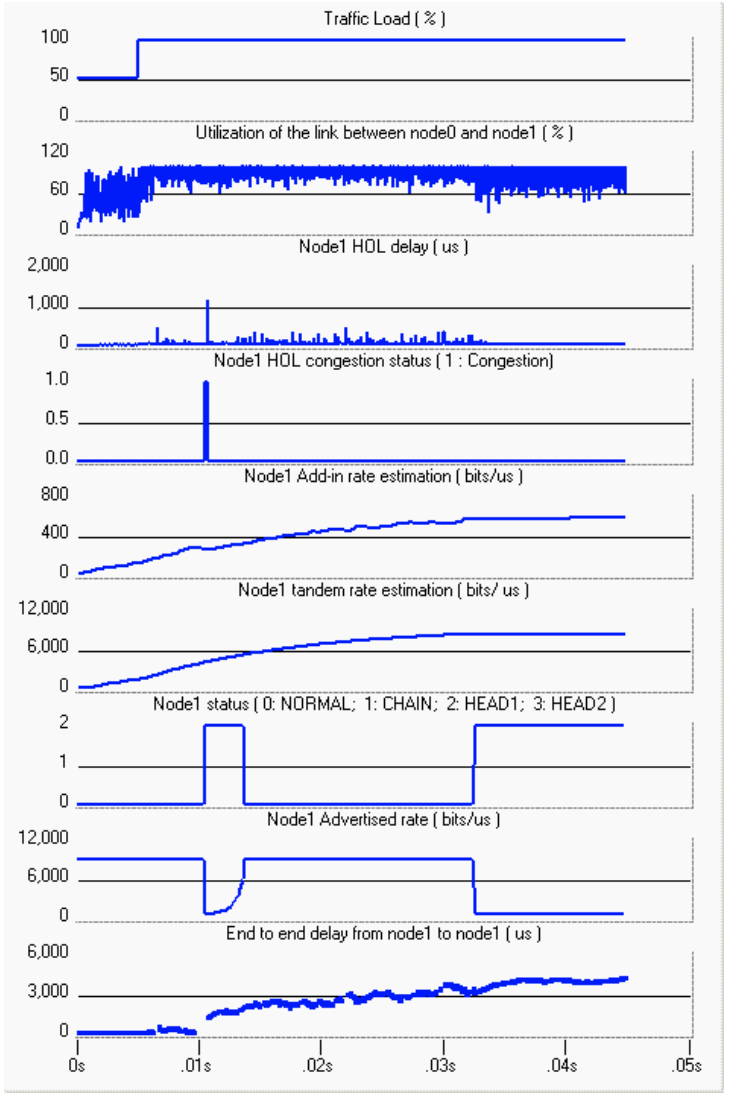
- Two types of scenarios:
  - nonoverloading
  - overloading
- Common parameters:
  - Link Utilization Max Threshold : 0.9
  - HOL Delay Threshold: 1,000us
  - Sample Window: 200 us
  - Token Size: 1,000 bits
  - Token Bucket Size: 15,000 bits
  - Tandem Rate Min Threshold : 0.0001
  - Add Rate Min Threshold: 0.0001
  - Packet Size 12,000 bits
  - Link rate : 10 G bps
  - Propagation delay: 70 us (20 KM)

Scenarios in detail

	Data rate per node (mean value)	Weight for Tandem rate and Add rate Estimators	Simulation duration	Comment
Scenario 1 - 1	50%*10G/15 bps (0 < t <= 5 ms) 100%*10G/15 bps (t>5 ms)	32	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 50% to 100% at time t = 5 ms following the input load jumps.
Scenario 1 - 2	50%*10G/15 bps (0 < t <= 5 ms) 100%*10G/15 bps (t>5 ms)	64	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 50% to 100% at time t = 5 ms following the input load jumps.
Scenario 2 - 1	100%*10G/15 bps (0 < t <= 5 ms) 150%*10G/15 bps (t>5 ms)	32	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 100% to 150% at time t = 5 ms following the input load jumps.
Scenario 2 - 2	100%*10G/15 bps (0 < t <= 5 ms) 150%*10G/15 bps (t>5 ms)	64	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 100% to 150% at time t = 5 ms following the input load jumps.
Scenario 2 - 3	100%*10G/15 bps (0 < t <= 5 ms) 200%*10G/15 bps (t>5 ms)	32	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 100% to 200% at time t = 5 ms following the input load jumps.
Scenario 2 - 4	100%*10G/15 bps (0 < t <= 5 ms) 200%*10G/15 bps (t>5 ms)	64	45 ms	Mean utilization of the link between Node_1 and Node_0 jumps from 100% to 200% at time t = 5 ms following the input load jumps.

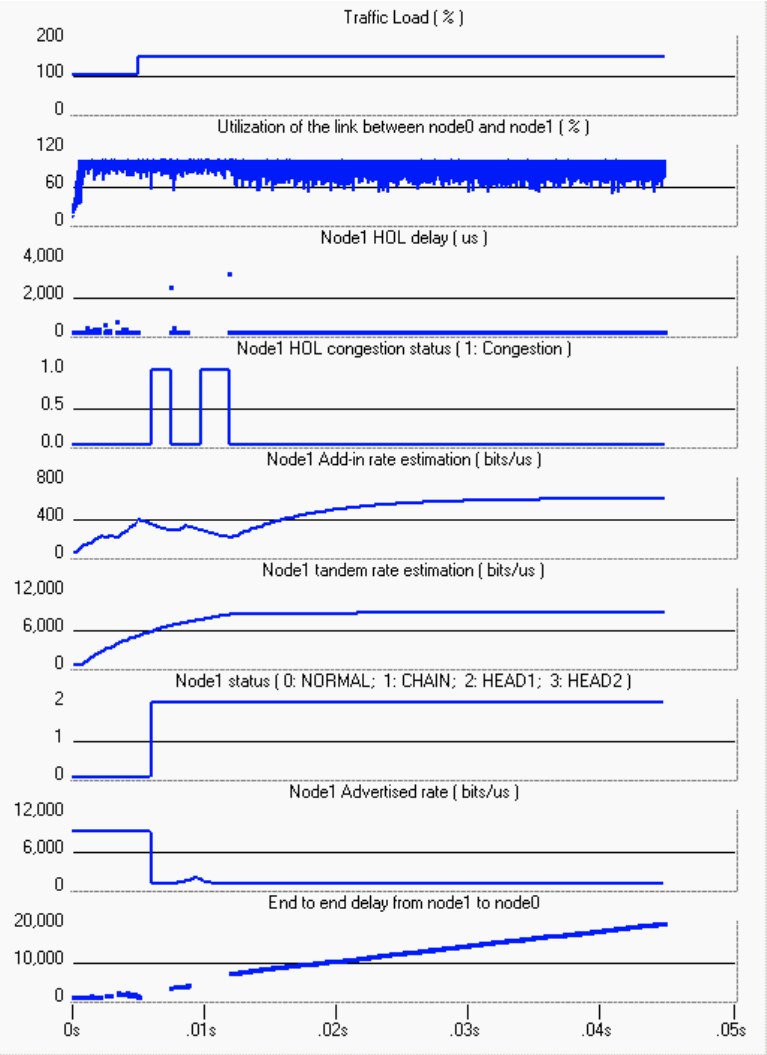
Selective results

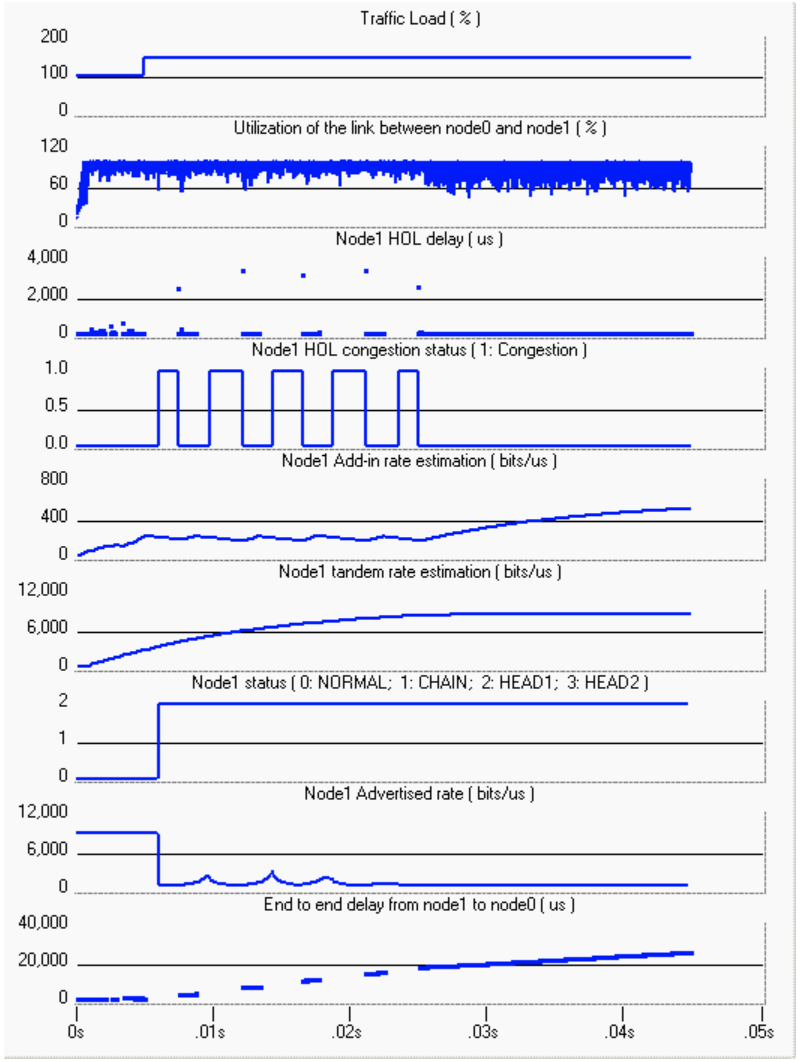




Scenario 1-1 vs. Scenario 1-2

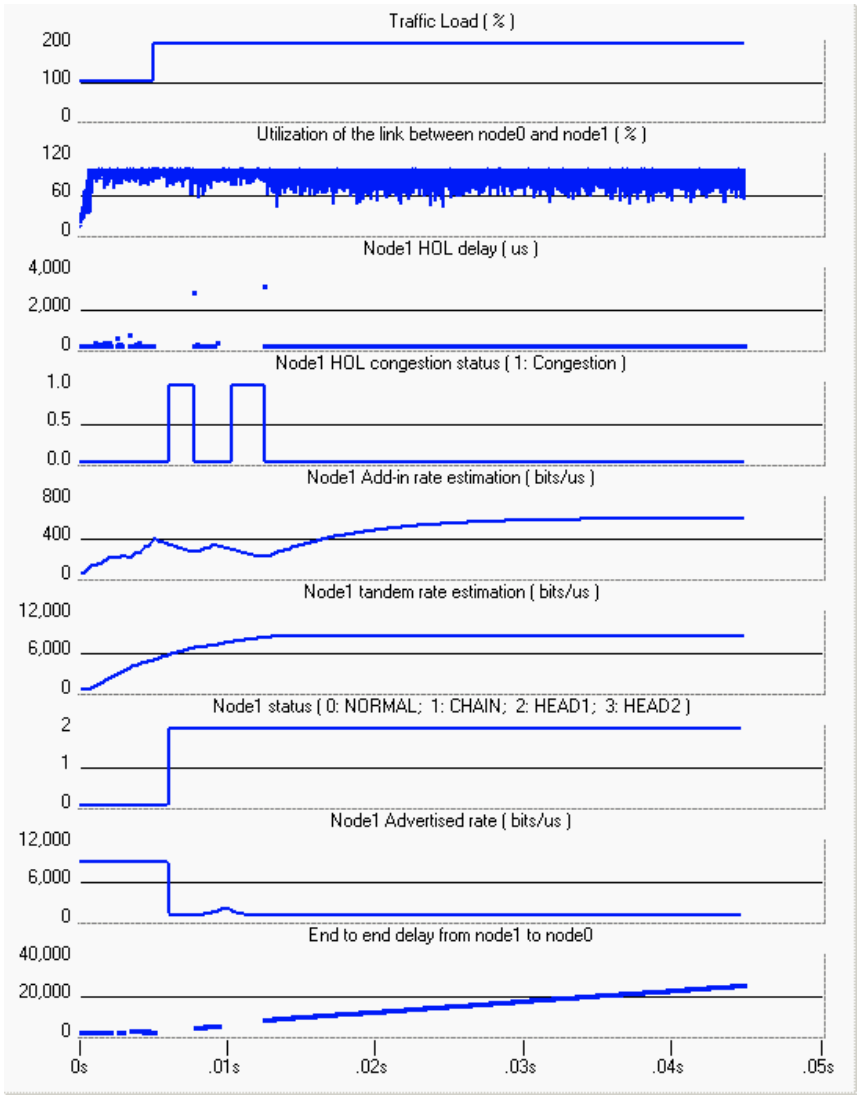
Selective results (cont'd)

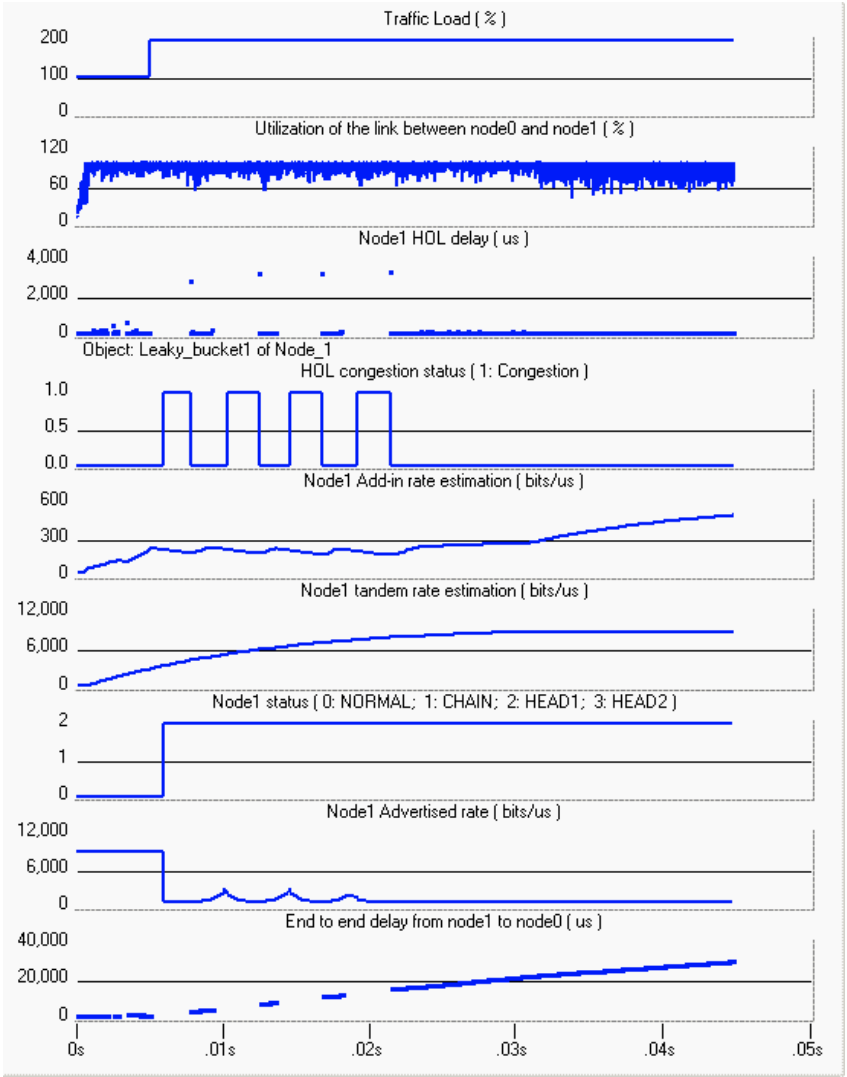




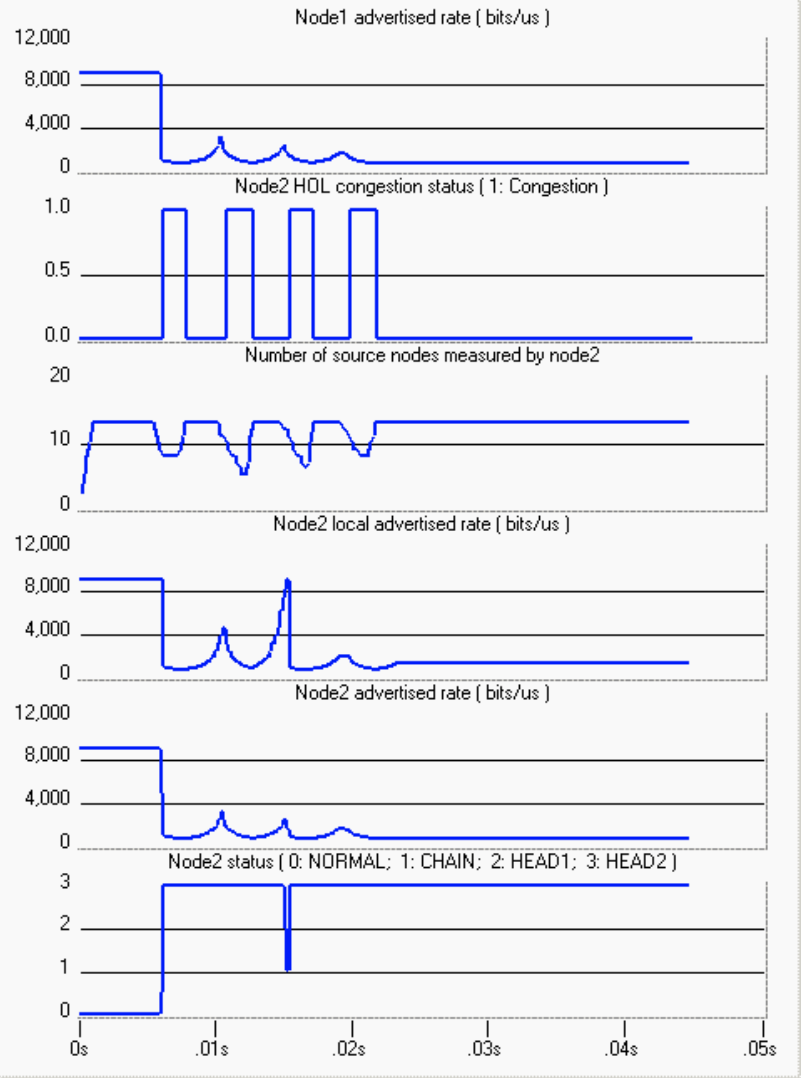
Scenario 2-1 vs. Scenario 2-2

Selective results (cont'd)





Fully distributed algorithm in operation



Node Status:
0 Normal
1 Chain
2 Head1
3 Head2

Scenario 2-4
(CBR traffic)

Conclusions

- OPE-RPR ring can achieve more than 95% utilization and low MAC 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
- HOL delay depends on utilization and traffic burstiness but is very small at very high utilization (>95%)

What’s next

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