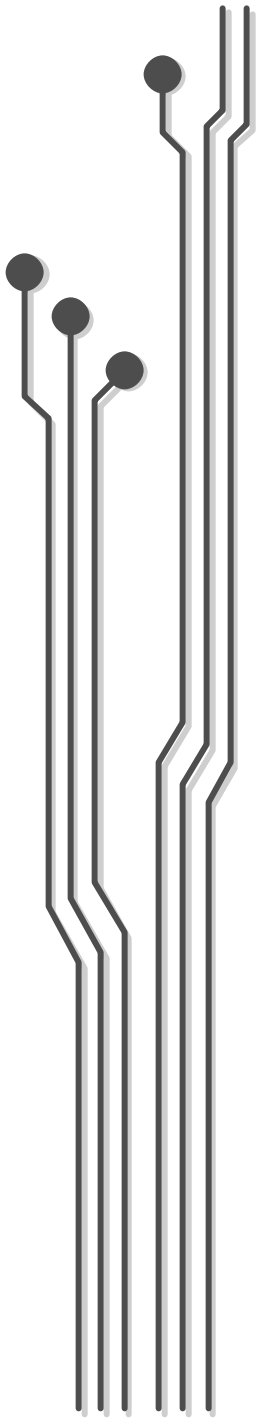

Performance Simulation of Nortel OPE-RPR Ring (III)

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September 4, 2001

Agenda

- Objectives
- Fairness under unequal high priority
- Unequal low priority
- Distributed applications
- Conclusions

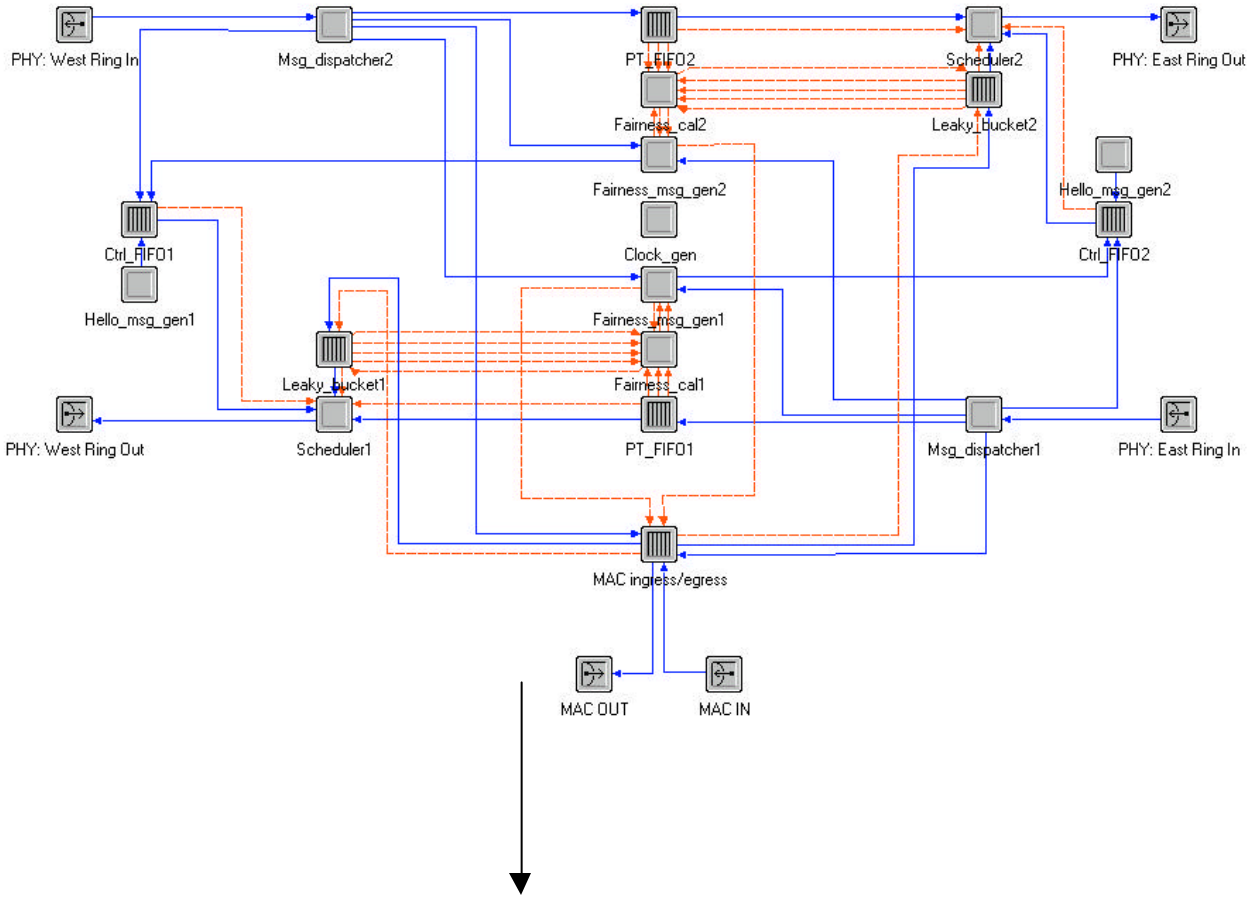
Objectives

- Phase III
  - Examine the support for unequal bandwidth requirements
    - Fairness under unequal high priority traffic bandwidth requirements
    - Unequal low priority traffic bandwidth requirements
  - Examine the support for distributed applications

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.

Simulation setup: Node model



Backpressure information

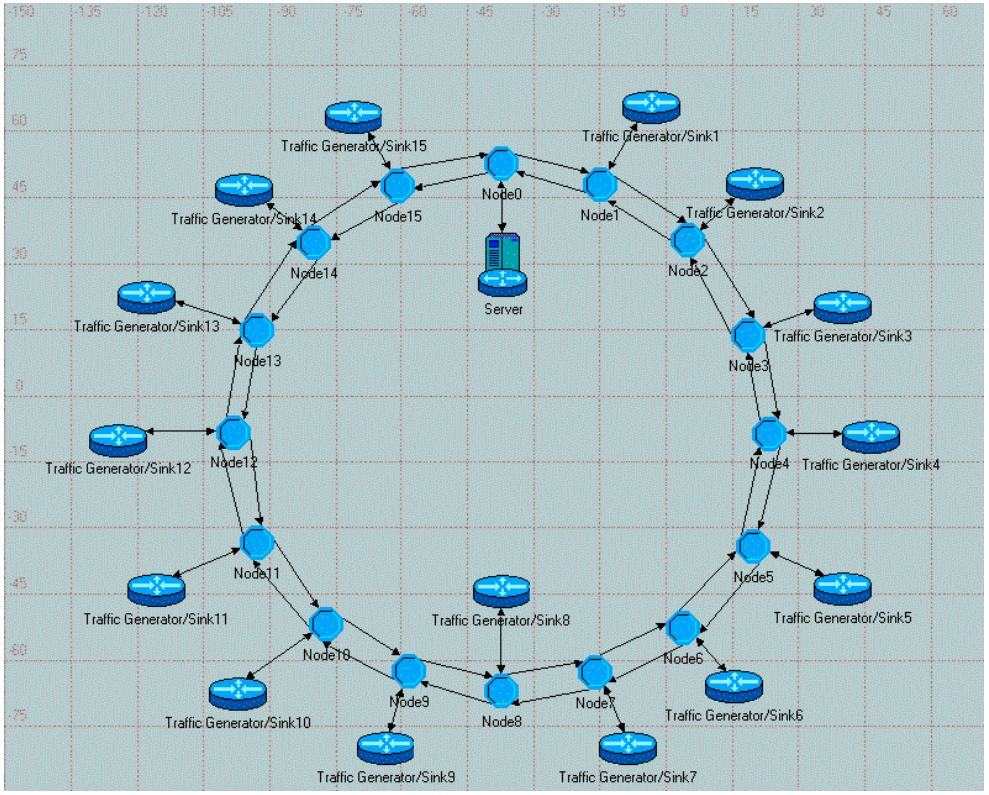
Traffic description

- 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

Simulation setup (hub case)

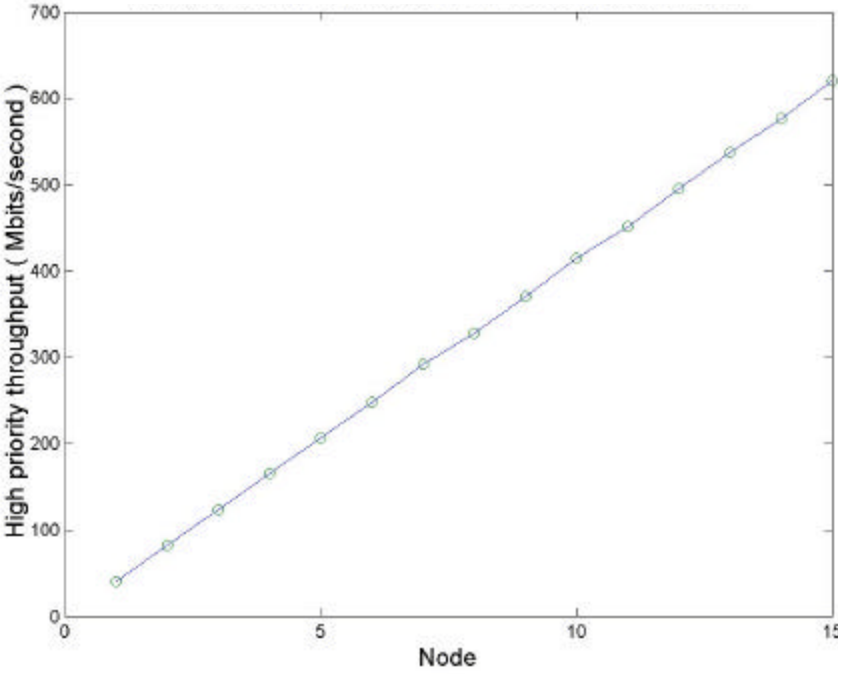
- Common parameters:
  - HOL Delay Threshold: 1,000us
  - Sample Window: 200 us
  - Token Size: 1,000 bits
  - Token Bucket Size: 15,000 bits
  - Tandem Rate Min Threshold : 0.0001
  - Add Rate Min Threshold: 0.0001
  - Link rate : 10 Gbps
  - Propagation delay (per link): 70 us (about 15KM)

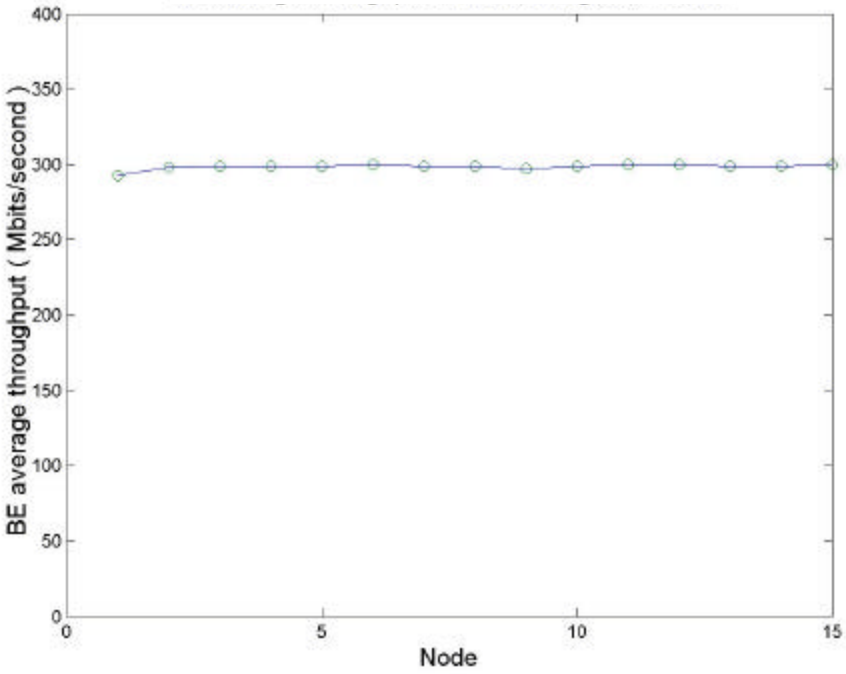
Simulation setup: Ring model (hub case)



Node 0 is the hub node. Node 1 to Node 15 send traffic to node 0 along counter clock direction (inner ring).

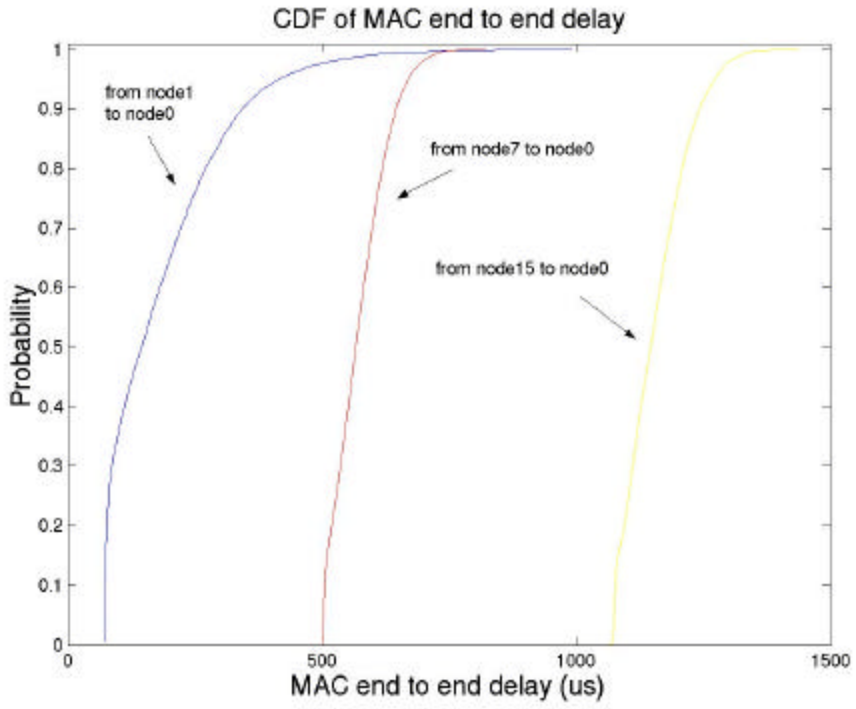
Fairness under unequal high priority

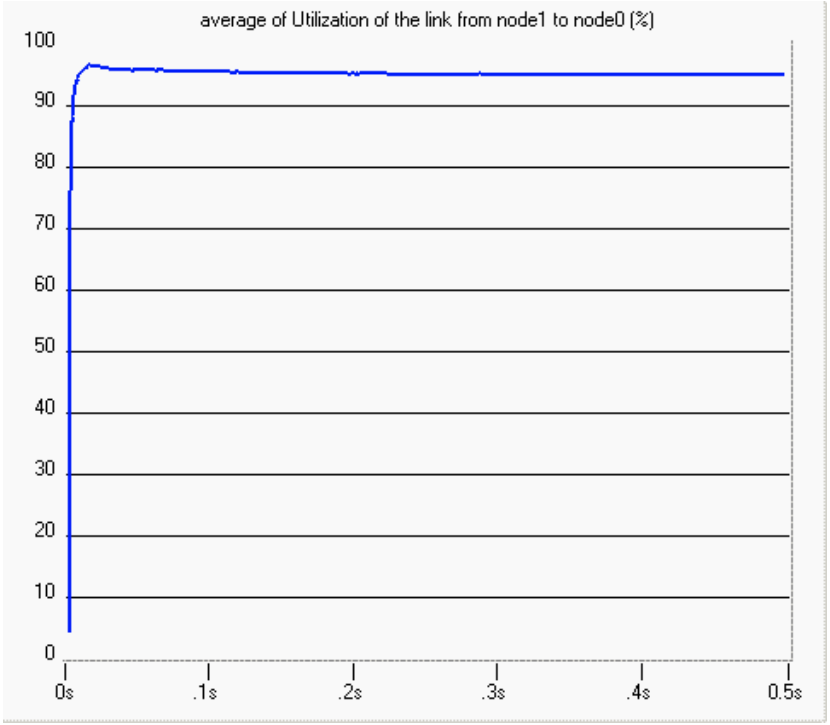




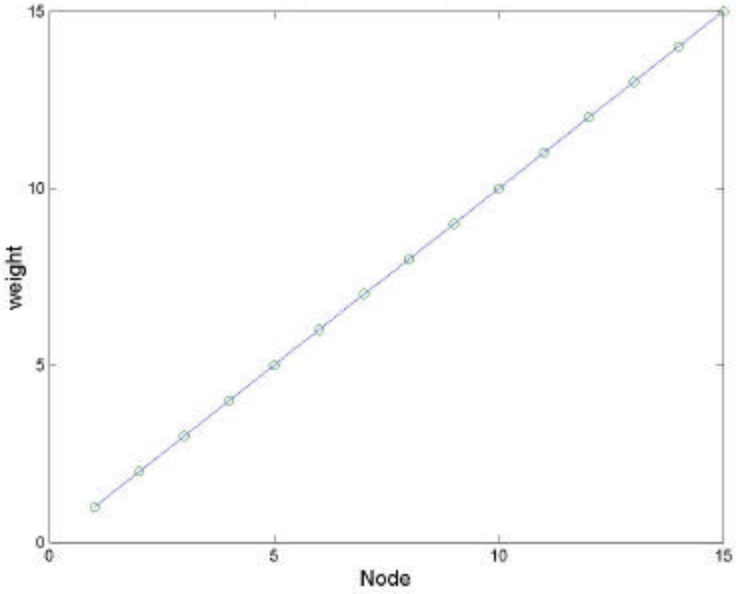
Link 1 to 0 is 200% loaded, target utilization is 100%.

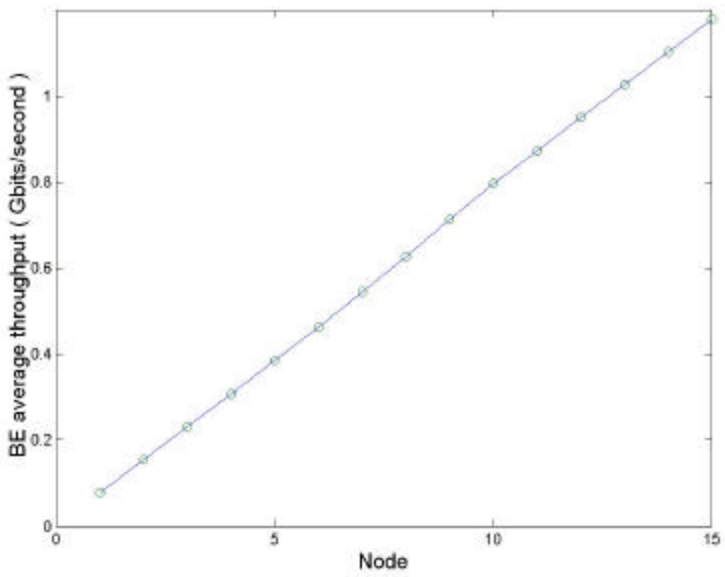
Delay and transient utilization





Support for unequal low priority traffic





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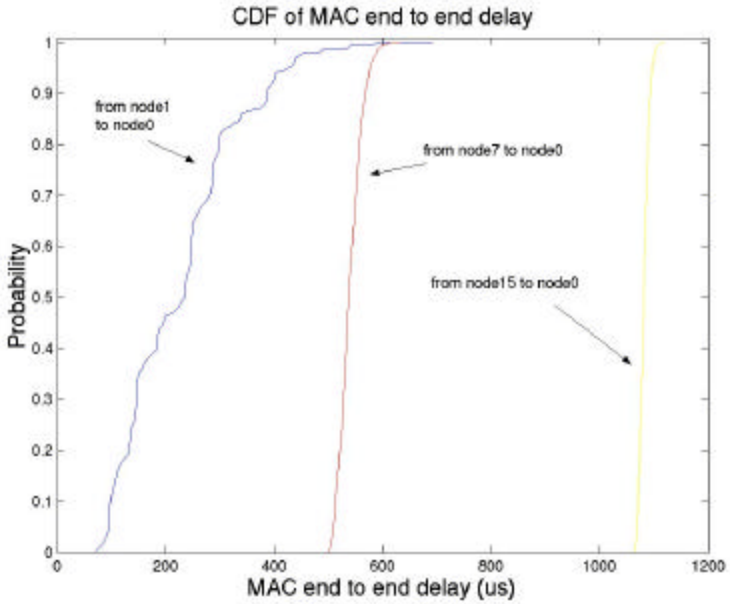
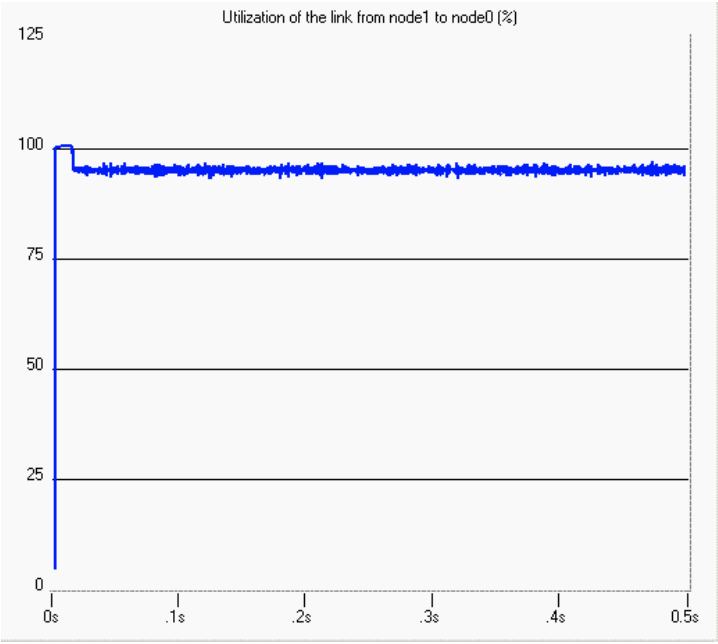
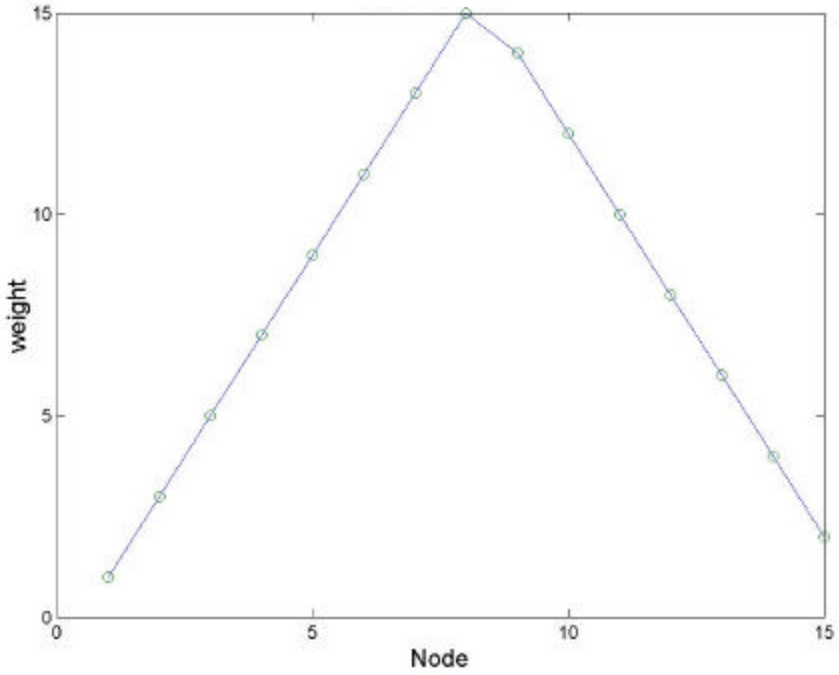
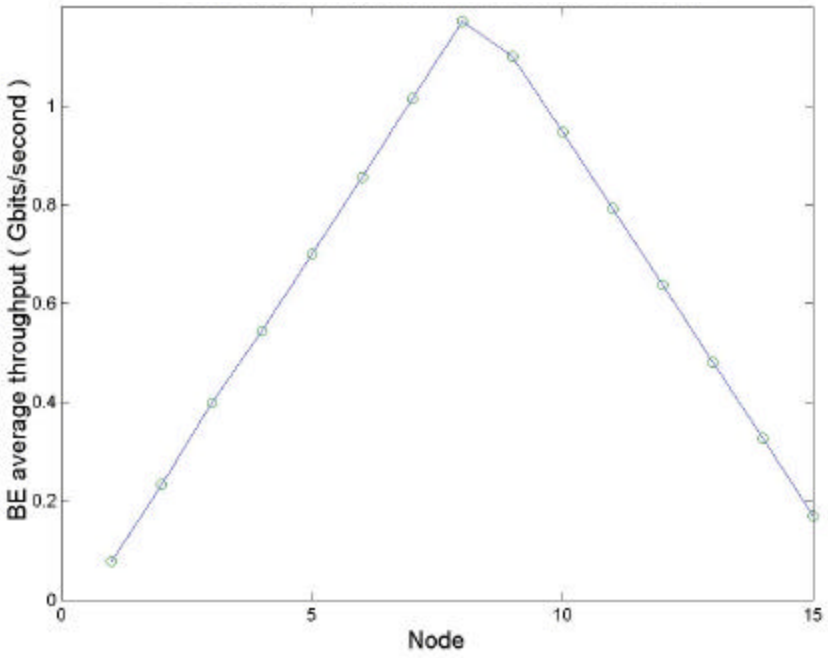




Support for unequal low priority traffic(cont'd)





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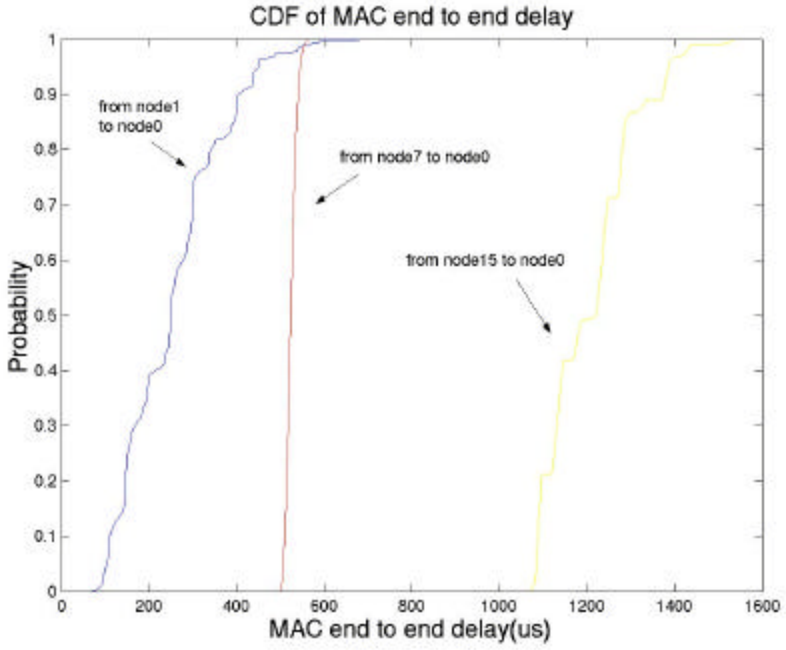
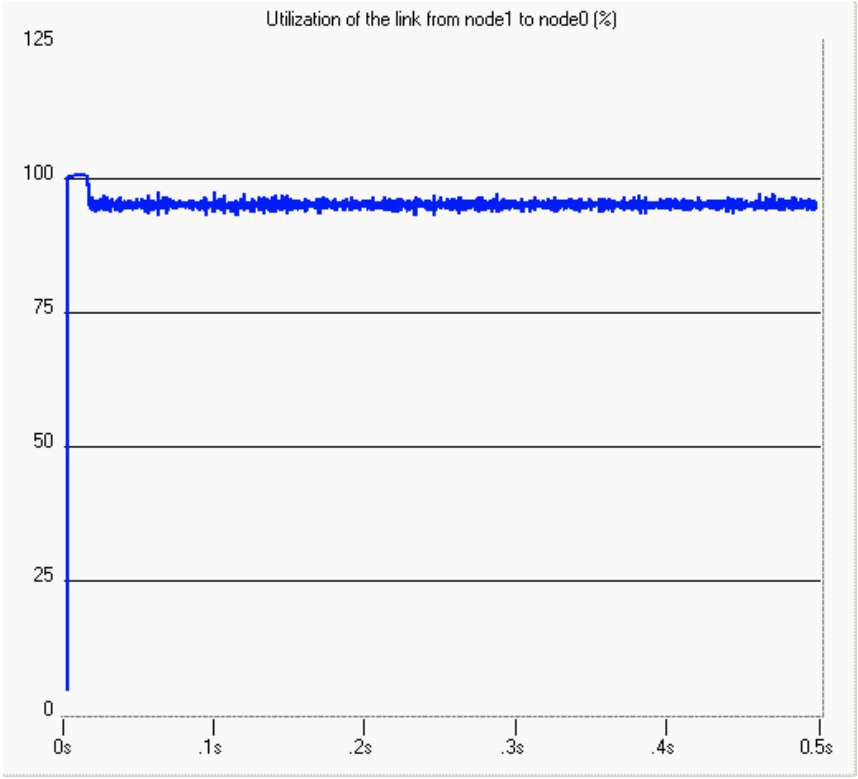
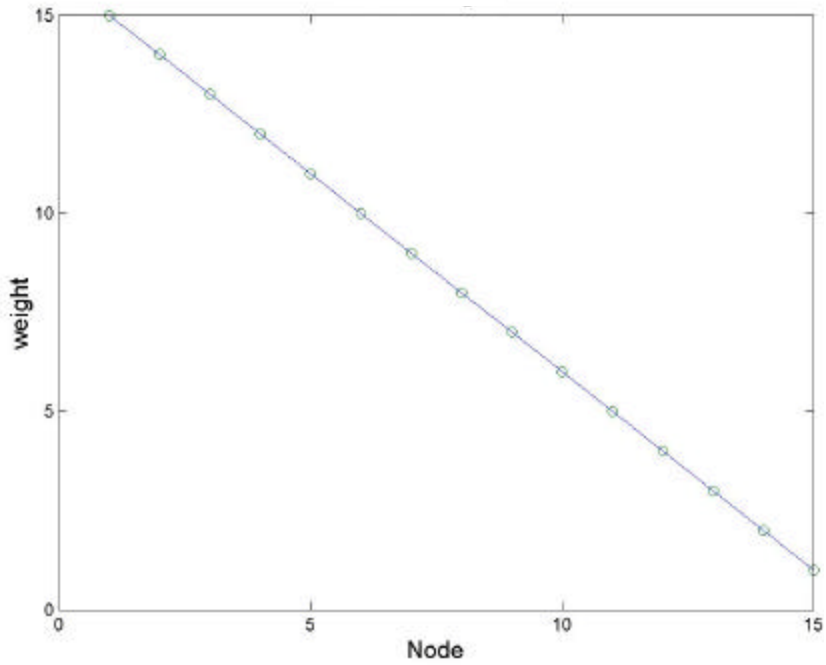
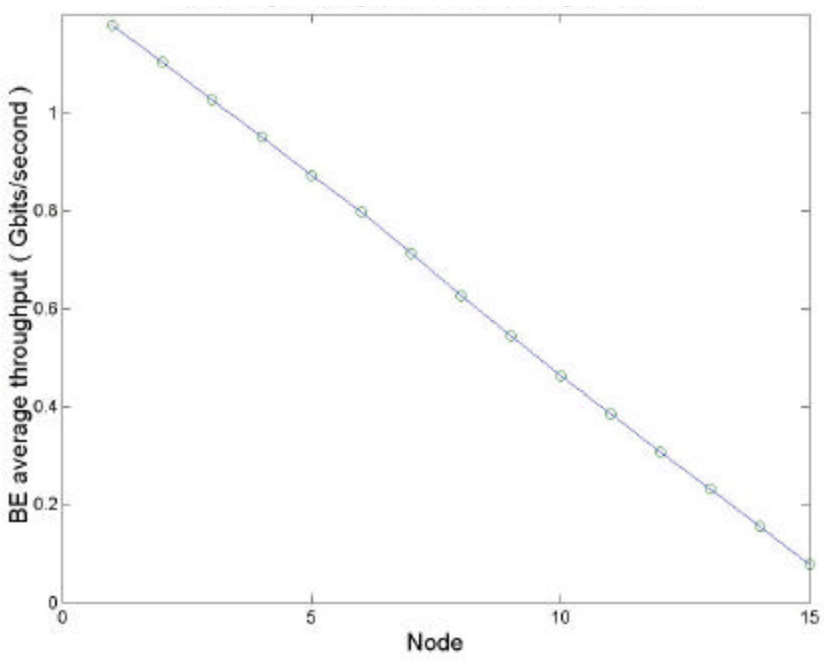
Delay and transient utilization





Support for unequal low priority traffic(cont'd)





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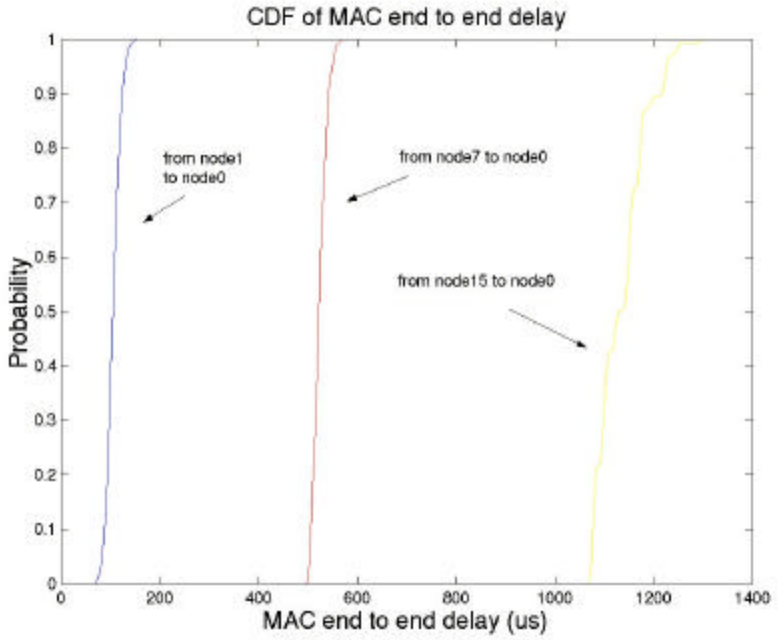
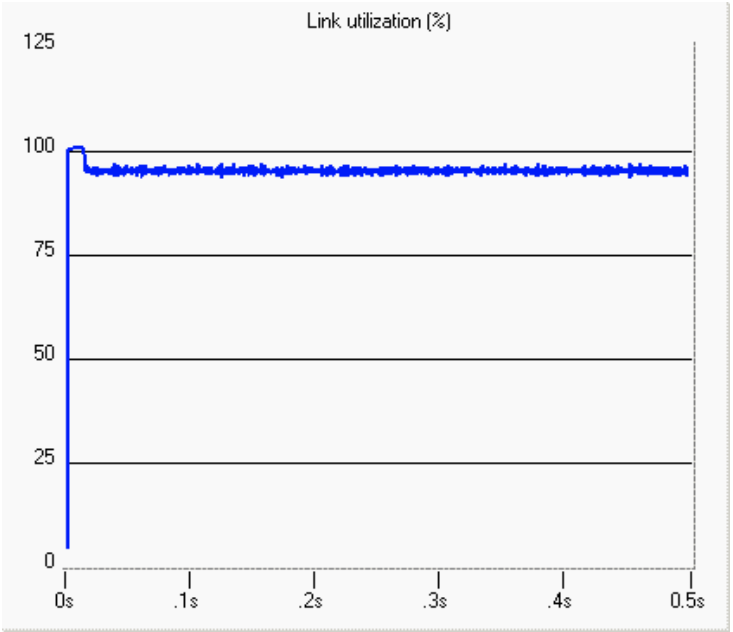
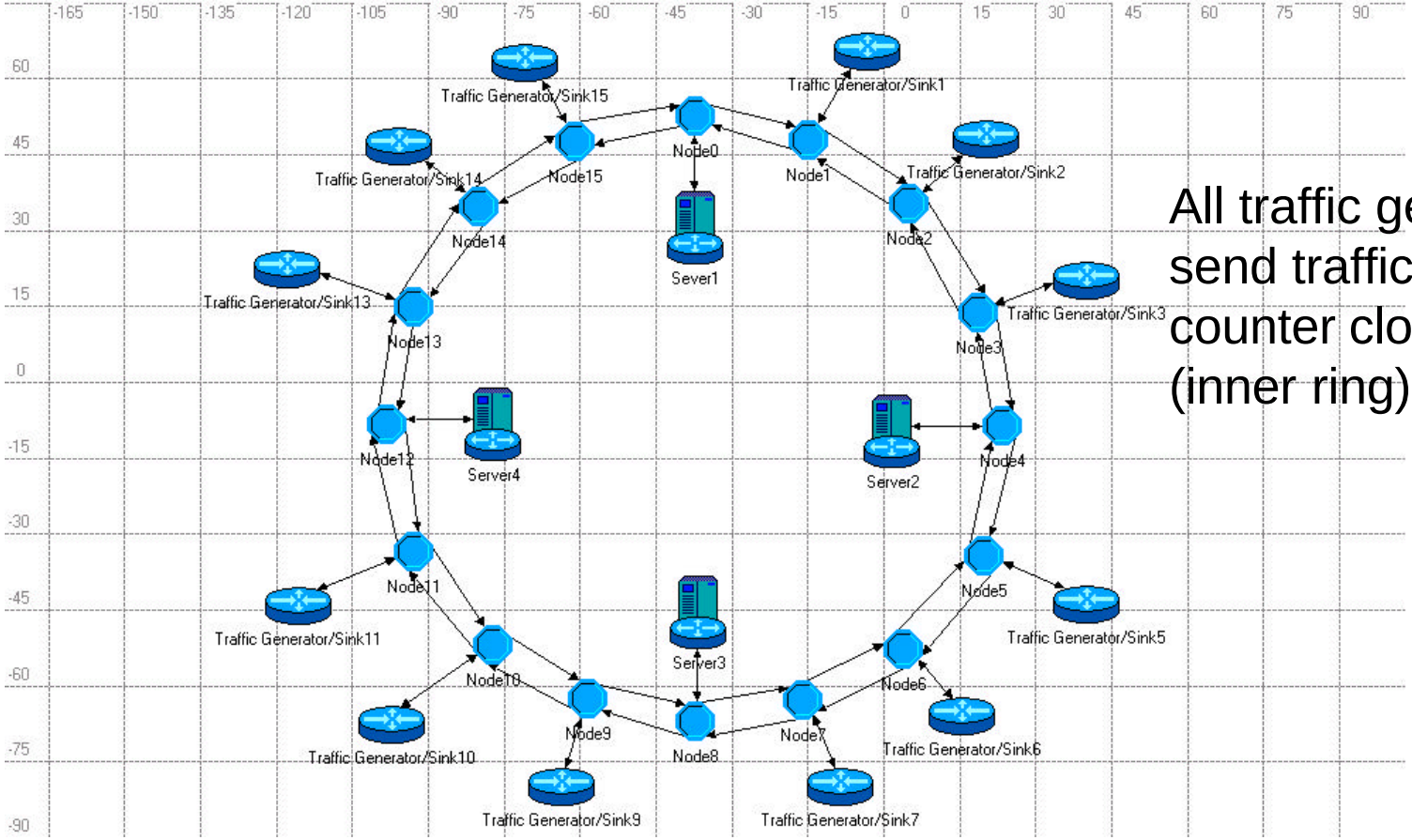
Delay and transient utilization



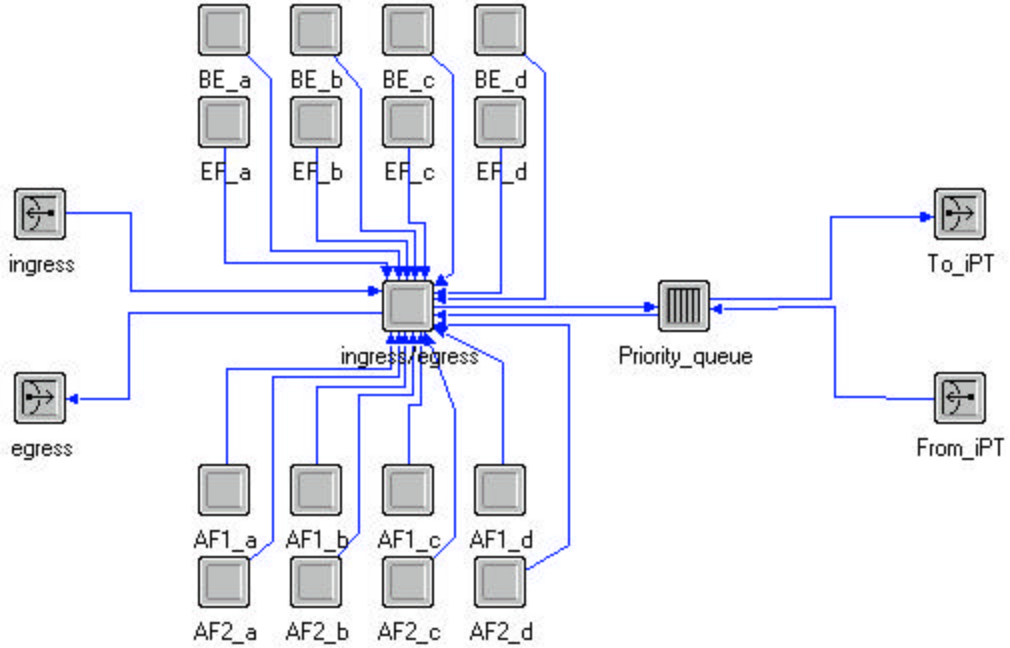


Simulation setup:Ring model (distributed case)



All traffic generators send traffic along counter clock direction (inner ring)

Traffic generator



Traffic configuration

Unit: Gbps

	Server 1	Server 2	Sever 3	Server 4	Total
TG 1	0.8830	0.0500	0.0500	0.0500	1.0330
TG 2	0.8830	0.0500	0.0500	0.0500	1.0330
TG 3	0.8830	0.0500	0.0500	0.0500	1.0330
TG 5	0.8830	0.0500	0.0500	0.0500	1.0330
TG 6	0.8830	0.0500	0.0500	0.0500	1.0330
TG 7	0.8830	0.0500	0.0500	0.0500	1.0330
TG 9	0.8830	0.0500	0.0500	0.0500	1.0330
TG 10	0.8830	0.0500	0.0500	0.0500	1.0330
TG 11	0.8830	0.0500	0.0500	0.0500	1.0330
TG 13	0.8830	0.0500	0.0500	0.0500	1.0330
TG 14	0.8830	0.0500	0.0500	0.0500	1.0330
TG 15	0.8830	0.0500	0.0500	0.0500	1.0330
Total	10.5960	0.6000	0.6000	0.6000	

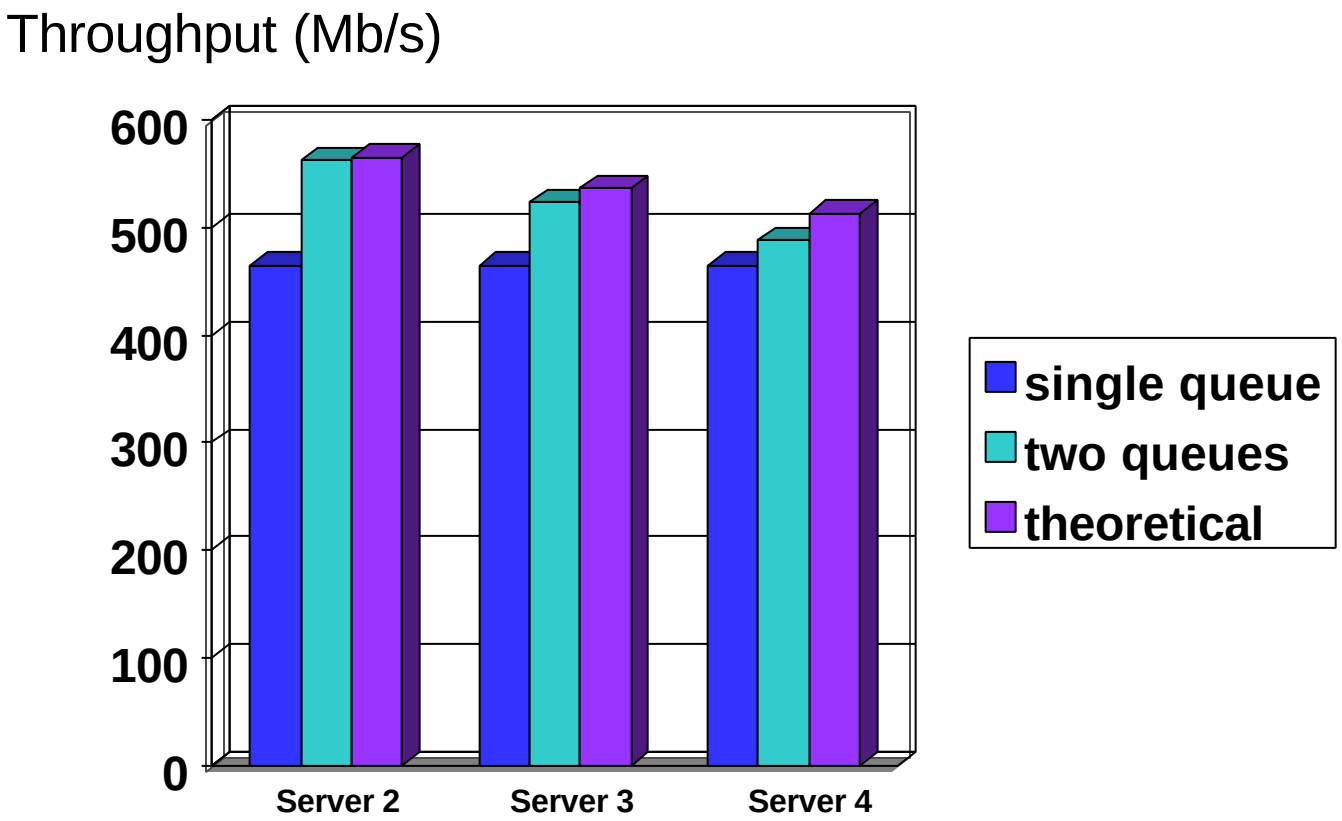
Link 1 to 0 is the most congested link (115% loaded), target utilization is 95%.

Theoretical throughputs

Unit: Gbps

	Server 1	Server 2	Server 3	Server 4	Total
TG 1	0.6764	0.0383	0.0383	0.0383	0.7913
TG 2	0.6764	0.0383	0.0383	0.0383	0.7913
TG 3	0.6764	0.0383	0.0383	0.0383	0.7913
TG 5	0.7117	0.0500	0.0403	0.0403	0.8423
TG 6	0.7117	0.0500	0.0403	0.0403	0.8423
TG 7	0.7117	0.0500	0.0403	0.0403	0.8423
TG 9	0.7497	0.0500	0.0500	0.0425	0.8921
TG 10	0.7497	0.0500	0.0500	0.0425	0.8921
TG 11	0.7497	0.0500	0.0500	0.0425	0.8921
TG 13	0.7921	0.0500	0.0500	0.0500	0.9421
TG 14	0.7921	0.0500	0.0500	0.0500	0.9421
TG 15	0.7921	0.0500	0.0500	0.0500	0.9421
Total	8.7894	0.5649	0.5358	0.5132	

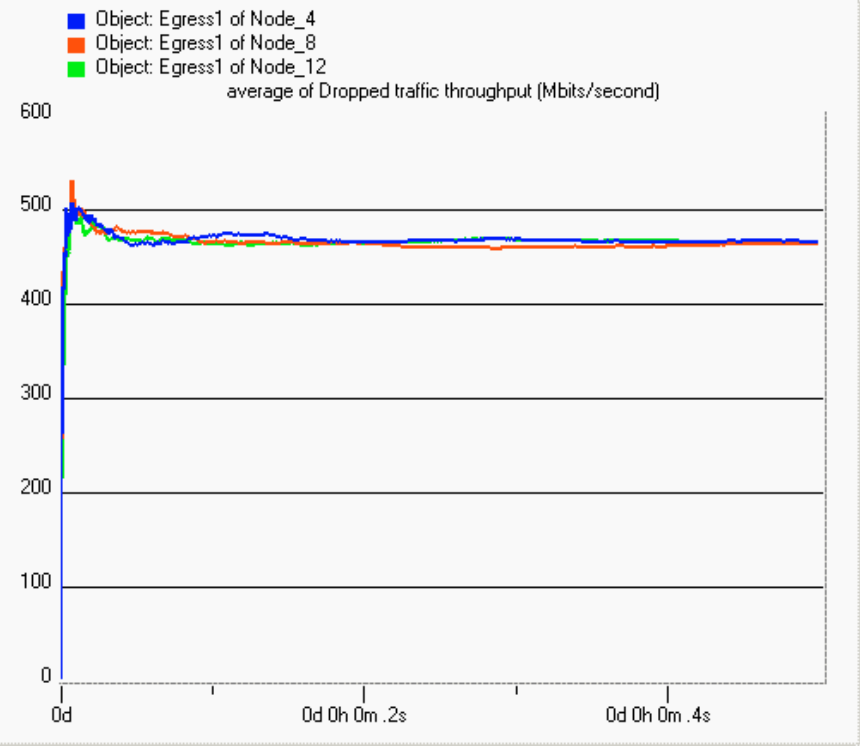
Single queue vs. multiple (two) queues

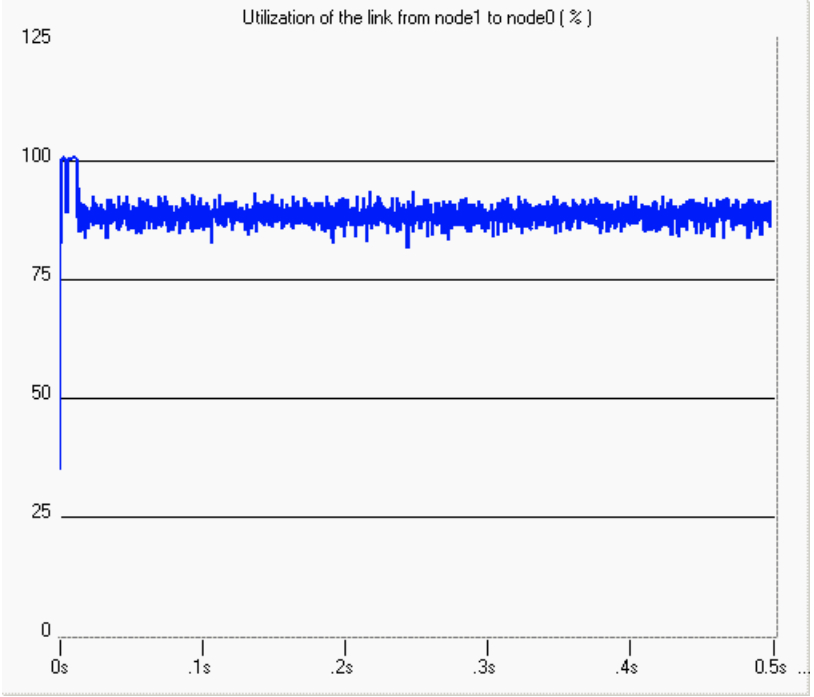


Throughputs of drop off traffic

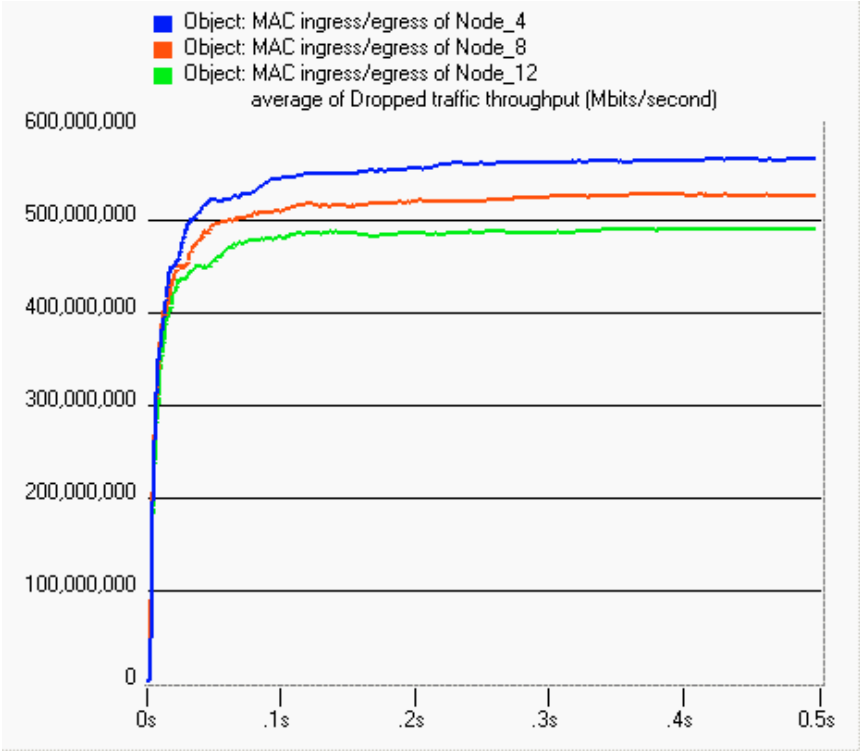
Two queues: one in-span queue, one out of span queue.

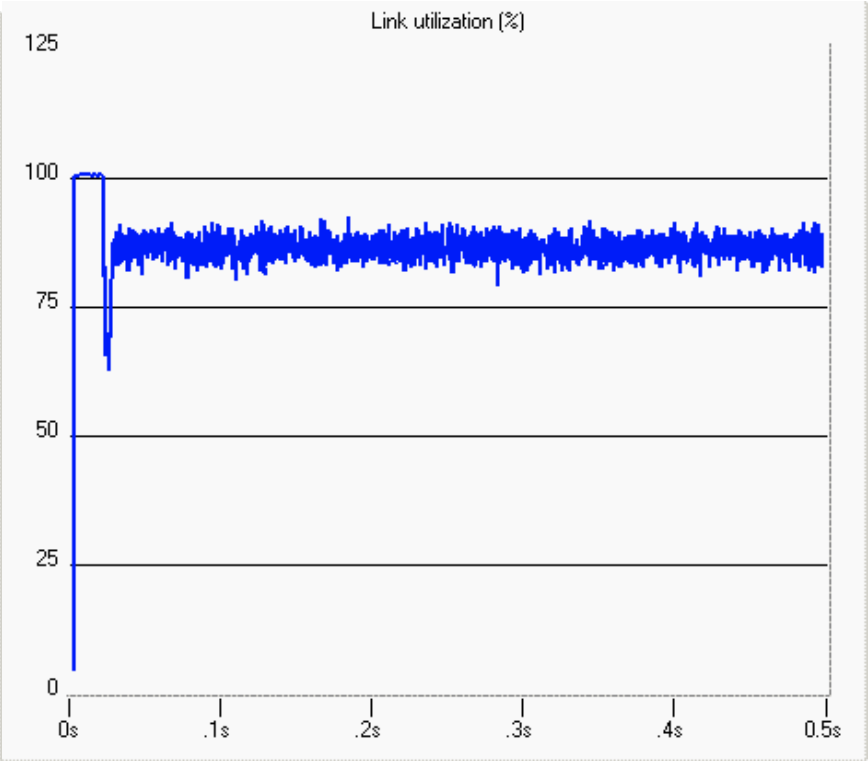
Transient results with single queue



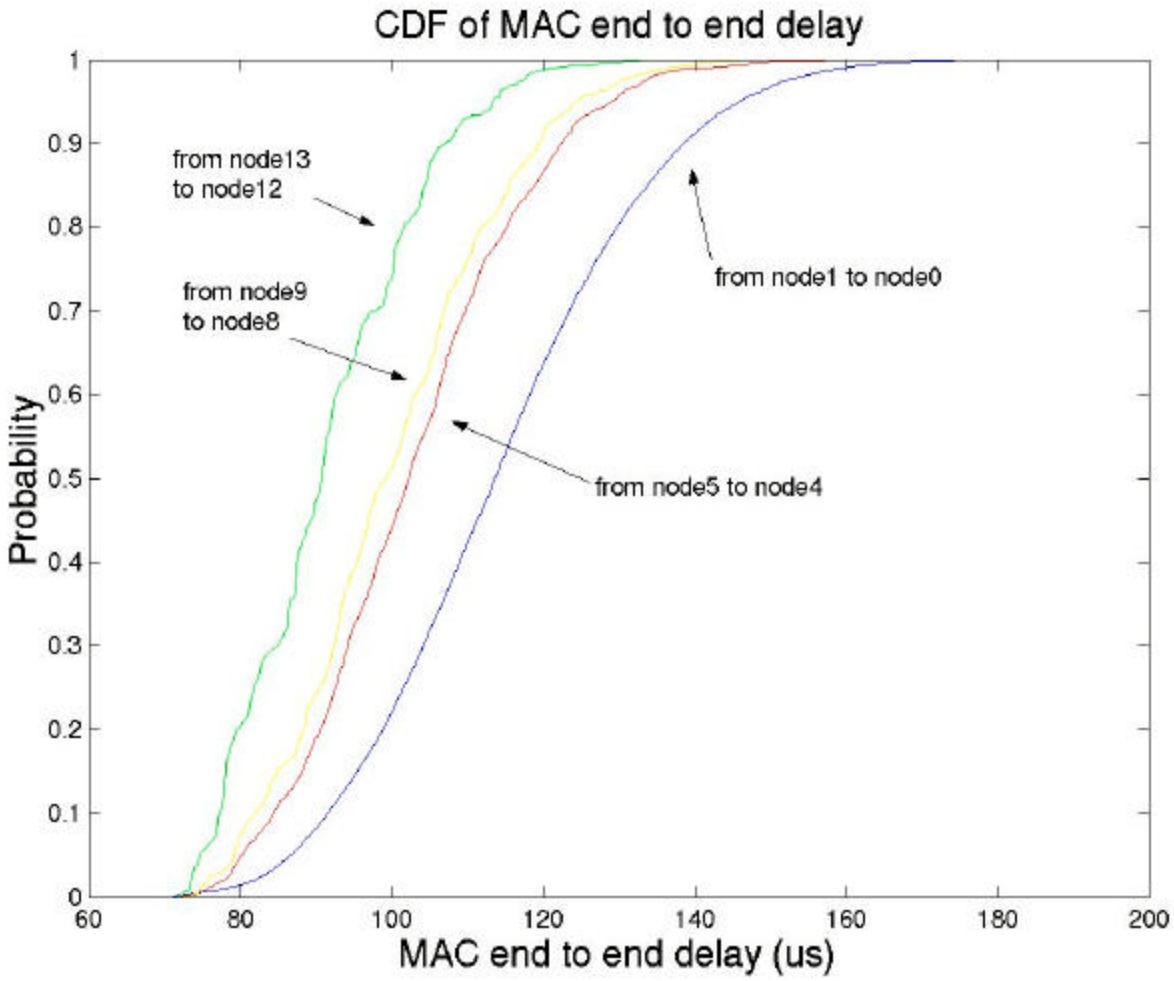


Transient results with two queues





Delay (two queues)



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 works effectively as predicted under unequal high priority bandwidth requirements
- OPE-RPR fairness algorithm can effectively support unequal bandwidth requirements for low priority traffic as predicted
- OPE-RPR can support distributed applications effectively as predicted.