Performance Issues and Requirements

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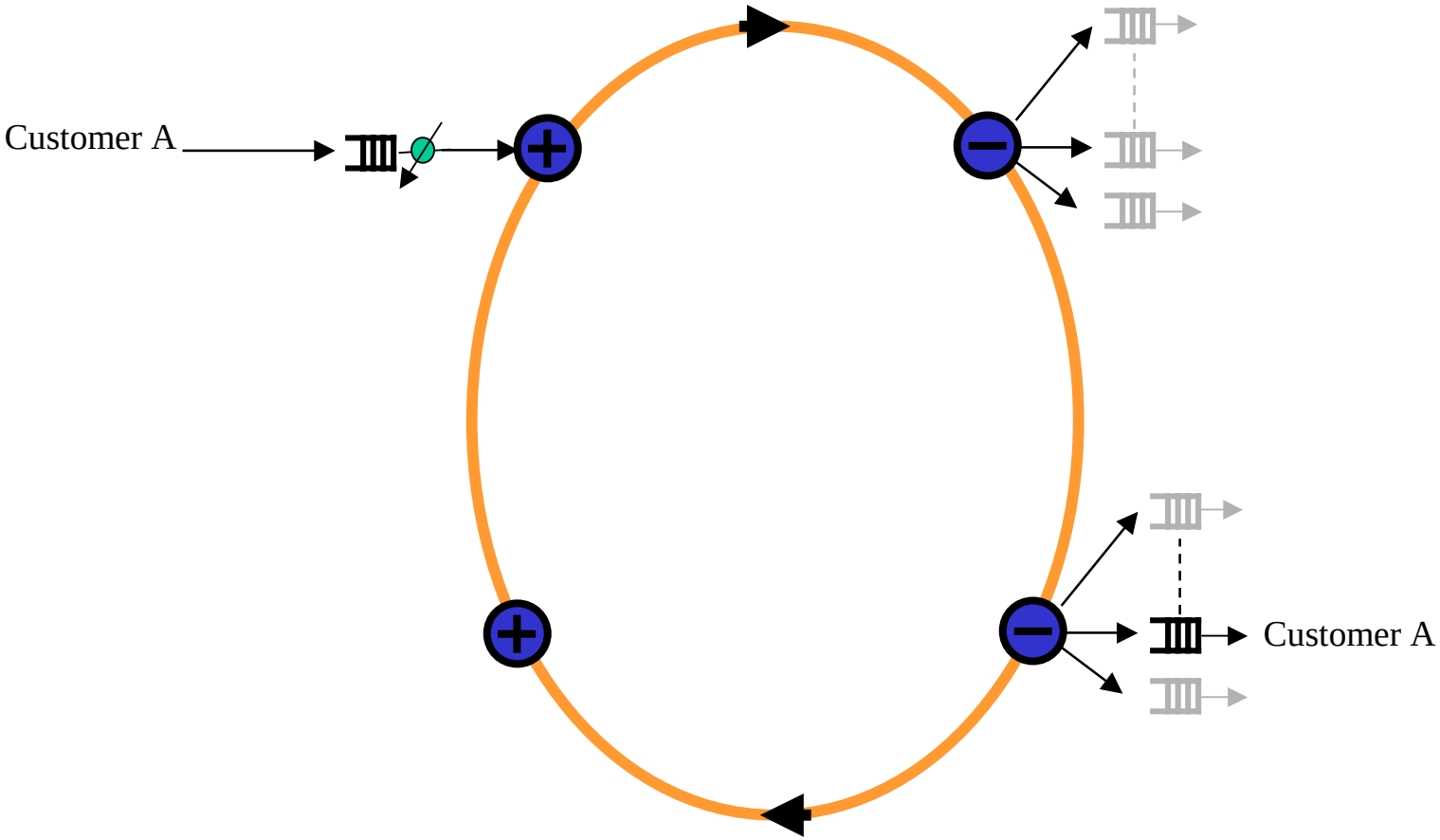
Outline

- General Performance Issues
- A Case of Low Throughput in an RPR network

Requirement Perspective

- Customer wants
  - QoS
    - ✓BW guarantees
    - ✓No Loss
    - ✓Low Delay&Jitter
    - ✓High Reliability
  - Low Cost
- Network Operator's interested in
  - ROI
    - ✓SLA support (service differentiation)
    - ✓Efficiency

Customer's Expectations: dedicated resources



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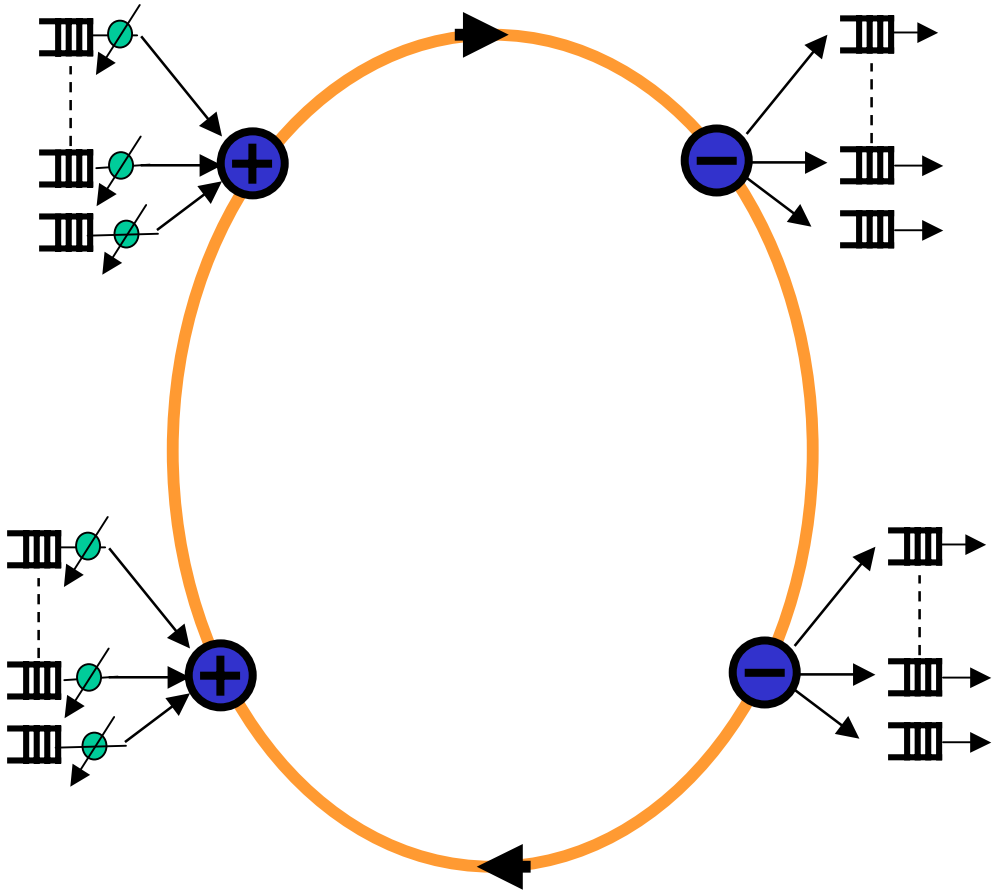
Network Operator's Expectations: maximize number of customers



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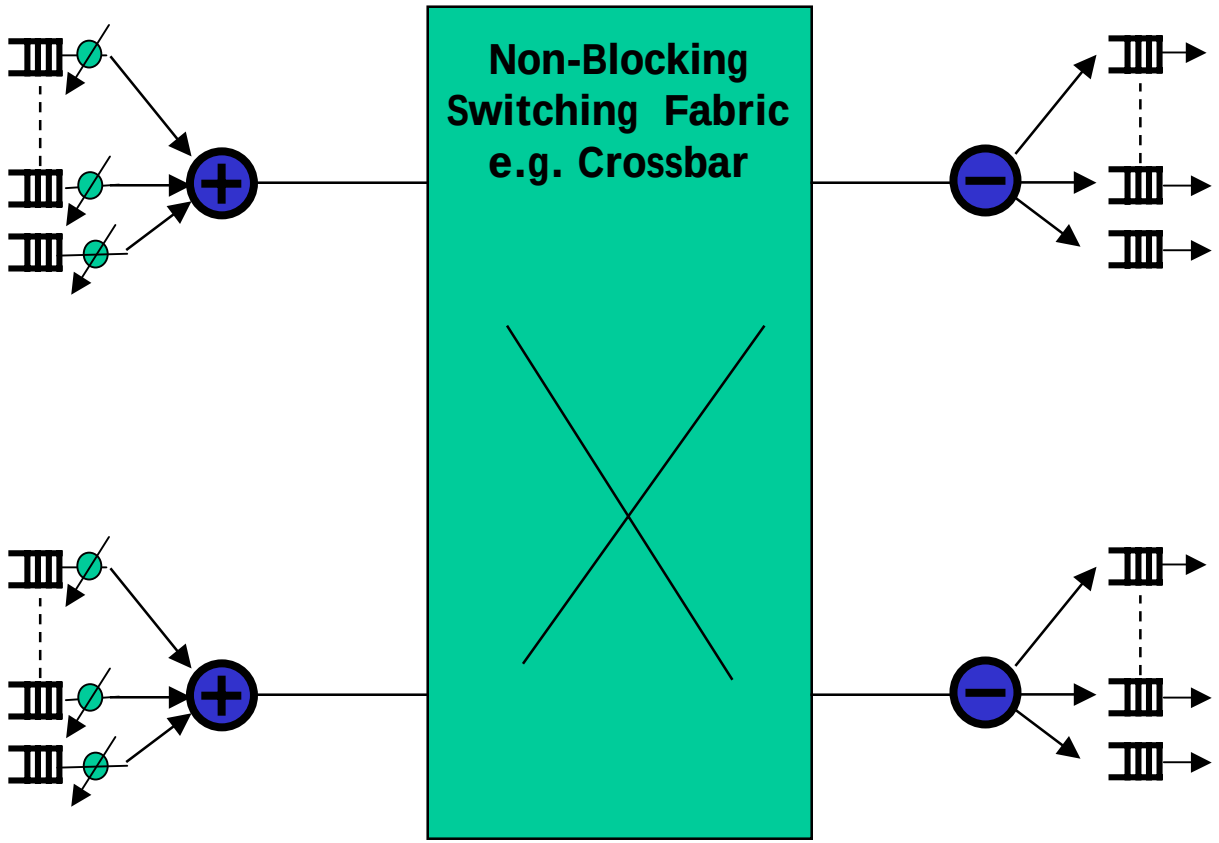
Similarity: RPR Ring vs.Switch



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Known Problems in switch design

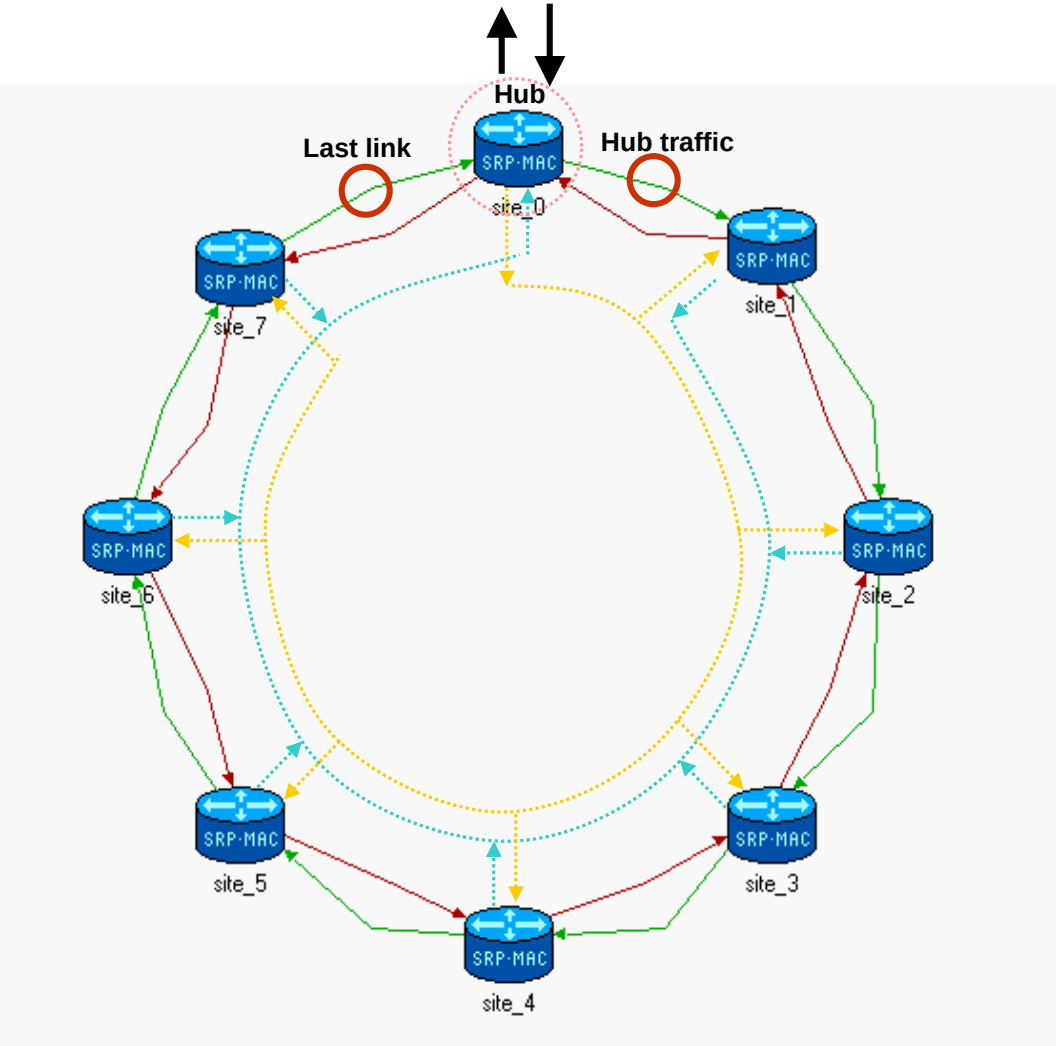
- HoL blocking at ingress queues can result in 58% throughput limit [Karol, et. al 87]
- Switching fabric needs to have necessary and sufficient QoS supports:
  - Sufficient BW to carry full load.
  - Traffic separation (flow/port/class) to ensure sufficient BW for each flow through the fabric
- Low throughput when traffic is Non-Uniform

Old Issues Resurface

- Real-traffic is not uniformly distributed. Therefore, we can't assume equal BW distribution.
- QoS compromised by the fabric can't be recovered by higher layers.

A Case Study:
Low throughput
in a ring network

Non-Uniform Traffic: Bi-Directional Hubbing



Model used:
OPNET standard SRP model
– Model Library release March 2001-01

Traffic Pattern

All nodes send traffic to the hub.

Hub sends traffic to each node.

Ingress traffic at each node = 300Mbps

Parameter Setting

As recommended in RFC2892

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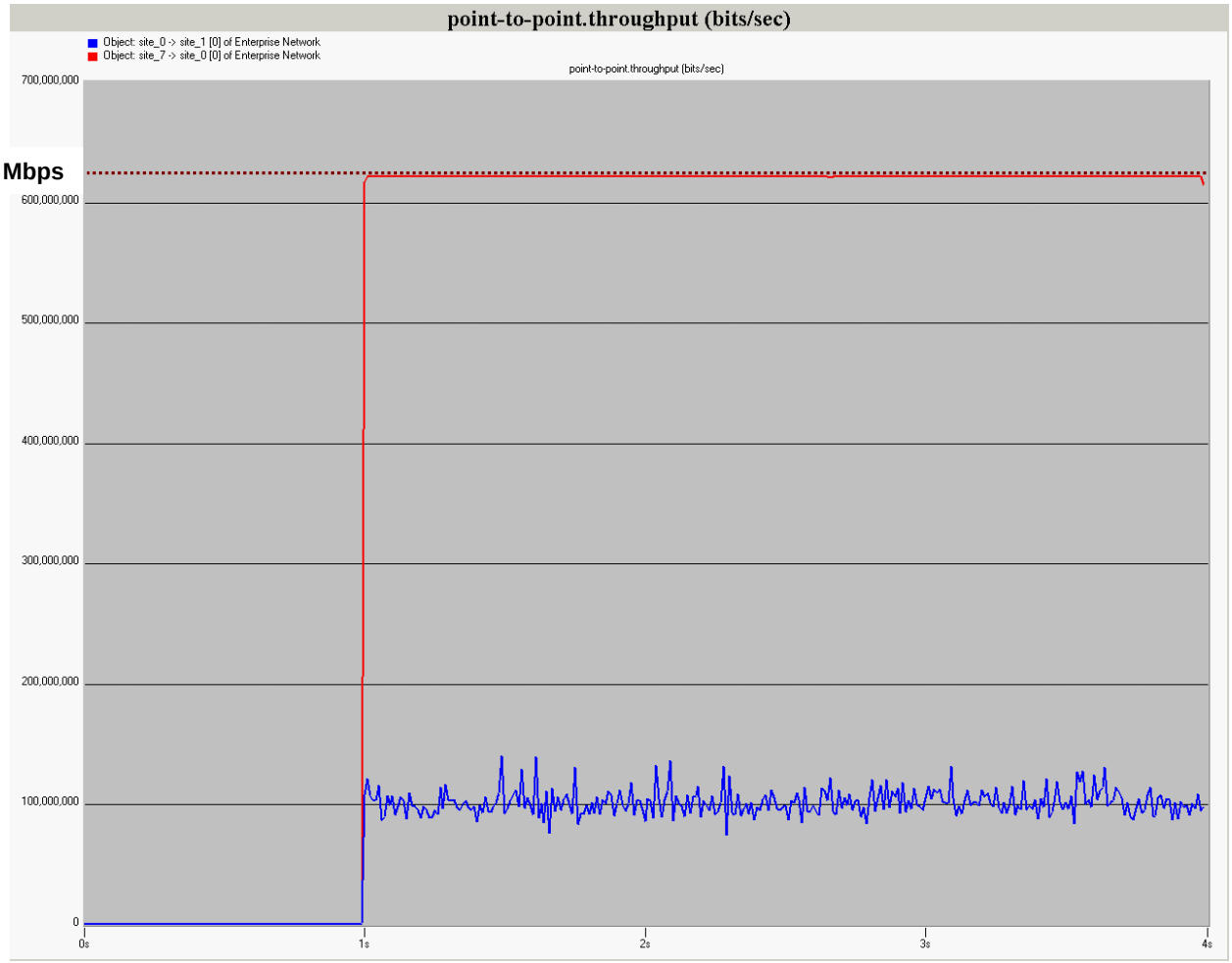
Link Utilization (SRP)



622 Mbps

site_0 → site_1

site_7 → site_0

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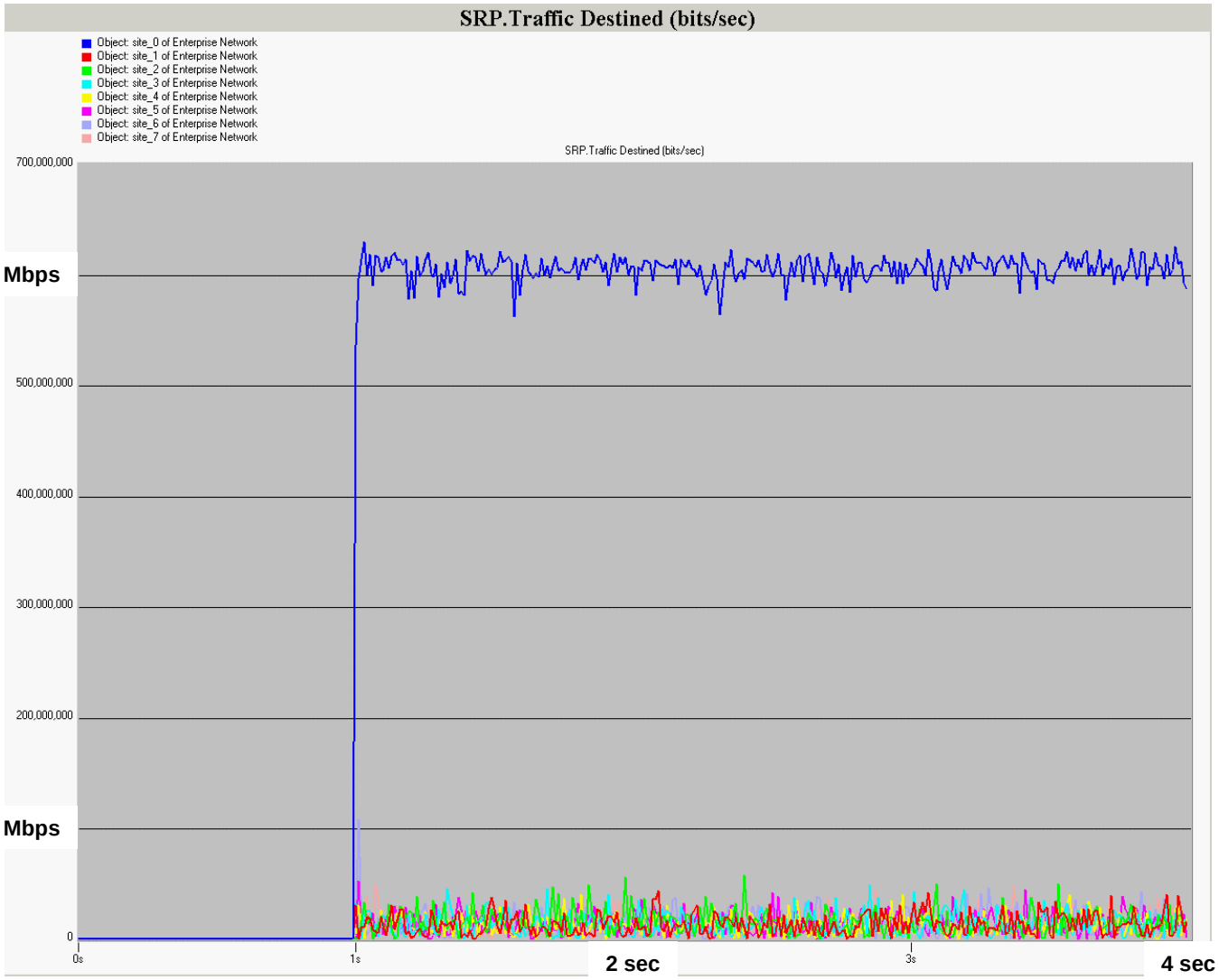
Per Node Egress Throughput (SRP)



600 Mbps

100 Mbps

Hubbing node

All other nodes

2 sec

4 sec

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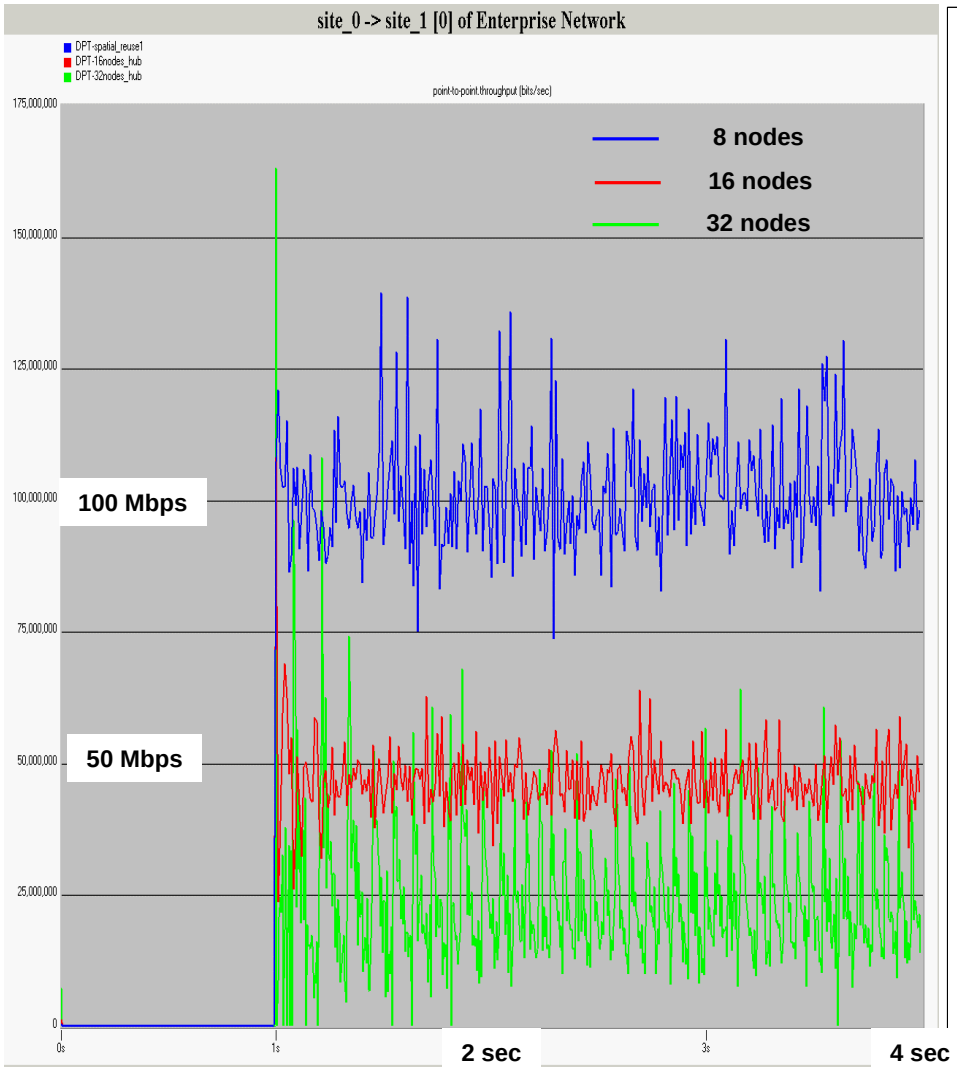
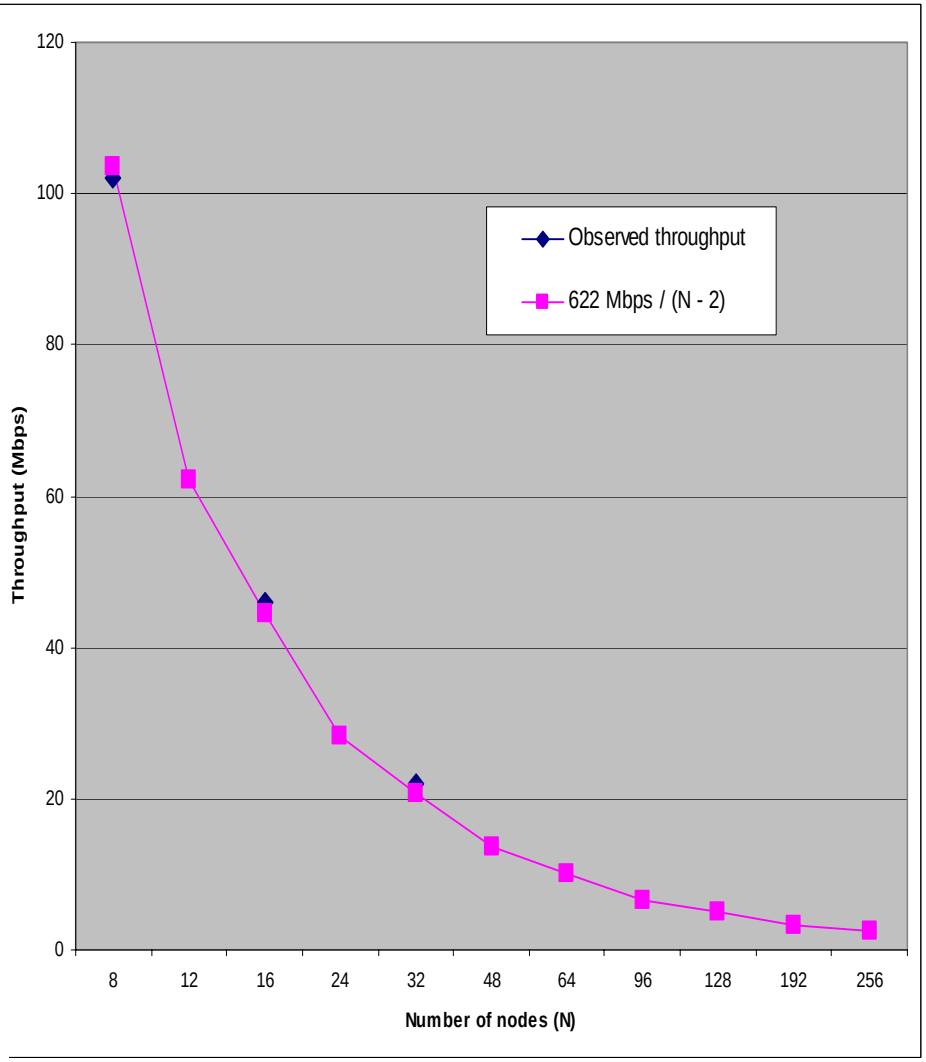
Link Utilization vs. #Node (SRP)





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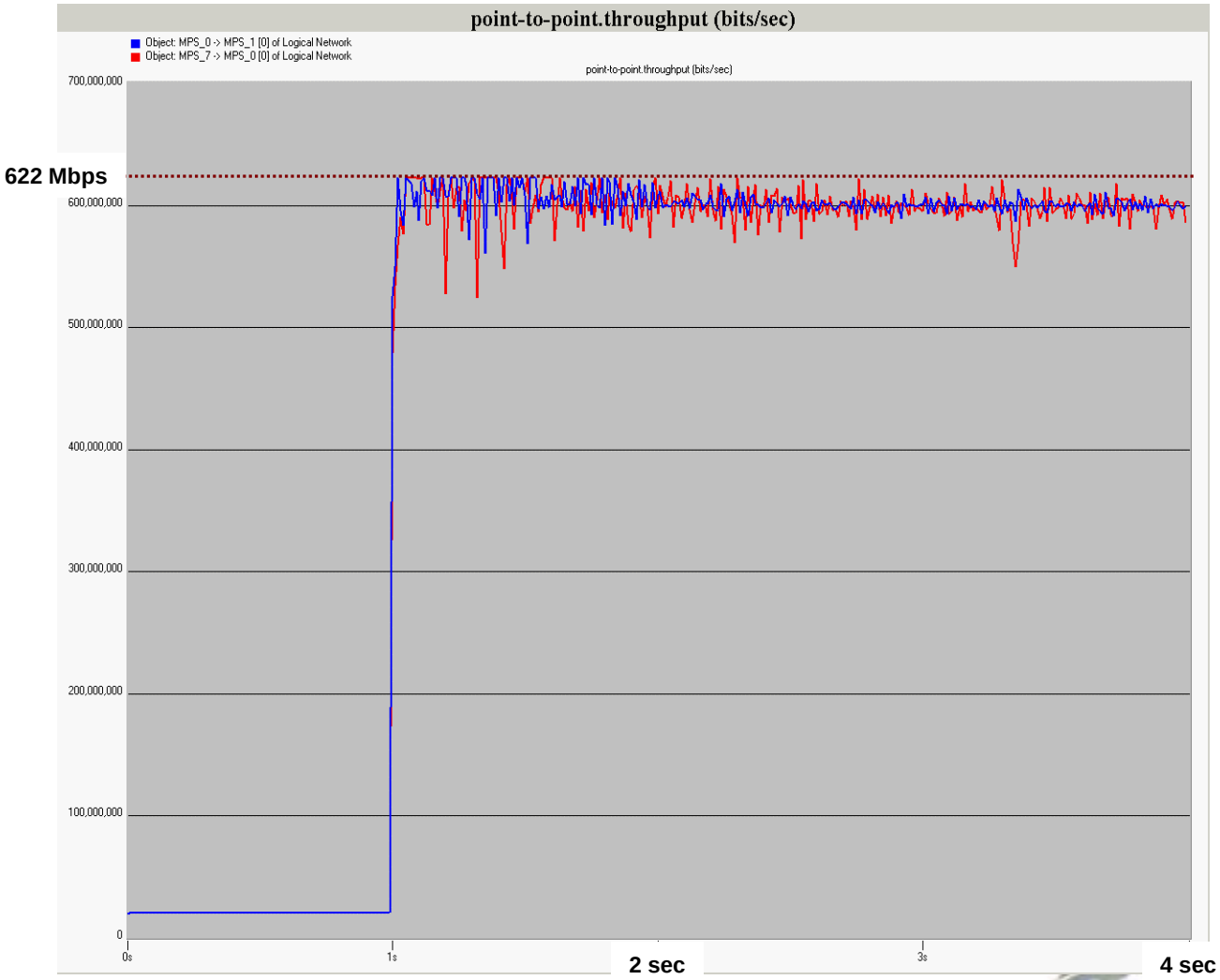
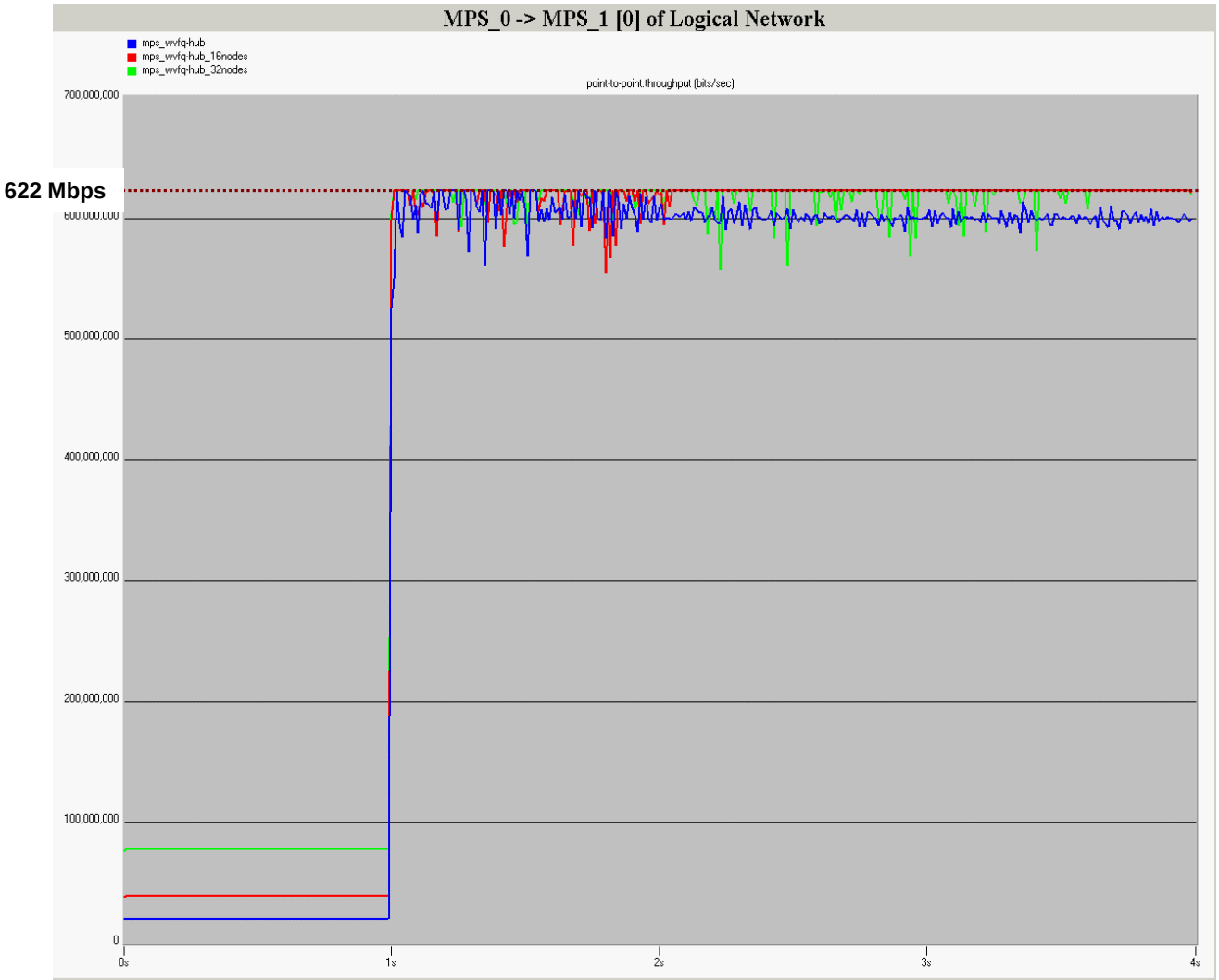
Link Utilization (Lantern)



LANTERN COMMUNICATIONS

Link Utilization vs. #Node (Lantern)



622 Mbps

8 nodes

16 nodes

32 nodes

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Summary

- Multiple insert-queues (at least per node, inside or outside MAC) with independent insertion rates to avoid low throughput due to HoL blocking.
- Dynamic and fair BW allocation that can adapt to traffic patterns in order to maintain maximum ring throughput.