

# >> Study of Quality of Service Issues in RPR

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# Objectives

- Type of service requirement in provider networks in metro and core
- Study of congestion control and fairness requirements and solutions
- RPR framework proposal

# Provider Network Type of Service Requirements

- Legacy leased lines
- Voice over IP
- Video services
- Committed Access Rate data service (VLL)
- Over Committed Access Rate data services
- Best effort services

# Class of Service

- Time sensitive committed class
  - ◆ Legacy leased line, Voice over IP, Protected, No degradation on protection
- Time Sensitive committed class
  - ◆ Video, Protected, No degradation on protection
- Time insensitive committed class
  - ◆ Committed data Services, Protected, No degradation on protection
- Time insensitive over-committed class
  - ◆ Over committed data services, degradation on protection
- Best Effort Service
  - ◆ Best effort data services, degradation on protection

# Class of Service support

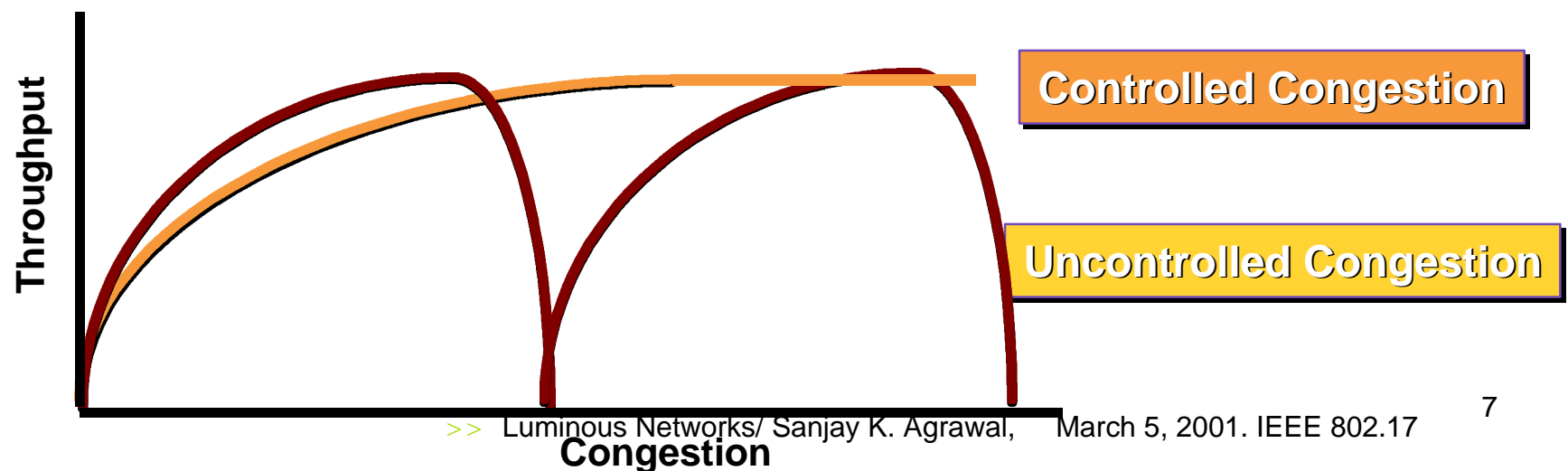
- Bandwidth provisioning maintained on per class basis
- Traffic from one class should not effect the traffic in the other class.

# Issue of Congestion & Fairness

- Only necessary in the over-committed class.

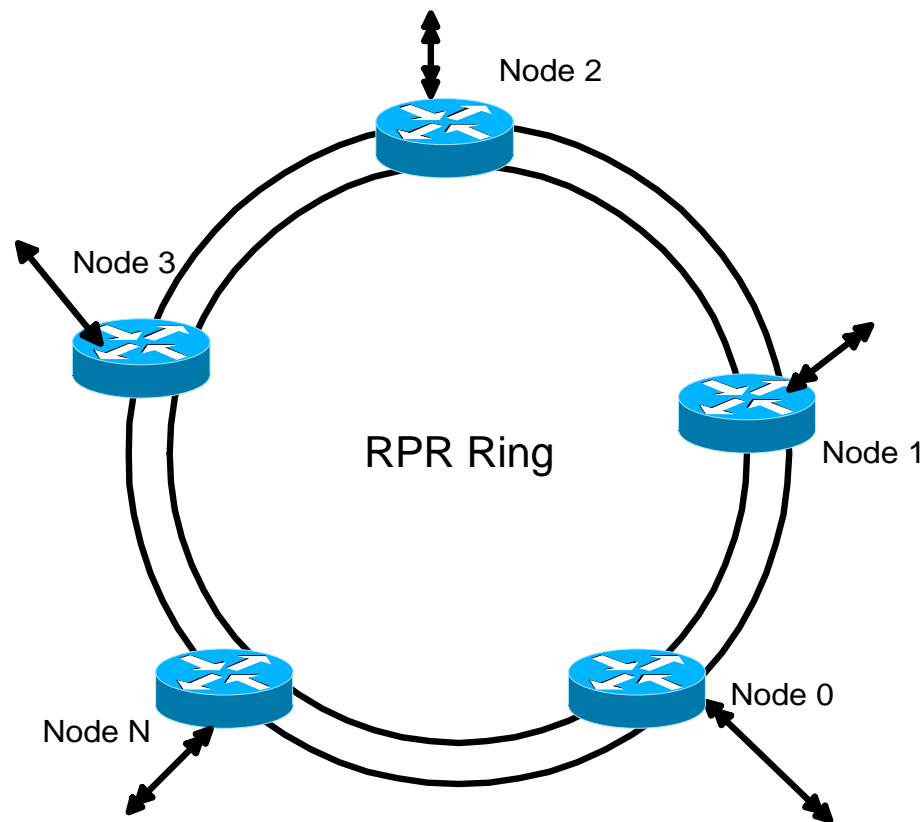
# The Problem of Congestion

- Traffic sources: TCP linearly increase their bandwidth usage till resources are exhausted. On packet drop they back off exponentially
- Uncontrolled congestion seriously degrades performance
  - ◆ Buffers fill up
  - ◆ Packets are dropped, resulting in re-transmissions
  - ◆ Result: more packet loss and increased latency
  - ◆ Problem builds until throughput collapses
  - ◆ 35% link utilization on MAN and WAN links [Caída: [www.caida.org](http://www.caida.org)]



# Problem of Fairness

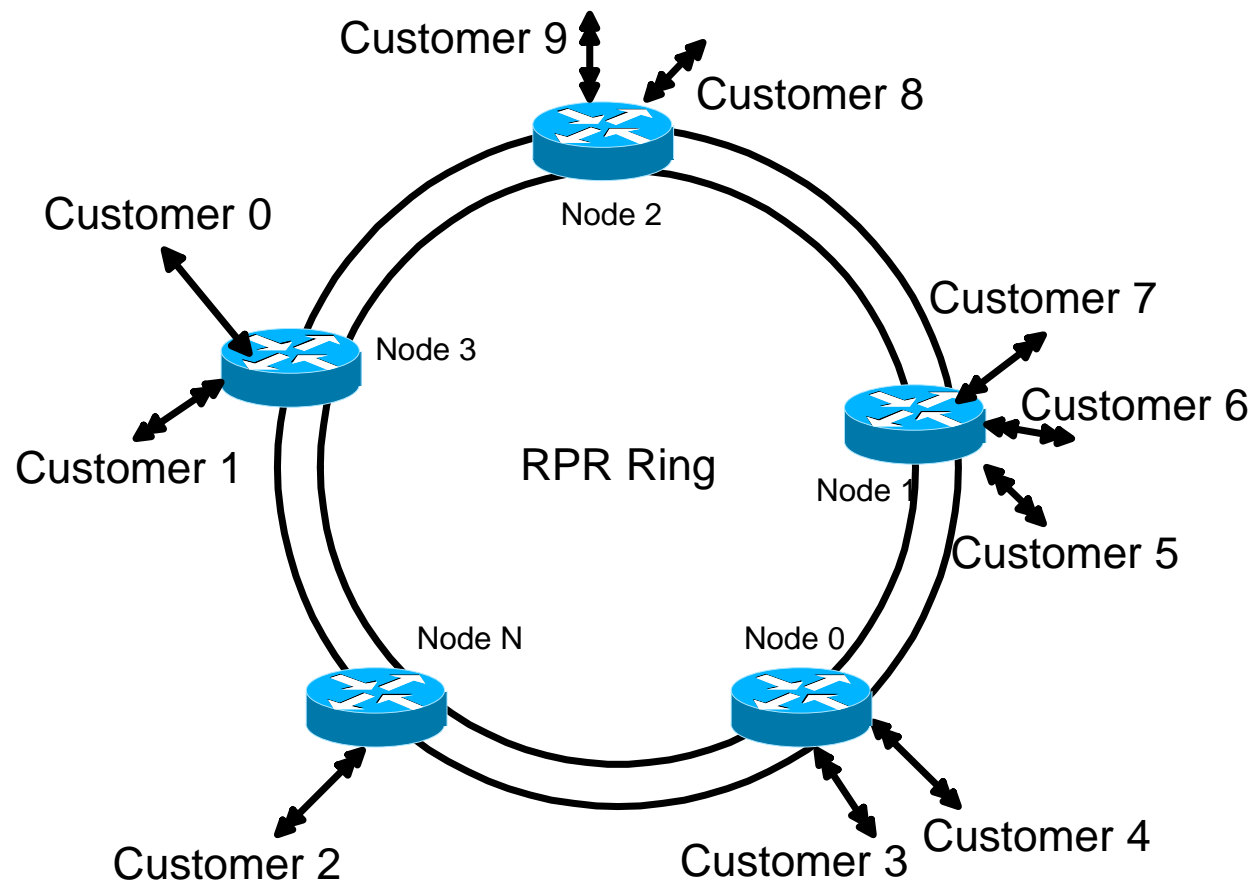
- Per node Fairness in the rings





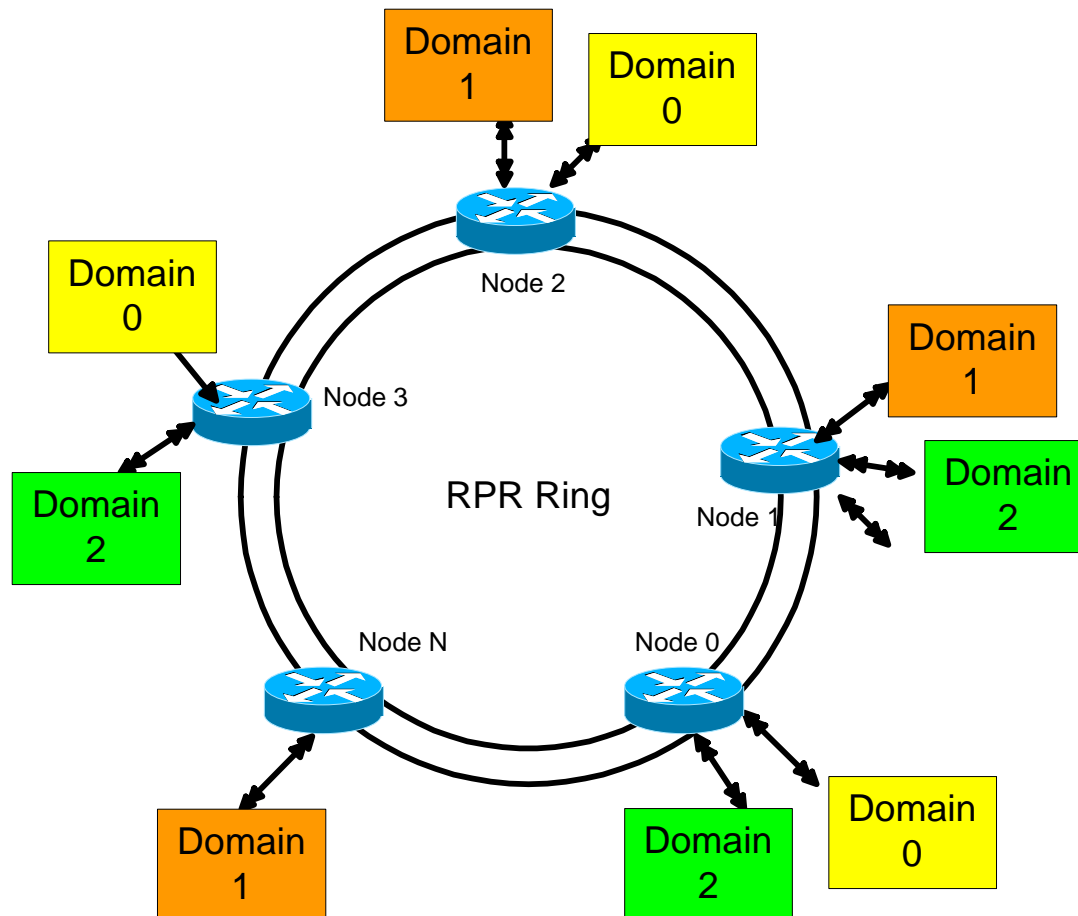
# Problem of Fairness (cont..)

- Per customer/subscriber fairness in the rings



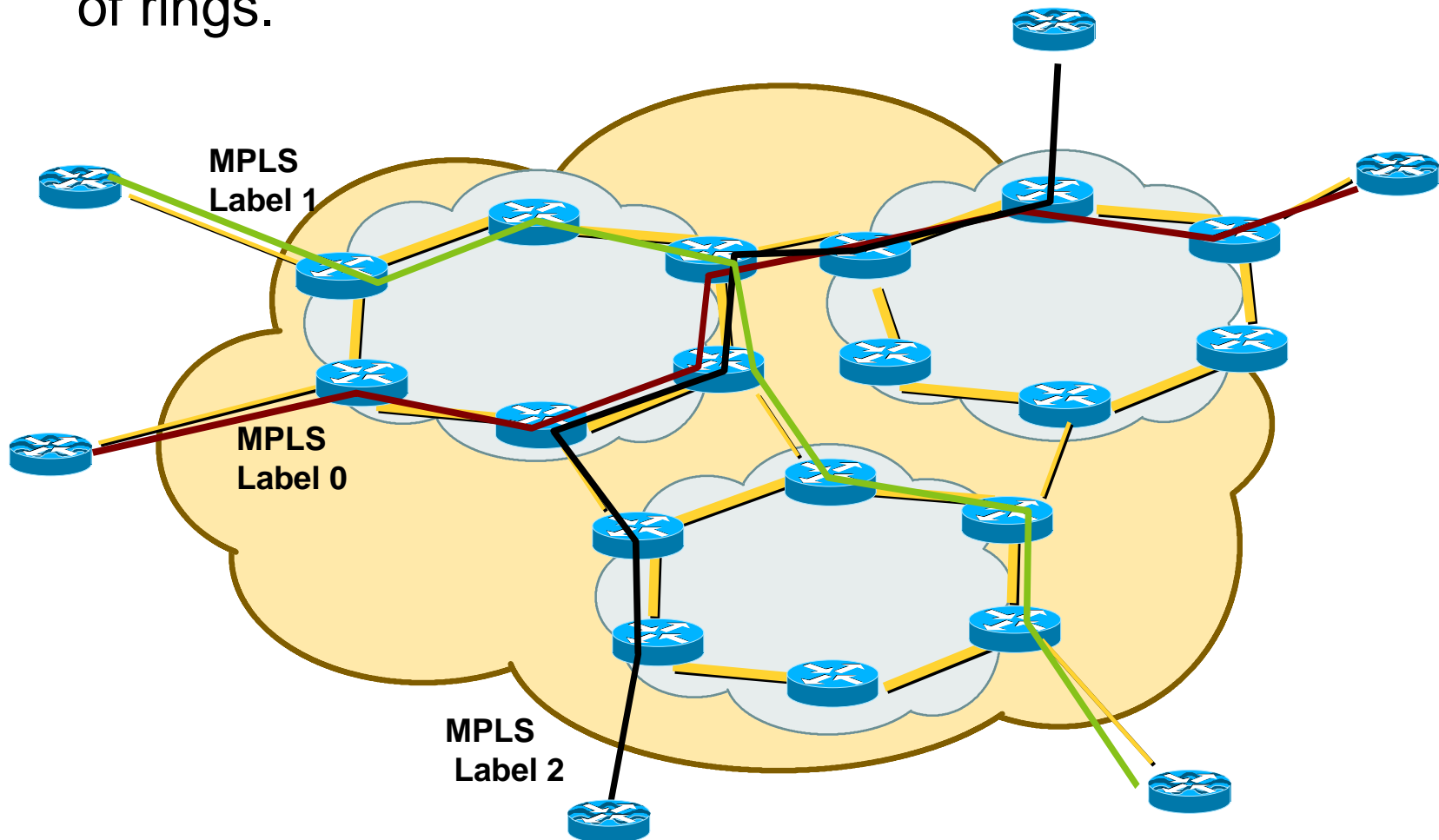
# Problem of Fairness (cont..)

- Per domain fairness in the rings in Public Transparent LAN services



# Problem of Fairness (cont..)

- Per MPLS aggregate fairness in the rings and mesh of rings.



# Congestion Control & Fairness

- Per Flow Queuing
  - ◆ ATM environment
  - ◆ Deterministic QoS per flow
  - ◆ Serious scaling issues in IP networks
- Per Aggregate Flow Queuing
  - ◆ Aggregates based on VPN domain, MPLS labels, nodes, customers.
  - ◆ Deterministic QoS per aggregate flow
  - ◆ Scaling issue. 1k customers/port, 12 port/line card, 12 line cards/ chassis, 128 chassis in a ring.
  - ◆ Scheduling and congestion control very difficult

# Congestion Control & Fairness

- Per class queuing
  - ◆ Scales very nicely
  - ◆ Deterministic and statistical QoS per aggregate
  - ◆ Scheduling and congestion control relatively simple

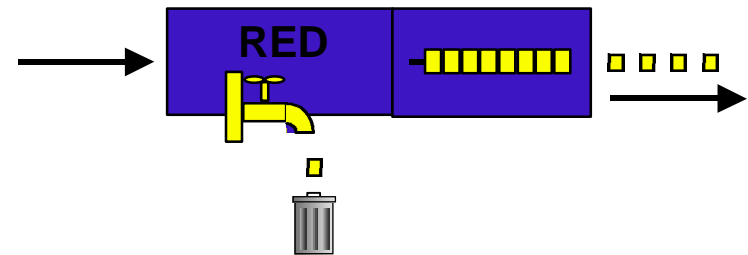
# Random Early Detection (RED)

## ◆ RED:

- Anticipates congestion
- Slows down traffic before queue overflows
- Avoids TCP oscillations
- Maximizes throughput

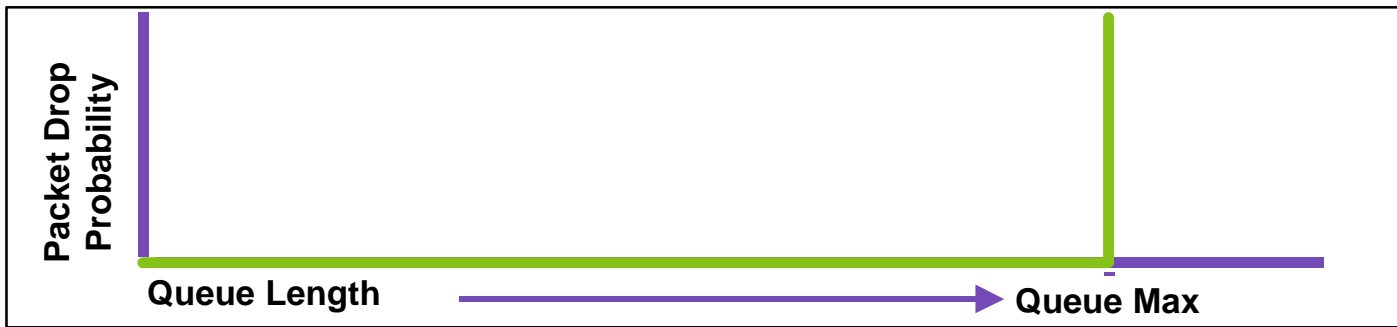
## ◆ RED uses selective packet loss to signal TCP to slow down

## ◆ new RED, Blue

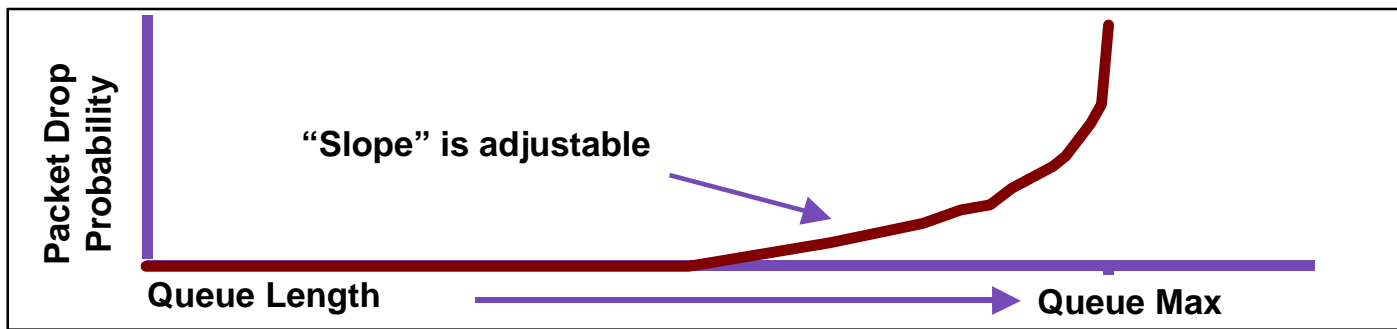


# Random Early Detection

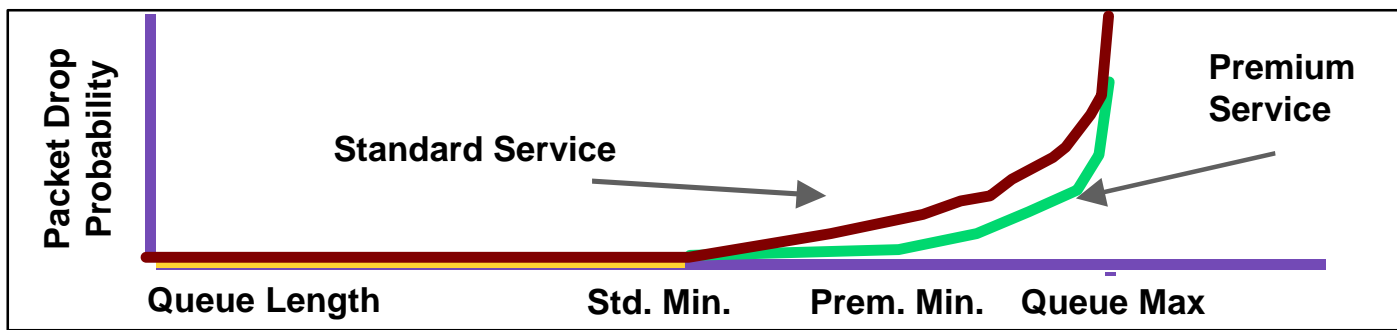
Without RED



With RED



With WRED



# Problem of Congestion Control & Fairness

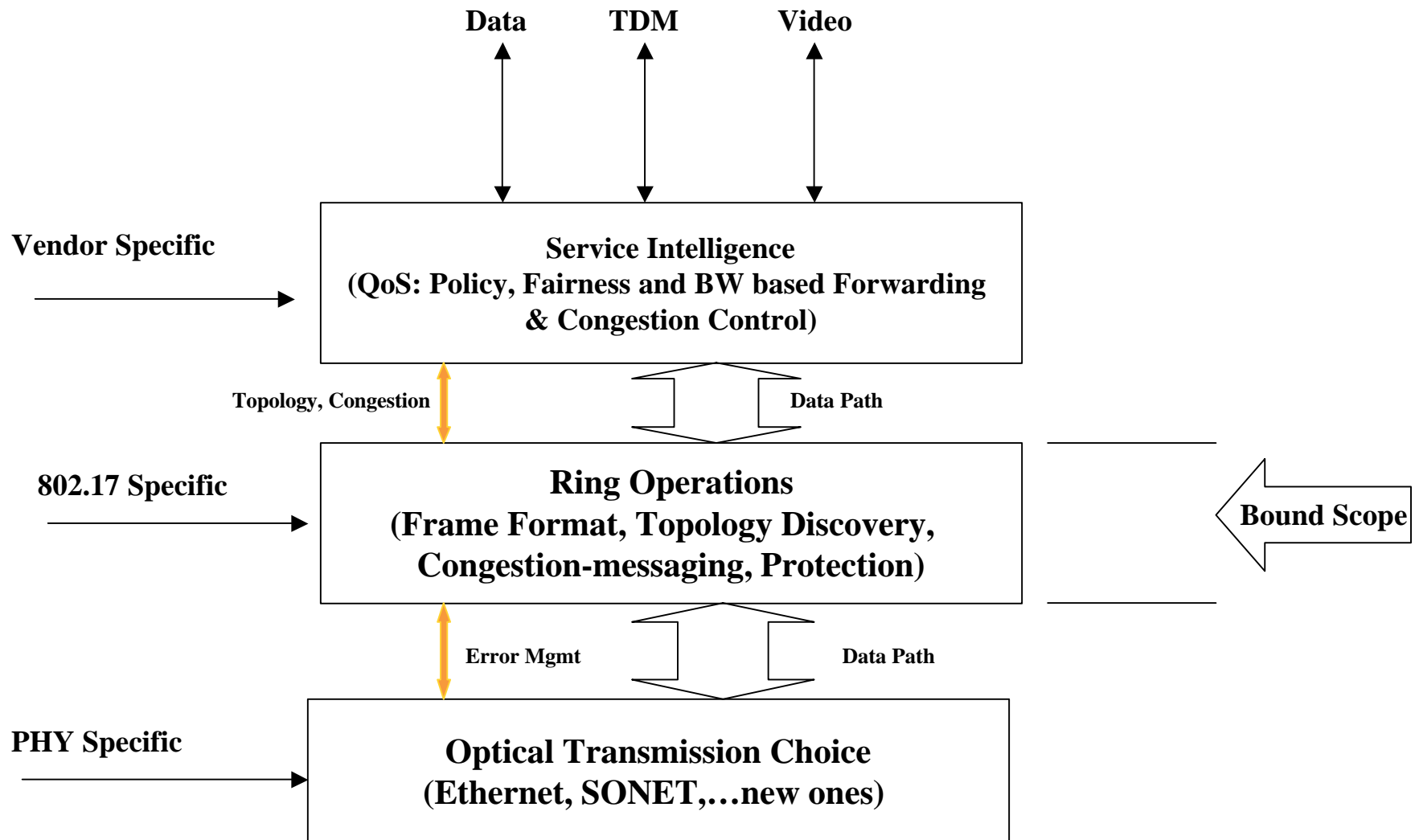
- Fairness across flows
- Fairness across responsive and non responsive flows
- Fairness across round trip times (RTT)
- Weighted fairness across aggregates



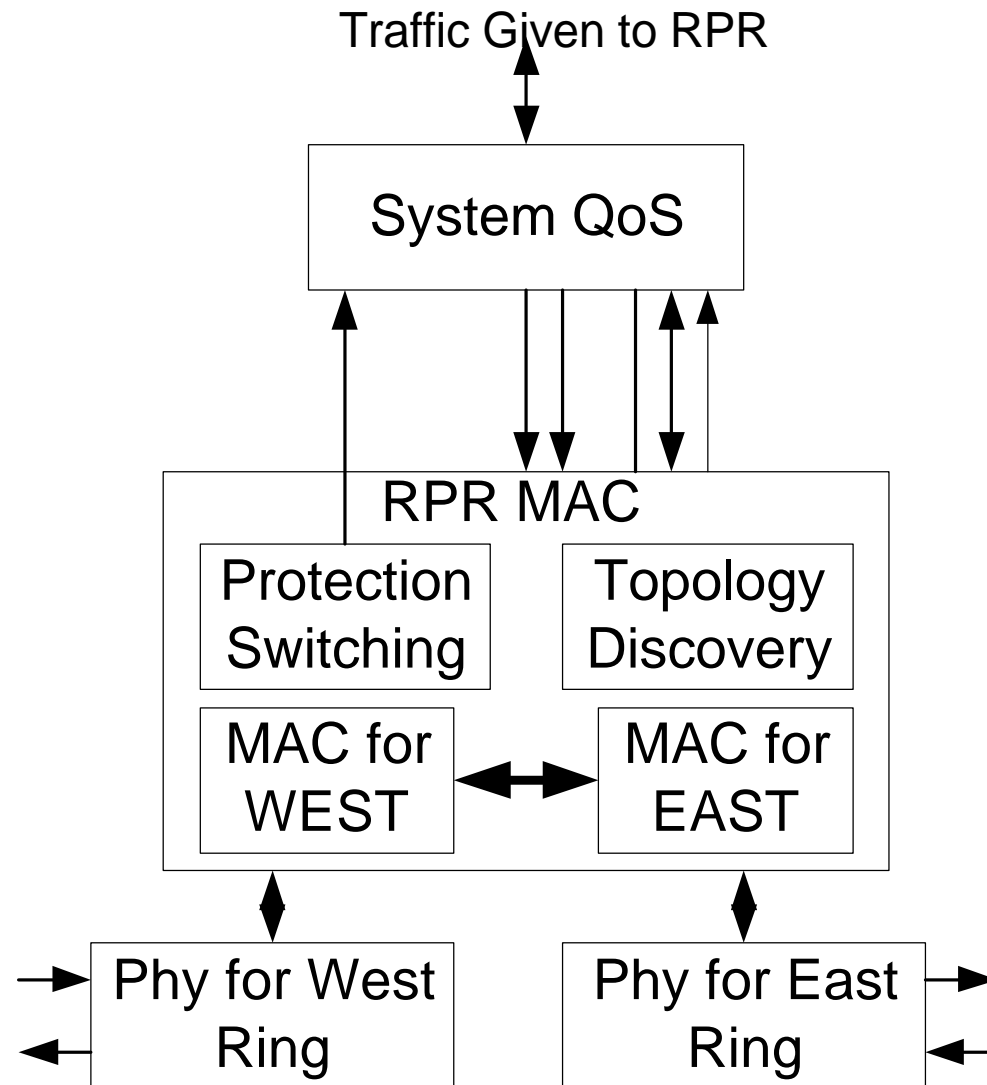
# Buffering vs. BCN

- Backward Congestion Notification (BCN)
  - ◆ Avoids buffering in the intermediate nodes in the rings.
  - ◆ Propagates congestion to source nodes.
  - ◆ Flow control signaling frequency and span distances may be issue
  - ◆ Interaction with upper layer protocols (TCP or any adaptive) may be issue.
- Buffering
  - ◆ Avoids internode signaling.
  - ◆ Well tested
  - ◆ Requires 50-100ms buffering

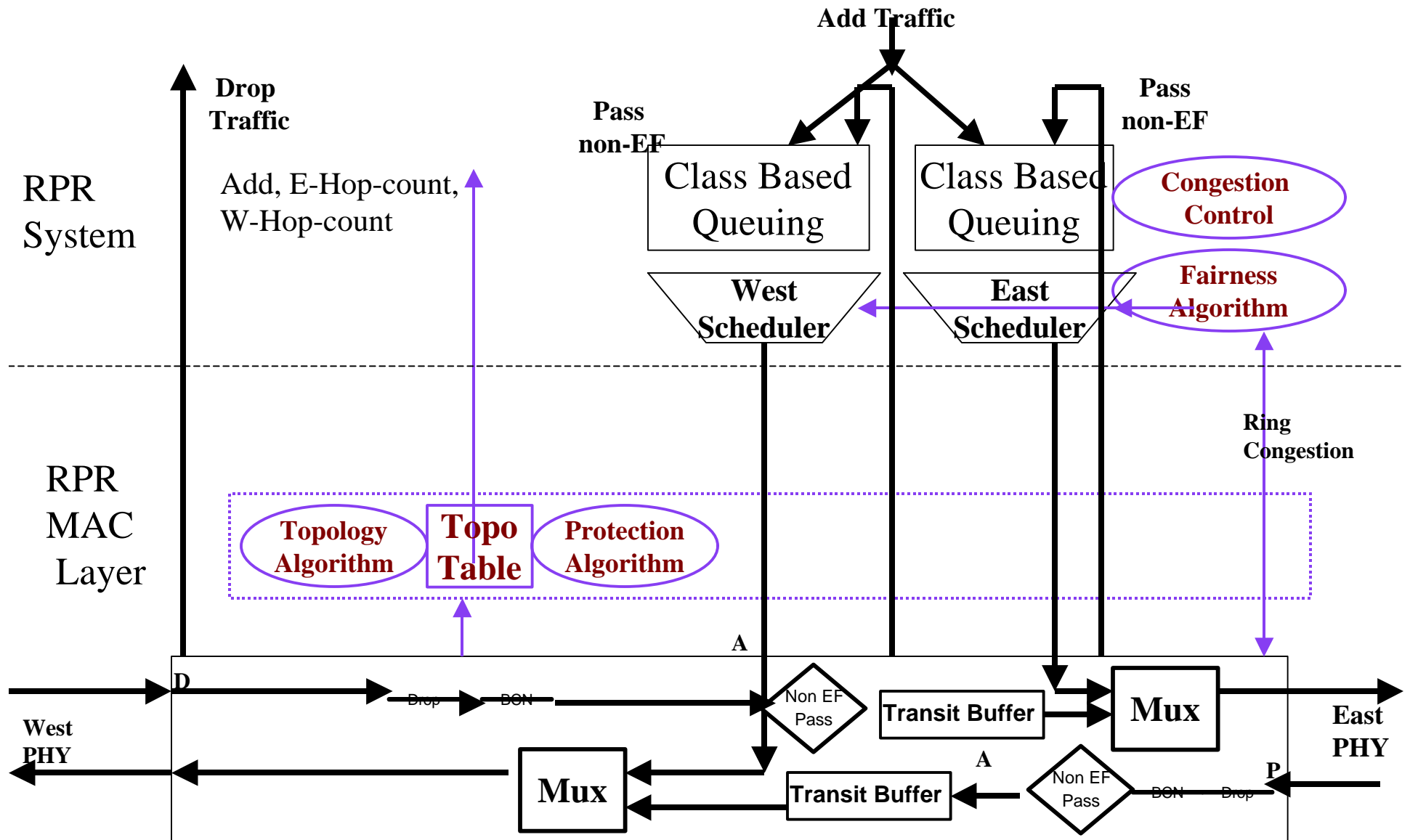
# Simplify MAC



# Proposed RPR MAC Implementation



# Proposed RPR System Architecture



# Conclusion

- Many service scenarios
- QoS above RPR MAC layer
- Proposal not tied to a particular implementation that addresses only a set of needs.
- Doesn't preclude services of present and future
- Open to innovation and evolution
- Allows vendor differentiation while insuring interoperability