Study of Quality of Service Issues in RPR

Sanjay K. Agrawal

Luminous Networks

sanjay@luminousnetworks.com

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

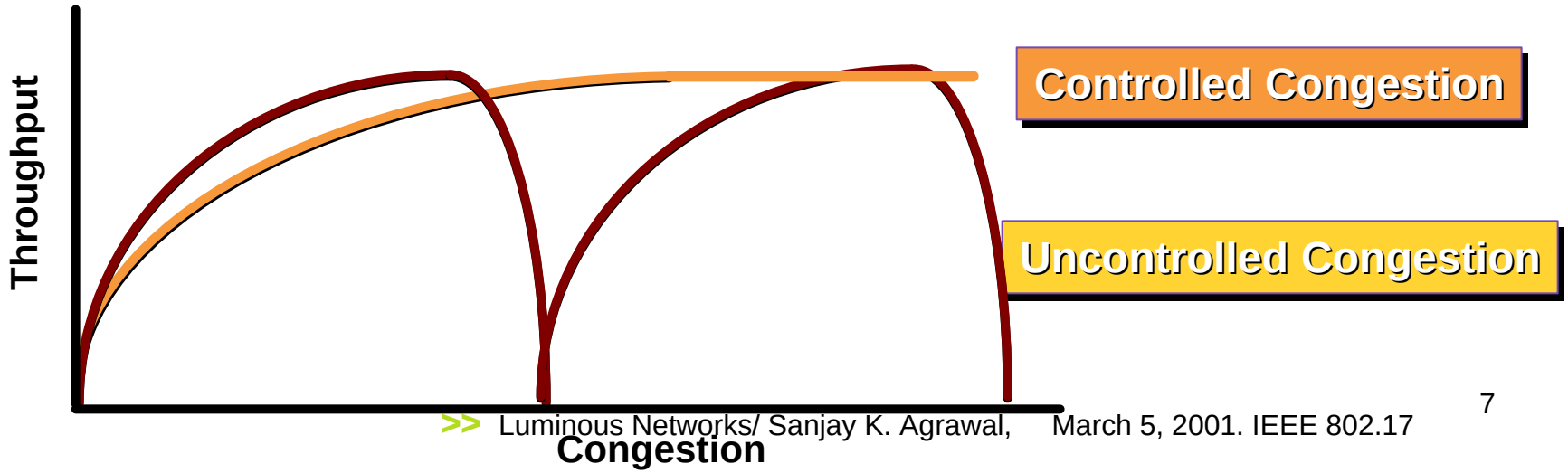
- Bandwidth provisioning maintained on per class basis
- Traffic from one class should not effect the traffic in the other class.

Issue of Congestion & Fairness

- Only necessary in the over-committed class.

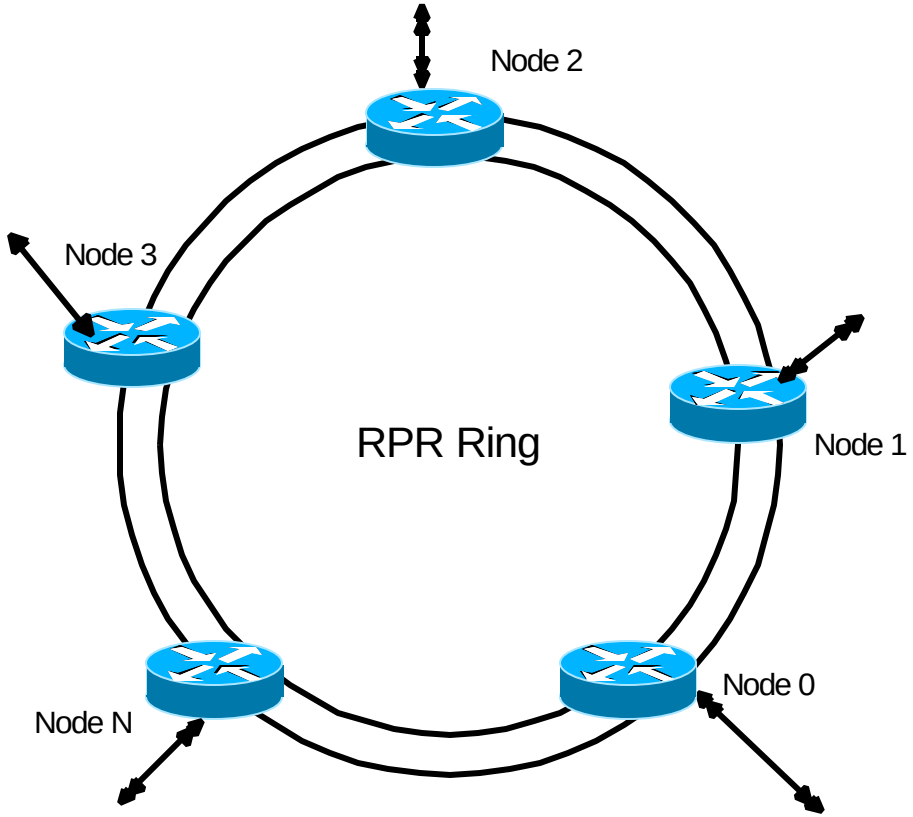
The Problem of Congestion

- 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 [Caida: www.caida.org]



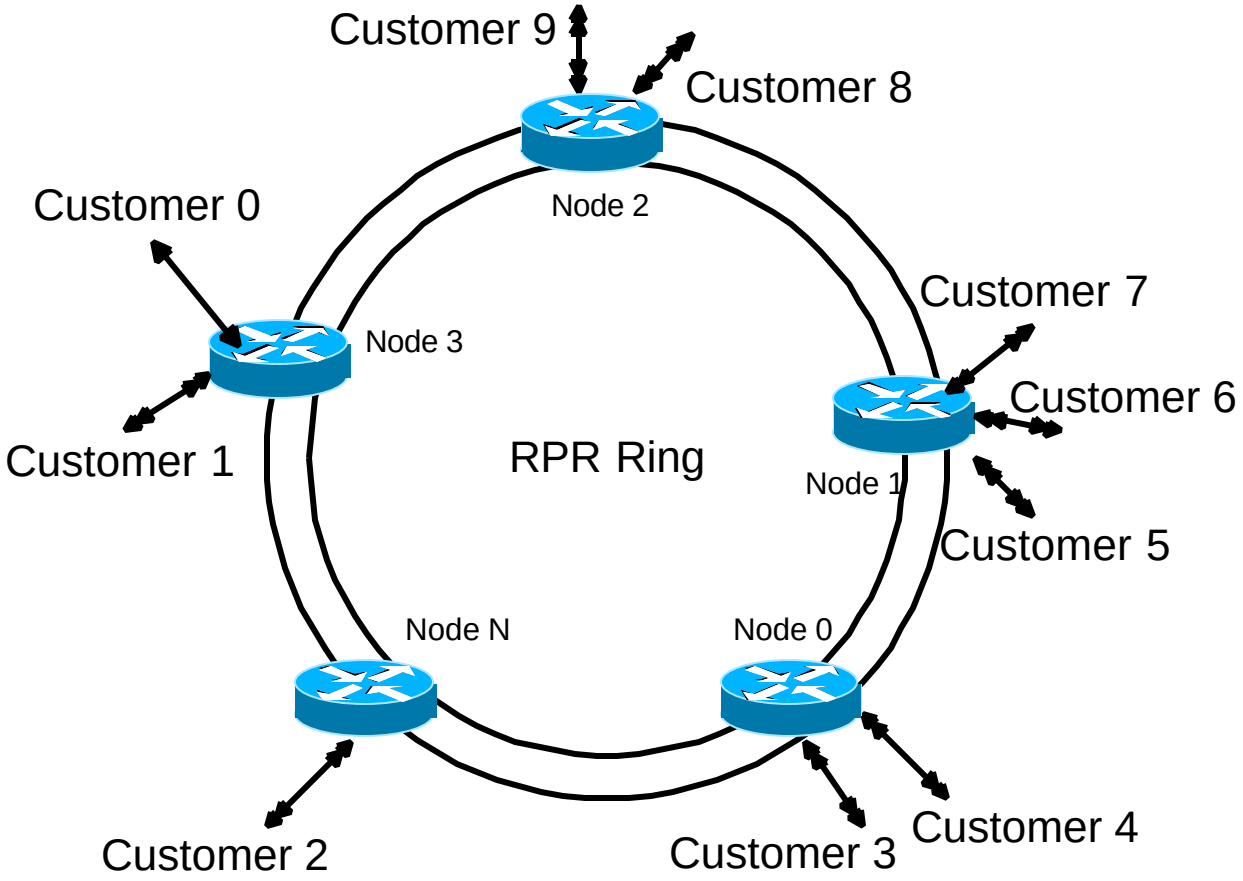
Problem of Fairness

- Per node Fairness in the rings



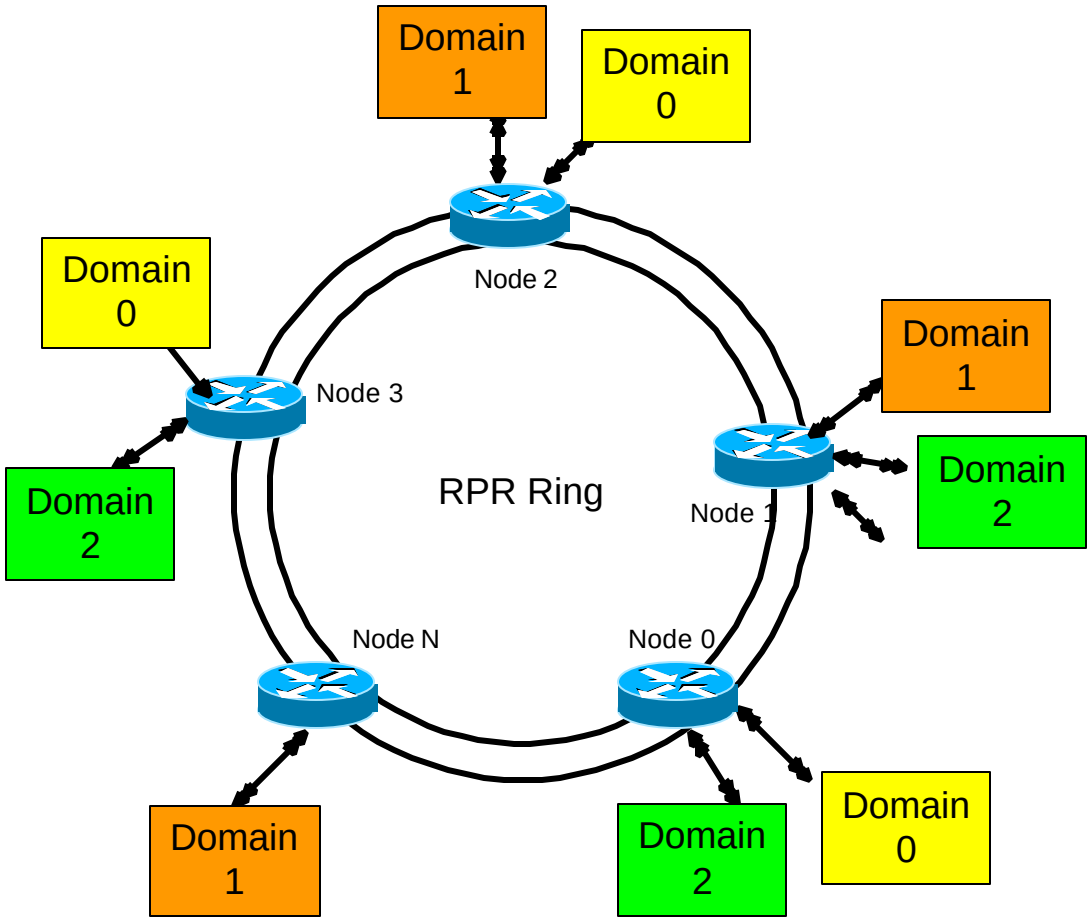
Problem of Fairness (cont..)

- Per customer/subscriber fairness in the rings



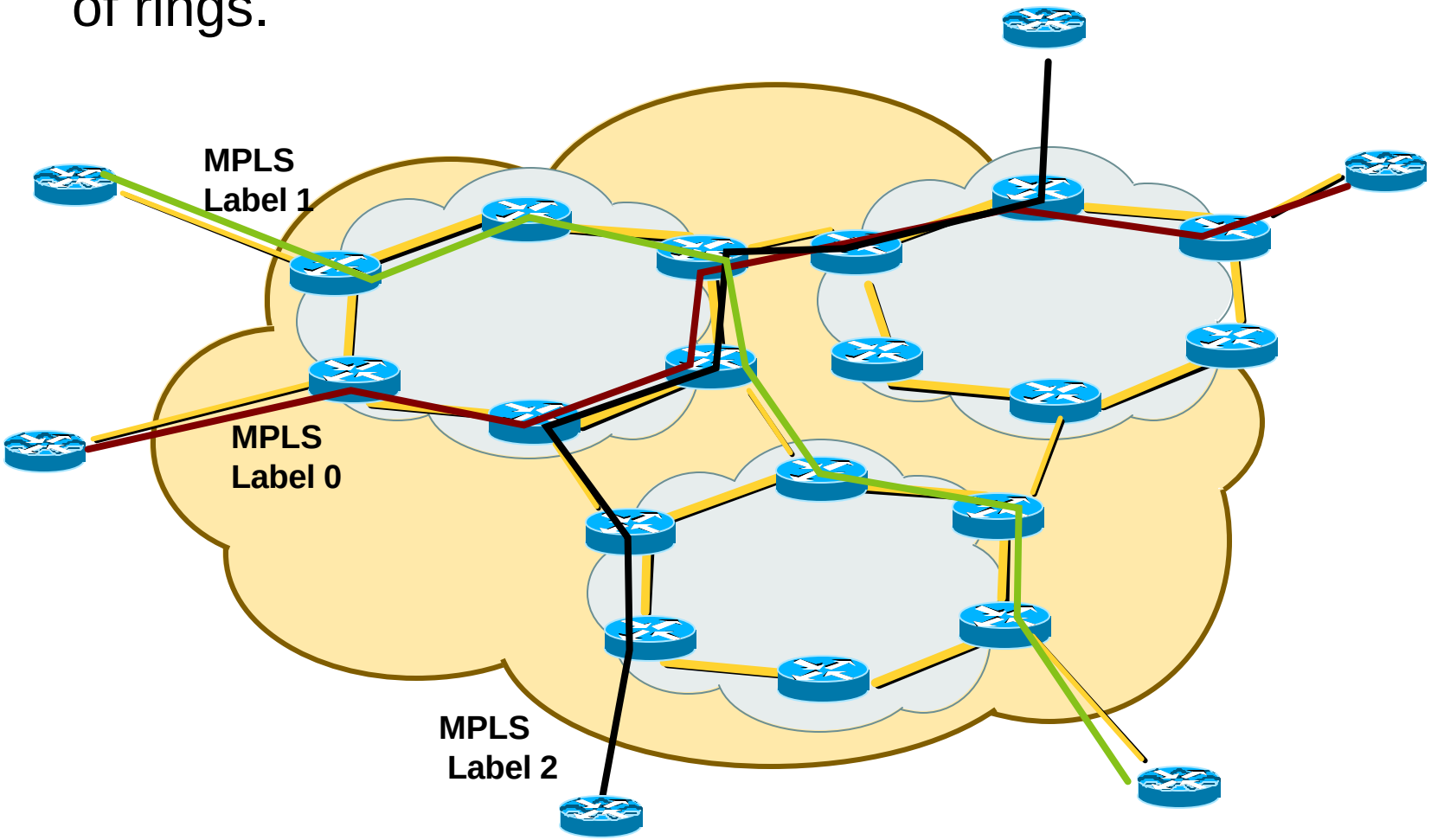
Problem of Fairness (cont..)

- 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.



>> Luminous Networks/ Sanjay K. Agrawal, March 5, 2001. IEEE 802.17

Congestion Control & Fairness

- Per Flow Queuing
  - ATM environment
  - Deterministic QoS per flow
  - Serious scaling issues in IP networks

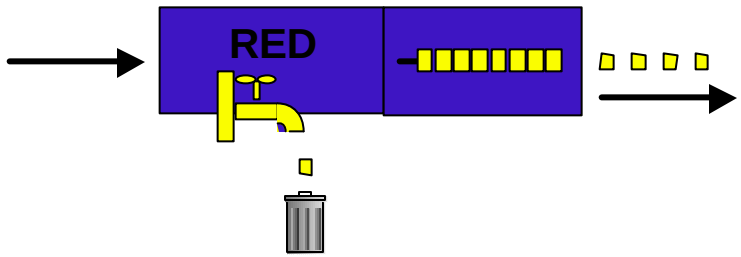
- Per Aggregate Flow Queuing
  - Aggregates based on VPN domain, MPLS labels, nodes, customers.
  - Deterministic QoS per aggregate flow
  - Scaling issue. 1k customers/port, 12 port/line card, 12 line cards/ chassis, 128 chassis in a ring.
  - Scheduling and congestion control very difficult

Congestion Control & Fairness

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

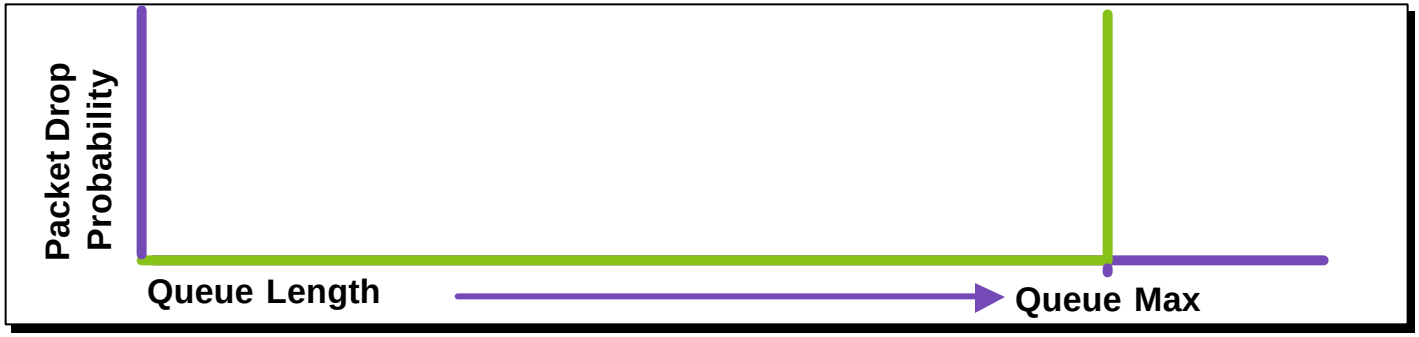
Random Early Detection (RED)

- 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

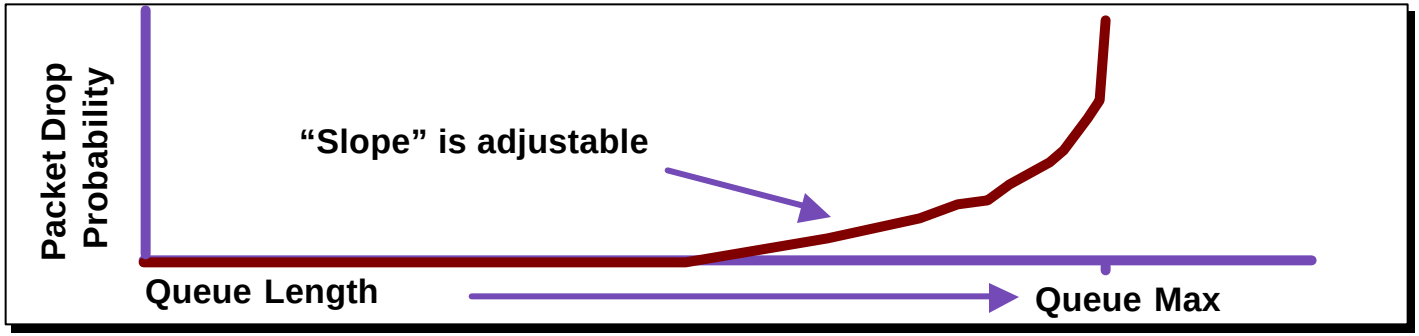


Random Early Detection

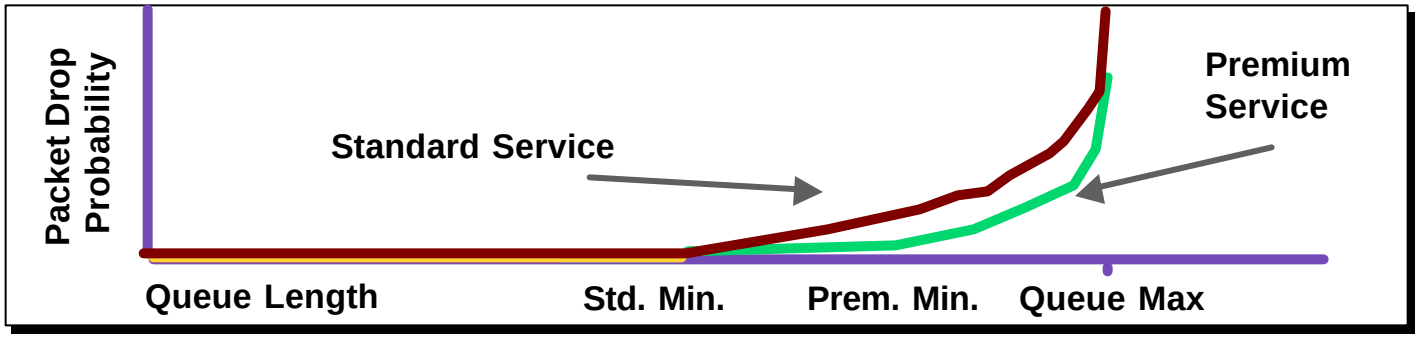
Without RED



With RED



With WRED



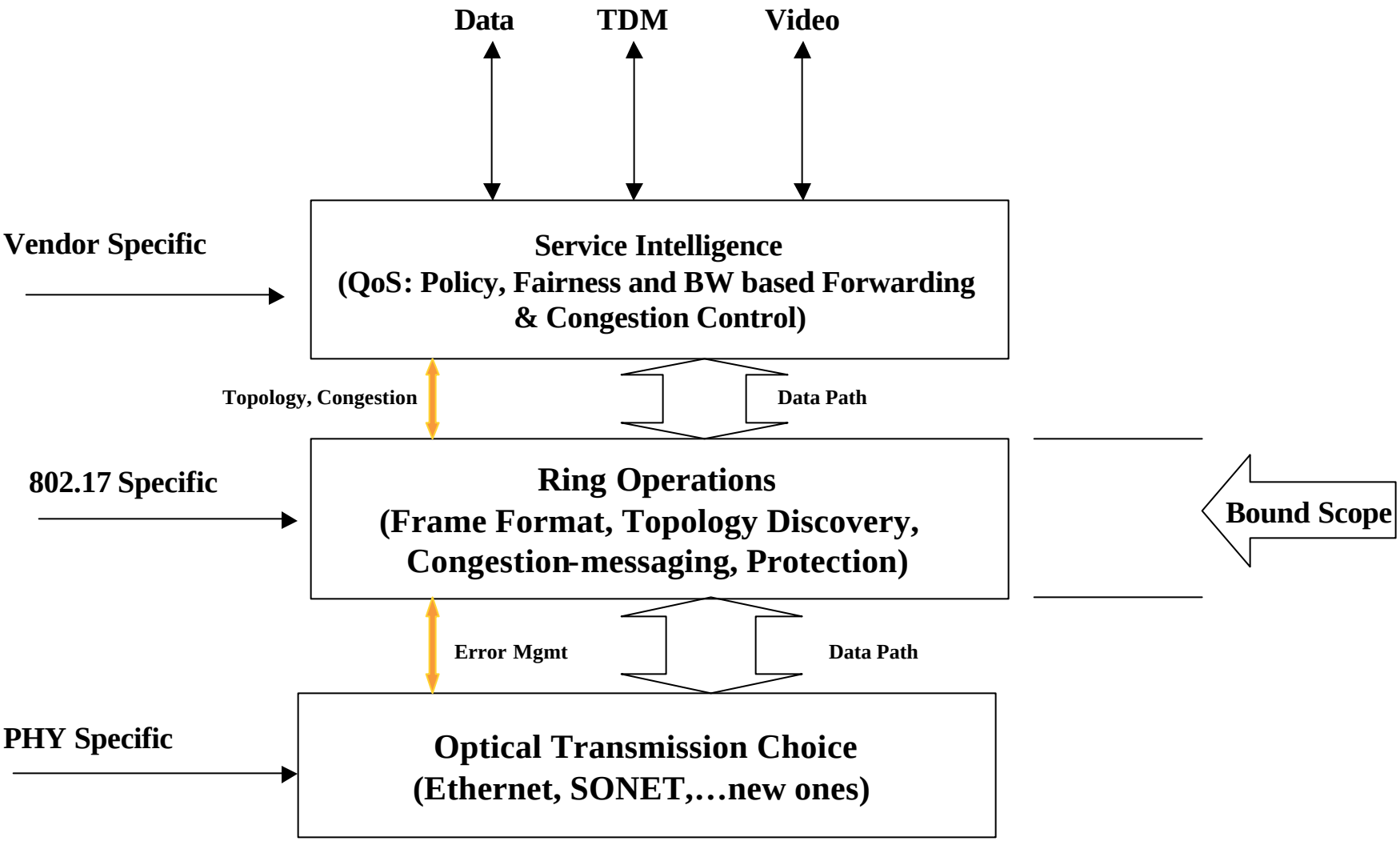
Problem of Congestion Control & Fairness

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

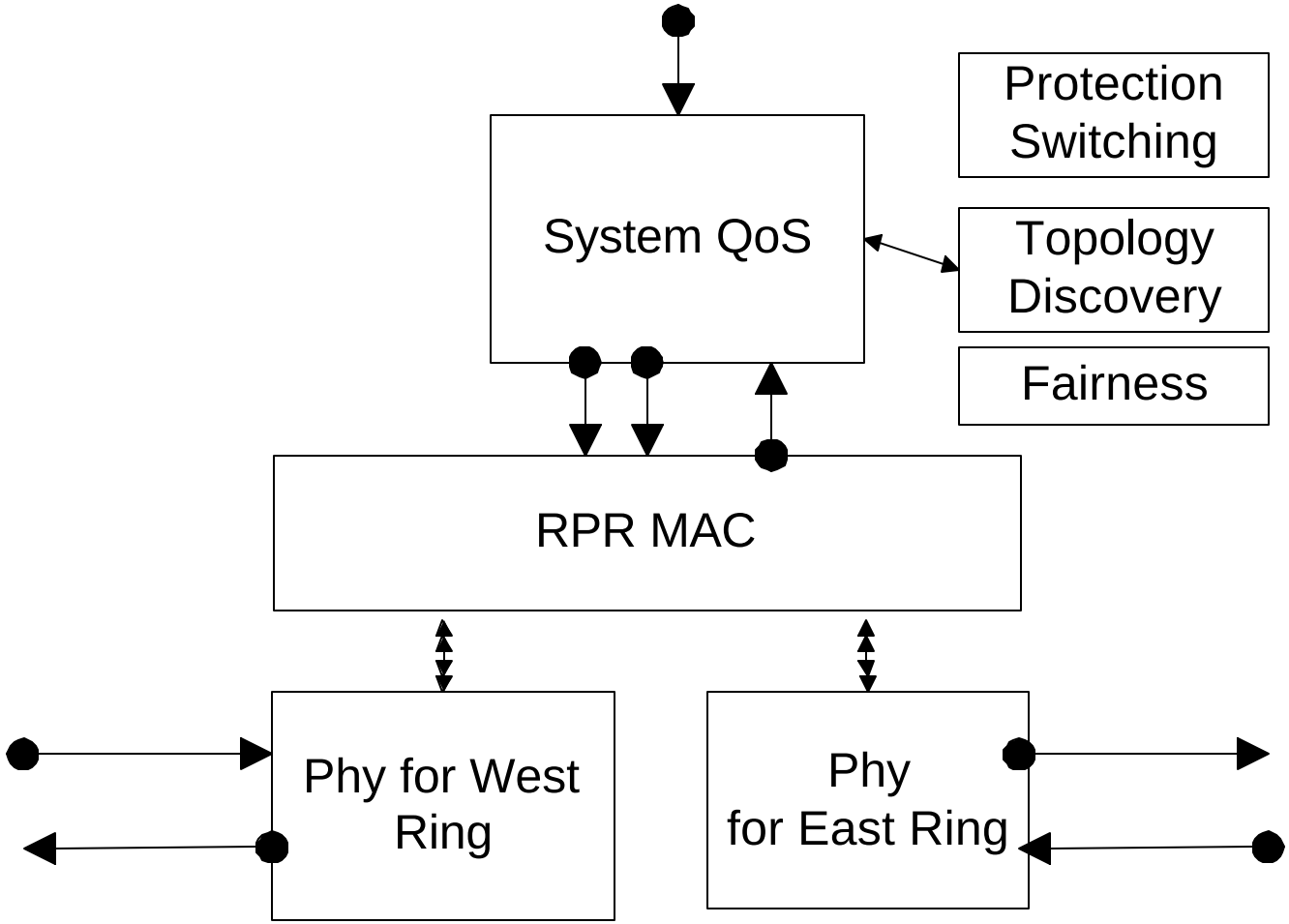
Buffering vs. BCN

- 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

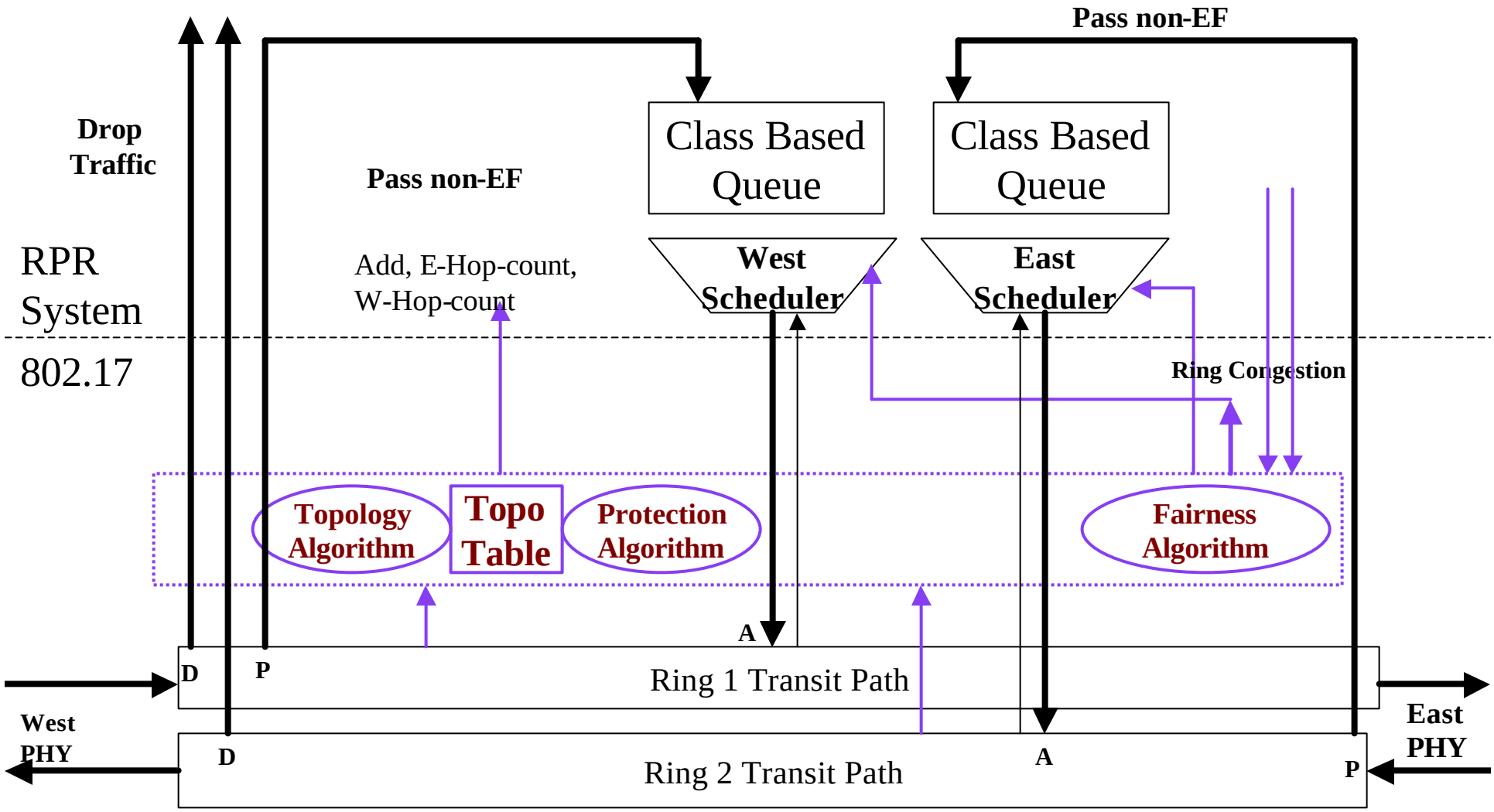
Simplify MAC



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