Transient Performance of EPRCA and EPRCA++

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Overview

- Why worry about transient performance?
- Transient performance and bursty traffic
- EPRCA++
- Simulation Results
- Future Improvements
Why Worry About Transients?

On most networks:
- There are no infinite sources.
- Sources come and go
- VCs may stay but are mostly inactive
- Traffic is highly bursty

⇒ Networks are operating in the transient region, most of the time.
Legacy LANs vs ATM

- Today’s LANs have a very fast transient response. Can get to the peak rate within a few microseconds

- On ATM LANs:
  Wait for connection setup and then...
  Everytime, a burst arrives, take several milliseconds to ramp up

- Q: Given 100 Mbps Switched Ethernet and 155 Mbps ATM at the same price, which one would you buy?
Transient vs Steady State Design

- Optimistic vs pessimistic design
- You get:
  - Either Fast ramp up
  - Or small oscillations
- Unless you design carefully
Rate-Based Schemes

- Bit Scheme
  - PRCA
  - EPRCA
    - EPRCA (Oct)
    - EPRCA++
  - MIT Scheme
    - OSU Scheme
      - EPRCA+

EPRCA++

- Count-based: Every Nth cell is an RM cell
  Not every $\Delta T$ interval
- AIR = PCR
- Decrease rate only if RM cell not received in $k*N$ cells, $k >> 1$
- Fully compatible with current RM Cell format
- Different $O(1)$ switch algorithm
Source Algorithm

ACR = \text{Min}(ER, ACR + AIR, PCR)
Switch Algorithm

- Monitor:
  Overload = Input rate/Target Utilization
  Fair Share = fn(Available rate, # of active VCs)

- This VC’s Share = fn(CCR, Overload)

- ER = Max(Fair Share, This VC’s Share)
  ER in Cell = Min(ER in Cell, ER)

- A few other minor details
Features

- Congestion Avoidance
  - High throughput, Low delay
  - Small queues
- Bounded oscillations $\Rightarrow$ Good for Video traffic
- Parameters: Few, insensitive, easy

Diagram:
- Link Utilization vs. Time
- Queue Length vs. Time

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EPRCA++ Parameters

- **Source:**
  
  Nrm = 16  
  ICR = PCR/20

- **Switch:**
  
  Target Utilization = 95%
  Averaging interval = 30 cells
EPRCA Parameters

[AF-TM 94-0735R1]

- AIR = Additive increase rate = 0.212 Mbps
- MDF = Multiplicative decrease factor = $2^8$ (Adjusted for Nrm)
- Nrm = RM cell interval = 16
- SW_HT = High threshold = 50
- SW_LT = Low threshold = 45
- SW_DQT = Very congested threshold = 100
- SW_IMR = Initial rate for MACR = PCR/100 = 1.49
- SW_VCS = VC Separator = 1-2^{-3}
- SW_AV = Exponential averaging factor = 2^{-4}
- SW_MRF = Major reduction factor = 2^{-1} for WAN, 2^{-2} for LAN
- SW_DPF = Down pressure factor = 1-2^{-3}
- SW_ERF = Explicit reduction factor = 1-2^{-4}

The SW_* parameters have been removed in EPRCA++
Parking Lot Configuration

- All links 155 Mbps, 1 km
- Max-min optimal: 51.3, 51.3, 51.3 Mbps
- Goal: Test fairness
Simulation Results

- EPRCA++ takes shorter time to converge
  \[ = \text{Max (RM Cell Interval, Round trip delay)} \]
- Smaller oscillations
- Considerably smaller queue lengths:
  1-3 in EPRCA++
  50-60 in EPRCA
- Cell delay for \( Q = 50 \) for T1 or small ABR bandwidth may be considered large.
- This applies to most configurations
Transient Configuration

- All links 155 Mbps, 1 km
- Second source at 5 ms, transmits 0.7 Mb
- Goal: To check time to adapt to load changes
Other Options: Queue Control

- Allows setting queue goal at any desired value
- Allows operation at any point between the knee and the cliff
- Allows utilization of all available capacity
- Useful when available bit rate varies widely.

<table>
<thead>
<tr>
<th>Queue Length</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
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<table>
<thead>
<tr>
<th>Link Utilization</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee</td>
<td>100%</td>
</tr>
</tbody>
</table>

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Summary

- Real networks are mostly in transient state ⇒ Transient performance is important
- Slow transient ⇒ poor burst performance
- Fast transient and good steady state is possible