Performance Evaluation of CL-PHB Admission and Pre-emption Algorithms

draft-zhang-pcn-performance-evaluation-01.pdf

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Outline

- **Simulation results for the example admission control algorithm described in http://www.ietf.org/internet-drafts/draft-briscoe-tsvwg-cl-phb-0**
- **Flow Preemption simulation results for the example algorithm described in http://www.ietf.org/internet-drafts/draft-briscoe-tsvwg-cl-phb-0**

Note: Admission and Preemption were run independently

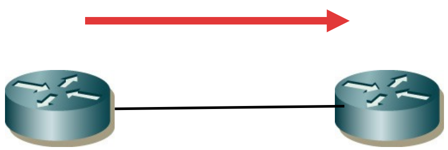
- **Reasonable if admission and preemption thresholds are sufficiently apart (10-20%)**
- **Further work needed to simulate interaction between Admission and Preemption if threshold are closer together**

Simulation Environment (Traffic Model)

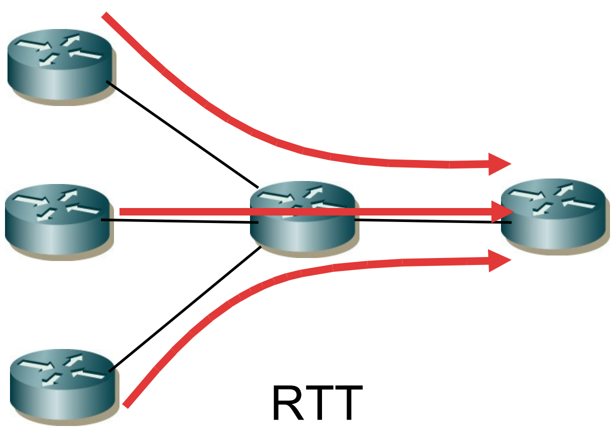
- **CBR**
  - – average rate: 64Kbps
- **On-Off Voice (VBR)**
  - – Voice w/silence suppression
  - – average rate: 21.76Kbps
- **Synthetic "Video" (SVD)**
  - – High Peak-to-Mean Ratio (4:1) on-off VBR Traffic
  - – Average rate: 12Mbps
- **Real Video Traces (VTR) – new in this version of the draft**
  - – Frame size traces of MPEG-4 and H.263 encode video
  - – Average rate: 769Kbps
  - – http://www.tkn.tu-berlin.de/research/trace/trace.html
- **Randomization of Base Traffic Models – new in this version of the draft**
  - – Randomly moving the packet by a small amount of time around its transmission time to simulate small queuing delays

Simulation Environment (Topologies)

- **Single Bottleneck**

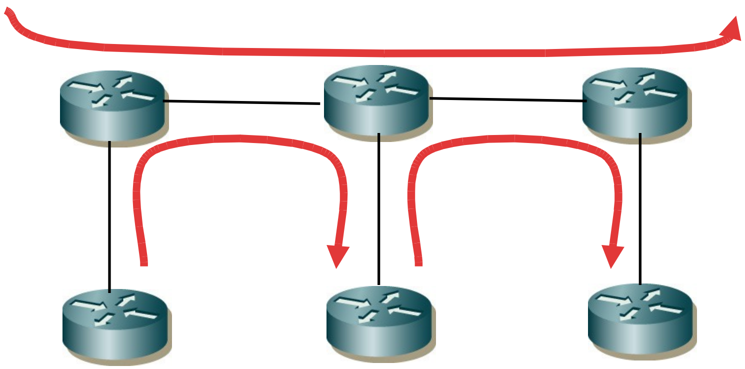


Single Link



RTT

- **Multiple Bottlenecks (new)**



2-BN Parking Lot (PLT)
(3 and 5 bottleneck
PLT also simulated)

Admission Control Results

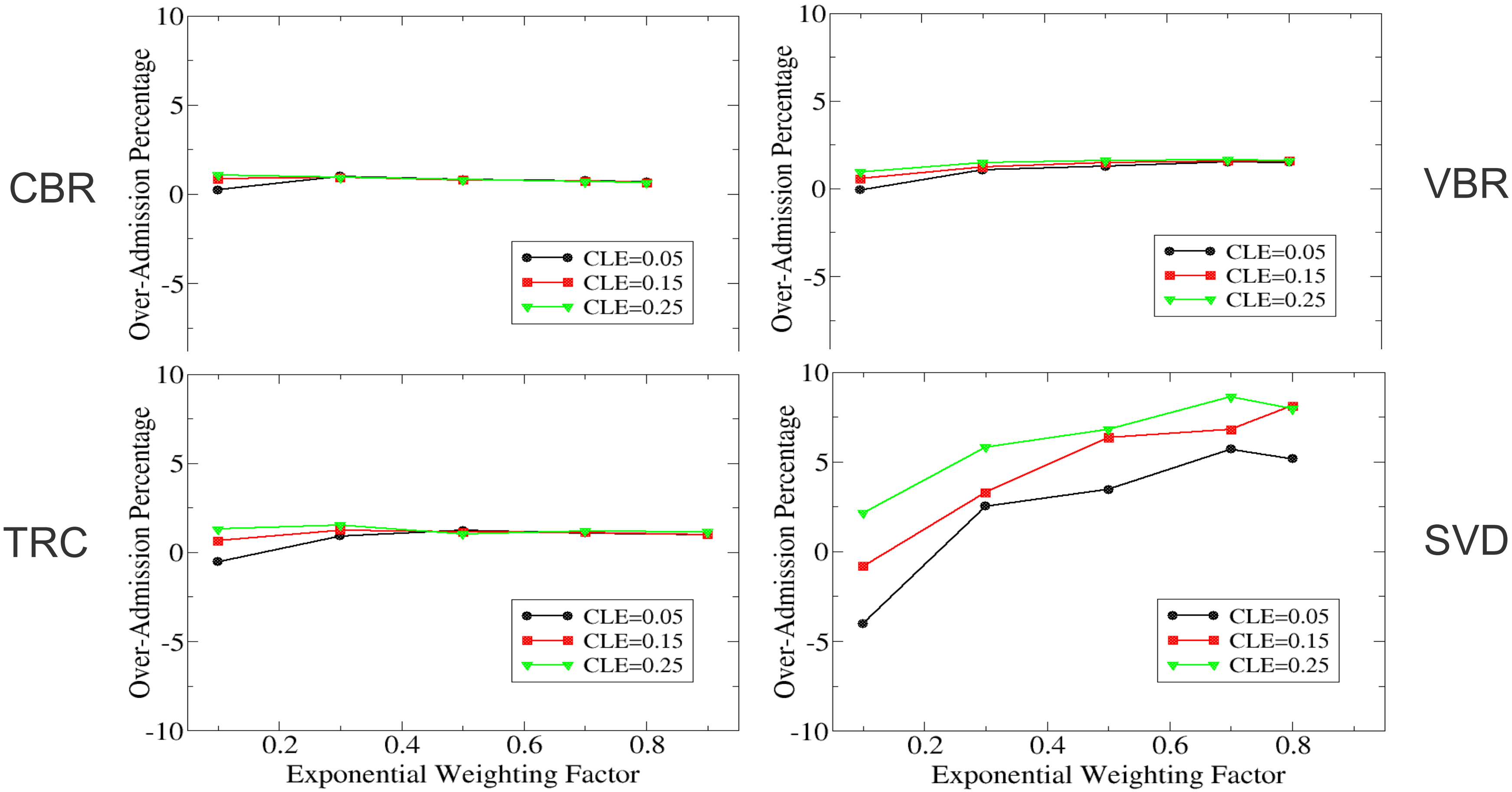
- Sensitivity to call arrival assumption (Poisson vs. burstier Batch): works well for both on links 10M and up
- Sensitivity to marking thresholds

  (Ramp vs step): no substantial difference in the simulated setup

  Limited variation of upper/lower marking threshold: relatively insensitive, but more study needed
- Sensitivity to RTT: no effect in the one bottleneck/stable traffic case
- Sensitivity to EWMA weight and CLE: Relatively insensitive to parameter change
- Effect of Ingress-Egress Aggregation: no effect
- Effect of Multiple Bottlenecks: no effect

Admission Control Results
Sensitivity to EWMA weight and CLE

- **Relatively insensitive to parameter change**
  - **More stressful for SVD, but within -3% to +10% over-admit**



Admission Control Results
Effect of Ingress-Egress Aggregation

- **Difference in Ingress-Egress aggregation appears to have no effect on the performance in the simulation we performed**
  - **requires further investigation**

	CBR	VBR	VTR	SVD
SingleLink	1.905	1.948	1.539	8.62
RTT (100 Ingress)	1.956	2.199	1.868	11.26

over-admission-perc. on the bottleneck

Admission Control Results
Effect of Multiple Bottlenecks

- **No visible multiple bottleneck effect**

	CBR	VBR	VTR	SVD
SingleLink	1.905	1.948	1.539	8.62
PLT (5BN)	1.149	1.501	1.117	4.737

over-admission-perc. on the bottleneck
Note: In the case of PLT, the worst among the 5 BN is used

Admission Control Results (Conclusion)

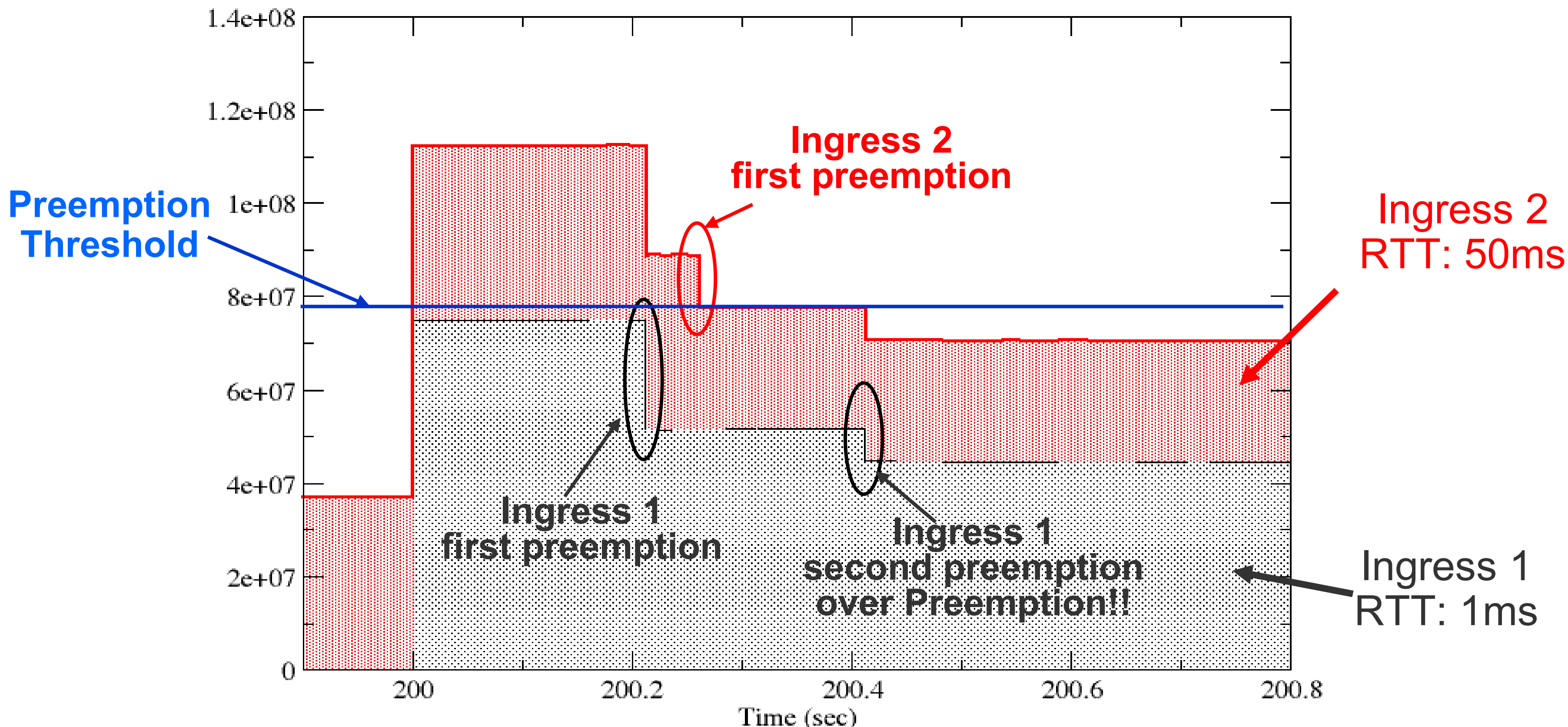
- Performance remains reasonable even for really low ingress-egress aggregation levels
- The algorithm is relatively insensitive to variation of key parameter settings
- Synthetic video traffic SVD was the most challenging for all topologies, and the performance of real video traces (VTR) was substantially better
- No performance degradation is observed in a multi-bottleneck topology
- To summarize, so far all seem performing as advertised

Preemption Results

- **Sanity check on SingleLink topology:** worked as expected
- **Effect of RTT Difference:** Visible effect with relative RTT difference, though not significant
- **Effect of Ingress-Egress Aggregation:** visible effect with low aggregation, though not as feared
- **Effect of Multiple Bottlenecks:** worked as expected

Preemption Results: Effect of RTT Difference

- **Absolute value of RTT has no effect**
- **Relative difference in RTT causes limited over-preemption**
  - **6% – 10% in experiments we run**

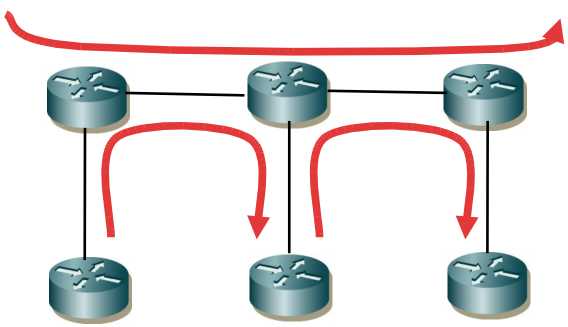


Preemption Results: Effect of Ingress-Egress Aggregation

- In theory, at low aggregation serious over-preemption may occur
  - When ingress-egress aggregate has only one flow, all flows can get marked at the bottleneck and all get preempted
- As a rule, over-preemption does occur but much smaller than the worst case behavior
  - e.g. for randomized CBR
    - 0.53% over-preemption with sufficient aggregation
    - 13.19% over-preemption 1 Flow/Ingress
- In some simulations, it does not occur at all
  - Due to marking synchronization or specific traffic patterns
  - Can not be relied on in general
- Over-preemption for low aggregation can not be written off as a “corner case”

Preemption Control Results
Effect of Multiple Bottlenecks

- **Ingress-Egress Aggregates that travel more bottlenecks will see “beat-down” effect (over-preemption), as theoretically expected**
  - **Long-haul flow gets excessively marked at subsequent bottlenecks**
  - **Upstream bottlenecks become underutilized**
  - **The absolute amount of “beat-down” depends on traffic matrix**
- **Actual simulation results are very close to the theoretically expected ones**



	CBR	VBR	VTR	SVD
Long-haul Flow	13.56	16.30	14.77	23.31
First Bottleneck	9.61	11.59	11.06	18.13
Last Bottleneck	0.92	2.13	2.89	10.85

over-preemption-perc.

Key directions for further evaluation

- further investigation on call arrival assumptions (burstier than Poisson)
- more sophisticated and/or realistic topology and traffic matrix
- Mix of traffic types on bottleneck
- Interaction between admission and preemption