Comments on the Performance of Measurement Based Admission Control Algorithms

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Infocom 2000
Survey of Measmt Based AC Schemes

Many different varieties of MBACs:
• Some based on “solid” math models (eg, theory of large deviations)
• Others “ad hoc” (no theory underpinning)
• Different load estimations: from simple point estimate, to exp averaging, combined mean and variance measmts, etc

How to compare them?
• Use *packet loss* as measure of service failure
• *Loss-load curve*: loss rate occurring at given level of service utilization
The Ingredients of MBAC

Two key components:

• Network load measurements (on aggregate rather than per flow)
• Adm control decision based on load measmt
Service Characterization

Service requested by appl:
• defined by token bucket params – token rate \( r \), bucket depth \( b \)

Service delivered:
• Measured in terms of packet drop rate
MBACs surveyed

**Measured Sum:**
- Token rate of new flow + aggregate measured rate of existing flows must be less than utilization threshold

**“Hoeffding” bounds:**
- Peak rate of new flow + aggregate equiv bdw of existing flows must be less than link bdw

**Tangent of equiv bdw curve:**
- A given “function” of equiv bdw less than link bdw

**Measure CAC:**
- Peak rate of new flow + “large deviation” equiv bdw estimate less than link bdw

**Aggregate Traffic Envelopes, etc**
**Meas.mts vs Parameter Adm Control**

**Parameter based** Adm Control:
- *Hard* real time services
- decision based on worst case bounds
- typically, low network utilization

**Measurement based** Adm Control:
- *Soft* real time services (occasional pkt loss or delay violation)
- Decision based on existing traffic measurements
- Higher utilization than parameter – based
- The Adm Control scheme of choice in DiffServ
MBACs surveyed (cont)

Each one of the surveyed CAC schemes has two components:

(a) **Load estimate** (including new flow)
(b) **Admission control decision**

Can pair up Load estimate and Adm decision across schemes (mix and match)!
MBACs surveyed (cont)

- Each scheme has a parameter that can be tuned to make it more or less "aggressive", eg. Target loss rate or Target link utilization
- Performance can be measured by loss-vs-load curve
Simulation Methodology

Two types of sources:

- ON/OFF sources: random ON and OFF intervals
- Video traces

Sources policed by token bucket

- Token bucket parameters used in “parameter based” Call Admission control
- For ON/OFF token rate = 64kbps; bucket depth=1
Configuration Parameters

- **Single bottleneck link**: 10 Mbps
- Bottleneck buffer: 160 pkts
- Packet length: 128 bytes
- Heavy offered load (to force CAC and rejections)
ON/OFF traffic experiments
Mix and match: time window load estimates
Mix and match: exp avg load estimates
Mix and match: point sample load estimates
Model Robustness

• The experiments show extraordinary robustness of performance to different MBCA schemes

• Additional experiments (not shown here) show similar robustness to: very bursty ON/OFF sources; long range dependant processes; video sources etc
Heterogenous traffic

Two simultaneous sources:

- Star Wars: 350Kbps avg, 1200 Kbps peak; 
r=800Kbps, b=200 Kb
- CRB: 800Kbps; r=800Kbps, b=1.6Kb (single pkt)

Measured Sum scheme- two versions:

- **Token rate** used for new flow: SW=CBR=800;
- **Peak rate** used for new flow: SW=1200; CBR=800
Peak rate favors CBR; it leads to 3:1 CBR/SW mix; lower loss
Comparing with Ideal CAC

- **Ideal CAC** algorithm: maintain the “quota” of flows constant = N, where N is determined by target loss rate
- Ideal CAC has prior knowledge of current # of flows
- **Measured Sum** alg must “guess” N from load measurements;
- Ideal CAC is open loop; it wins as it leads to lower load fluctuations
- Measured Sum uses closed loop feedback control; it tend to overreact leading to higher oscillations and possible instability
Ideal CAC (ie Quota) vs Measured Sum

Traffic source: ON/OFF
Ideal CAC (ie Quota)
Ideal vs MS in Long Range Dependance

• Long Range Dep source: ON/OFF interval 
Pareto distributed; flow lifetime lognormal
• “Quota” does not work very well here: no 
notion of ideal quota valid all the time
• Measured Sum, on the other hand, can track 
the flow fluctuations => lower loss rate!
Long range dep sources

Quota vs Measured Sum
Can we predict MBAC loss?

- Network operators would like to predict loss to set operating point (e.g., target utilization in the Measured Sum scheme)
- **Question**: can we preselect the “control knobs” and expect results consistent with prediction?
- **Answer**: not quite! Better to measure resulting loss rate and adjust knobs accordingly
- Results in next slide are based on:
  - **MC** scheme: measure CAC – large dev estimate of existing flows + peak of new flow
  - **TE** (Traffic Envelope): measured max aggregate envelope of existing + peak of new flow
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<th>Actual Loss Rate</th>
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Conclusions

• All MBAC schemes achieve identical loss-load performance (no matter the effort spent in developing sophisticated measurements)

• Flow heterogeneity must be addressed by policy – aggregated measured based control is unfair

• MBAC does better than Ideal “Quota” scheme in Long Range Dependency

• Predictive “knobs” do not work well; need to monitor loss directly and use feedback