ATM Traffic Management over Satellite Networks: Recent Issues

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1. Optimization of TCP/IP over ATM over satellite networks
2. Guaranteed Frame Rate vs Guaranteed Rate
3. Multipoint connections
4. Video background
5. Bursty WWW traffic over ATM
1. TCP over UBR Optimization

- **Past Work**: TCP over
  - UBR
  - UBR + Early Packet Discard (EPD)
  - UBR + EPD + Selective Drop
  - UBR + EPD + Fair Buffer Allocation
  - Fast Retransmit and Recovery (FRR)

# Policies

## End-System Policies

<table>
<thead>
<tr>
<th>Switch Policies</th>
<th>No EPD</th>
<th>EPD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No FRR</td>
<td>FRR</td>
</tr>
<tr>
<td>No EPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPD</td>
<td>Plain EPD</td>
<td>Selective Drop</td>
</tr>
</tbody>
</table>
TCP over UBR: Results

- In LANs, switch improvements (PPD, EPD, SD, FBA) have more impact than end-system improvements (Slow start, FRR, New Reno, SACK).
- In WANs and satellite networks, end-system improvements have more impact than switch-based improvements.
- FRR hurts in WANs and satellite networks.
- Fairness depends upon the switch drop policies and not on end-system policies.
- Unless implemented properly, congestion window may get stuck at 256 kB.
2. Guaranteed Frame Rate (GFR)

- UBR with minimum cell rate (MCR) ⇒ UBR+
- Frame based service
  - Complete frames are accepted or discarded in the switch
  - Traffic shaping is frame based.
    - All cells of the frame have CLP = 0 or all cells have CLP = 1
  - All frames below MCR are given CLP = 0 service. All frames above MCR are given best effort (CLP = 1) service.
Guaranteed Rate Service

- Guaranteed Rate (GR): Reserve a small fraction of bandwidth for UBR class.

<table>
<thead>
<tr>
<th>GR</th>
<th>GFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>per-class reservation</td>
<td>per-VC reservation</td>
</tr>
<tr>
<td>per-class scheduling</td>
<td>per-VC accounting/scheduling</td>
</tr>
<tr>
<td>No new signaling</td>
<td>Need new signaling</td>
</tr>
<tr>
<td>Can be done now</td>
<td>In TM4+</td>
</tr>
</tbody>
</table>

**Ref:** Guaranteed Rate for Improving TCP Performance on UBR+ over Terrestrial and Satellite Networks, ATM Forum 97-0424, April 1997
Guaranteed Rate: Results

- Guaranteed rate is helpful in WANs.
- For WANs, the effect of reserving 10% bandwidth for UBR is more than that obtained by EPD, SD, or FBA.
- For LANs, guaranteed rate is not so helpful. Drop policies are more important.
- For Satellites, end-system policies seem more important.
3. Multicast ABR

Ref: Performance analysis of ABR point-to-multipoint connections for bursty and non-bursty traffic with and without VBR background, ATM Forum 97-0422, April 1997
Multipoint Connections: Issues

- Minimum of ER from branches is sent upstream
  Should we wait for all branches?

- If you send BRM on every FRM, you may give feedback without receiving any
  ⇒ Need to ensure that at least one feedback has been received before sending a BRM.
  Otherwise, you may give PCR

- Not all downstream feedbacks in an upstream feedback
  ⇒ Consolidation noise
Multipoint: Results

- ABR with ERICA (extended for multipoint) work ok
- Efficiency, fairness, responsiveness is maintained
- Consolidation noise due to asynchronous arrival of feedback from different leaves appears as oscillations
- Additional delay due to FRM wait and BRM consolidation
  \[ \Rightarrow \] slower transient response than point-to-point
- Minimum of all paths is allocated
  \[ \Rightarrow \] some links are underutilized
- Queue control (ERICA+) is required for stability
4. Data + Video over ATM

- MPEG2 VBR Video: Piecewise CBR

Data + Video over ATM : Results

- MPEG2 compressed video = piecewise CBR, long-range dependent rate, random inter-MPCR intervals
- ABR with appropriate switch algorithm can handle the randomness in ABR capacity
- With ERICA+ and Infinite TCP Traffic:
  - Queue lengths < 3 × Feedback delay
  - Efficiency close to the maximum possible.
  - Queues are similar to those with deterministic VBR
5. WWW (Bursty) Traffic over ABR

- Large number of sources
- SPECweb’96 benchmark
- Results: ABR is stable.

**Ref:** Performance of Bursty World Wide Web (WWW) Sources over ABR, ATM Forum 97-0425, April 1997
Summary

- For satellite networks, end-system policies (SACK) have more impact than switch policies (EPD).
- Reserving a small fraction for UBR helps it a lot in satellite networks.
- ABR works OK
  - In multipoint VCs
  - In presence of video background
  - Even with large # of WWW sources
Our Contributions and Papers

All our contributions and papers are available on-line at http://www.cis.ohio-state.edu/~jain/

- See Recent Hot Papers for tutorials.