Traffic Shaping in ATM Networks

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Overview

- Leaky bucket
- Generic Cell Rate Algorithm
- GCRA Implementations:
  - Virtual Scheduling Algorithm
  - Leaky bucket algorithm
- Examples
Leaky Bucket

- Provides traffic shaping: Input bursty. Output rate controlled.
- Provides traffic policing: Ensure that users are sending traffic within specified limits. Excess traffic discarded or admitted with CLP = 1
Generic Cell Rate Algorithm: GCRA(I, L)

- I = Increment = Inter-cell Time = Cell size/PCR
- L = Limit ⇒ Leaky bucket of size I + L and rate 1

Last Cell Time

<table>
<thead>
<tr>
<th>Last Cell Time</th>
<th>No</th>
<th>OK</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I-L</td>
<td>L</td>
<td>I</td>
</tr>
</tbody>
</table>

Theoretical Arrival Time

- Time
GCRA: Virtual Scheduling Algorithm

Cell Arrival at \( t \)

- \( TAT < t? \) Late?
  - Yes (late)
  - No (early)

  - \( TAT > t + L? \)
    - Yes
    - Too early?
      - No
      - TAT = TAT + I
        - Conforming Cell
  - TAT = \( t \)

Non Conforming Cell

TAT = Theoretical Arrival Time
GCRA: Leaky Bucket Algorithm

\[ F = X - (t - LCT) \]

- **Non-Conforming Cell**
  - Yes
- **F > L?**
  - No
  - Yes
  - **F = 0**

- **F < 0?**
  - Yes
  - **Non-Conforming Cell**
  - No
  - **Conforming Cell**

\[ X = F + I; \ LCT = t \]

LCT = Last Compliance Time
X = Bucket contents at LCT
F = Bucket contents now

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\[ \delta = \text{cell time} = 2.73 \mu s \text{ at 155 Mbps} \]

- **GCRA(4.5 \( \delta \), 0.5 \( \delta \)):**

- **GCRA(4.5 \( \delta \), 7 \( \delta \)):**
**Maximum Burst Size**

\[ \delta = \text{cell time at Peak Cell Rate (PCR)}, \]
\[ I = \text{cell time at Sustained Cell Rate (SCR)}, \ L = \text{Limit} \]
\[ N = \text{Maximum burst size (MBS)} \]

\[ \text{GCRA}(I, L): \]

\[ (N-1)\delta < L \]

\[ MBS = N = \text{Int}[1 + \frac{L}{(I - \delta)}] \]

\[ L = (MBS - 1)(I - \delta) \]
Summary

- Leaky bucket is used to smooth bursty arrivals
- GCRA requires increment (inter-cell arrival time) and limit (on earlyness)
- Two implementations: Virtual scheduling and leaky bucket
Homework

- Read Section 12.5.2, 22.1, 22.2.1-22.2.3 of McDysan’s book.
  Or Read pages 505-513 of Stallings’ ISDN and Broadband ISDN with Frame Relay and ATM)

- Conduct Lab exercise 1