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

Theoretical

Last Cell Time

No

OK

Yes

Time
**GCRA: Virtual Scheduling Algorithm**

- **Cell Arrival at** \( t \)
  - **TAT** \( < t \)? Late?
    - Yes (late) \( \rightarrow \) \( \text{Yes} \)
    - No (early) \( \rightarrow \) **TAT** \( = t \)
  - **TAT** \( > t + L \)? Too early?
    - Yes \( \rightarrow \) **Non Conforming Cell**
    - No \( \rightarrow \) **Conforming Cell**

- **TAT** \( = \text{Theoretical Arrival Time} \)

- **TAT** \( = \text{TAT} + I \)
**GCRA: Leaky Bucket Algorithm**

- **F < 0?**
  - Yes: **Non-Conforming Cell**
  - No: **F > L?**
    - Yes: **F = 0**
    - No: **X = F + I; LCT = t**

*LCT = Last Compliance Time*

*X = Bucket contents at LCT*

*F = Bucket contents now*
δ = cell time = 2.73 µs at 155 Mbps

- GCRA(4.5 δ, 0.5 δ):

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

\[ \delta = \text{cell time at PCR}, \ I = \text{cell time at SCR}, \ L = \text{Limit} \]

\[ N = \text{Maximum burst size} \]

GCRA(I, L):

\[
\begin{align*}
0 & \quad \delta & \quad (N-1)\delta \\
0 & \quad I & \quad (N-1) \ I \\
0 & \quad 4 & \quad 8 & \quad 12 & \quad 16 \\
(N-1) I - (N-1)\delta & < L \\
MBS = N = \text{Int}[1 + \frac{L}{(I - \delta)}] \\
L &= (MBS - 1)(I - \delta)
\end{align*}
\]
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

  (Or Read pages 505-513 of Stallings’ ISDN and Broadband ISDN with Frame Relay and ATM)
- Conduct Lab exercise 1