Traffic Shaping in ATM Networks

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These slides are available at
http://www.cis.ohio-state.edu/~jain/cis777-00/
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 Arrival Time

Last Cell Time

No

OK

Yes

I-L

L

I

Time
GCRA: Virtual Scheduling Algorithm

Cell Arrival at t

TAT < t? Late?

- Yes (late)

- No (early)

TAT > t + L? Too early?

- Yes

- No

TAT = TAT + I

Conforming Cell

Non Conforming Cell

TAT = Theoretical Arrival Time

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GCRA: Leaky Bucket Algorithm

F = X - (t - LCT)

F < 0?  
Yes

Non-Conforming Cell

No

F > L?  
Yes

F = 0

No

X = F + I; LCT = t

Conforming Cell

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

$\delta = \text{cell time} = 2.73 \, \mu s \text{ at } 155 \text{ Mbps}$

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

  Arrivals
  
  TAT
  
  Time
  
  0  4  8  12  16

- **GCRA(4.5 $\delta$, 7 $\delta$):**

  Arrivals
  
  TAT
  
  Time
  
  0  4  8  12  16
Maximum Burst Size

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

GCRA(I, L):

\[ \text{Arrivals} \]
\[ \text{TAT} \]
\[ \text{Time} \]

\[ 0 \quad \delta \quad (N-1)\delta \]
\[ 0 \quad I \quad (N-1)I \]
\[ 0 \quad 4 \quad 8 \quad 12 \quad 16 \]

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