Current Issues in ATM Traffic Management

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Guaranteed Frame Rate (GFR) Service: Recent Issues

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Overview

- Overview
- Known Results
- Problems w Definition
- Wentworth GCRA Graphs: Notation
- Effect of MCR Inaccuracy
- Variable Limit Frame-GCRA
- Recent Modifications to GFR Text
- Service Guarantee Interworking
Guaranteed Frame Rate (GFR)

- UBR with minimum cell rate (MCR)
  \[ \Rightarrow \text{UBR+} \]
- 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 CLP = 1
  - All frames below MCR are given CLP = 0 service.
    - All frames above MCR are given best effort (CLP = 1) service.
Known Results

- You cannot allocate all uncommitted bandwidth in MCRs with FIFO buffering. Need per-VC Queueing.

- If you want to guarantee throughput for CLP=0 frames, you need dual threshold on queue length. CLP=0 cells are dropped after $Q_{\text{high}}$; CLP=1 cells are dropped after $Q_{\text{low}}$. For throughput guarantees (w/o considering CLP), one threshold is sufficient.
Known Results (Cont)

- With $\Sigma \text{MCR} << \text{Link Capacity}$ and SACK TCP, per-VC accounting may be sufficient under certain circumstances:
  - TCP, SACK (?)
  - $\Sigma \text{MCRs} < \text{Uncommitted bandwidth}$
  - Same RTT (?), Same frame size (?)
  - No other non-TCP or higher priority traffic (?)

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To be Analyzed

- Other TCP versions.
- Effect to non-adaptive (UDP) traffic
- Effect of RTT
- Effect of tagging
- Effect of frame sizes
- Parameter study
- Buffer threshold setting formula?
- How much buffer can be utilized?
Problems w Definition

- Measure offered rate and MCR over what period
- Served rate can be much smaller even if offered rate is MCR.
- Note: Most GCRA/GFR figures are courtesy of Robert Wentworth from his ATMF Presentation.
- Ref: 97-0922*, 97-0954
Problem (Cont)

- MCR is a real number ⇒ Need tolerance
- Given a cell stream with cell/frame arrivals at t1, t2, …, tn and given a GCRA implementation and a reference GCRA, is the implementation conforming:
  - Tag/not tag the same frames?
  - Tag/not tag the same number of frames?
  - Tag/not tag at least a given number of frames?

\[ F-GCRA1 \xrightarrow{} F-GCRA2 \]
Wentworth Graphs

Frame conformance decisions are made on 1st cell arrival ⇒ Only 1st cell arrivals are shown (dots).
GCRA Compliance

Leaky Bucket Contents

Failed
Passed

F-GCRA1
F-GCRA2

Synchronization lost

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Effect of MCR

Inaccuracy

- Frame size can be between 1 and MFS cells
- In the example shown:
  - Larger MCR: $n \times \text{MFS} + 1$ cells eligible
  - Smaller MCR: $(n+1) \times \text{MFS}$ cells eligible.
  $\Rightarrow$ Larger MCR can yield smaller throughput.
- Both these GCRAs are static. L is fixed.
- Variable Limit F-GCRA
- Limit $L$ is a function of time $L(t)$
- $L(t) > BT + CDVT_{MCR}$
Recent Modifications

- MFS and MBS decoupled
- Marked vs Tagged (User vs Network)
- Network tagging allowed only if requested by the user
- Service eligible vs conforming
  \[\Rightarrow\] Changed “if” conditions in F-GCRA pseudocode

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- Non-conforming
- Ineligible
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Recent Mod. (Cont)

- MCR ≠ Guaranteed Service rate
  \[ \text{MCR} = \text{Maximum eligibility rate} \]

- New text says nothing about service
  ⇒ Networks can store and deliver later
  Networks can drop all non-eligible frames
  Such nets are compliant but "undesirable"

- \( \text{CDVT}_{\text{PCR}} \) and \( \text{CDVT}_{\text{MCR}} \)

- \( \text{GCRA}(1/\text{PCR}, \text{CDVT}_{\text{PCR}}), \text{F-GCRA}(1/\text{MCR}, f) \)
  Conformance and eligibility

- \( f \geq BT + \text{CDVT}_{\text{MCR}} \)
  \[ \text{BT} = (\text{MBS}-1)*(1/\text{MCR} - 1/\text{PCR}) \]
Recent Mod. (Cont)

- f can be a time-varying function. VLF-GCRA is allowed.
- Non-conforming CLP=0 cells: pass unchanged, discard, or tag if allowed.
- Last cell is not discarded if any cells of the frame have gone through. Last cell is discarded if all cells of the frame have been discarded.
- CLR applies only to eligible CLP=0 cells.
- Fairness is implementation dependent.
- Conformance when passing between networks.
Service Guarantee
Interworking

- Traffic contracts at successive networks
- Conforming traffic may become non-conforming
- Particularly important for GFR
- Need: How to calculate exit traffic characteristics? Still an open issue.

Ref: 97-0954R1
TM 5.0

- 1st Straw (Jul 98)
- Final (Dec 98)
- Will include GFR
Summary

- GFR Conformance is a complex issue
- MCR tolerance and Frame level guarantees are not trivial to specify
- TM5.0 will specify GFR