Current Issues in ATM Forum Traffic Management Group

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Overview

- Effect of VS/VD
- GFR
- Virtual Paths
- ITU vs ATMF
- CDV Accumulation
- CLR with EPD
Overview (Cont)

- Joint Work with other Groups
  - TM and Net Mgmt
  - ABR API
  - TM and RBB
  - TM and SAA
  - TM and Test
Virtual Source / Virtual Destination (VS / VD)

- Segments the end-to-end ABR control loop.
- Coupling between loops is implementation specific.
- VS/VD can help in buffer management across the network.
- ABR switches separated by non-ATM network could also implement VS/VD.
A Simple VS/VD Model

- Internal Service Rate = f(External/Downstream Feedback, Local congestion)
- Local Congestion = f(Q_i); Q_i = q_i + Σ q_{ij}
- Upstream feedback = Internal service rate
- Example: Downstream = 100 Mbps, Internal = 90 Mbps = Upstream Feedback
Simple VS/VD Model

- Desired input rate to class queue is also fed back to the upstream switch.

- **Problem:**
  - Transient per-VC queues cannot drain. Input rate $s_{ij} = \text{Output rate } r_{ij}$
  - Queues that build up during open loop phase do not drain.
Correct VS/VD Model

- Internal Service Rate = f(External/Downstream Feedback, Switch algorithm using $q_i$)
- $ACR_{ij} = f($Internal service rate, end system rules$)$
- Upstream feedback = $f(q_{ij})ACR_{ij}$
- Example: Downstream = 100, Service = 90, ACR = 80, Upstream feedback = 70 Mbps
Per-VC ERICA+

- BRM received:
  - $ER_{ij}^{\text{external}} := ER$ in RM cell

- FRM received:
  - $ER$ in RM := $ER_{ij}^{\text{feedback}}$

- At the end of each averaging interval:
  - $ER_{ij}^{\text{internal}}$
    := $\text{Min}\{\text{Max} \left( r_{ij} / \text{Overload}, g(q_i) R_i / N \right), ER_{ij}^{\text{external}}\}$
  - Output rate
    $ACR_{ij} = r_{ij} := \text{fn}\{ER_{ij}^{\text{internal}}, \text{end system rules}\}$
  - $ER_{ij}^{\text{feedback}} := g(q_{ij}) r_{ij}$
VSVD Results

- VS/VD switch architecture:
  - Per-VC queues drain at an ACR based only on the external congestion and class Q.
  - Feedback to upstream queue must include external congestion, class Q, and per-VC Q.
  - Each queue must monitor its input and output rate.

- Action (Feb’98): Added a sample VS/VD scheme to baseline text.
Results (Cont)

- With correct implementation of VS/VD:
  Maximum queue at each switch ≤ Bandwidth delay product of the previous loop ⇒ Can help isolate long-delay hops from short-delay hops.

- Workgroup switches on satellite paths will not need buffering proportional to round-trip even if they are the bottleneck.
VS/VD: Other Issues

- Effect on ABR parameters
- Ref: 96-1639
GFR

- Status of Feb’98 Meeting
- Signaling Parameter for GFR
  - $\text{PCR}_{0+1}$
  - $\text{MCR}_0$
  - MBS
  - $\text{MFS} = \text{Min}\{\text{CPCS PDU Size, MBS}\}$
  - Tagging
  - Best Effort
- Attempt to replace GFR with VBR.4 failed
- Attempt to include flow charts for conformance was tabled.
Virtual Paths

- VC to VP Aggregation
- EFCI State
VC to VP Aggregation

- VP = Σ VCs
- VP Traffic contract ≠ Σ VC traffic contracts
- QoS of VP = QoS of most demanding VC?
- An appendix has been added to TM5.0 describing the problem (Feb’98). No known general solution.
- Ref: 97-0714, 97-0624, 97-0168R2, 95-1519
VP sources should not reset EFCI

Solution 1: Use VS/VD at VP ends

Solution 2: Only reflect EFCI at VP source. Not full VD.

Ref: 97-0386
ITU vs ATMF

- ATMF vs ITU Classes
- QoS Parameters
ATMF VBR Definitions

- **VBR.1** ⇒ Non-conforming cells are discarded
- **VBR.2** ⇒ CLP=0 that overflow SCR bucket are dropped, CLP=1 that pass PCR bucket are eligible
- **VBR.3** ⇒ CLP=0 that overflow SCR bucket are tagged and then eligible for best effort service
ITU QoS Classes

- High priority cell vs aggregate stream
  \( \text{CLR}_0 \) vs \( \text{CLR}_{0+1} \)
- I.356 applies only to public networks
  - Class 1: Delay & \( \text{CLR}_{0+1} \)
  - Class 2: \( \text{CLR}_{0+1} \)
  - Class 3: \( \text{CLR}_0 \)
  - Unspecified Class
ATMF vs ITU Classes

- Five Service Categories vs four QoS Classes
- CBR = Class 1
- rt-VBR.1 = Class 1
- rt-VBR.2 = ?
- rt-VBR.3 = ?
- nrt-VBR.1 = 2
- nrt-VBR.2 = 3
- nrt-VBR.3 = 3
- ABR = 3, U
- UBR = U
QoS Parameters

- ATM Forum uses maxCTD and peak-to-peak CDV
- ITU uses meanCTD and 2-pt CDV
- MaxCTD $= \text{CTD}_{1-\alpha}$
- MeanCTD $= \frac{1}{n} \sum \text{CTD}$
- Peak-to-peak CDV $= \text{CTD}_{1-\alpha} - \text{CTD}_{\text{fixed}}$
- 2-pt CDV $= \text{CTD}_{1-\alpha/2} - \text{CTD}_{\alpha/2}$
- Ref: 97-0895, 97-0290, 97-0562, 97-0427, 97-0404, 96-0369
CDV Accumulation

- TM4.0 uses Mean, variance, discrepancy
- Discrepancy = Measured CDV(\(\alpha\)) - CDV(\(\alpha\)) from Gaussian distribution
Worst case $\Rightarrow$ Overestimate
$\Rightarrow$ Underutilization, Blocking

Suggest using Chernoff method or Markovian Inequality

Assumes local delays at switches are independent.

Assumes delays at each switch are gamma distributed.
Switch Delay pdf: $f(t) = \frac{\lambda^r t^{r-1} e^{-\lambda t}}{\Gamma(r)}$
$\lambda = $ scale parameter of the switch delay
$r = $ shape parameter of the switch delay
CDV Algorithm

- \( s_i = \min_{1<j\leq i} \frac{\lambda_j}{c}, \; c>1 \)
- If \( s_i \) is less than requested end-to-end CDV, accumulate \( r_i \log(\frac{\lambda_i}{(\lambda_i-s_i)}) \)
- How do you select \( c \)? Need more guidance.
- Ref: 97-0293
CLR with EPD

- Cells dropped due to EPD be not counted in CLR
Joint Work with Other Groups

- TM and Net Mgmt
- ABR API
- TM and RBB
- TM and SAA
- TM and Test
Management of ABR Service

Count invalid RM cells, valid RM cells

Invalid: BN=1 and DIR=0, ER>PCR, ...

Ref: 97-0478R2

Traffic Descriptors for CBR, VBR, ABR, UBR

CBR Traffic Descriptor: PCR, SCR, MBS, CDVT, p-to-p CDV, max CTD CLR

Ref: 97-0923

Accumulative Parameters: FRTT, maxCTD, peak-to-peak CDV
ABR API

- Query and Set: PCR, MCR, ICR, RIF, RDF, MCRmin
- Query: FRTT, TBE
- Set: ER (<PCR), MCR
- Query: ACR
- Ref: 97-0999*, 97-1020*, 97-1100*
Querying ACR

- When should the applications be notified of ACR change?
- Suggestion: two threshold crossing
- Ref: 97-1020*

```
0  MCR  ACR_{lo}  ACR_{hi}  PCR

0  MCR

ACR_{lo}

0  MCR

ACR_{lo}  ACR_{hi}
```

Notify only if invalid

Notify if service down or up
TM and RBB

- RBB: Shared access over cable, asymmetric links
- Simplification of traffic parameters for residential users
- Effect of dual delays in cable modems
- Ref: 97-1081
VBR Video

- Given mean, PCR of a video stream, how does one request SCR, MBS, ...
- Effective BW = (1-\(\alpha\))Mean + \(\alpha\) PCR
- Higher Effective BW \(\Rightarrow\) Lower MBS
- Ref: 97-0756*, 97-0733, 97-0797
- Service Category for Video: CBR, VBR, ABR, ABT
Effect of VS/VD: Buffers = previous hop
GFR: Signaling parameters.
Virtual Paths: Not easy to compute QoS
ITU classes vs ATMF service categories
CDV Accumulation: Chernoff Inequality
Future Issues

- ABR Policing
- Multipoint
- ABR Fairness and Pricing
- Effective Number of Active Sources
- Varying Phy Bandwidth
- TCP/IP over ATM
- FUNI Conformance