****

ATM Forum Document Number: ATM Forum/95-468

****

Title: The Case of Negative ABR Bandwidth:
Need for a probe interval parameter

****

Abstract:
When all VBR VCs start using their peak cell rate, the total load may exceed the link capacity making the capacity available for ABR negative. A solution to this problem is described.

****

Source:

Raj Jain, Shiv Kalyanaraman, and Rohit Goyal
The Ohio State University
Department of CIS
Columbus, OH 43210-1277
Phone: 614-292-3989, Fax: 614-292-2911, Email: Jain@ACM.Org

Raj Jain is now at
Washington University in Saint Louis
Jain@cse.wustl.edu
http://www.cse.wustl.edu/~jain/

The presentation of this contribution at the ATM Forum is sponsored by NIST.

****

Date: April 9-14, 1995

****

Distribution: ATM Forum Technical Working Group Members
(Traffic Management)

****

****

Network links are generally shared by CBR, VBR, and ABR, with CBR taking the highest priority, VBR taking the next priority and ABR

running at the lowest priority. The capacity available to ABR is:

ABR bandwidth = Link bandwidth - CBR bandwidth - Bandwidth used by VBR

A similar relationship exists for the allowable input rates:

Allowable ABR input rate = Link bandwidth - CBR input rate
- VBR input rate

The VBR connections declare an average sustained cell rate (SCR) and a peak cell rate (PCR). The PCR is typically much higher than SCR. For example, a VBR connection may declare SCR and PCR of 10 Mbps and 100 Mbps, respectively. The bandwidth used by VBR changes continuously resulting in changes to the bandwidth available to ABR. The explicit-rate feedback to the sources must follow the changes quickly to avoid building up large queues in the switches and to avoid cell loss.

In many situations, the VBR may be overbooked in the sense that the sum of PCRs may exceed the link capacity. In such cases, the allowable ABR input rate may turn negative. In other words, if the switch was allowed to, it would take the buffer space away from the ABR and give it to VBR. This is the case of negative (or zero) ABR bandwidth.

When the ABR bandwidth is zero, the ER returned to the sources is MCR or zero. If a sources' rate is set to zero, it cannot send any further RM cells since they are counted in the sources allocated rate. The next question is how can it start transmitting again. We looked at the following two solutions to this problem:

1. Send a "Restart" RM cell from the switch

2. Sources are allowed to send periodic "probe" RM cells

After some thought it becomes clear that the first approach will result in too much overhead for the switches and in unnecessary traffic in the network since all switches may send the restart cell to the same source. We, therefore, prefer the second solution which consists of the waiting sources being allowed to send RM cells periodically with a CCR field of zero. Note that a waiting source is one which has data to send but has been denied transmission due to network overload. It is different from an inactive source which have no desire to send any data.

Current source specs allow inactive sources to send an RM cell if they become active after 100ms. Although a waiting source can use this mechanism and send an RM cell every 100 ms, the time is quite long for a 155 Mbps link and even longer for 622 and higher speeds. Our proposal is to allow waiting sources to send the probe RM cells every N cell-times, where the cell time is computed at PCR of the VC.

The N should be set small so that the link capacity is used as soon as it becomes available. It should be large so that a large number of waiting sources can send the probe cells without unduely loading the link. A reasonable value is in the range of 1000 to 3000 cells causing probe cells to be sent every 3ms to 10ms on 155 Mbps links.

MOTION:

Add the following sentence to the source behavior:

"A source whose ACR has been set to zero due to extreme network overload, can send RM cells every PI/PCR seconds, where PI is the probe interval parameter specified in number of cells."