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The Case of Negative ABR Bandwidth: A Solution

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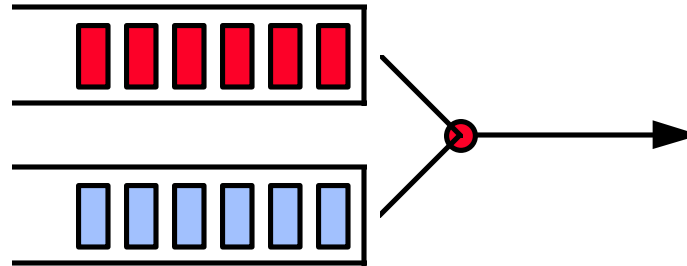
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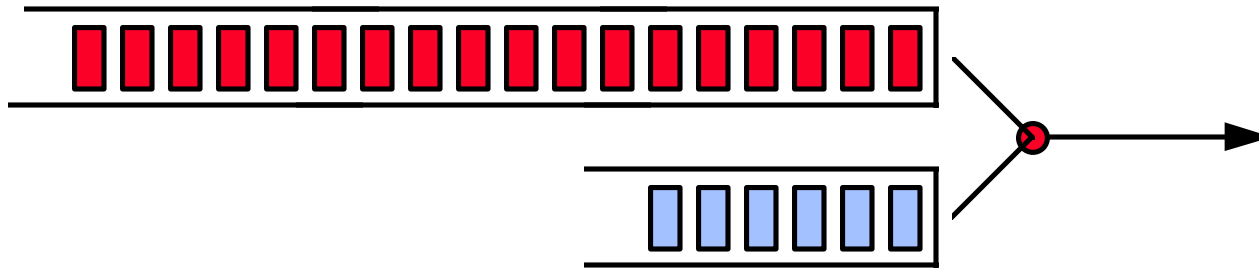
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ABR Capacity



- ❑ ABR bandwidth
= Capacity - CBR - VBR load
- ❑ VBR traffic declares SCR and PCR
- ❑ VBR may be overbooked
$$\Sigma PCR_i > \text{Link capacity}$$
$$\Sigma SCR_i < \text{Link capacity}$$
- ❑ VBR traffic may exceed the link capacity for some intervals \Rightarrow Negative ABR capacity

Problem: $ER=0$



- ❑ If the explicit rate field is set to zero, the sources with $MCR=0$ will not be able to send any further RM cells
- ❑ Waiting Sources: Sources with $ER=0$
- ❑ Q: How and when to resume?

Problem: Low Rate Sources

- ❑ The inter-RM cell time can be large even on LAN with very short round-trip delays
- ❑ Sources put to low rate cannot come up fast
- ❑ The problem is worse on WANs. BECN does not help in increasing sources' rates.
- ❑ Solution: Allow sources the freedom to send RM cells at or below N_{rm} .

Solution

- ❑ Although VBR has a higher priority, the switches reserve certain minimum bandwidth for ABR.
- ❑ The switches never set $ER=0$. They always set to some non-zero value ER_{\min} depending upon the number of active ABR VCs (or the total number of ABR VCs) and the switch's ABR reservation.
- ❑ When a source is running at very low rate, it can send RM cells more frequently than N_{rm} .
- ❑ **Low rate = $1/T_{rm}$**
- ❑ Allow T_{rm} to be set according to desired responsiveness.
 $T_{rm} = 1 \text{ ms} \Rightarrow$ Guaranteed to see RM cells in 2ms
 \Rightarrow Idle intervals of 2 ms or longer will be utilized by ABR.

Motion

- ❑ “Remove the following note from source/switch/destination specs:
2) Trm shall be set to 100 (msec).”

Solution 1: Resume Cell

- ❑ The switch that sets $ER=0$ sends a “Resume cell” to the sources that it put to waiting state.
- ❑ Disadvantages:
 - ❑ Switch complexity: Switch has to remember all VC with $ER=0$
 - ❑ Too much traffic: Many switches on the path may send the resume cells
 - ❑ What if the resume cells are lost?

Solution 2: Probe Cells

- ❑ Sources that are waiting (at $ER=0$) are allowed to send “Probe Cells” periodically to find out if they can resume.
- ❑ Period: 100 ms is too late for most LANs
- ❑ Disadvantages:
 - ❑ Deciding the period is difficult for sources.
 - ❑ The period should be a function of the number of waiting sources so that the total traffic is bounded. Sources do not have this information.

RM Cell Frequency

- ❑ The unfairness problem was caused earlier by allowing sources to rise by fixed AIR on every RM.
- ❑ There were two solutions:
 - ❑ Make AIR a per cell parameter. The rate increase amount depends upon the number of cells since the last RM
 - ❑ Sources be not allowed to send RM cells before Nrm data cells
- The current proposal implements both.
- ❑ The source pays for the RM cells and should be allowed to send them whenever it wants.

Alternative

[Not Recommended]

- ❑ If sources are not allowed to send RM cells before Nrm data cells then:
 - ❑ Add an “NRM1” (Nrm One) bit in the RM cell.
 - ❑ The switches set the bit when they set ER to ERmin
 - ❑ On receiving an RM cell with this NRM1 bit on, the sources are allowed to send RM cells (at ERmin rate) without any intervening data cells.