CCITT SG XV
Working Party XV/1
Experts Group for ATM Video Coding

Document AVC-89
1 August 1991

SOURCE : JAPAN
TITLE : Considerations on the window size of traffic descriptor
PURPOSE : Information

---

1. Background

In B-ISDN, the transmission rate is regulated to satisfy a traffic descriptor in order to guarantee proper network operation. There are several possible algorithms which limit peak and average transmission rates. In those schemes, the window size of rate control is supposed to be a dominant factor in coded picture quality.

The effect that window size makes on picture quality is investigated by a computer simulation in the system which includes feedback control mechanisms to satisfy the traffic descriptor.

2. Simulation

The coding system is shown in Fig. 1.

(i) The coder is based on RM8, and quantizer step size is controlled to converge the average coding rate to a target (see ANNEX).

(ii) The packetizing buffer quits coding and makes all the macro blocks (MBs) 'Fixed' when the buffer occupancy Br exceeds $k*B$ where B is buffer capacity and $0<k<1$. Coding is resumed when Br goes down to less than $k*B$.

(iii) The packetizing buffer sends cells to the network at the peak rate, i.e. the minimum valid cell interval is d.

(iv) Valid cells are counted within each jumping window and the system quits cell-output just before the number of valid cells exceeds a threshold Th determined by the target average bit rate. The counter is reset when the next window starts.

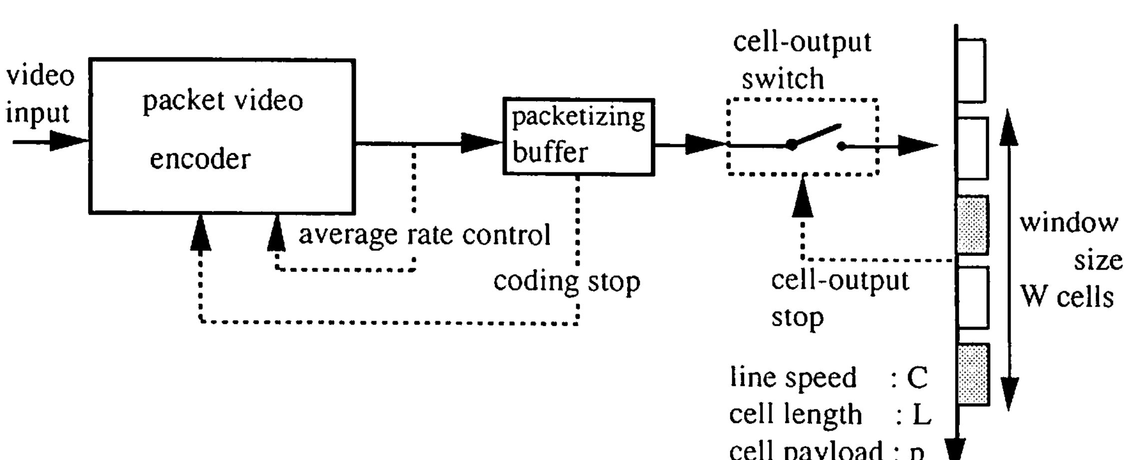

Fig. 1 Configuration of simulation system

Simulation parameters

Line speed	: C=150.96 Mbit/s
Cell length	: L=53 Byte
Cell payload	: p=45 Byte
Coding timing	: each MB
Video format	: CIF (396 MB / frame, 29.97 frame / sec)
Average coding rate	:Vm=(C*p)/(L*n) given by n
Peak coding rate	: Vp=(C*p)/(L*d) given by d
Peak/average ratio	: Rv=Vp/Vm
Window size	: W cells
Threshold	: Th=W/n
Packetizing buffer capacity	: B
Packetizing buffer delay	: Db=B/Vm
Video sequence	: news program (several persons, fixed camera and 2 sec. zooming scene - 510 frames -)

Simulation results

Coding stop rate (R_1) and cell-making stop rate (R_2) are defined as follows.

R_1=(Coding-stopped MBs) / (All MBs) * 100 (%)

R_2=(Windows with cell-output stop) / (All windows) * 100 (%)

Both rates and SNR for several window sizes are shown in Table 1.

Table 1 Simulation results

Window size	Coding stop rate	Cell-output stop rate	SNR
0.1 sec	4.21 %	17.06 % (29/170)	40.01 dB
0.5 sec	2.92 %	14.71 % (5/ 34)	40.30 dB
1.0 sec	2.09 %	11.76 % (2/ 17)	40.40 dB
2.0 sec	0.55 %	11.11 % (1/ 9)	40.65 dB
5.0 sec	0.44 %	0.00 % (0/ 4)	40.71 dB

Vm=2.24 Mbit/s (n=48)   B=4*L=212 Byte
Rv=4.0 (d=12)   Db=0.76 msec

3. Discussion

A cell-output stop occurs at the two second zooming scene in this simulation, and that leads to a continuous coding stop because of buffer full occupancy. When the window size is large enough (2.0 sec and 5.0 sec), no effect of cell-output stop can be observed.

Coding-stopped MBs independent of cell-output stop can be reduced when a large packetizing buffer is provided, although buffer delay has to be considered.

4. Conclusions

Window sizes of the traffic descriptor were considered by using a coding model. Several seconds in this model are required for the window size to absorb the changes of video sequences such as zooming without large degradation when we exploit the advantage of VBR coding.

End

ANNEX

Average Rate Control Mechanism

In this system, the average rate is controlled by changing the quantizer step size (Q). The Q selecting algorithm for the rate convergence is based on feedback control using the coding results of the previous frames, which is denoted as follows.

$Q_n = Q_{n-1} + \Delta Q$

$\Delta Q = a(I_{n-1} - I_0) + b(I_f - I_0)$

where

ΔQ : differential of Q

a,b : sensitivity constants

I_0 : target value of output amount per rate control unit
(ex. GOB as rate control unit)

I_{n-1} : output amount of previous rate control unit

n : number of currently coded rate control unit

I_v : average of output amount per rate control unit so far $= \sum_{i=1}^{n-1} \frac{I_i}{n-1}$

I_f : target value of output amount in the next N rate control units

$= \frac{1}{N}\{I_0(n-1+N) - \sum_{i=1}^{n-1} I_i\}$

(a target value to make the average of n-1+N rate control units equal to I_0)

N : parameter for rate convergence speed

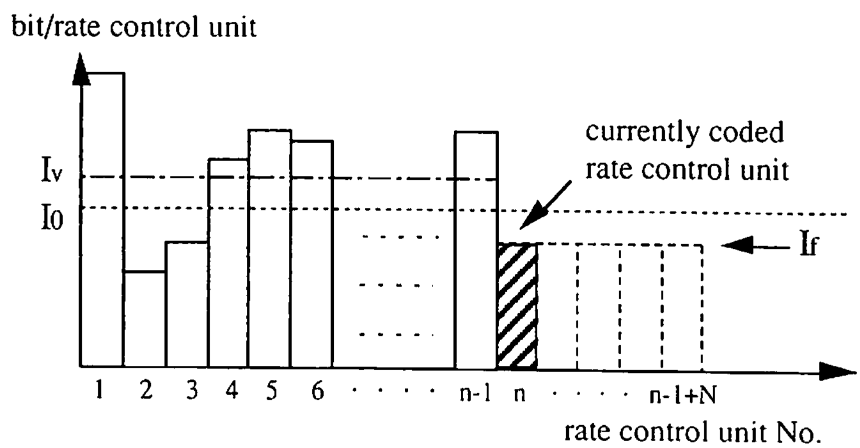

Fig. Coding output amount and target values