MPEG 92/186

CCITT
STUDY GROUP XV WP XV/1
Experts Group for ATM Video Coding
Stockholm, 18-20 March 1992

Document # AVC-252

English Version

SOURCE: A. R. Reibman, C. Horne, and R. Aravind; AT&T Bell Laboratories
TITLE: Coding results for SCIF progressive images
PURPOSE: Informational

1 Introduction

In this contribution, we present some coding results for SCIF progressive images. The sequences were digitized from progressive 60Hz, 70mm film from Showscan. It was digitized in RGB with a density of 2k by 1k pixels. A window of 576 lines by 720 pixels was selected and converted to YCbCr. The chrominance was decimated by two vertically and horizontally, after filtering with a simple 1-2-1 filter. The aspect ratio of the resulting image is 4:3. Two sequences are generated: "passenger", which is 103 frames, and "roll", which is 121 frames.

We first present the compression efficiency and quality resulting from using an MPEG1 encoder on these progressive sequences. We also examine a "low-delay" mode that uses P' frames that are B frames with forward-only prediction. Next, we present the necessary leaky bucket and sliding window parameters such that the VBR video stream will have no bits that are non-compliant [1]. Finally, we present some results given cell losses, using an MPEG1-compatible bit-stream.

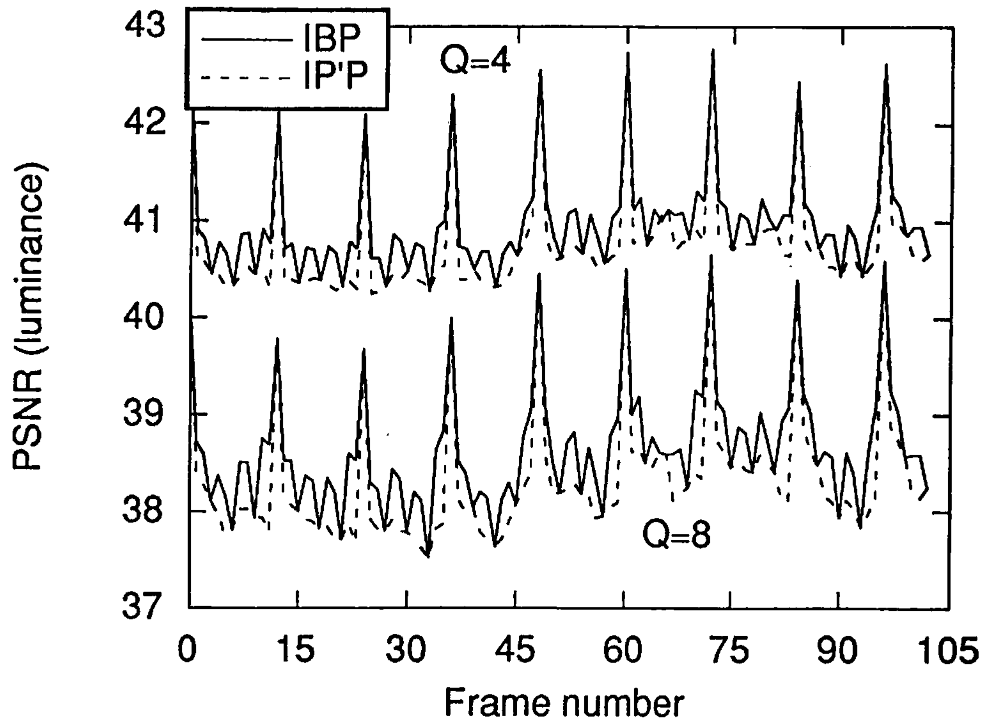
2 Coding efficiency

2.1 $M = 3, N = 12$, IBP

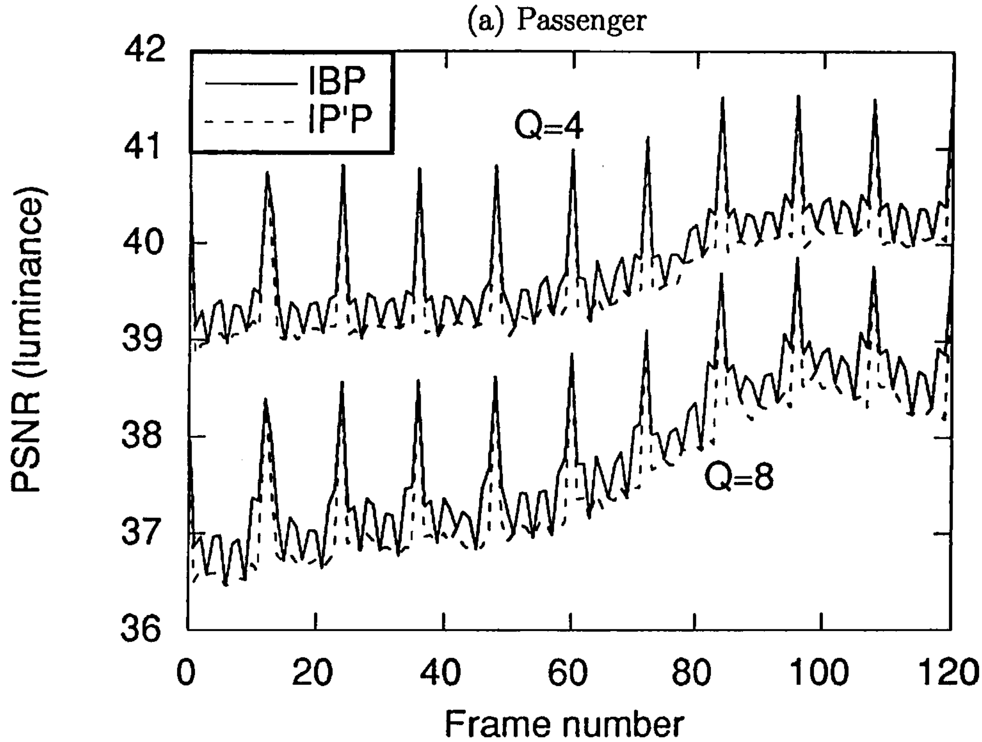
We use an MPEG1 encoder, with $M = 3$ and $N = 12$. First, we use the PWD0 rate control algorithm at 4 and 9 Mb/s. The buffer sizes are 450 kbits and 900 kbits respectively. Table 1 summarizes the bit-rate and PSNR (luminance) statistics for each frame type.

Next, we use a constant quantizer parameter, Q=4 and Q=8. The PSNR (luminance) and instantaneous bit-rate is shown as a function of time in Figures 1 and 2.

These images will be displayed on a interlaced monitor from a D1 tape (480 lines only, with alternating lines from each frame). In addition, the progressive images will be displayed on a progressive monitor.

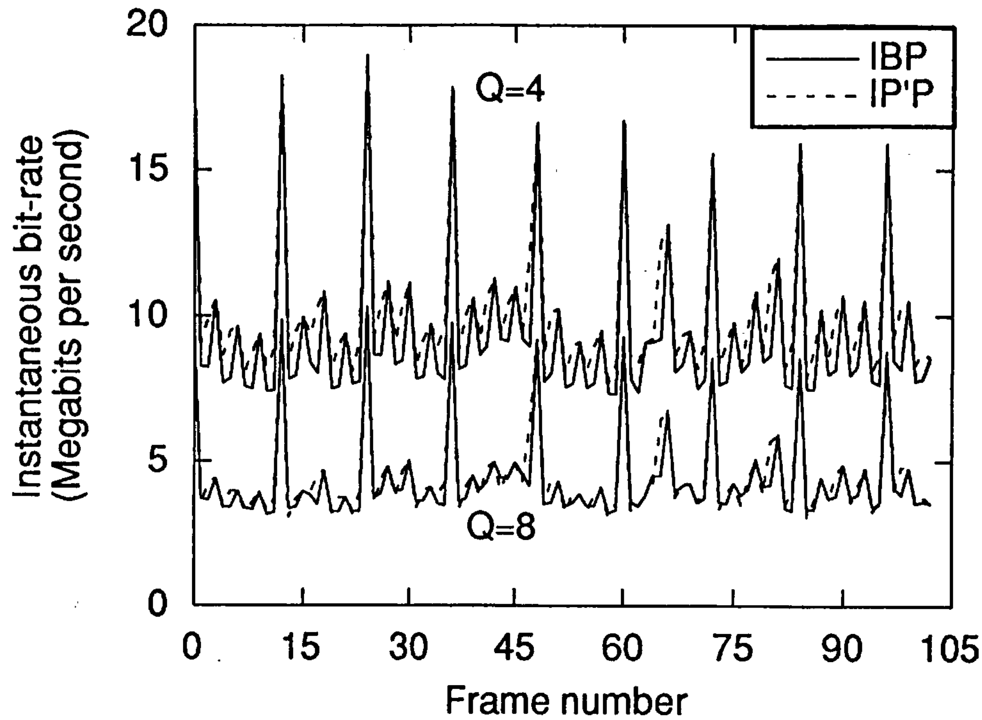


(a) Passenger

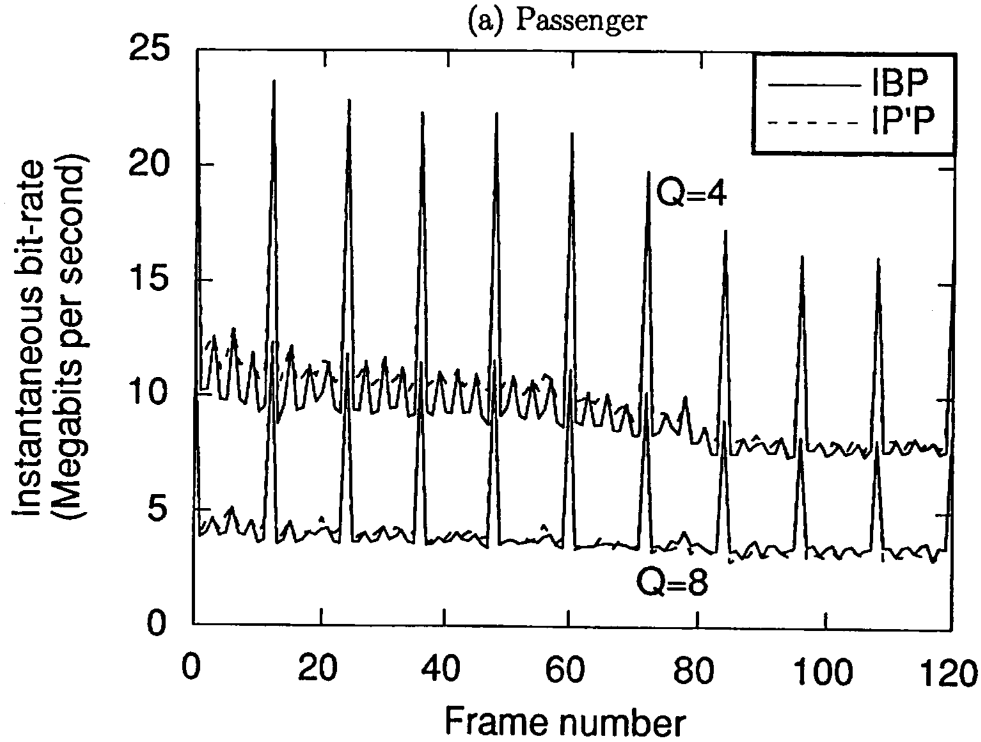


(b) Roll

Figure 1: Signal-to-noise ratio, constant quantizer



(a) Passenger



(b) Roll

Figure 2: Instantaneous bit-rate, constant quantizer

2.2 $M = 3, N = 12$, IP'P

We also demonstrate the results using P' frames, where P' frames, like B frames, are outside the coding loop, but unlike B frames, use only previous pictures for prediction. If the MPEG1 syntax allowed it, this would correspond to a low delay mode.

The PSNR (luminance) and instantaneous bit-rate for the "low-delay" mode is also shown in Figures 1 and 2. In all cases, the bit-rate for P' frames is greater than for B frames, and the PSNR is worse. This is particularly true for the second P' frame between two reference frames.

3 VBR traffic descriptor parameters

Figure 3 shows sliding window (SW) and leaky bucket (LB) parameters necessary to ensure the VBR video of section 2.1 can be transmitted without violation [1]. For the leaky bucket, the nominal average rate decreases sharply as the bucket size increases up to 2 frames. For passenger, an LB size of 4 is sufficient to make the nominal average rate equal to the actual average rate of the sequence. For roll, the size must be at least 6. However, for the same condition, the size of the sliding window must be much greater.

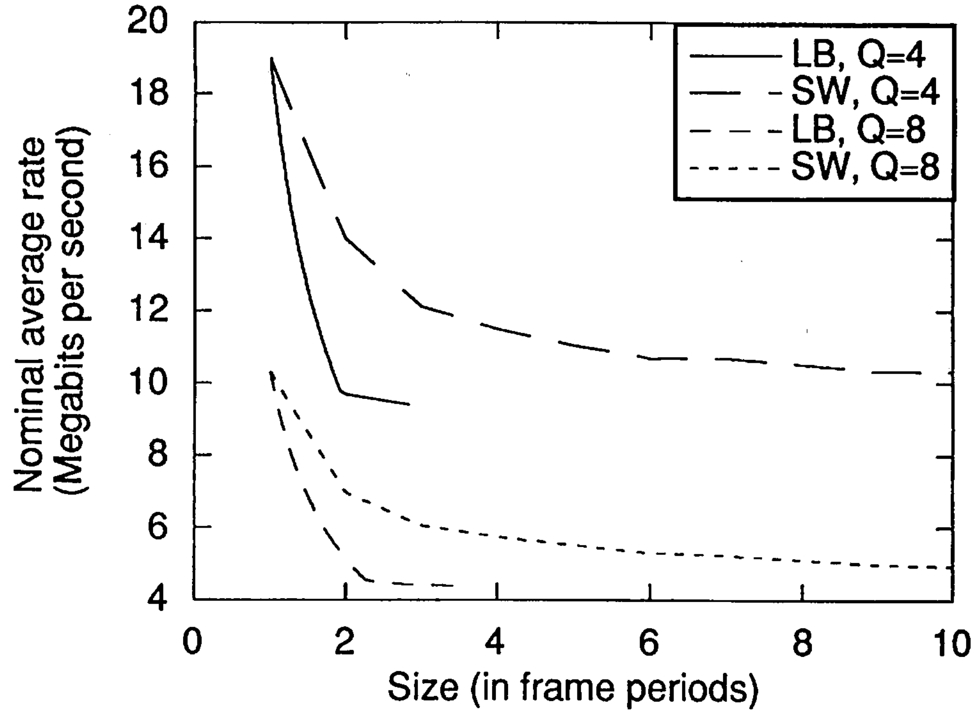
4 Cell losses

We examine the effect of cell-losses on an MPEG1 coded bitstream where a packetizer creates two layers for transmission. In all cases, files are created to contain cells as suggested in [2], section 1. Cells are lost as described in section 2 and 3 of [2]. In each case, the mean cell loss rate is 1 in 1000, and the mean burst length is 2.

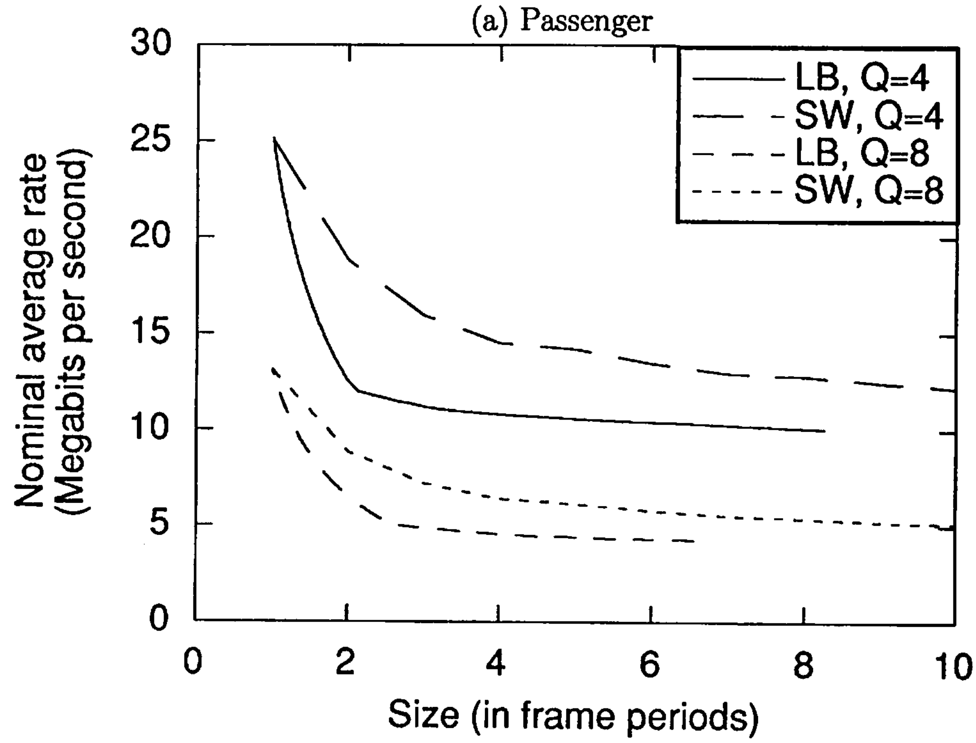
We consider three cases. In case 1, all data is transmitted as low priority and is subject to losses. In cases 2 and 3, the bit-stream is decomposed into both high and low priority data. Only the low priority data is subject to cell losses.

To create two layers, the packetizer demultiplexes on the basis of frame type. In case 2, all I frames are transmitted as high priority and all B and P frames are transmitted as low priority. In case 3, all I and P frames are transmitted as high priority and only the B frames are transmitted as low priority. In both cases 2 and 3, the packetizer puts a sequence start code and a sequence end code in both layers. Furthermore, the bits for the picture layer of the low priority frames is included in both the high and low priority data. The duplicated bits can be removed by the depacketizer before decoding. However, they are essential in the high priority layer so the decoder will have access to the picture type, and any motion parameters. Furthermore, they assist the depacketizer in re-multiplexing the MPEG1 bit-stream.

Tables 2 and 3 indicate the number of bytes used in each layer of each sequence when the quantizer parameter is fixed, $Q = 4$. The total number of bytes used in both layers is also shown.



(a) Passenger



(b) Roll

Figure 3: Traffic descriptor parameters, constant quantizer

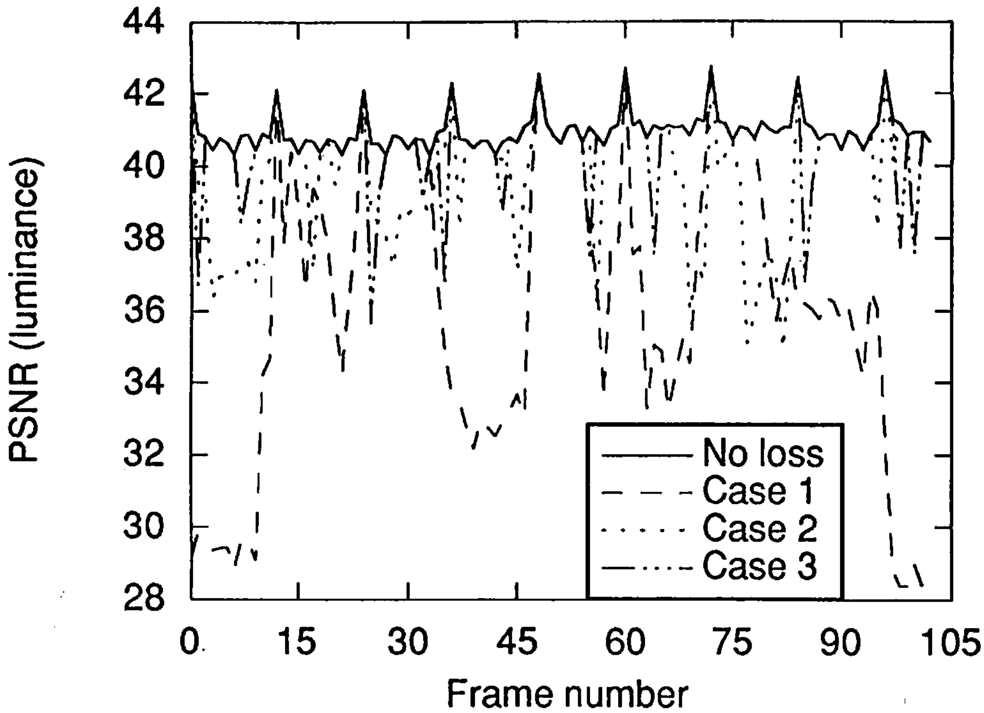
In each case, there is one slice per line, and the depacketizer, upon recognizing a cell loss (through cell sequence number), discards all subsequent bits until a new start code is found. Lost macroblocks in an I frame are replaced either using the same block in the previous P frame or (for the first frame) a grey block. Lost macroblocks in a P frame are replaced using the previous P or I frame. Lost macroblocks in a B frame are replaced with the average of the two blocks at the same location in the two reference frames.

The PSNR for the resulting images are shown in Figure 4. The resulting image quality will also be displayed.

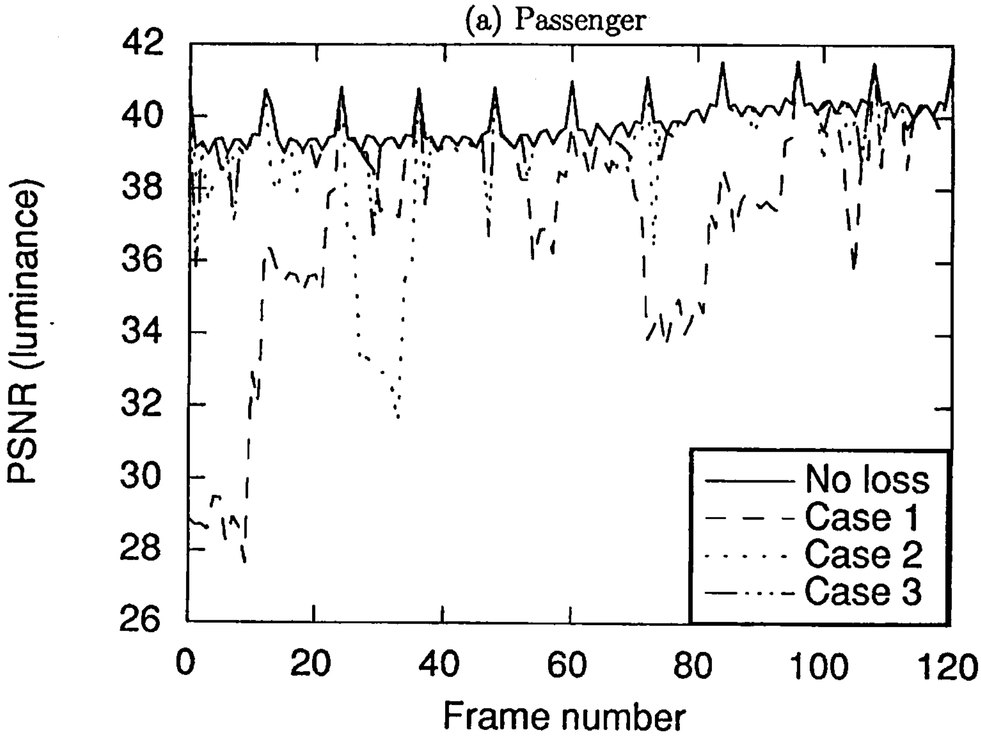
References

[1] AVC-202, "Selection of Traffic Descriptors and the Impact of Buffering", AT&T Bell Labs, Singapore, 6 January 1992.

[2] MPEG 92/027, "Cell loss experiment specifications", CCITT SGXV Experts Group for ATM Video Coding, Singapore, 7 January 1992.



(a) Passenger



(b) Roll

Figure 4: Signal-to-noise ratio with cell loss, $Q = 4$

Sequence	I-bits	P-bits	B-bits	I-snr	P-snr	B-snr
Pasg, 4 Mb/s	161580	79501	49375	39.79	37.45	37.69
Pasg, 9 Mb/s	354836	204351	102453	42.92	40.72	39.81
Roll, 4 Mb/s	183690	71378	49657	38.60	36.97	37.02
Roll, 9 Mb/s	395673	187783	103629	41.30	39.46	38.73

Table 1: Statistics, with PWD0 rate control

	High priority bytes	Low priority bytes	Total bytes
Case 1	0	2019371	2019371
Case 2	320426	1699935	2020361
Case 3	879708	1140419	2020127

Table 2: Bit count for sequence passenger, $Q = 4$

	High priority bytes	Low priority bytes	Total bytes
Case 1	0	2539385	2539385
Case 2	466883	2073636	2540519
Case 3	1098484	1441765	2540249

Table 3: Bit count for sequence roll, $Q = 4$