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Study Group 15
Experts Group for ATM Video Coding
(Rapporteur's Group on Part of Q.2/15)

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SOURCE: Tektronix
TITLE: H.26x Error Resiliency Based on Data Partitioning and Concealment
PURPOSE: Discussion

1. Introduction

The purpose of this contribution is to summarize some of the error resiliency results we have obtained so far by using data partitioning and concealment techniques. The concept of data partitioning was proposed in the Rome MPEG meeting (see Docs. MPEG 93/236, 240) with the aim to provide a simple method for error resiliency and "bitstream" scalability.

2. Description of Experiments

The simulations are carried out according to the following conditions:

TM4:	Frame Structure, N = 15, M = 3 and M = 1, N=51.
Picture Format:	4:2:0
Rate:	4 Mbits/sec
Motion Vector:	Frame (+-15, +-15)/frame
Sequences:	Flower Garden, Mobile & Cal 150 frames each.
CLR:	10**(-3)
Data Partitioning:	PBP_1(0) and PBP_1(3)
Concealment:	Motion Interpolation

The bitstream generated at the output of the encoder is packetized, at the slice-level, into a single packet or two high and low priority packets. In our implementation, a packet is called a high priority packet, if it only contains the high priority elements of data partitioning syntax. Otherwise, it is referred to as a low priority packet. High priority video data consists of 1) the picture and higher syntax layers; 2) high priority block run/level VLCs as described in MPEG 93/236, 240; and 3) the slice and macro block layers if there is some high priority data in each macro block. Peculiar to our implementation is that all the bits in B frames are treated as a low priority data (i.e., everything below picture layer). This, we felt, was justified for cases when a relatively small number of high priority cells is desired (e.g., %25 vs. %75). The syntax of the packet header follows the MPEG1 system syntax, and we have used the video stream address space to convey priority information. At the AAL, high/low priority packets are mapped into high/low priority cells and are sent to an ATM channel with the following assumptions: 1) for a given slice size, low priority cells will always follow high priority cells; 2) any cell containing high priority data is considered as a high priority cell; 3) all system layer data except for the payload of low priority packets will be treated as high priority data by the AAL; and 4) high priority cells will not experience any cell loss. The field structure of our AAL contains a 4-bit cell-sequence number and a 4-bit sequence number error protection field. Finally, in order to better judge the subjective effect of loss protection/concealment schemes and for graphical SNR comparisons, we have kept the spatial position of error patterns fixed.

In Figs. 1-6 we have illustrated the effect (in terms of SNR) of various cell loss protection schemes (i.e. simple concealment, data partitioning, and their combination). The meaning of the notation used in the Figures is as follows: "part.conc", means that a combination of data partitioning and concealment is used for loss protection; "conc", refers to the application of concealment only; "noerr" implies no loss at all; "maxerr", shows the accumulative effect of errors (including propagation) by replacing each errored macro blocks with 50% gray-level. In Tables 1-2, we have summarized the actual statistics we have obtained through our simulations. These include values such as average cell loss burst length etc.. In addition, we have a D1 tape demo to present our results.

3. Conclusions

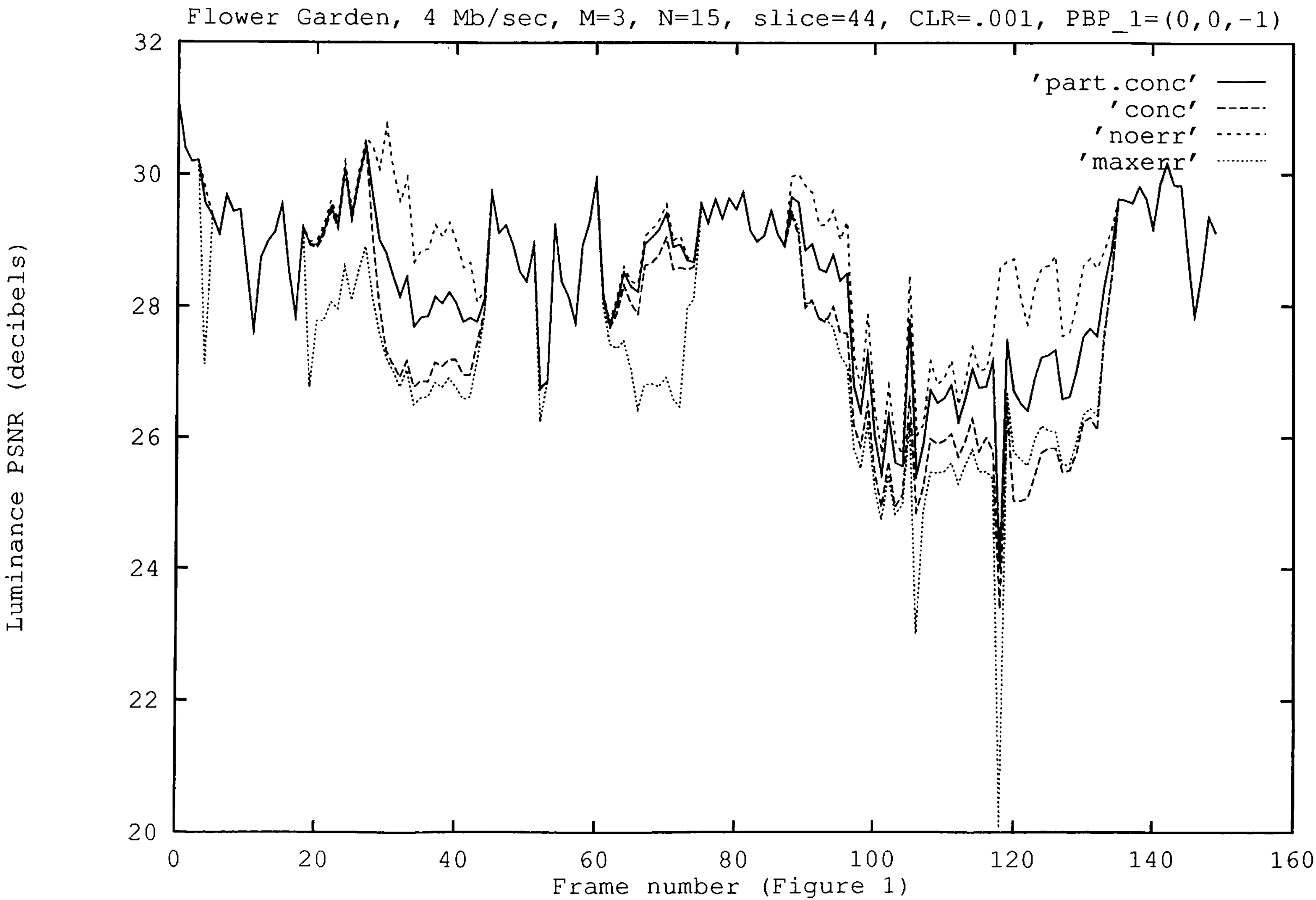
Based on the experiments we have done so far, we feel a combination of data partitioning and concealment techniques provide a powerful and yet simple tool for loss protection. Clearly, more study is needed to better explore and understand the potential and shortcomings of this technique.

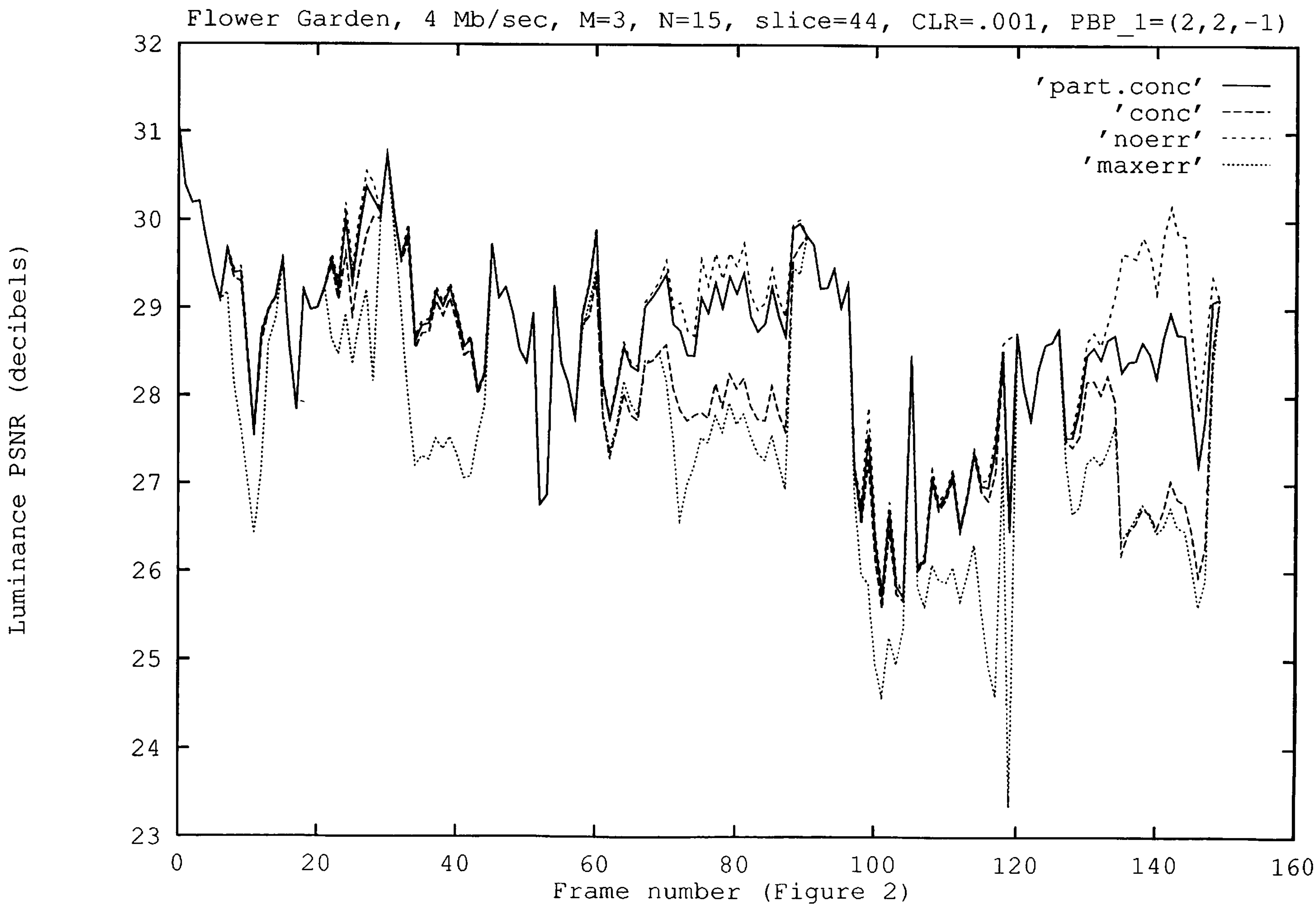
Table 1: Flower Garden

		M = 3		M = 1	
		PBP_1[0]	PBP_1[2]	PBP_1[0]	PBP_1[2]
Avg. SNR (no Error)		28.63	28.63	28.00	28.00
Avg. SNR (Part. + Con.)		28.20	28.46	27.96	27.87
Total Cells		55728	55728	54638	54638
% Low Cells		76%	68%	50%	42%
Cells Lost	I	5	11	0	1
	P	12	15	15	11
	B	13	4	0	0
Errored MBs	I	128	53	0	24
	P	77	148	248	203
	B	278	94	0	0
Avg. Burst	I	1.00	2.75	0	1.00
	P	2.00	1.67	1.50	1.57
	B	2.60	1.33		

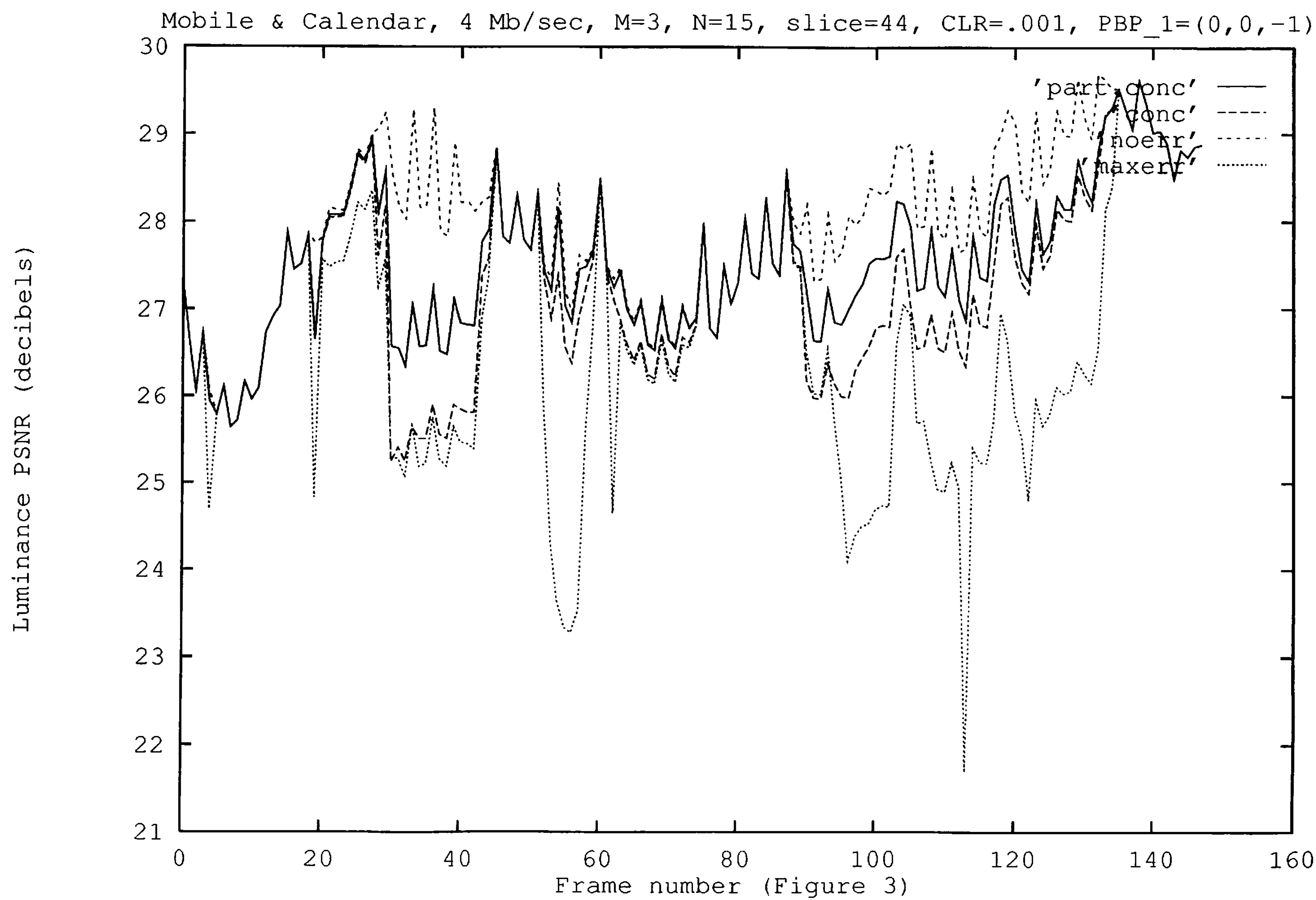
Table 2: Mobil & Cal

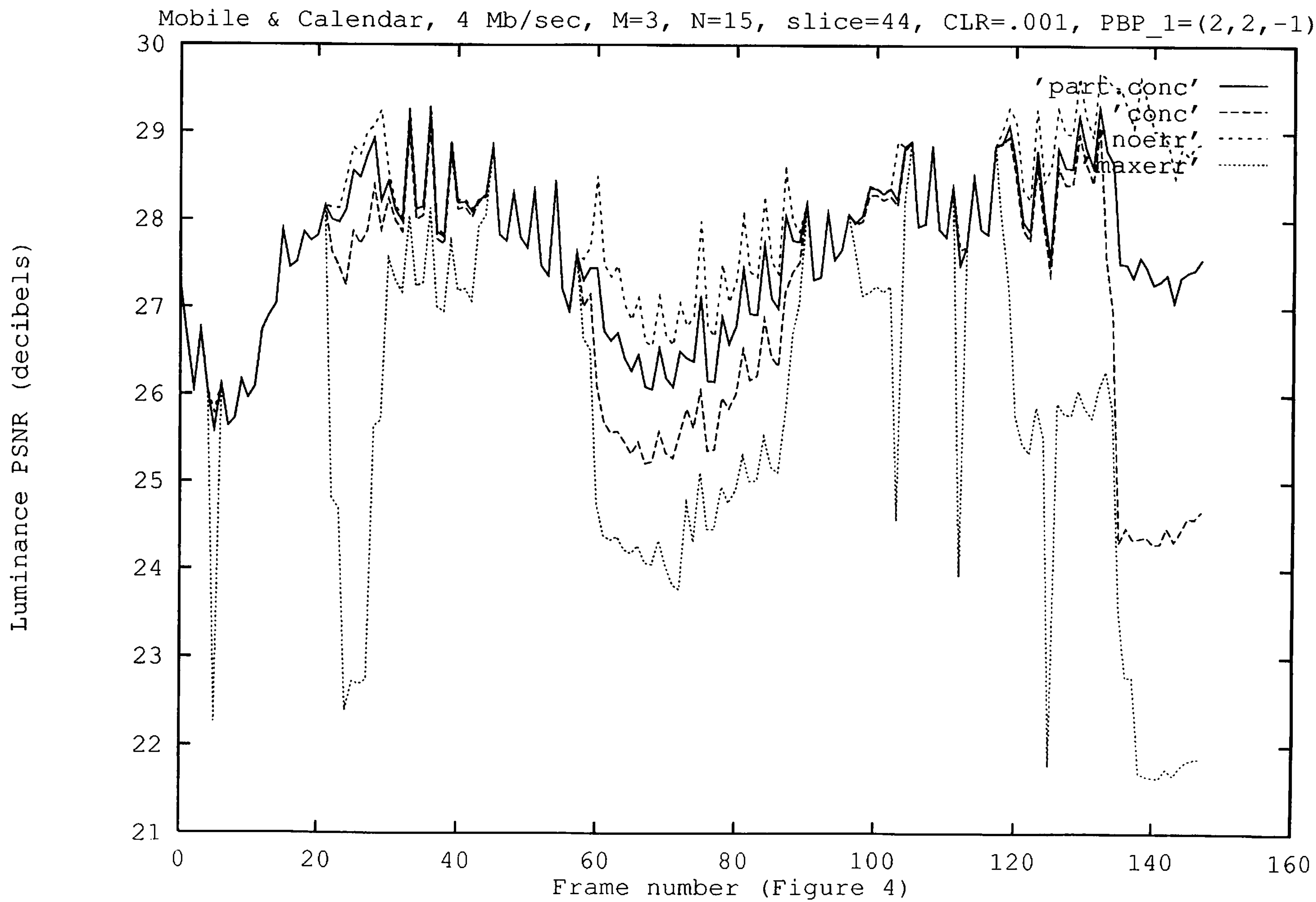
		M = 3	
		PBP_1[0]	PBP_1[2]
Avg. SNR (no Error)		27.89	27.89
Avg. SNR (Part. + Con.)		27.48	27.55
Total Cells		56014	56014
% Low Cells		76%	68%
Cells Lost	I	13	14
	P	11	9
	B	6	7
Errored MBs	I	130	188
	P	90	141
	B	159	148
Avg. Burst	I	2.17	2.33
	P	2.90	1.80
	B	1.20	1.40

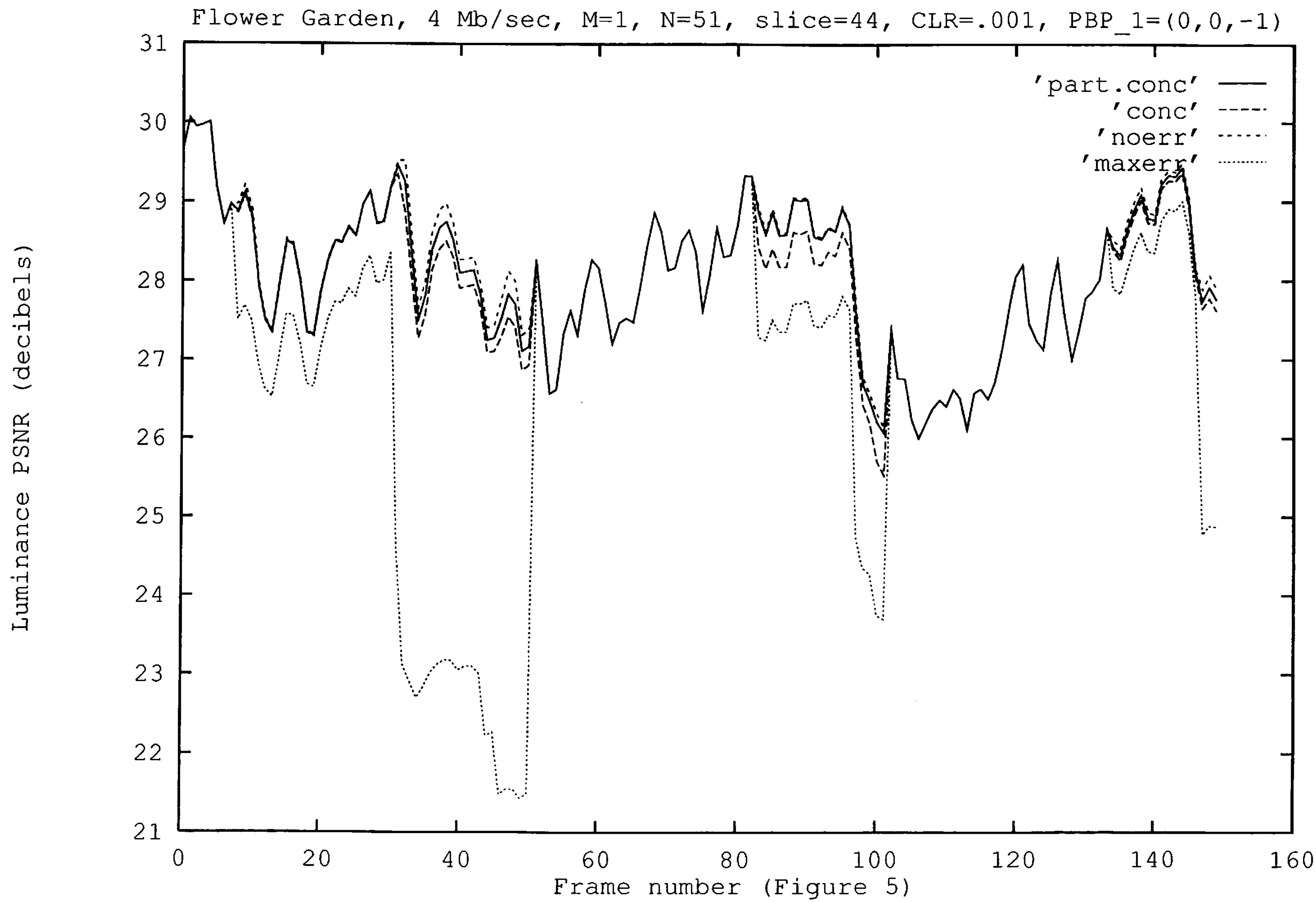

Flower Garden, 4 Mb/sec, M=3, N=15, slice=44, CLR=.001, PBP_1=(0,0,-1)
'part.conc'
'conc'
'noerr'
'maxerr'
Luminance PSNR (decibels)
32
30
28
26
24
22
20
0
20
40
60
80
100
120
140
160
Frame number (Figure 1)



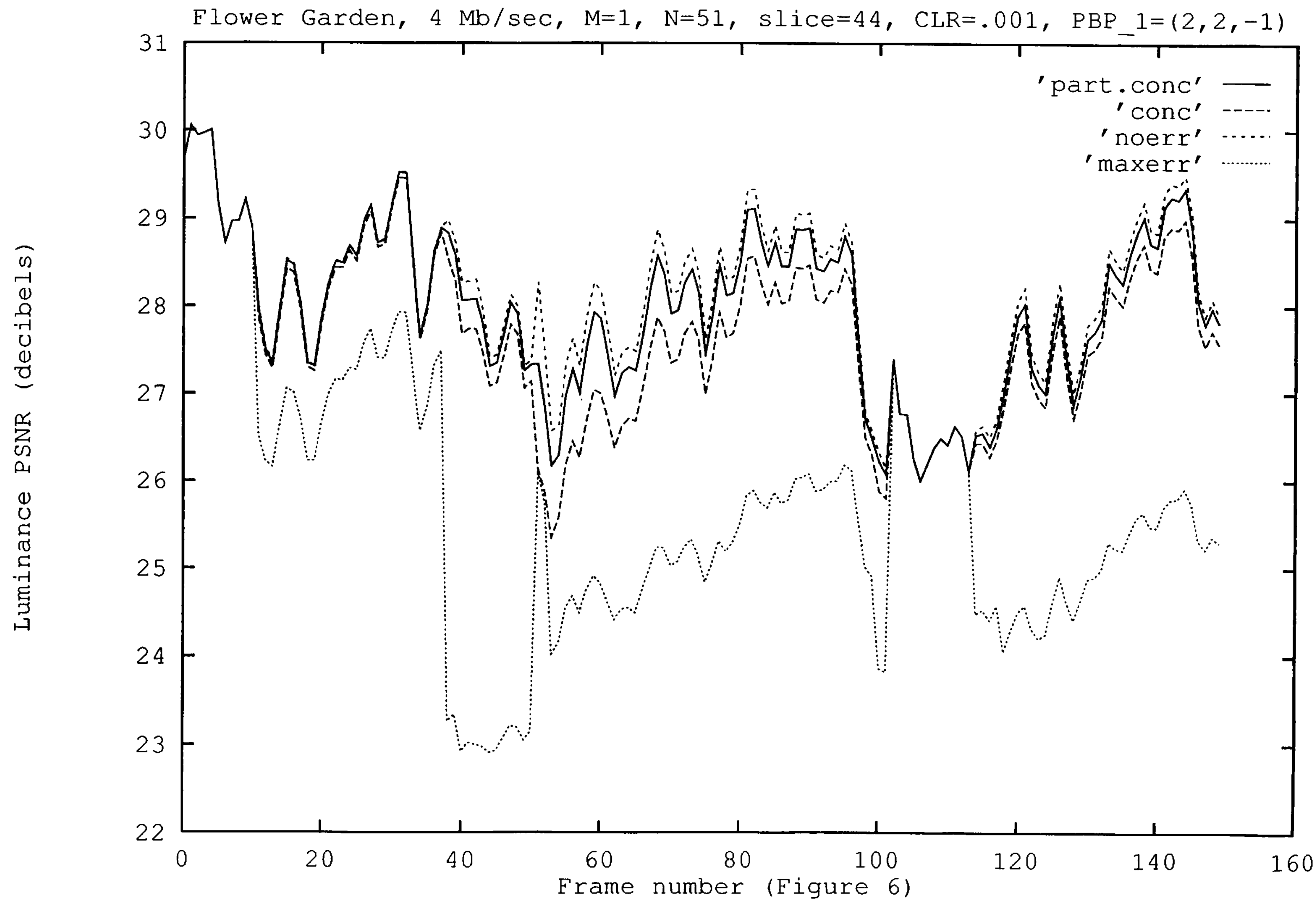
Flower Garden, 4 Mb/sec, M=3, N=15, slice=44, CLR=.001, PBP_1=(2,2,-1)
'part.conc'
'conc'
'noerr'
'maxerr'
Luminance PSNR (decibels)
32
31
30
29
28
27
26
25
24
23
0
20
40
60
80
100
120
140
160
Frame number (Figure 2)


Mobile & Calendar, 4 Mb/sec, M=3, N=15, slice=44, CLR=.001, PBP_1=(0,0,-1)
'part_conc'
'conc'
'noerr'
'maxerr'
Luminance PSNR (decibels)
30
29
28
27
26
25
24
23
22
21
0
20
40
60
80
100
120
140
160
Frame number (Figure 3)


Mobile & Calendar, 4 Mb/sec, M=3, N=15, slice=44, CLR=.001, PBP_1=(2,2,-1)
'part.conc'
'conc'
'noerr'
'maxerr'
Luminance PSNR (decibels)
30
29
28
27
26
25
24
23
22
21
0
20
40
60
80
100
120
140
160
Frame number (Figure 4)



Flower Garden, 4 Mb/sec, M=1, N=51, slice=44, CLR=.001, PBP_1=(0,0,-1)
'part.conc'
'conc'
'noerr'
'maxerr'
31
30
29
28
27
26
25
24
23
22
21
0
20
40
60
80
100
120
140
160
Luminance PSNR (decibels)
Frame number (Figure 5)


Flower Garden, 4 Mb/sec, M=1, N=51, slice=44, CLR=.001, PBP_1=(2,2,-1)
'part.conc'
'conc'
'noerr'
'maxerr'
Luminance PSNR (decibels)
31
30
29
28
27
26
25
24
23
22
0
20
40
60
80
100
120
140
160
Frame number (Figure 6)