AVC - 141

MPEG 91/208

J. MAU

DESCRIPTION OF THE VADIS-A3 COMMON SCHEME

MPEG2 PROPOSAL n° 9

Coding scheme proposed by the algorithm group 3 of the european VADIS project and supported by:

Proposers:

CCETT	F
EPFL	CH
HHI	D
LER	F
SIEMENS	D
UCL	B

Simulations and papers done by CCETT.
Source: J.Mau / CCETT-FRANCE

Introduction

This paper describes briefly the common scheme proposed by the Algorithm Group 3 of the european project **VADIS** (referenced as proposal n°9) and gives in annexes the useful information (VLC tables, statistics ...).

The block diagrams of the encoder and decoder are shown next page.

This 4.2.2 coding scheme is based on a two dimensionnal **PRMF** frequency splitting in 8*8 subbands.

PRMF means Perfect Reconstruction Modulated Filters, a newly developped subband technique by **CCETT**, and which will be presented in the early 1992 at the **ICASSP** conference in San-Francisco.

This **PRMF** subband scheme combines the advantages of subband techniques and can be implemented with a fast algorithm leading to a very efficient hardware implementation, with a total number of multiplications and additions comparable to the best 8*8 **DCT** solutions. (#A =7.5 and #M=2.5 per pixel for a 2D 8*8 splitting for **PRMF** to be compared with B.G. LEE algorithm for a 2D 8*8 **DCT**: #A=7.25 and #M=3).

These **PRMF** permit also local field/frame decisions which seems not to be possible in any other type of subband techniques.

Nevertheless a lot of particular points are still open to discussion and certainly need some more experiments. Many feedbacks are expected from, for example, hardware implementation people, but the general framework of this codec is now quite stable and presented in this paper.

A simple hardware cost evaluation is also given in this document.

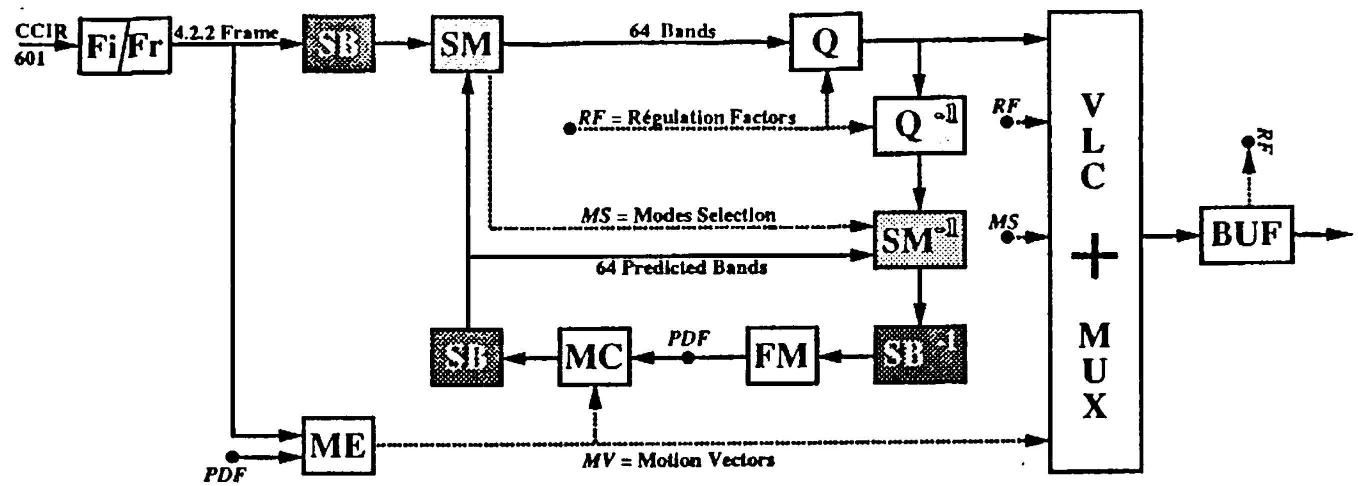
All the numbers will be related to luminance signals (except when specified). Chrominance signals are treated rather similarly except that some horizontal dimensions are to be divided by 2 due to the horizontal sub-sampling. This has to be known to estimate the hardware cost of a complete **Y/DB/DR** codec. At first approximation except for boxes **ME** and **SM** the cost for **DB+DR** is the same as for **Y**

On paths will be indicated the numbers of bits transferred per clock cycle except when followed by the '/' signifying that this number of bits is transferred at lower frequency (example 12/256 is equivalent to 12 bits each 256 cycles).

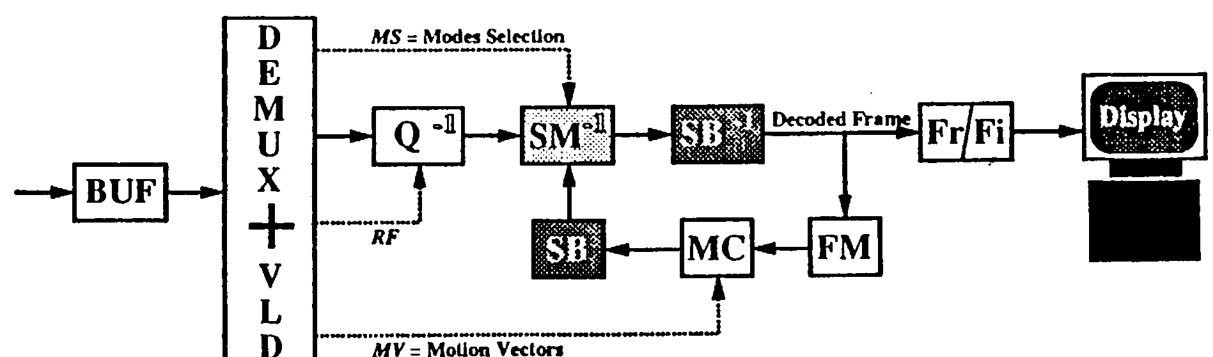
#A and #M mean respectively number of additions and multiplications per cycle (per pixel), #I and #O mean number of input bits and output bits per cycle. #MEM means size of the memory in bits.

LEGEND

SB	Separable two dimensionnal 8*8 subbands decomposition
SB^{-1}	Separable two dimensionnal 8*8 subbands reconstruction
SM	Selection of coding modes and execution
SM^{-1}	Receives the coding modes and executes the inverse processes
Q	Quantization of the 64 subbands
Q^{-1}	Inverse Quantization of the 64 subbands
FM	Frame memory
MC	Motion compensation process in the image domain
ME	Motion estimation process in the image domain
VLC	Variable length encoder
VLD	Variable length decoder
BUF	Buffer needed for bit-rate regulation
Fi/Fr	Fields to frame and lines to blocks conversion
Fr/Fi	Frame to fields and blocks to lines conversion
PDF	Previously decoded Frame



SUBBAND ENCODER



SUBBAND DECODER

LEGEND

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VLC	Variable length encoder
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BUF	Buffer needed for bit-rate regulation
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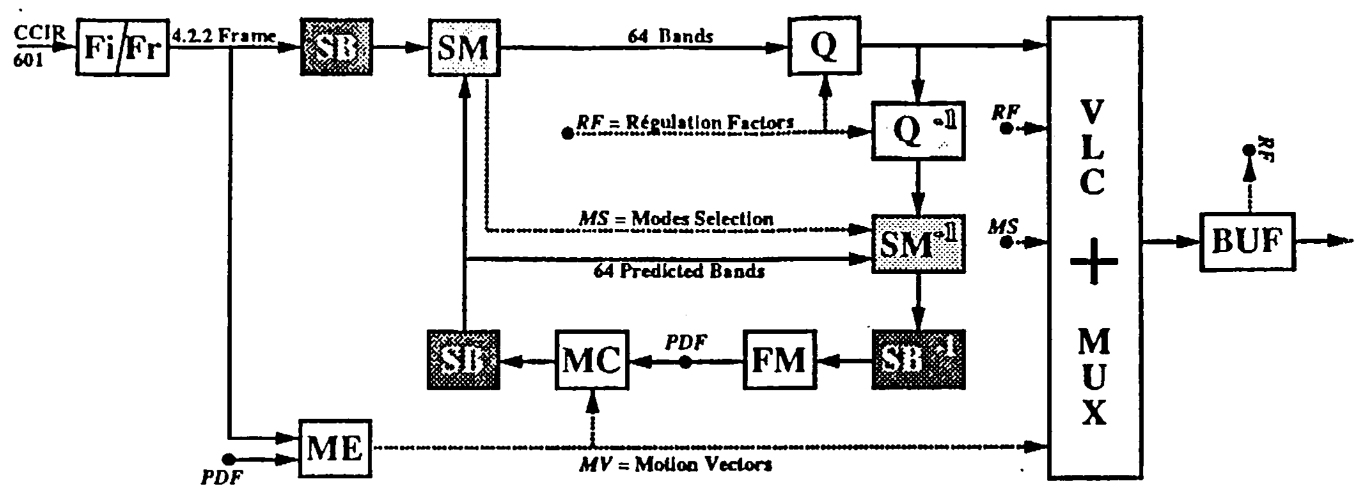
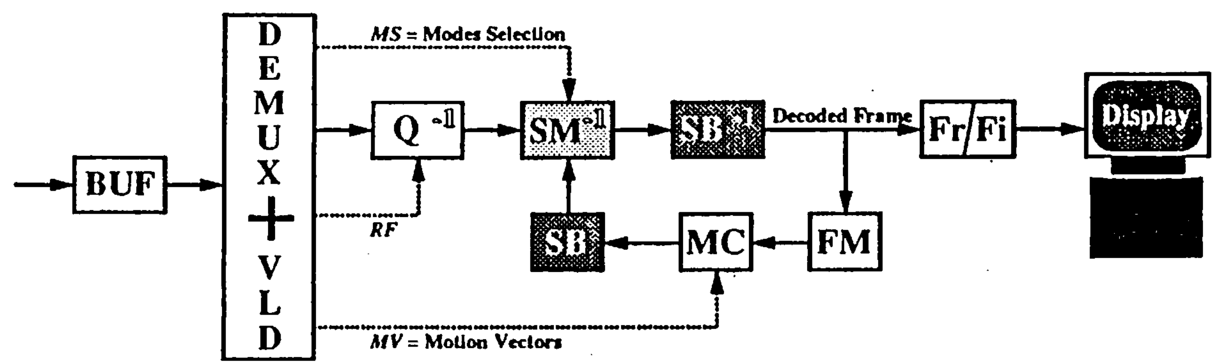
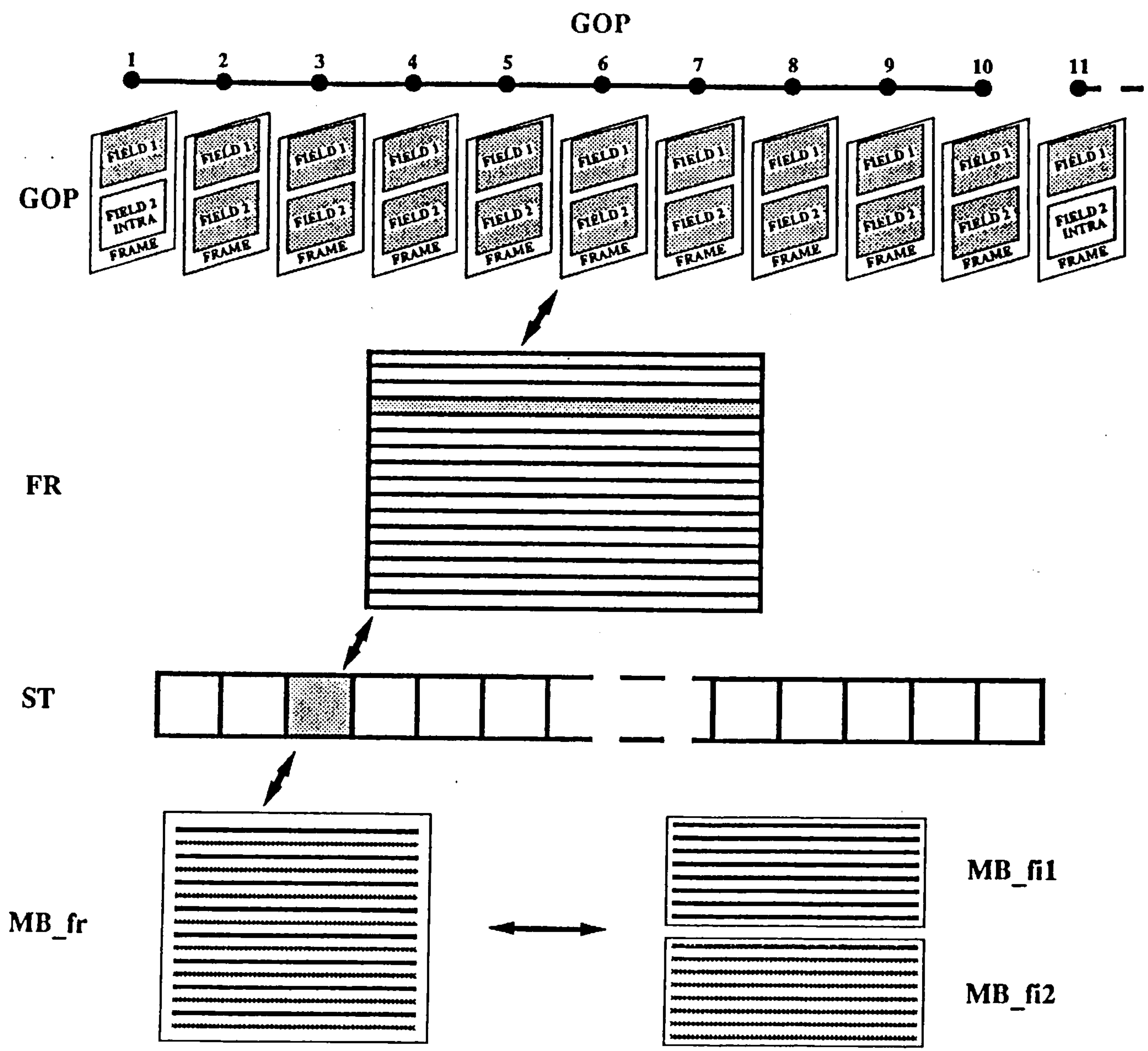
PDF	Previously decoded Frame



SUBBAND ENCODER



SUBBAND DECODER



GROUP OF FIELDS AND FRAMES

10 frames periodicity for intra-refresh,
just field2 of frames 1,11,21...
are intra coded.

FRAME

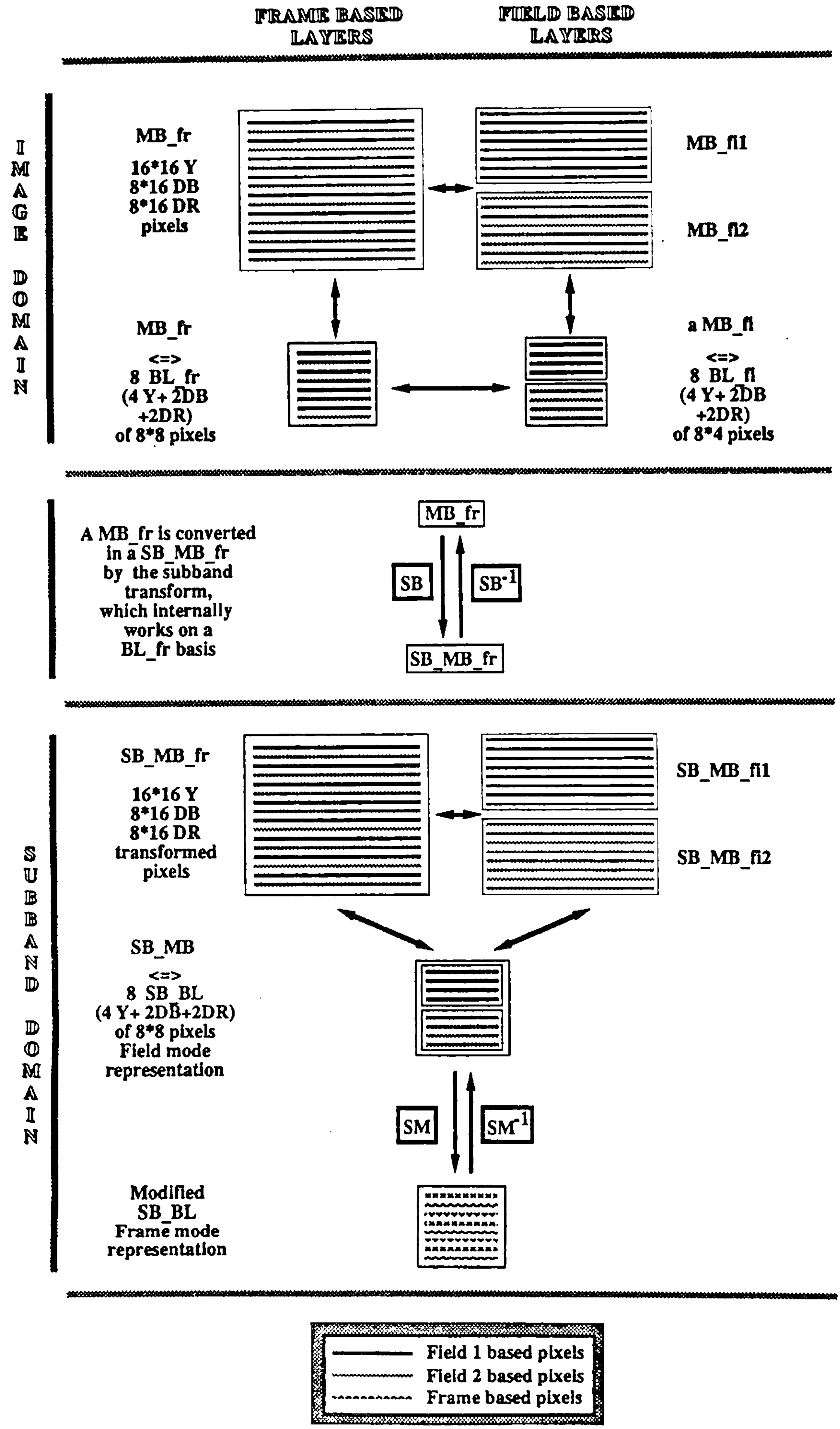
A frame is divided into 36 stripes of 16 lines each. (case of 4:2:2 pictures)

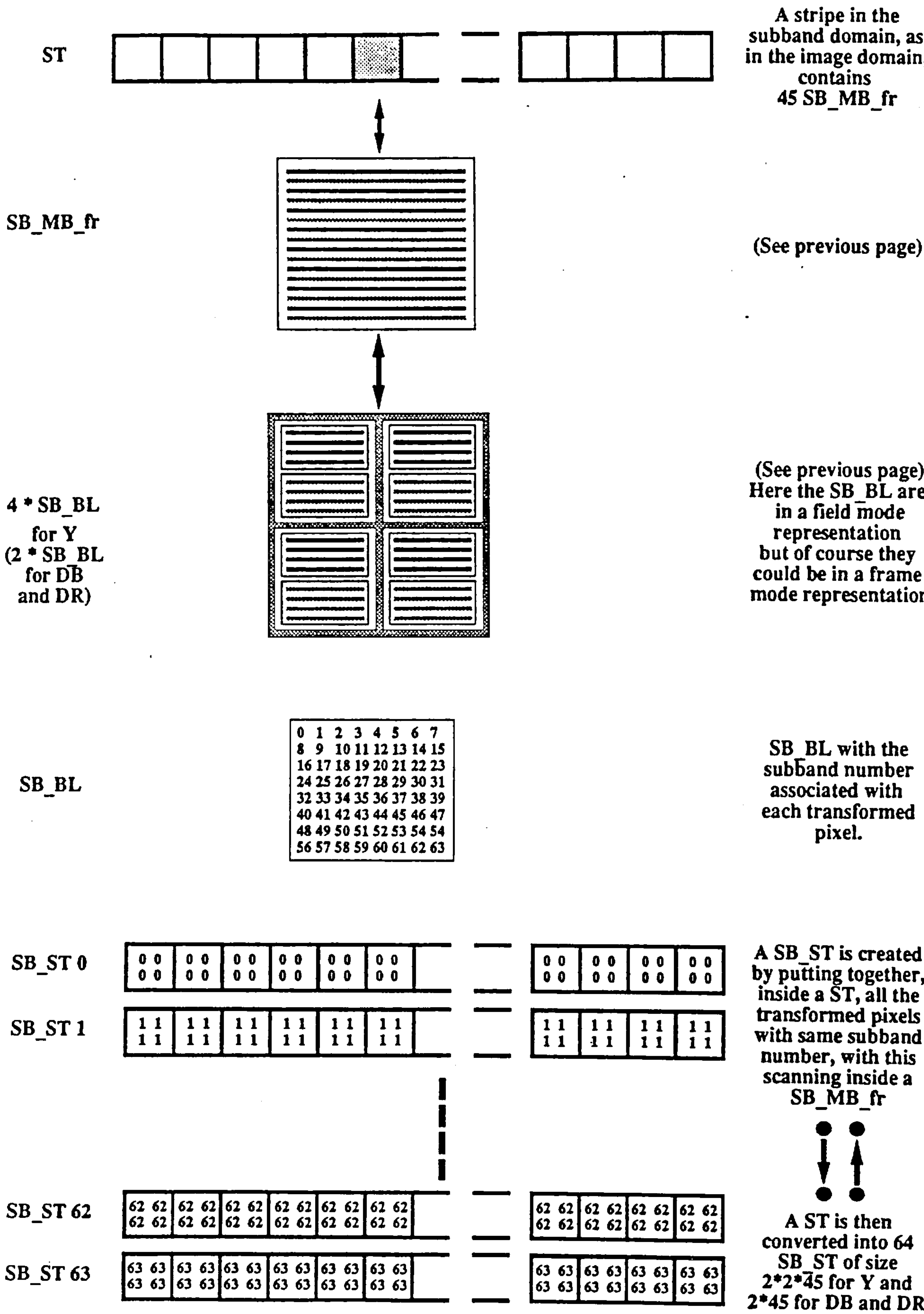
STRIPE

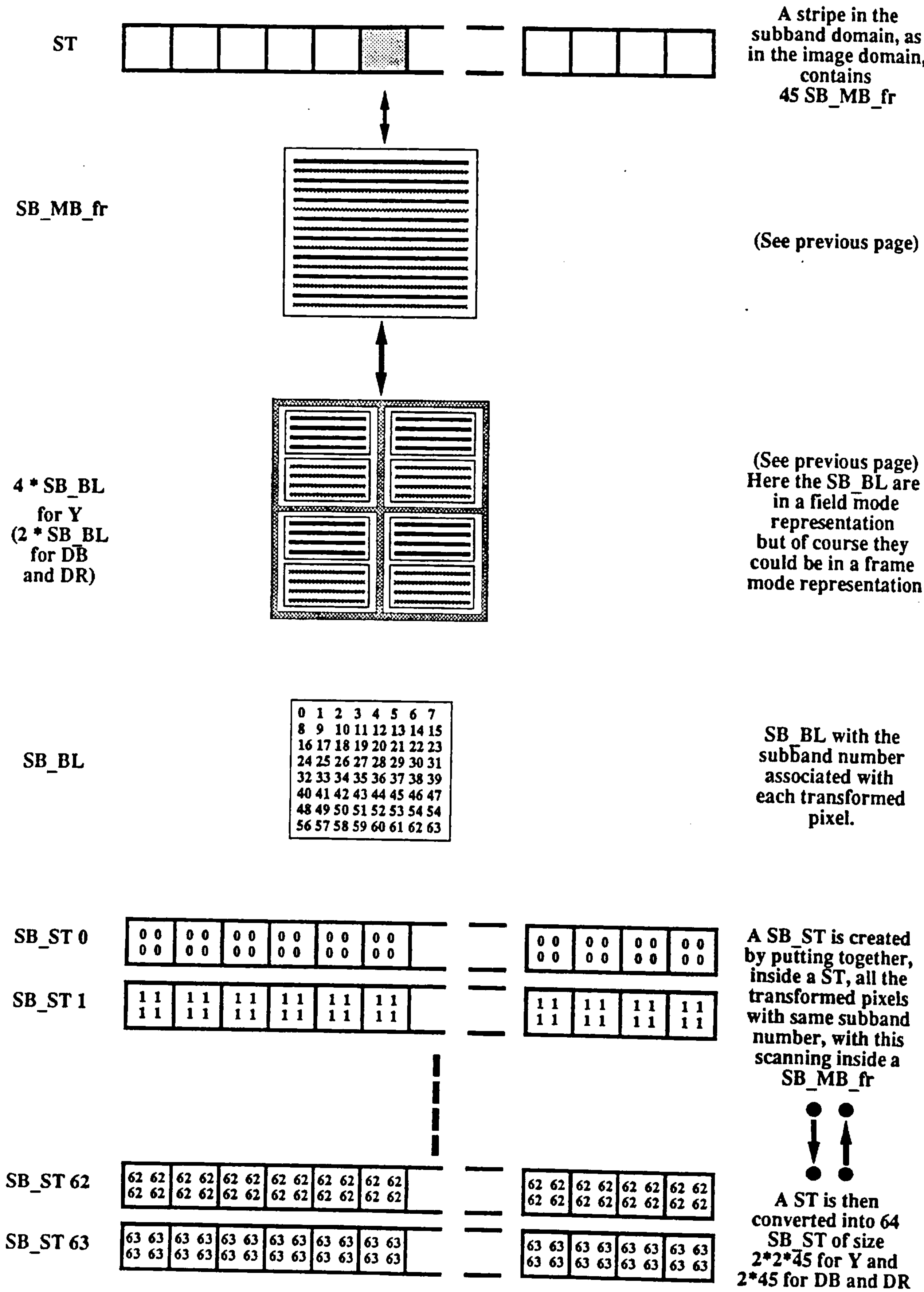
A stripe is a 16 lines part of a frame, and contains 45 macro-blocks.

MACRO_BLOCK

A macro-block (MB_fr) is a 16*16 frame based window, created by the interlacing of two 16*8 fields based macro-blocks (MB_fi).
A MB_fr contains then 16*16 Luminance pixels, and two 16*8 Chrominance pixels.
A MB_fi contains 16*8 Luminance pixels, and two 8*8 Chrominance pixels.


FRAME BASED LAYERS
FIELD BASED LAYERS
IMAGE DOMAIN
MB_fr
16*16 Y
8*16 DB
8*16 DR
pixels
MB_fl1
MB_fl2
MB_fr
<=>
8 BL_fr
(4 Y+ 2DB
+2DR)
of 8*8 pixels
a MB_fl
<=>
8 BL_fl
(4 Y+ 2DB
+2DR)
of 8*4 pixels
A MB_fr is converted
in a SB_MB_fr
by the subband
transform,
which internally
works on a
BL_fr basis
MB_fr
SB
SB-1
SB_MB_fr
SUBBAND DOMAIN
SB_MB_fr
16*16 Y
8*16 DB
8*16 DR
transformed
pixels
SB_MB_fl1
SB_MB_fl2
SB_MB
<=>
8 SB_BL
(4 Y+ 2DB+2DR)
of 8*8 pixels
Field mode
representation
SM
SM-1
Modified
SB_BL
Frame mode
representation
Field 1 based pixels
Field 2 based pixels
Frame based pixels


ST
A stripe in the subband domain, as in the image domain, contains 45 SB_MB_fr
SB_MB_fr
(See previous page)
4 * SB_BL for Y (2 * SB_BL for DB and DR)
(See previous page) Here the SB_BL are in a field mode representation but of course they could be in a frame mode representation
SB_BL
0 1 2 3 4 5 6 7
8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31
32 33 34 35 36 37 38 39
40 41 42 43 44 45 46 47
48 49 50 51 52 53 54 54
56 57 58 59 60 61 62 63
SB_BL with the subband number associated with each transformed pixel.
SB_ST 0
SB_ST 1
SB_ST 62
SB_ST 63
A SB_ST is created by putting together, inside a ST, all the transformed pixels with same subband number, with this scanning inside a SB_MB_fr
A ST is then converted into 64 SB_ST of size 2*2*45 for Y and 2*45 for DB and DR


ST
A stripe in the subband domain, as in the image domain, contains 45 SB_MB_fr
SB_MB_fr
(See previous page)
4 * SB_BL for Y (2 * SB_BL for DB and DR)
(See previous page) Here the SB_BL are in a field mode representation but of course they could be in a frame mode representation
SB_BL
0 1 2 3 4 5 6 7
8 9 10 11 12 13 14 15
16 17 18 19 20 21 22 23
24 25 26 27 28 29 30 31
32 33 34 35 36 37 38 39
40 41 42 43 44 45 46 47
48 49 50 51 52 53 54 54
56 57 58 59 60 61 62 63
SB_BL with the subband number associated with each transformed pixel.
SB_ST 0
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SB_ST 63
A SB_ST is created by putting together, inside a ST, all the transformed pixels with same subband number, with this scanning inside a SB_MB_fr
A ST is then converted into 64 SB_ST of size 2*2*45 for Y and 2*45 for DB and DR

Furthermore this fast algorithm needs 3 lines of internal memory, this is in the worst assumptions a 3*720*16= 34560 bits memory. (At first approximation these 3 lines are the overcost of this subband chip compared to a **DCT** chip)
Furthemore some extra memories are needed, like in a **DCT** chip to perform for example the transposition process (8*8*16=1024 bits).
The computational cost is the same for [SB] and [SB^{-1}], and in fact as for **DCT**, the same chip can perform both operations.
The inputs of the subband box is **MB_fr** based, the output is **SB_MB_fr** based (internally **BL_fr** (8*8 pixels) are converted into **SB_BL** (8*8 transformed pixels))
A frame **FR** is scanned in horizontal stripes **ST** of 45 **MB_fr**. Similarly in the subband domain a stripe **ST** contains 45 **SB_MB_fr**.
The chrominance signals are also split in 8*8 subbands by the same filter bank.

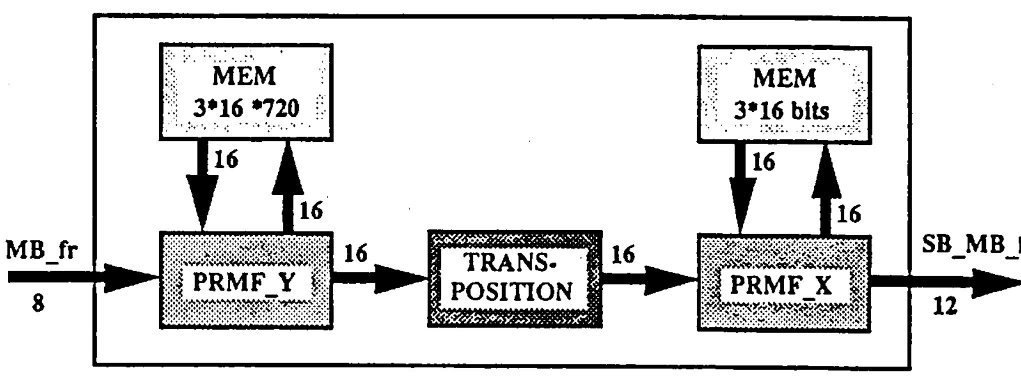
[SB] or [SB^{-1}]

[#A = 7.5, 16bits wide]

[#M = 2.5, 16bits wide, fixed coefficients]

[#MEM = 36,000]

[#I = 8 and #O = 12 for the bandwidth of the chip for coefficients]



[SB] chip

Selection of Modes: [SM] and [SM^{-1}]

In fact this box has to be split in 2 parts: The decision part, and the action part.
The decision part is just needed at the encoder side and for luminance signal only.

The decison part: (just for the encoder and luminance signal)

Inputs: 2 paths on 12 bits each, one giving an original **SB_MB_fr**, the other one giving the predicted SB_MB_fr coming from the prediction loop.

For a **SB_MB_fr**, 4 energies are calculated (energies on a **SB_MB_fi** base, see "**VARIOUS LAYERS**"), leading to 2 decisions coded then on 2 bits for a whole **SB_M_fr** with a total cost of #A = 2*2*16*8 , and also #M = 2*2*16*8 if L^2 norm is chosen, no multiplication if L^1 norm is preferred.
An internal storage of 2 times 16*16 pixels on 12 bits is also needed #MEM=2*12*16*16=6144 bits.

SM **decision part** (just at encoder side and for luminance signal)

#A = 2

#M = 2

#MEM = 6000

#I = 12*2 #O=12 for the bandwidth of coefficients

The action part: needed at encoder and decoder side for both luminance and chrominance signals: same complexity in SM and SM^{-1}

This part performs the appropriate action on the received **SB_MB_fr**, knowing the predicted **SB_MB_fr** and the decision taken in the decision part. According to the decision taken, the predicted **SB_MB_fi** are substracted (or added) or not from the original **SB_MB_fi**, and a field to frame subband representation conversion is performed if needed. (This field/frame commutation is rather close to two 8*4 **DCT** on **BL_fi** basis commuted with one 8*8 **DCT** on a **BL_fr** basis, except that here the commutation is performed in the subband domain, with a different technique). This local field/frame conversion is possible with a subband **PRMF** bank, but seems not to be possible with any other subband technique.
NOTE: The **SB_MB_fi2** for frame 1 in a **GOP** are forced to be **INTRA** coded.

SB_MB_fi1	SB_MB_fi2	MODE
INTER	INTER	FRAME
INTRA	INTER	FIELD
INTER	INTRA	FIELD
INTRA	INTRA	FRAME

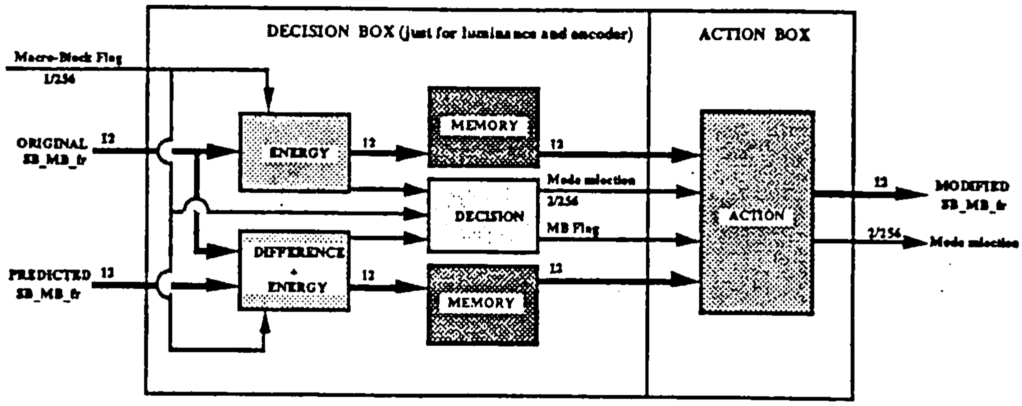
The global cost is #A = 2, no multiplication. No memory is needed if the **SB_MB_fr** is scanned in a good manner.

SM **or** SM^{-1} **decision part**

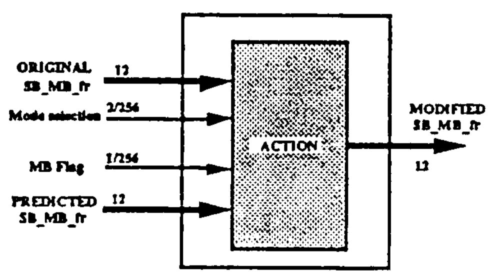
#A = 2

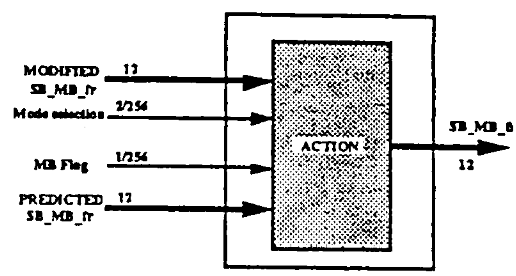
#I = 12*2 for the input coefficients bandwidth

#O = 12



[SM] for Luminance





[SM] for Chrominance signals [SM^{-1}]

Subband weighting and quantization: [Q] and [Q^{-1}]

Block [Q]

After splitting each subband pixel (transformed coefficients) is multiplied by a weigthing factor which depends on its frequency location (its location in a SB_BL of 8*8 pixels) and on the buffer regulation factor. This weigthing factor is the same along a whole stripe for a subband (pixels with same location in a SB_BL). After that each subband is linearly quantized. The quantizer is the same for all subbands.
Without going into details we have: W(sb) = weigthing factor for subband sb, F(sb) = frequency location factor of subband sb, RF = regulation factor, sb=0,63

$$P(sb)=Min[F(sb)-48,\ RF)]+RF$$
$$P(sb)=Max[0,P(sb)]$$
$$P(sb)=Min[175,P(sb)]$$
$$W(sb)=2**[\frac{-P(sb)}{16}]$$

if P(sb) is to be calculated, W(sb) can be calculated by means of binary shift by P(sb)/16 bits of $WM(i) = 2**[\frac{-i}{16}]$, i = mod(P(sb),16). These W M coefficients can be stored permanently and they need (accuracy is to be verified) 16*15 = 240 bits.
Nevertheless **P(sb)** (sb=0,63) have to be calculated once for a whole frame.
If **RF** is the incoming regulation factor, internally a set of up to three different **RF** factors can be needed:

- -For frames 2-10 in a **GOP**
  - * **RF** is used for all **SB_MB_fr** not coded in (**INTRA, INTRA**) mode
    (see **Selection of Modes:** SM **and** SM^{-1})
  - * **RF-8** is used for all **SB_MB_fr** coded in (**INTRA, INTRA**) mode
- -For frame 1 in a **GOP**
  - * **RF-8** is used for all **SB_MB_fr** coded in (**INTRA, INTRA**) mode
  - * Otherwise, **RF** is used for **SB_MB_fi2**, and the **SB_MB_fi1** blocks need the **RF** factor sent for the previous frame (8bits memory)

Each subband has a **F(sb)** factor (7 bits max) and that for intra and inter modes. Presently the intra mode is used only for field2 of frame 1 (Intra refresh) in a **GOP**, then for **sb** numbers from 32 to 63 in a **SB_BL** of frame 1. For all others fields the inter mode is used.
These tables can be found in Annexe 1. They show a vertical symmetry, because they are presently field based: The upper 8*4 coefficients represent a 8*4 subband block field1 based with the **DC** subband at upper left. The lower 8*4 coefficients represent a 8*4 subband block field2 based with the **DC** subband at lower left. When Frame mode is chosen, **SB_BL** (containing a 8*4 field1 and a 8*4 field2 subband block) are converted into a **SB_BL** of 8*8 coefficients frame based. The same 8*8 tables are taken with **DC** at upper left. (See **Various layers** part of this paper).
These tables can be externally loaded and cost #MEM = 2*7*8*4 = 448 bits.

For the Quantization process, if **c(sb)** is a subband pixel, **q(sb)** the quantized subband pixel and **Param** a fixed parameter (=.2) the formula is as follow :

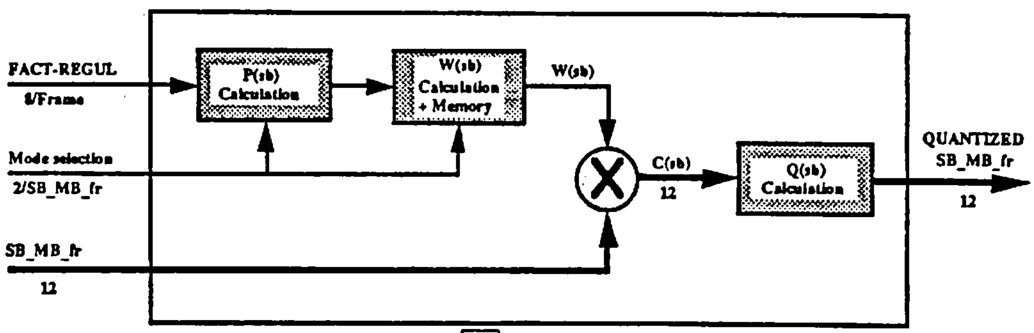
```
c(sb)=c(sb)*W(sb)        ! multiplication by the weigthing factor.

If (c(sb) .GE. 0) then
        q(sb)=int(c(sb)+Param)
else
        q(sb)=int(c(sb)-Param)
endif
```

The multiplication by the weigthing factor costs just 1 multiplication per pixel.
The quantization process cost is then a bit test, an addition, and a truncation .
Total cost (P(sb) counted for 1 add., W(sb) calculation neglected).

[Q] chip

[#A = 2]
[#M = 1]
[#I = #O = 12 bits for coefficients]
[#MEM = 700]



[Q] chip

Block [Q-1]

Formula:

P(sb)=Min[F(sb)-48, RF)]+RF ! see [Q] cost for F(sb)
P(sb)=Max[0,P(sb)]
P(sb)=Min[175,P(sb)] ! calculated for a whole Stripe
$W(sb)=2^{**}[\frac{P(sb)}{16}]$! see [Q] cost for W(sb)

For RF the same remarks as in [Q] are of course valid. (internal modification of RF according to the mode selection of the traited SB_MB_fr)

To reconstruct c(sb):

```
If (q(sb) .EQ. 0) then
        c(sb)=0
else if (q(sb) .GT. 0) then
        c(sb)=nint ( ( q(sb)+pq2(sb) ) * W(sb) )
else
        c(sb)=nint ( ( q(sb)-pq2(sb) ) * W(sb) )
endif
```

pq2(sb) are values between 0.0 and 0.5 , defined for each subband nevertheless a fixed value for all subbands should be possible, and will be experimented. Pq2 tables cost 6*8*4=192 bits. (because of the vertical symmetry, and the use of same tables for INTRA and INTER fields). Double cost for DB+DR.

Q-1 chip

#A = 2

#M = 1

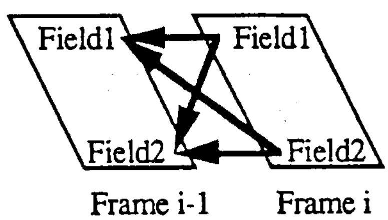
#I = #O = 12 bits for coefficients

#MEM = 900

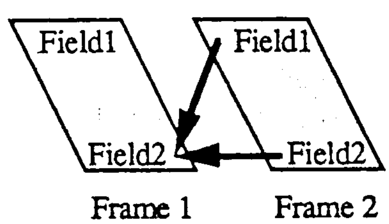
Motion estimation: ME

Motion vectors are calculated between original and previously decoded frames.
This box is not needed for Chrominance signals and for decoder.

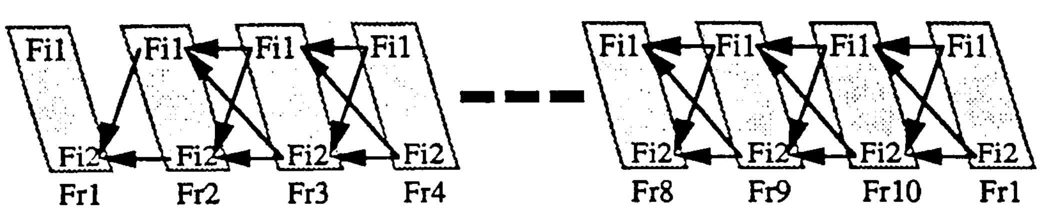
Blocks are **MB_fi** based (16*8 field based window). Then two blocks for a **MB_fr**.
Search area is -16:+15 horizontally and -8:+7 vertically (in a field).
Double prediction strategy: Each **MB_fi** can be predicted by using either the field of same parity in the previous frame or the other field.



When field 2 is intra coded (frame 1 in a **GOP**), the next frame is predicted by using just field2 as possible predictor, avoiding then error propagation.



For a **GOP** the various searchs are then:

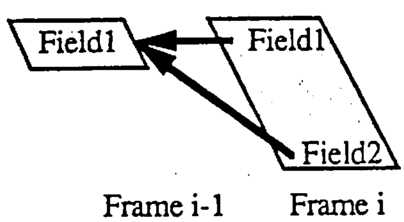


(To save power consumption it is possible to inhibit the prediction of field2 for frame 1 in a **GOP**).
Full search block-matching at pel accuracy and then local half-pel accuracy search, bilinear interpolation.

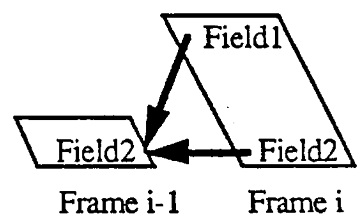
This double prediction strategy cost the same numbers of operations than one block matching technique with frame based blocks of 16*16 and a search window of -16:15 * -16:-15.
An implementation in .8 micron technology with a systolic architecture like in the Thomson chip STI3220 is possible with two identical chips in parallel.
They both receive the reference **MB_fr**, but one receives the odd lines of the search window (then from field 1, **MB_fi1** only) and the other one the even lines (then from field 2, MB_fi2 only).
They both give at the output the minimal distorsions and the corresponding vectors for the two MB_fi in the reference **MB_fr**.
An outside comparison between the distorsions has to be done to select finally which prediction is kept for each **MB_fi**.

For each chip: Number of transistors = 725000
Area = 115 mm^2
Package = 80 pins ceramic
#I = 3 paths on 8 bits, one for the reference block, the 2 others for the search window
Internal Frequency = 27 MHz

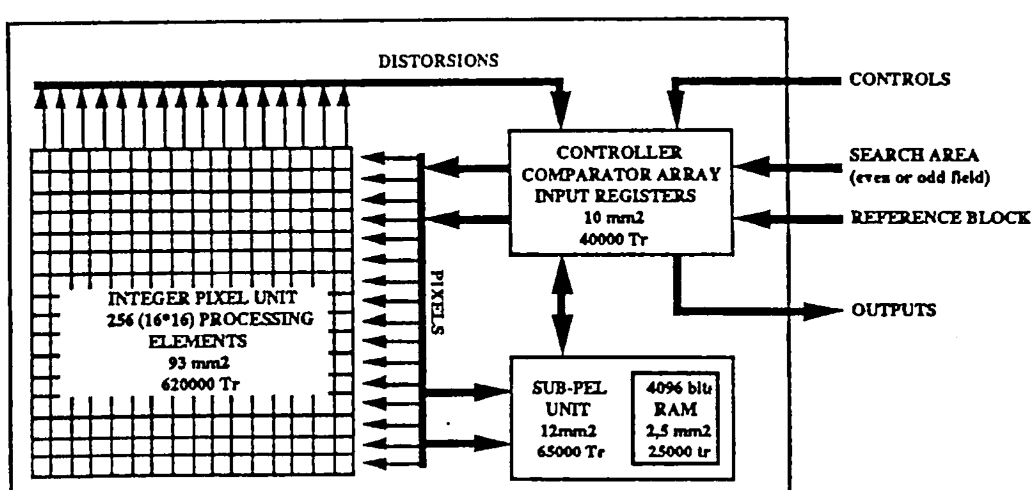
(Values kindly given by Mr R. PACALET from ENST-FRANCE, fax=33.1.45.80.40.36)



First ME chip



Second ME chip



ME chip

Motion compensation: MC

Classical block in a hybrid DCT coding scheme.
Prediction of a 16*8 block in a field with a 16*8 block taken in the previous decoded frame by applying a displacement vector given by the motion estimation process.

Frame memory: FM

The decoded frame after SB^{-1} is stored in a frame memory, to be afterwards used for MC.

#I = #O = 8 bits for coefficients
#MEM ≈ 3,318,000 (≈720*576*8)

Variable length coding and decoding: VLC and VLD

Each stripe in the subband domain (2*2*64*45) is composed in fact of 64 subband stripes SB_ST (a stripe inside a subband) of size 2*2*45 (see Various layers).
To go from a ST representation into a SB_ST representation (or inverse conversion for decoder), a block to line conversion is needed, which cost 2*2*64*45*12bits of memory. At the same time a counter works to calculate in each SB_ST the number of non-zero pixels. #MEM ≈ 138,200
The VLC strategy used here is clearly related to the approach chosen in [1,2] where HDTV/TV compatibility were explored. Nevertheless, as compatibility is not claimed here, this strategy could be simplified and use for example the same VLC blocks oriented (8*8), like in most DCT based codec, and take for example MPEG1 VLC tables... Thereafter will be explained, nevertheless, the VLC and VLD used in our simulations, even if this part could be greatly simplified, especially in term of memory (divided by 180 if VLC block oriented).

VLC block: Just for the encoder

The SB_ST are VLC encoded. One word to specify the number of non-zero pixels (nb_nz) in a SB_ST followed by the relative addresses and the values of non-zero coefficients (nb_nz pairs). Addresses and values are coded using ACVLC techniques (arithmetically computed VLC, a VLC technique created by Thomson LER).
A ACVLC table is fully described by means of 8 words of 4 bits.
example: 3211111B describes a full VLC table.
Each subband has different ACVLC tables for addresses and non-zero coefficients and also for intra and inter and they can be down-loaded to optimize the coding efficiency at different bit-rates.The intra tables are just used for the intra

refresh fields (field 2 frame 1 in a **GOP** => **sb** 32 to 63 in a **SB_BL**, then ACVLC tables for **sb=0,31** are not useful in that presented scheme, and consequently they are not counted). Cost in memory: #MEM = 32*32*1 + 32*64*1. #MEM = 3072 bits

ACVLC principle. (extract from **CMTT/321-E** document)

$l_1\ l_2\ l_3\ l_4\ l_5\ l_6\ l_7\ l_8$ describes a VLC in that way:
A VLC word includes k groups of bits, which lengths are $l_1, l_2, ..., l_k$
All the bits belonging to the first k-1 groups are set to one. The last group is the only one that must contain at least one zero.
The arithmetic rules to encode an integer value e are the following ones:

-if $e < S_1 = 2^{l_1} - 1$ then e is coded with l_1 bits
-if $S_1 \le e < S_1 + 2^{l_2} - 1$ then the codeword is constituted of two informations:

*the prefix made of l_1 bits equal to '1'
*the suffix, which is the $e\text{-}S_1$ value, binary coded with l_2 bits

-and more generally if $S_i \le e \le S_{i+1} = S_i + 2^{l_{i+1}} - 1$
*the prefix is filled with $l_1 + l_2 + l_3 + ... + l_i$ bits equal to '1'
*the suffix, which is the $e\text{-}S_i$ value, binary coded with l_{i+1} bits

ex 3211111B ACVLC
the value 0 is coded '000'
the value 2 is coded '010'
the value 6 is coded '110'
the value 7 is coded '111.00'
the value 9 is coded '111.10'
the value 11 is coded '111.11.1.0'

The maximum VLC word length is 32 bits.
The relative addresses of non-zero coefficients are directly coded that way, the non-zero coefficients are previously modified:
1 -> 0
-1 -> 1
2 -> 2
-2 -> 3 ..., in fact, i -> 2*i-1 ; -i -> 2i (i≥1)
These now positive values are coded by classical ACVLC techniques.

For luminance signals, the **Nb_nz** values of four consecutive **SB_ST** inside a ST are put together, and bit '0' is transmitted if all the $\mathbf{nb\_nz}_i$, $i=\overline{0,3}$ are equal to zero (<=> $\mathbf{nb} = \sum \mathbf{nb\_nz}_i = 0$), in the other hand bit '1' is transmitted followed by the sequential VLC coding of the 4 $\mathbf{nb\_nz}_i$.
$\mathbf{Nb\_nz}_i$ VLC coding:
$\mathbf{nb\_nz}_i = 0$ then bit '0' is transmited
$\mathbf{nb\_nz}_i \neq 0$ then bit '1' followed by the binary value on 8 bits = 9 bits

For chrominance signals, nb is the sum of eigth $\mathbf{nb\_nz}_i$, four consecutive $\mathbf{nb\_nz}_i$ from **DB** and four from **DR**. Bit '0' is transmitted if **nb = 0**, in the

other hand bit '1' is transmitted followed by the sequential VLC coding of the 4 **nb_nz**$_i$ from DB and the 4 **nb_nz**$_i$ from DR.
Nb_nz$_i$ VLC coding:

nb_nz$_i$ = 0 then bit '0' is transmited
nb_nz$_i$ ≠ 0 then bit '1' followed by the binary value on 7 bits = 8 bits

Motion vectors are encoded with a simple VLC. More sophisticated VLC are under study. The MB_fi1 and MB_fi2 can be predicted by using either field1 or field 2 of the previously decoded frame. This is the prediction-choice (pc) equal to 0 or 1, 0 if same parity, 1 either. (see Motion Estimation).
Inside a ST, the motion vectors mv(i) (i=0,44) relative to MB_fi1 (resp. MB_fi2) are VLC encoded that way:

```
if( (pc(i) .eq. pc(i-1)) .and. (mv(i).eq.mv(i-1) ) then
    '0'                          ! Same motion vector than previous block

else if( (pc(i) .eq. pc(i-1)) .and. (|mv(i)-mv(i-1)| .le. .5) then
    '1'+ '0' + 3bits             ! Difference with previous vector is (dx,dy)
                                 ! with |dx| ≤ .5 and |dy| ≤ .5
else
    '1'+ '1' + 'pc(i)' +11bits
                                 ! All other cases, pc(i) is just one bit
                                 ! 11 bits to encode mv(i), the scanning is to
endif                            ! be decided
```

A simple VLC is also used to encode the two mode decisions for a SB_MB_fr.

SB_MB_fi1	SB_MB_fi2	MODE	VLC 1	VLC 2
INTER	INTER	FRAME	'0'	
INTRA	INTER	FIELD	'110'	
INTER	INTRA	FIELD	'111'	'0'
INTRA	INTRA	FRAME	'10'	'1'

VLC 1 is used for pictures 2-10 in a GOP (see "VARIOUS LAYERS"), VLC 2 is used for picture 1 in a GOP, for the simple raison that Field2 is forced to be in INTRA mode to perform the intra-refresh, with 10 frames periodicity.

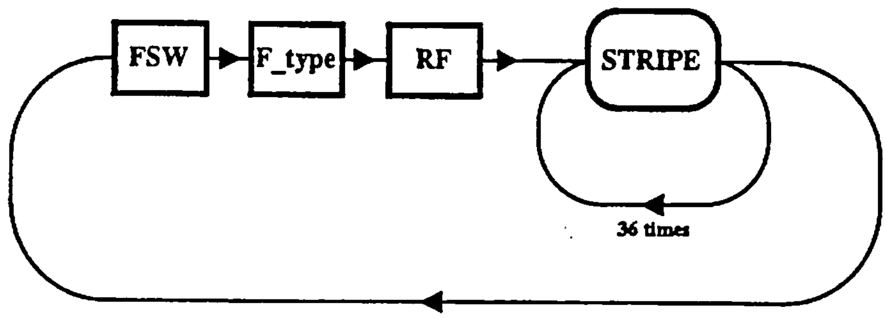
The Regulation Factor, at present time, is constant over a whole frame, is FLC encoded and costs 8bits.

VLD block: just for decoder.

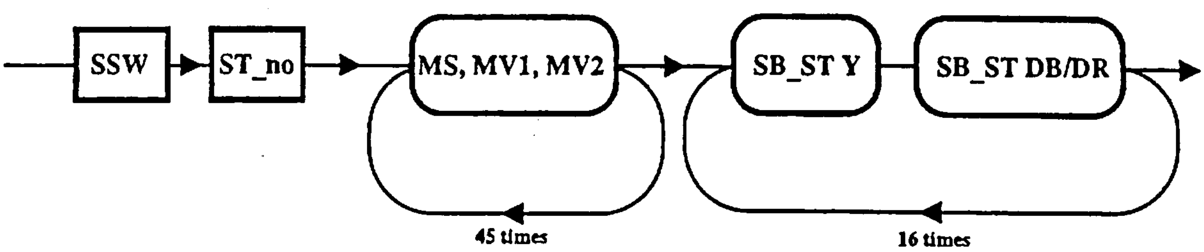
For VLD and the use of the ACVLC $l_1\, l_2\, l_3\, l_4\, l_5\, l_6\, l_7\, l_8$:
The first '0' found give the value of k (A VLC word includes k groups of bits, which lengths are $l_1, l_2, ..., l_k$, all the bits belonging to the first k-1 groups are set to one. The last group is the only one that must contain at least one zero).
The l_k bits gives the value $e-S_{k-1}$ then e is equal to $S_{k-1} + (e-S_{k-1})$.

MUX box: see next page

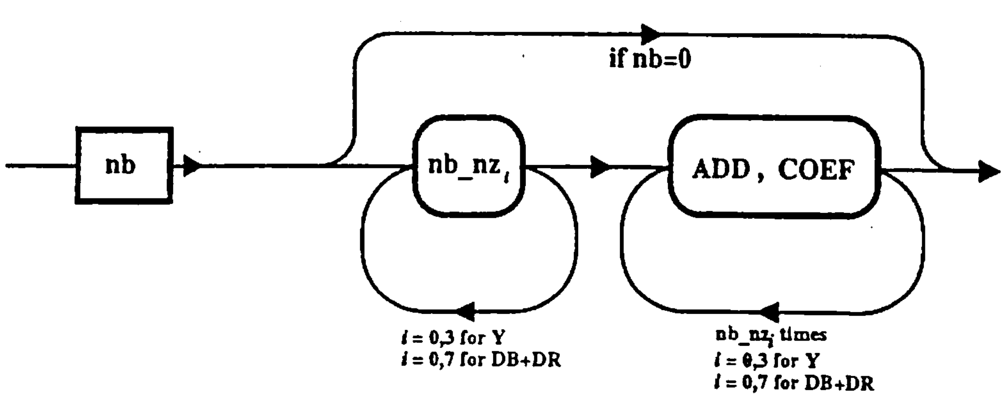
FRAME LAYER



STRIPE LAYER



SB_ST LAYER



Buffer memory capacity: BUF

It includes Y+DB+DR

#MEM = 800,000 bits at 4Mbit/s
#MEM = 1,200,000 bits at 9Mbit/s

Buffer regulation:

A regulation strategy is needed to smooth the intra refresh peak bit-rate and to have at the buffer output a constant bit-rate. The goal is obtained by modifying the regulation factor **RF** used in the subband weigthing box.
At present time this regulation factor is constant over a whole frame, but should and could be changed at each stripe.

Global size of picture buffers for Y/DB/DR:

Encoder or decoder:

Just one Fi/Fr or Fr/Fi conversion is needed

(288+16)*720*8 ≈ 1,750,000 bits for Luminance
(288+16)*360*8*2 ≈ 1,750,000 bits for DB+DR
THEN GLOBALLY Y+DB+DR ≈ 3,500,000 bits

Just one Frame Memory is needed

720*576*8 ≈ 3,320,000 bits for Luminance
360*576*8*2 ≈ 3,320,000 bits for DB+DR
THEN GLOBALLY Y+DB+DR ≈ 6,650,000 bits

Data buffer size

800,000 Bits at 4Mbit/s bit-rate (<=> 200 ms)
1,200,00 Bits at 9Mbit/s bit-rate (<=> 133 ms)

As noted before it is maybe possible at the decoder side to merge into an unique memory the Fr/Fi process and the FM process, because the video lines needed in Fr/Fi are also stored in FM (Nevertheless, as I am far from being a hardware specialist, this point is let to the decision of hardware people ...)

HDTV/TV compatibility:

HDTV/TV compatible codec has already been detailed in [1,2] for progressive scannings. Promising results are already obtained for interlaced scannings with the use of a **PRMF** bank and will be demonstrated, but nevertheless the codec presented here is a non-compatible one.

Coding delay:

The maximun delay between the encoder and decoder is two times one field, plus the data buffering. This delay can be reduced for particular needs by acting on the buffer regulation to artificially reduce the buffer size (ex: an admitted excursion from 0% to 50% for the buffer, reduces the data buffer delay by a factor of 2).

Others:

Fast Forward and **Fast Reverse** are obtained by picking up in each **GOP** the intra coded field 2 of frame 1.

---

[1] J. Mau , "HDTV/TV COMPATIBLE CODEC WITH PQMF FILTER BANK",THIRD HDTV WORKSHOP, TORINO 1991

[2] J. Mau , "SYSTEME DE CODAGE NUMERIQUE EN SOUS-BANDES MULTISTANDARD ET COMPATIBLE, GRETSI 1991

ANNEXES

In annexes you will find the tables for :

ACVLC at 4 and 9 Mbits, for non-zero coefficients and addresses, for inter and intra modes.

F(sb) and PQ2(sb) for intra and inter modes.

SNR of the whole frames in a sequence under the numbers 1, 2,.. 10 which are the numbers of the frames in a GOP. Under GOP is the mean SNR for a GOP. SNR are given for Y, DB, DR.

Count of Bits for a frame (Y+DB+DR) in a sequence, and under GOP the total number of bits until the beginning of the sequence.

Several items averaged over a sequence.

Bit-stream files and corresponding bit-rates

Mean SNR for Y, DB, DR over the sequences

ACVLC TABLES FOR NON ZERO COEFFICIENTS AT 4Mbit/s

COEFF#0 LUMI INTRA

6641111B	2455221B	2244321B	2223411B	1111233B	1123111B	1111111B	1111111B
3643111B	2444111B	1132312B	1122222B	1111221B	1111111B	1111111B	1111111B
3552111B	2433111B	1122231B	1122112B	1111111B	1111111B	1111111B	1111111B
2533111B	2333111B	1122211B	1121111B	1111111B	1111111B	1111111B	1111111B
3444321B	2331322B	2123321B	1122221B	1111211B	1111111B	1111111B	1111111B
3553111B	3333331B	2233331B	1122331B	1111222B	1111111B	1111111B	1111111B
4554111B	3443311B	3333321B	2233222B	2122222B	1121122B	1111111B	1111111B
7421121B	4554111B	3444411B	3344321B	2333322B	2232212B	1111222B	1111111B

COEFF#0 DB INTRA

4442111B	2233211B	1123221B	2332111B	1112111B	1111111B	1111111B	1111111B
1122231B	1111212B	1121111B	1121111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111212B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1121122B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
2233311B	2222222B	1111212B	1111111B	1111111B	1111111B	1111111B	1111111B
4542211B	3343211B	2233321B	1122312B	1111213B	1111111B	1111111B	1111111B

COEFF#0 DR INTRA

3454111B	2422211B	2322211B	1123111B	1121111B	1111111B	1111111B	1111111B
2221311B	1121212B	1122111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111211B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
2223212B	1121222B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B
4543211B	2333322B	2223311B	1121232B	1111212B	1111112B	1111111B	1111111B

COEFF#0 LUMI INTER

1123444B	1111235B	1111243B	1111223B	1111222B	1111112B	1111121B	1111111B
1111234B	1111233B	1111232B	1111232B	1111211B	1111121B	1111111B	1111111B
1111234B	1111231B	1111232B	1111222B	1111112B	1111111B	1111111B	1111111B
1121334B	1111212B	1111122B	1111112B	1111111B	1111111B	1111111B	1111111B
1124422B	1111223B	1111222B	1111113B	1111211B	1111121B	1111111B	1111111B
1124433B	1123332B	1122132B	1122222B	1111123B	1111111B	1111111B	1111111B
1124541B	1123433B	1123332B	1123321B	1122231B	1111212B	1111221B	1111111B
1146431B	1123543B	1122443B	1111334B	1122333B	1111313B	1111223B	1111111B

COEFF#0 DB INTER

1123331B	1111222B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1121111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111212B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111332B	1111211B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B
1134421B	1111233B	1111223B	1111123B	1111112B	1111111B	1111111B	1111111B

COEFF#0 DR INTER

1124322B	1111331B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B
1111221B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111122B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1133511B	1122222B	1111222B	1111112B	1111111B	1111111B	1111111B	1111111B

ACVLC TABLES FOR ADDRESSES OF NON ZERO COEFFICIENTS AT 4Mbit/s

ADDR#0 LUMI INTRA

11111118	11112448	11112258	12351118	13541118	15521118	15421118	12111118
11112248	12235118	12344118	12452218	25511118	25111118	31111118	11111118
11123448	12344218	12452118	12611118	25111118	42111118	11111118	11111118
12344118	12451118	12611118	25311118	34111118	31111118	11111118	11111118
11135538	11135548	11246418	12464118	13641118	36111118	41111118	11111118
11125528	11123618	11135548	12463218	12563118	12553118	45111118	11111118
11112558	11113558	11135538	11135538	12356118	12464118	36411118	32111118
11111118	11125518	11112558	11135548	11135618	12561118	12561118	13611118

ADDR#0 DB INTRA

11141118	12541118	12541118	12431118	12411118	12321118	31111118	21111118
12531118	12511118	12511118	12511118	23311118	11111118	11111118	11111118
12521118	22421118	24111118	42111118	21111118	11111118	11111118	11111118
24311118	24111118	31111118	21111118	11111118	11111118	11111118	11111118
24531118	55111118	54211118	43111118	31111118	11111118	11111118	11111118
12454118	23542118	35431118	55111118	54111118	41111118	21111118	11111118
11125518	12454218	12454118	24541118	25511118	54211118	51111118	12111118
11114218	11255118	12551118	12552218	12551118	13551118	15511118	15111118

ADDR#0 DR INTRA

11121118	12531118	12531118	12531118	13431118	24111118	41111118	12111118
11115218	11251118	12441118	13511118	33111118	12111118	11111118	11111118
12521118	12511118	34111118	41111118	21111118	11111118	11111118	11111118
34311118	24111118	32111118	11111118	11111118	11111118	11111118	11111118
25511118	35411118	52111118	32111118	11111118	11111118	11111118	11111118
12551118	35511118	35511118	45111118	51111118	32111118	21111118	11111118
12551118	12551118	13621118	13611118	36111118	54111118	42111118	11111118
11134218	11145228	12454218	12551118	12551118	12551118	15511118	14211118

ADDR#0 LUMI INTER

13752118	37511118	37521118	37611118	37512118	37611118	37521118	65111118
24741118	37521118	47511118	47511118	47511118	67111118	66411118	54111118
24741118	47511118	47511118	57411118	75111118	75111118	66111118	53111118
35711118	47511118	47511118	57411118	75211118	74111118	65111118	54111118
13671118	47511118	47511118	37511118	75211118	66311118	65111118	51111118
24741118	47511118	47511118	37521118	37511118	27511118	66111118	55111118
13671118	25731118	37521118	47511118	37521118	37611118	37411118	63111118
13662811	13662811	13752118	13751118	25731118	15741118	27531118	16541118

ADDR#0 DB INTER

26411118	16421118	16421118	16411118	16311118	15511118	54111118	14311118
36311118	64111118	61111118	61111118	53211118	41111118	42111118	31111118
55411118	46111118	61111118	51111118	51111118	41111118	41111118	31111118
55411118	55111118	51111118	43111118	43111118	41111118	32111118	11111118
36411118	55111118	42111118	42111118	41111118	31111118	31111118	21111118
36411118	64211118	62111118	51111118	51111118	43111118	42111118	31111118
26422118	64311118	64211118	64211118	61111118	54211118	51111118	41111118
12642118	26431118	12642118	12641118	15541118	15531118	16111118	43111118

ADDR#0 DR INTER

15541118	16411118	16411118	16311118	16111118	15411118	34111118	21111118
15531118	55111118	54111118	52111118	51111118	32111118	21111118	11111118
55111118	54211118	43111118	31111118	21111118	11111118	11111118	11111118
55111118	52111118	11111118	31111118	11111118	11111118	11111118	11111118
45321118	51111118	21111118	41111118	11111118	11111118	11111118	11111118
36211118	61111118	51111118	32111118	11111118	11111118	11111118	11111118
26411118	26421118	64111118	61111118	52111118	33111118	42111118	31111118
12641118	26431118	12641118	12641118	15531118	15511118	15411118	31111118

ACVLC TABLES FOR NON_ZERO COEFFICIENTS AT 9Mbit/s

COEFF#0 LUMI INTRA

7721111B	3571111B	3553111B	2334421B	1123432B	1122411B	1111212B	1111111B
366A1111	2455111B	2344111B	1123411B	1122222B	1111111B	1111111B	1111111B
3661111B	2353311B	1123333B	1121323B	1111221B	1111111B	1111111B	1111111B
3641111B	2443121B	1123321B	1122212B	1111112B	1111111B	1111111B	1111111B
4561111B	3444111B	2234331B	2123232B	1111223B	1111112B	1111111B	1111111B
4661111B	3445221B	3444221B	2233333B	1122233B	1111222B	1111111B	1111111B
566A1111	4554111B	3444411B	3443311B	2333321B	1122332B	1111223B	1111111B
8421111B	566A1111	4561111B	3456111B	2344431B	2334212B	1122223B	1111111B

COEFF#0 DB INTRA

5542111B	2343211B	2341111B	1134321B	1123211B	1122111B	1111111B	1111111B
2333211B	2123211B	1123111B	1121221B	1111221B	1111111B	1111111B	1111111B
2112211B	1121112B	1121111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1121223B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
2222223B	1121113B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B
3443211B	2333321B	2122223B	1111223B	1111113B	1111111B	1111111B	1111111B
5643111B	4542111B	3344311B	2233322B	2112332B	1111222B	1111211B	1111111B

COEFF#0 DR INTRA

4653111B	2444111B	2441111B	2233211B	1111321B	1111111B	1111111B	1111111B
3333211B	2331211B	2122311B	2121111B	1111111B	1111111B	1111111B	1111111B
2121221B	1111222B	1112111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111112B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111222B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
2121222B	1111213B	1111211B	1111111B	1111111B	1111111B	1111111B	1111111B
3441111B	2233221B	2121212B	1111222B	1111112B	1111111B	1111111B	1111111B
5652111B	3444221B	2334321B	2233411B	1122231B	1111213B	1111112B	1111111B

COEFF#0 LUMI INTER

1123562B	1122345B	1121235B	1111224B	1111234B	1111223B	1111214B	1111111B
1122345B	1111235B	1111235B	1111234B	1111214B	1111223B	1111113B	1111111B
1121345B	1111224B	1111234B	1111233B	1111233B	1111222B	1111122B	1111111B
1122345B	1111224B	1111234B	1111223B	1111222B	1111231B	1111121B	1111111B
1122463B	1111234B	1111234B	1111214B	1111223B	1111223B	1111221B	1111111B
1122465B	1111235B	1111244B	1111244B	1111234B	1111232B	1111213B	1111211B
1123571B	1122455B	1122454B	1111354B	1122441B	1111234B	1111233B	1111221B
113672B1	1123563B	1122356B	1122355B	1122444B	1111344B	1111234B	1111223B

COEFF#0 DB INTER

1123531B	1122233B	1121232B	1121222B	1111222B	1111113B	1111121B	1111111B
1111232B	1111212B	1111311B	1111121B	1111111B	1111111B	1111111B	1111111B
1111221B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111221B	1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1123232B	1111222B	1111211B	1111111B	1111111B	1111111B	1111111B	1111111B
1111235B	1111233B	1111223B	1111223B	1111212B	1111112B	1111112B	1111111B
2455311B	1122344B	1123242B	1132233B	1122232B	1111213B	1111122B	1111111B

COEFF#0 DR INTER

1123541B	1122333B	1122213B	1121222B	1111112B	1111112B	1111111B	1111111B
1111233B	1111222B	1111211B	1111211B	1111111B	1111111B	1111111B	1111111B
1111131B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111112B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1111223B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B	1111111B
1122332B	1111232B	1111222B	1111123B	1111111B	1111111B	1111111B	1111111B
2456111B	1123433B	1123324B	1123233B	1122122B	1111212B	1111111B	1111111B

ACVLC TABLES FOR ADDRESSES OF NON_ZERO COEFFICIENTS AT 9Mbit/s

ADDR#0 LUMI INTRA

1111111C	1111224C	1111341C	1112342C	1113343C	1344111C	2551111C	1431111C
1111222C	1111243C	1112244C	1234411C	1345111C	1551111C	5311111C	1111111C
1112233C	1112343C	1234411C	1345111C	2551111C	2511111C	4111111C	1111111C
1112342C	1234321C	1245221C	1261111C	1253111C	4211111C	1111111C	1111111C
1112551C	1112355C	1113554C	1246421C	1256211C	2461111C	5511111C	1111111C
1112551C	1111255C	1112455C	1123553C	1246411C	1246511C	1263111C	4111111C
1112541C	1112543C	1111255C	1113551C	1124543C	1256111C	1246411C	2611111C
1111111C	1114441C	1112541C	1112451C	1113444C	1235421C	1255411C	1365111C

ADDR#0 DB INTRA

1112321C	1244211C	1253111C	1254111C	1252111C	1251111C	1241111C	1321111C
1244111C	1253111C	1252111C	1252111C	1251111C	4211111C	3311111C	1111111C
1251111C	1252111C	1251111C	2511111C	4311111C	3111111C	3211111C	1111111C
1135111C	2511111C	3411111C	5111111C	2111111C	3211111C	1111111C	1111111C
1245411C	2355111C	3551111C	3532111C	5421111C	5411111C	4211111C	1111111C
1235411C	1245411C	2355111C	2461111C	3551111C	4531111C	5411111C	3211111C
1111453C	1113543C	1124541C	1255211C	1246111C	2551111C	2551111C	5311111C
1113211C	1124441C	1124531C	1245411C	1254321C	1245321C	1255111C	1255111C

ADDR#0 DR INTRA

1111111C	1234311C	1134411C	1253111C	1253111C	1252111C	1341111C	1331111C
1244221C	1252111C	1135111C	1215111C	1343111C	4211111C	3211111C	1111111C
1111511C	1253111C	1251111C	1441111C	3411111C	3111111C	1111111C	1111111C
1252111C	1243211C	3321111C	4111111C	1211111C	1111111C	1111111C	1111111C
2454111C	2552111C	3551111C	4531111C	5211111C	5211111C	3211111C	1111111C
1235421C	1245411C	1255211C	3611111C	3611111C	5421111C	5111111C	3111111C
1113541C	1125511C	1235432C	1255111C	2255111C	2552111C	4541111C	5111111C
1113321C	1124511C	1113541C	1113551C	1125432C	1255111C	1255111C	1551111C

ADDR#0 LUMI INTER

12465C11	12465C11	1357111C	1357111C	1357111C	3571111C	14661C11	2753111C
12465C11	24651C11	24651C11	3571111C	3571111C	3671111C	4751111C	1743111C
12465C11	24651C11	3571111C	3572111C	4751111C	4751111C	5741111C	6611111C
12465C11	2357111C	3571111C	467B1111	4751111C	5741111C	6711111C	6511111C
12465C11	2357111C	3571111C	3572111C	466B1111	4751111C	5731111C	6521111C
12465C11	1236611C	1357111C	3571111C	3571111C	3671111C	4751111C	6611111C
1246511C	12465C11	13563C11	1357111C	3571111C	3571111C	467B1111	2751111C
12465C11	12465C11	12465C11	1357111C	1357111C	1357111C	14661C11	2752111C

ADDR#0 DB INTER

1255411C	2642111C	2642111C	1642111C	2641211C	2641111C	1641111C	1551111C
2641111C	2642111C	6431111C	6431111C	6431111C	6411111C	6111111C	5211111C
2642111C	6432111C	6431111C	6411111C	6311111C	5421111C	5411111C	4311111C
3641111C	6431111C	6411111C	6411111C	6111111C	5421111C	5111111C	3211111C
3641111C	6432111C	6431111C	6431111C	6211111C	5421111C	5411111C	4311111C
3641111C	5543111C	6511111C	6431111C	6431111C	6311111C	6111111C	5321111C
2555111C	3641111C	2643111C	2643111C	2642211C	1642211C	6411111C	6111111C
1255511C	1455311C	1463111C	1264222C	1264221C	2643111C	2642211C	1632111C

ADDR#0 DR INTER

1264111C	1264311C	1264111C	1263221C	2641111C	1264111C	1631111C	1441111C
2641111C	2642111C	2641111C	6411111C	6411111C	5411111C	5111111C	2111111C
3632111C	6411111C	6211111C	5411111C	4211111C	4111111C	1211111C	1111111C
6411111C	5521111C	5411111C	5321111C	4211111C	2111111C	1111111C	1111111C
3641111C	6421111C	6111111C	6111111C	5111111C	4111111C	1111111C	1111111C
3641111C	6431111C	6431111C	6421111C	6111111C	5211111C	5111111C	2111111C
1264311C	2643111C	2642211C	2642211C	1643111C	6411111C	6111111C	5111111C
1255421C	1264221C	1264311C	1264311C	1264311C	1264211C	2643111C	1621111C

WEIGHTING TABLES F(SB)

LUMI INTRA

0	0	3	6	10	15	21	28
0	3	6	10	15	21	28	36
3	6	11	16	22	29	37	46
6	10	16	23	30	37	47	58
6	10	16	23	30	37	47	58
3	6	11	16	22	29	37	46
0	3	6	10	15	21	28	36
0	0	3	6	10	15	21	28

DB & DR INTRA

0	1	2	3	4	5	7	10
2	3	4	5	7	10	12	15
4	5	7	10	12	15	17	19
7	10	12	15	17	19	21	23
7	10	12	15	17	19	21	23
4	5	7	10	12	15	17	19
2	3	4	5	7	10	12	15
0	1	2	3	4	5	7	10

LUMI INTER

0	0	1	1	2	3	5	7
0	1	1	2	3	5	6	10
1	2	3	4	5	7	10	13
2	3	5	6	7	9	13	16
2	3	5	6	7	9	13	16
1	2	3	4	5	7	10	13
0	1	1	2	3	5	6	10
0	0	1	1	2	3	5	7

DB & DR INTER

0	0	1	1	2	2	3	5
1	1	2	2	3	5	6	7
2	2	3	5	6	7	8	9
3	5	6	7	8	9	10	11
3	5	6	7	8	9	10	11
2	2	3	5	6	7	8	9
1	1	2	2	3	5	6	7
0	0	1	1	2	2	3	5

NOTE

Presently DB & DR TABLES for INTRA are modified by adding 8 (resp 6) to all subband weighting factors for DB (resp DR)

TABLES PQ2(SB)

LUMI INTRA & INTER

48	46	44	42	38	34	20	10
46	42	40	36	28	10	10	10
44	40	34	28	10	10	10	10
42	34	28	10	10	10	10	10
42	34	28	10	10	10	10	10
44	40	34	28	10	10	10	10
46	42	40	36	28	10	10	10
48	46	44	42	38	34	20	10

DB INTRA & INTER

40	35	30	22	18	18	10	10
35	30	22	18	10	10	10	10
30	22	22	10	10	10	10	10
22	22	22	10	10	10	10	10
22	22	22	10	10	10	10	10
30	22	22	10	10	10	10	10
35	30	22	18	10	10	10	10
40	35	30	22	18	18	10	10

DR INTRA & INTER

48	39	30	22	18	18	10	10
40	30	22	18	10	10	10	10
30	30	22	10	10	10	10	10
30	30	22	10	10	10	10	10
30	30	22	10	10	10	10	10
30	30	22	10	10	10	10	10
40	30	22	18	10	10	10	10
48	39	30	22	18	18	10	10

POPPLE 9Mbit/s

SNR_Y

GOP	1	2	3	4	5	6	7	8	9	10
35.56	37.21	34.22	34.47	35.05	35.41	35.64	35.81	36.03	36.21	36.42
35.68	37.02	35.02	34.94	35.28	35.46	35.65	35.82	36.00	36.01	36.01
35.47	36.78	34.96	34.70	35.01	35.22	35.44	35.60	35.65	35.84	35.84
35.45	36.84	34.81	34.75	35.07	35.27	35.48	35.65	35.66	35.67	35.65
34.68	36.76	34.78	34.65	34.79	34.73	34.56	34.52	34.53	34.33	33.75
34.70	35.45	34.48	34.49	34.54	34.52	34.58	34.46	34.64	34.82	35.13
36.40	36.80	35.50	35.95	36.10	36.24	36.40	36.54	36.70	36.89	37.15
36.49	38.22	36.08	36.35	36.49	36.45	36.47	36.44	36.31	36.31	36.09
35.28	37.52	35.82	35.73	35.68	35.45	35.22	35.02	34.69	34.50	34.05
32.94	36.03	34.81	34.15	33.67	33.24	32.75	32.51	31.94	31.63	31.02
31.82	33.59	33.41	32.62	32.07	31.57	31.57	31.26	31.17	31.05	30.84
32.02	33.62	33.22	32.70	32.38	32.02	31.86	31.56	31.34	31.19	31.09
	33.65	33.23	32.43	32.10	31.89					

SNR_DB

GOP	1	2	3	4	5	6	7	8	9	10
39.38	41.80	38.50	38.41	38.74	39.08	39.27	39.44	39.63	39.84	39.99
39.49	41.01	39.16	38.89	39.04	39.19	39.34	39.51	39.71	39.70	39.67
39.28	40.80	39.22	38.67	38.79	38.92	39.12	39.25	39.34	39.47	39.58
39.32	40.88	39.16	38.76	38.92	39.09	39.21	39.32	39.36	39.40	39.35
38.56	40.71	39.11	38.70	38.67	38.55	38.29	38.20	38.18	38.12	37.72
38.79	39.48	39.00	38.70	38.73	38.61	38.59	38.53	38.55	38.72	39.04
40.80	41.24	40.21	40.20	40.29	40.47	40.67	40.90	41.20	41.44	41.63
40.60	43.44	40.73	40.82	40.86	40.70	40.51	40.37	40.03	39.94	39.58
38.08	41.49	39.50	39.02	38.68	38.38	37.95	37.64	37.18	36.78	36.32
34.92	38.69	37.70	36.74	35.79	35.27	34.69	34.28	33.84	33.19	32.67
33.61	35.45	36.06	34.94	33.97	33.51	33.20	32.84	32.69	32.61	32.43
33.82	35.12	35.63	34.73	34.26	33.93	33.62	33.36	33.04	32.78	32.75
	35.41	35.80	34.59	33.96	33.65					

SNR_DR

GOP	1	2	3	4	5	6	7	8	9	10
40.49	43.16	39.98	39.71	39.93	40.12	40.30	40.35	40.62	40.74	40.87
40.53	41.99	40.54	40.06	40.16	40.21	40.34	40.46	40.59	40.59	40.64
40.36	41.74	40.53	39.88	39.96	40.06	40.22	40.27	40.31	40.43	40.44
40.29	41.74	40.42	39.88	39.98	40.04	40.15	40.27	40.23	40.29	40.19
39.62	41.62	40.43	39.92	39.81	39.61	39.33	39.20	39.16	39.18	38.62
39.48	40.45	40.28	39.77	39.54	39.47	39.26	39.02	38.96	39.01	39.27
40.92	41.49	40.55	40.51	40.51	40.67	40.73	40.90	41.08	41.35	41.59
40.60	43.45	40.88	40.79	40.84	40.67	40.44	40.32	40.11	39.93	39.59
38.29	41.67	39.81	39.21	38.95	38.55	38.10	37.87	37.38	37.04	36.48
35.10	39.00	38.10	36.96	36.07	35.46	34.86	34.45	33.90	33.41	32.80
33.77	35.51	36.41	35.13	34.26	33.61	33.37	33.02	32.74	32.80	32.57
34.06	35.41	36.05	34.97	34.49	34.08	33.91	33.57	33.27	33.01	32.90
	35.73	36.30	34.95	34.27	33.87					

BITS

GOP	1	2	3	4	5	6	7	8	9	10
3404192	616374	286793	237156	278184	302768	305138	325471	332255	352801	367252
7018488	847357	347757	252959	281654	290855	302932	310985	328924	327351	323522
10612220	870209	349584	244422	278331	288823	296320	312659	306709	325425	321251
14224646	867321	339107	256179	283966	296019	303927	313451	316416	316810	319229
17920554	901717	338208	269487	309386	320425	305067	298595	315115	334314	303595
21418184	870022	298015	300220	299604	304171	314152	285083	280604	269926	275832
24999392	753174	239190	292219	294919	305935	318270	324682	330873	337049	384900
28656186	841412	269608	298288	315068	317941	325672	333494	317626	323699	313983
32314926	796464	302392	314644	325044	322842	329886	317708	326257	322960	300542
35945568	919956	357028	357820	308123	322203	291239	290637	281606	253761	248265
39491936	930373	381903	346694	309453	292639	270857	266311	245084	260605	242451
43085224	897614	348968	311871	318071	317237	295684	293923	277671	262730	269518
	937857	373941	329290	307880	295071					

MOBILE & CALENDER 4Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
					SNR_Y					
27.36	32.36	27.74	27.81	27.33	27.11	26.98	26.71	26.61	26.62	26.67
27.71	28.45	27.96	28.02	27.77	27.83	27.65	27.56	27.40	27.27	27.28
28.38	29.01	28.38	28.29	28.09	28.31	28.31	28.35	28.31	28.42	28.36
28.44	29.69	28.40	28.25	27.88	27.96	28.10	28.21	28.44	28.74	29.07
28.08	30.20	28.43	28.52	28.50	28.31	28.09	27.79	27.48	27.27	26.98
26.98	28.62	27.88	27.38	26.99	26.84	26.58	26.51	26.49	26.56	26.44
27.12	28.28	27.69	27.56	27.30	27.21	26.90	26.79	26.62	26.59	26.57
27.32	28.41	27.63	27.68	27.58	27.45	27.20	26.98	26.92	26.89	26.70
27.78	28.44	27.97	28.14	27.94	27.74	27.53	27.54	27.53	27.57	27.56
28.34	29.18	28.26	28.62	28.92	28.84	28.63	28.28	28.01	27.70	27.34
27.39	28.87	27.99	27.86	27.64	27.46	27.26	27.12	26.88	26.78	26.49
27.62	28.15	27.76	27.71	27.50	27.58	27.53	27.37	27.50	27.55	27.60
	29.03	27.76	27.97	27.77	27.68					
					SNR_DB					
33.05	35.30	34.12	33.67	33.25	32.93	32.75	32.55	32.37	32.28	32.24
33.06	33.08	33.74	33.53	33.34	33.26	33.08	32.91	32.73	32.59	32.52
33.29	33.35	33.78	33.58	33.39	33.34	33.25	33.16	33.09	33.06	32.99
33.25	33.54	33.73	33.55	33.30	33.20	33.09	32.97	32.99	33.05	33.16
32.93	33.63	33.70	33.47	33.29	33.08	32.87	32.70	32.47	32.30	32.11
32.36	32.96	33.32	32.88	32.62	32.41	32.15	31.97	31.87	31.89	31.79
32.39	32.67	33.35	33.05	32.74	32.47	32.29	32.09	31.94	31.84	31.78
32.48	32.70	33.28	33.03	32.82	32.64	32.42	32.22	32.10	31.98	31.80
32.49	32.69	33.29	33.07	32.80	32.58	32.31	32.18	32.12	32.08	32.00
32.80	32.86	33.44	33.24	33.17	33.03	32.89	32.69	32.49	32.30	32.10
32.39	32.86	33.36	33.07	32.79	32.56	32.28	32.09	31.91	31.80	31.58
32.36	32.44	33.02	32.82	32.57	32.39	32.25	32.11	32.08	32.04	32.00
	32.74	33.21	32.97	32.73	32.63					
					SNR_DR					
35.15	37.37	36.51	35.95	35.44	35.14	34.84	34.58	34.37	34.23	34.14
35.08	35.02	36.06	35.77	35.49	35.34	35.08	34.87	34.63	34.43	34.42
35.30	35.33	36.03	35.79	35.52	35.38	35.23	35.07	34.99	34.95	34.86
35.20	35.46	35.91	35.63	35.34	35.13	34.98	34.86	34.86	34.91	35.01
34.88	35.54	35.95	35.60	35.32	35.05	34.80	34.55	34.35	34.15	33.94
34.31	34.79	35.56	35.01	34.70	34.40	34.12	33.87	33.73	33.74	33.58
34.32	34.54	35.67	35.10	34.73	34.45	34.16	33.98	33.81	33.66	33.58
34.43	34.60	35.62	35.21	34.90	34.59	34.32	34.07	33.96	33.82	33.62
34.38	34.53	35.47	35.09	34.74	34.42	34.13	34.04	33.95	33.89	33.81
34.69	34.72	35.69	35.31	35.18	34.89	34.70	34.50	34.30	34.06	33.85
34.39	34.70	35.65	35.22	34.83	34.56	34.26	34.06	33.87	33.71	33.48
34.38	34.41	35.30	34.95	34.66	34.46	34.28	34.08	34.03	33.95	33.89
	34.74	35.60	35.20	34.88	34.63					
					BITS					
1548962	556934	82594	135744	123087	121404	111427	107608	106010	103452	100702
3143581	553572	87493	128451	112037	126663	113047	128155	123085	112063	110053
4737890	550809	86918	132044	111631	122567	122787	122292	107173	119492	118596
6338501	559381	94701	134840	104695	113124	123447	112981	113564	108966	134912
7955965	568779	95754	121038	125585	121264	119399	121292	118021	113901	112431
9533998	568781	129154	126451	113393	115565	106977	105571	101181	114371	96588
11143774	570127	105871	124760	117143	121697	115788	120525	108048	112703	113114
12745598	570849	107522	116695	116144	120849	120178	112563	115543	115108	106374
14337068	567847	88890	123084	112694	123961	106161	120323	117364	115191	115956
15961044	570807	82437	99935	117628	120928	136161	125220	123009	121582	126270
17549262	584444	112701	120613	111067	117437	110957	116587	107407	113413	93594
19148942	564301	108781	123740	107936	119222	122555	106377	112765	115674	118328
	589780	95001	122170	115667	114294					

MOBILE & CALENDER 9Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
					SNR_Y					
31.31	36.72	32.49	31.66	31.47	30.96	30.80	30.46	30.41	30.48	30.56
32.00	32.64	32.24	31.88	32.05	32.02	32.00	31.99	32.02	31.59	31.61
32.81	33.50	32.63	32.40	32.39	32.72	32.70	32.73	32.81	33.11	33.28
32.89	34.69	32.84	32.36	32.26	32.27	32.28	32.57	32.86	33.43	33.95
32.26	35.09	32.94	32.53	32.86	32.57	32.27	31.99	31.49	31.22	30.90
30.95	32.83	32.61	31.57	31.01	30.68	30.38	30.12	30.36	30.32	30.56
31.23	32.65	31.88	31.35	31.22	31.17	31.12	30.82	30.83	30.82	30.80
31.45	32.85	32.10	31.43	31.55	31.46	31.41	31.14	31.13	30.92	30.88
32.10	32.85	32.27	31.96	32.09	31.98	31.70	31.91	31.92	32.19	32.22
32.80	33.93	32.60	32.75	33.36	33.54	33.40	33.13	32.58	31.97	31.37
31.53	33.16	32.87	31.92	31.82	31.50	31.24	31.17	30.91	30.83	30.60
31.62	32.55	32.08	31.53	31.43	31.35	31.52	31.28	31.49	31.51	31.57
	33.38	32.24	31.76	31.76	31.67					
					SNR_DB					
35.35	39.36	36.67	35.98	35.56	35.09	34.87	34.61	34.48	34.45	34.47
35.75	36.05	36.52	36.07	35.97	35.88	35.73	35.54	35.49	35.22	35.18
36.20	36.55	36.57	36.27	36.08	36.13	36.07	36.02	36.09	36.08	36.20
36.27	37.24	36.62	36.28	36.16	36.02	35.86	35.91	36.01	36.29	36.50
35.80	37.43	36.72	36.24	36.22	36.02	35.77	35.54	35.19	34.93	34.66
34.70	36.02	36.19	35.42	34.95	34.59	34.28	34.04	34.04	33.99	34.15
35.00	35.64	36.01	35.54	35.26	35.00	34.86	34.60	34.52	34.44	34.42
35.22	35.91	36.03	35.64	35.44	35.26	35.15	34.95	34.87	34.68	34.56
35.43	36.00	36.19	35.78	35.66	35.42	35.16	35.12	35.06	35.08	35.01
35.92	36.45	36.39	36.21	36.33	36.32	36.19	36.00	35.65	35.22	34.77
35.16	36.14	36.38	35.79	35.55	35.26	34.97	34.77	34.56	34.43	34.29
35.19	35.73	36.03	35.63	35.35	35.11	35.03	34.81	34.86	34.78	34.81
	36.09	36.15	35.68	35.53	35.36					
					SNR_DR					
37.45	41.16	39.05	38.33	37.82	37.29	36.96	36.67	36.50	36.41	36.36
37.75	37.85	38.91	38.34	38.10	37.90	37.68	37.49	37.38	37.13	37.06
38.16	38.41	38.94	38.49	38.20	38.14	37.98	37.89	37.87	37.86	37.93
38.21	38.95	38.93	38.45	38.17	38.00	37.80	37.78	37.86	38.05	38.27
37.78	39.11	38.98	38.40	38.27	38.00	37.68	37.43	37.16	36.92	36.62
36.67	37.82	38.44	37.56	37.00	36.61	36.29	36.03	35.94	35.89	35.96
37.01	37.43	38.44	37.77	37.35	37.08	36.87	36.56	36.49	36.35	36.28
37.22	37.74	38.48	37.87	37.57	37.32	37.07	36.84	36.73	36.59	36.40
37.39	37.84	38.57	37.93	37.70	37.45	37.13	37.00	36.90	36.90	36.82
37.87	38.15	38.76	38.33	38.35	38.21	38.07	37.87	37.53	37.12	36.68
37.18	37.98	38.76	38.02	37.69	37.30	36.95	36.73	36.55	36.38	36.19
37.26	37.57	38.48	37.91	37.51	37.24	37.09	36.83	36.84	36.75	36.74
	37.96	38.68	37.99	37.69	37.51					
					BITS					
3452048	922127	352596	278235	320785	287636	279310	264661	258995	247353	240350
7039011	1006926	305226	260230	291107	278053	281147	305577	325715	272688	260295
10644560	1006923	299176	282799	276096	281436	285608	285299	279067	290900	318246
14222878	1041211	318938	290343	283799	267375	263808	267309	256956	274955	313623
17890968	1048150	338147	234576	310284	298517	303573	313475	278919	273642	268806
21461744	1043151	404657	310779	298004	281788	263729	231962	239902	240408	256397
25074716	1046993	329961	270160	281196	284969	293272	275254	273569	279738	277861
28666734	1045935	352781	251244	278618	285722	299309	278531	278218	257783	263876
32239064	1035728	302842	248545	298326	300074	257045	286858	273540	287848	281523
35938640	1049076	291506	208748	271365	297213	334592	346718	310429	300330	289602
39501160	1067532	392136	266699	282177	271816	262445	267883	250393	258528	242907
43069048	1062259	337578	260447	265523	259518	295598	258489	264760	277880	285845
	1081385	337243	258819	276488	282293					

FLOWERGARDEN 4Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
SNR_Y										
29.37	35.58	29.68	29.77	29.46	29.24	28.92	28.75	28.66	28.53	28.41
29.98	30.43	29.68	29.81	30.10	30.15	30.12	30.03	30.05	29.93	29.58
29.73	31.55	30.13	30.12	30.36	29.69	29.50	29.68	29.43	28.88	28.61
29.84	30.56	29.51	29.57	29.46	29.54	29.92	30.13	30.32	29.89	29.62
29.24	31.31	29.76	29.90	29.77	29.69	29.39	28.78	28.59	28.01	28.18
29.20	30.25	30.02	29.84	29.53	29.22	29.17	28.80	28.59	28.54	28.48
30.59	30.50	29.86	30.40	30.75	30.80	30.80	31.11	30.46	30.92	30.45
29.93	31.99	30.15	30.54	30.68	30.77	30.47	29.76	28.91	28.71	28.52
29.17	30.53	30.10	30.01	29.88	29.47	28.76	28.57	28.74	28.41	28.00
28.54	30.09	29.13	28.97	28.78	28.55	28.18	28.17	28.04	28.13	27.84
28.61	30.06	29.52	29.43	29.10	28.80	28.29	28.07	27.94	27.80	27.77
29.20	29.86	29.01	28.97	29.00	29.02	29.11	29.60	29.62	28.92	29.06
	31.17	29.40	29.27	29.24	29.69					
SNR_DB										
33.70	36.34	34.69	34.16	33.89	33.66	33.34	33.19	33.03	32.93	32.84
33.97	33.85	34.62	34.35	34.30	34.15	34.00	33.84	33.75	33.61	33.40
33.83	34.34	34.75	34.41	34.33	33.88	33.70	33.61	33.47	33.19	32.97
33.75	34.03	34.39	34.00	33.80	33.66	33.72	33.68	33.72	33.43	33.21
33.44	34.14	34.05	34.09	33.96	33.77	33.52	33.14	32.94	32.61	32.61
33.41	33.79	34.61	34.05	33.81	33.48	33.32	33.12	32.88	32.80	32.64
34.24	33.65	34.68	34.59	34.51	34.41	34.32	34.35	34.06	34.10	33.83
33.87	34.47	34.69	34.65	34.53	34.41	34.00	33.55	33.20	32.94	32.80
33.53	33.84	34.69	34.17	34.13	33.85	33.42	33.17	33.04	32.88	32.57
33.25	33.72	34.03	33.81	33.61	33.33	33.09	32.98	32.82	32.78	32.60
33.37	33.67	34.66	34.08	33.76	33.47	33.17	32.95	32.82	32.79	32.70
33.60	33.74	34.11	33.86	33.74	33.51	33.58	33.70	33.53	33.17	33.16
	34.09	34.31	33.99	33.82	33.83					
SNR_DR										
34.72	36.75	35.70	35.23	35.04	34.76	34.42	34.21	34.08	33.96	33.86
34.93	34.77	35.61	35.44	35.35	35.11	34.98	34.76	34.64	34.49	34.29
34.97	35.10	35.71	35.46	35.43	35.12	34.92	34.80	34.68	34.45	34.27
34.95	35.00	35.50	35.29	35.18	35.03	34.97	34.94	34.79	34.55	34.40
34.85	35.16	35.30	35.35	35.35	35.30	34.94	34.62	34.40	34.20	34.15
34.69	34.97	35.63	35.24	35.11	34.89	34.67	34.48	34.19	34.06	33.93
35.23	34.75	35.64	35.65	35.56	35.42	35.28	35.28	35.10	35.00	34.76
34.93	35.26	35.59	35.61	35.48	35.34	34.98	34.63	34.40	34.27	34.12
34.73	34.88	35.60	35.26	35.26	35.09	34.68	34.51	34.29	34.13	33.89
34.58	34.75	35.22	35.13	34.95	34.69	34.52	34.39	34.23	34.12	33.96
34.60	34.81	35.58	35.21	35.03	34.78	34.48	34.30	34.12	34.07	33.95
34.69	34.78	35.26	35.12	34.97	34.73	34.72	34.71	34.49	34.19	34.12
	34.86	35.31	35.13	34.91	34.81					
BITS										
1546042	452091	92829	133043	126569	131061	118630	124204	128994	118552	120069
3158897	531555	94627	104568	113045	127298	127910	122285	126766	128414	136387
4732079	530775	98950	113877	134037	127224	100287	123305	136741	120801	87185
6320844	524127	103226	129930	116245	108289	133237	99358	145645	133515	95193
7921404	538939	112306	121783	125141	123278	140765	118754	135928	108310	75356
9536696	524513	89898	137507	129459	112628	139053	117106	122841	129539	112749
11118284	534613	90113	93770	113968	139134	111005	166501	83177	148768	100538
12752462	537150	104394	102802	116335	125979	144725	155162	117903	115047	114682
14364764	550832	90250	127102	127902	130269	121935	98445	130944	113257	121365
15949744	553660	115565	114931	120283	118117	114191	111201	112131	113778	111124
17543234	542838	91082	127720	125735	123991	123487	112941	126079	111675	107943
19134928	549794	109533	117261	110588	116846	100819	117747	146514	118227	104365
	527572	111842	121155	92589	143038					

FLOWERGARDEN 9Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
SNR_Y										
34.15	39.96	34.64	34.44	34.40	34.02	33.65	33.53	33.51	33.23	33.16
34.88	35.20	34.42	34.28	34.77	34.99	34.99	34.93	35.20	35.07	35.07
34.64	36.85	34.88	34.68	35.17	34.72	34.37	34.57	34.63	33.92	33.42
34.61	35.32	34.33	33.98	34.06	34.00	34.52	34.83	35.39	35.11	34.86
33.94	36.59	34.51	34.23	34.20	34.21	33.99	33.56	33.41	32.91	32.88
34.02	34.95	34.50	34.34	34.31	33.99	34.08	33.85	33.70	33.44	33.27
35.42	35.22	34.36	34.67	35.27	35.77	35.69	36.02	35.50	36.06	36.03
34.79	37.46	35.07	34.96	35.22	35.46	35.33	34.87	34.01	33.54	33.33
33.81	35.32	34.80	34.51	34.63	34.02	33.50	33.01	33.13	33.19	32.77
33.21	34.89	33.96	33.32	33.21	33.06	32.83	32.85	32.75	32.88	32.79
33.34	35.01	33.91	33.91	33.84	33.53	33.11	32.83	32.77	32.58	32.50
33.94	34.63	33.66	33.26	33.32	33.50	33.83	34.53	34.72	34.34	33.98
	35.96	34.42	33.94	33.89	34.70					
SNR_DB										
36.70	40.51	37.55	36.94	36.79	36.55	36.29	36.15	36.04	35.96	35.81
37.26	37.20	37.43	37.28	37.42	37.36	37.32	37.18	37.24	37.15	37.00
37.06	38.24	37.68	37.47	37.48	37.10	36.97	36.91	36.76	36.35	36.09
36.94	37.48	37.26	36.70	36.61	36.63	36.83	37.00	37.17	36.96	36.86
36.42	38.06	36.93	36.84	36.77	36.66	36.38	36.07	35.89	35.54	35.64
36.30	37.19	37.34	36.69	36.58	36.33	36.19	36.04	35.84	35.66	35.53
37.53	36.97	37.38	37.37	37.55	37.72	37.68	37.69	37.52	37.74	37.69
36.98	38.54	37.63	37.52	37.53	37.55	37.27	36.82	36.30	35.86	35.61
36.26	36.99	37.48	36.98	36.93	36.57	36.09	35.78	35.62	35.53	35.21
35.93	36.94	36.63	36.23	36.08	35.86	35.67	35.66	35.47	35.53	35.44
36.09	36.90	37.22	36.63	36.42	36.15	35.85	35.66	35.48	35.53	35.45
36.47	36.85	36.68	36.34	36.19	36.09	36.41	36.78	36.72	36.43	36.31
	37.66	37.09	36.70	36.66	36.85					
SNR_DR										
37.01	40.78	38.03	37.29	37.12	36.83	36.59	36.43	36.31	36.22	36.14
37.41	37.46	37.95	37.69	37.67	37.48	37.36	37.22	37.23	37.16	36.98
37.36	38.32	38.23	37.86	37.74	37.39	37.23	37.13	37.01	36.66	36.42
37.28	37.73	37.88	37.30	37.16	37.05	37.13	37.22	37.28	37.09	37.04
36.95	38.29	37.60	37.50	37.39	37.25	36.87	36.53	36.37	36.10	36.12
36.79	37.60	38.09	37.28	37.10	36.84	36.68	36.48	36.26	36.09	35.93
37.82	37.36	38.11	38.05	37.99	37.97	37.80	37.82	37.67	37.75	37.68
37.31	38.62	38.16	37.99	37.88	37.79	37.42	37.03	36.64	36.31	36.04
36.77	37.42	38.17	37.55	37.43	37.09	36.57	36.29	36.11	36.00	35.72
36.50	37.32	37.35	37.06	36.82	36.48	36.26	36.18	36.02	35.98	35.87
36.58	37.33	37.95	37.23	36.95	36.67	36.31	36.14	35.93	35.96	35.86
36.82	37.28	37.31	36.98	36.77	36.58	36.74	36.89	36.80	36.51	36.39
	37.68	37.54	37.11	36.93	36.97					
BITS										
3461052	767565	294653	309971	325616	308473	285453	299401	303554	282449	283917
7072851	947193	288708	243982	268299	298515	299324	286233	311687	310414	357444
10645002	956405	303294	266182	319668	325034	253147	284220	341727	303115	219360
14211882	925086	320499	293848	290487	242845	300953	245175	345238	336941	265808
17807080	974363	315425	288229	295150	286946	324236	297477	330944	289051	193379
21459812	922121	268654	316212	325597	278171	332328	308781	319788	306181	274899
25027068	942817	267666	211852	264576	347533	273266	369498	244987	331257	313806
28713718	978024	329811	224598	275714	289143	337465	379751	314817	273029	284297
32316108	990006	289076	291205	325762	304675	309284	228359	275346	291013	297663
35880072	992568	330485	274230	292947	277280	286912	272555	265930	280756	290301
39471960	964981	270041	288930	318226	303890	307015	282824	305703	278133	272139
43024704	982628	313813	277625	263247	270382	254260	283390	342673	328696	236039
	916792	338313	294115	223381	337391					

TABLE TENNIS 4Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
					SNR_Y					
27.93	30.54	25.97	26.40	27.10	27.28	27.92	26.57	29.54	30.17	31.58
33.92	32.89	32.46	33.00	33.48	34.62	34.18	35.19	34.68	34.89	34.80
34.72	35.58	34.44	34.55	34.68	34.76	34.67	34.67	34.74	34.64	34.54
34.13	35.44	34.08	34.27	34.30	34.29	34.08	33.92	33.82	33.77	33.61
33.55	34.70	33.31	33.55	33.54	33.42	33.32	33.33	33.45	33.48	33.52
31.99	34.57	33.24	33.49	31.06	30.75	30.96	31.37	31.75	32.04	32.22
32.58	33.32	31.07	31.45	31.93	32.54	32.73	33.21	33.27	33.75	33.48
33.03	33.87	31.44	31.74	32.41	32.75	33.24	33.44	33.76	33.74	35.17
29.43	34.83	30.95	28.83	28.45	28.46	28.56	28.82	29.07	29.50	29.85
31.08	30.94	29.16	29.96	30.74	31.26	31.79	32.03	32.24	31.79	31.93
30.55	32.48	30.40	30.21	30.57	30.32	30.31	30.37	30.34	30.47	30.43
31.32	31.58	30.14	30.52	30.82	31.03	31.36	32.09	32.31	31.93	32.00
	32.86	30.65	30.82	30.97	31.03					
					SNR_DB					
35.33	35.91	34.81	34.73	34.68	34.67	34.74	34.73	36.31	36.42	37.16
38.66	37.77	38.16	38.19	38.38	38.87	38.71	39.20	39.12	39.21	39.24
39.26	39.43	39.29	39.22	39.28	39.32	39.28	39.23	39.24	39.18	39.10
38.86	39.45	39.28	39.23	39.04	39.00	38.83	38.67	38.48	38.50	38.31
38.40	38.77	38.60	38.51	38.47	38.39	38.29	38.22	38.25	38.24	38.27
36.80	38.63	38.56	38.40	36.08	36.07	36.01	36.05	36.29	36.47	36.62
37.68	37.63	37.32	37.32	37.40	37.59	37.64	37.85	37.89	38.16	38.08
37.94	38.18	37.38	37.39	37.57	37.65	37.87	38.03	38.24	38.24	39.06
35.01	38.84	37.29	34.44	34.35	34.35	34.39	34.43	34.48	34.69	34.90
36.15	35.70	35.68	35.81	35.96	36.13	36.33	36.45	36.60	36.49	36.47
36.13	36.81	36.29	36.13	36.11	36.08	36.04	36.01	35.96	35.98	35.99
36.48	36.44	36.24	36.26	36.29	36.33	36.45	36.61	36.81	36.70	36.69
	37.04	36.44	36.36	36.33	36.31					
					SNR_DR					
37.80	38.94	37.96	37.72	37.55	37.52	37.60	37.29	37.56	37.70	38.39
40.26	39.29	39.90	39.87	40.02	40.49	40.18	40.78	40.75	40.85	40.76
40.60	41.12	41.17	40.88	40.83	40.69	40.55	40.37	40.33	40.20	40.03
39.66	40.58	40.42	40.13	39.97	39.87	39.57	39.33	39.14	39.07	38.90
39.16	39.71	39.40	39.21	39.19	39.09	38.96	38.95	39.05	39.06	39.03
38.21	39.81	39.77	39.43	37.61	37.47	37.38	37.61	37.79	37.99	38.20
39.75	39.44	39.69	39.49	39.54	39.68	39.71	39.91	39.91	40.16	40.04
40.08	40.32	39.69	39.60	39.71	39.86	40.03	40.13	40.28	40.25	41.07
37.25	40.93	39.57	36.80	36.43	36.41	36.43	36.64	36.85	37.11	37.36
38.99	38.25	38.97	38.83	38.87	38.98	39.18	39.25	39.32	39.15	39.16
38.78	39.52	39.31	39.00	38.88	38.75	38.61	38.55	38.49	38.43	38.44
39.02	38.96	39.21	38.94	38.88	38.83	38.87	39.07	39.22	39.12	39.09
	39.48	39.40	39.13	38.99	38.78					
					BITS					
1514585	482143	92024	87582	129629	92736	233813	110588	89267	79851	116952
3123148	351328	54849	100282	127052	212096	118097	216243	125284	163185	140147
4725691	405736	72986	122106	126653	151913	138749	149923	144491	149108	140878
6338774	452597	65738	115872	133952	145729	142884	137380	140074	142996	135861
7927762	449019	80094	128217	140219	128517	129660	128562	135979	133707	135014
9524816	460756	74896	124261	474362	32144	43646	69799	95955	110947	110287
11081724	528026	86240	83077	97857	125072	111383	143863	119142	169716	92532
12869552	523416	100286	82214	119355	108206	136938	124078	154930	116804	321601
14335234	591263	80167	410153	33673	35104	38521	47593	53637	83765	91806
15938320	473566	71677	87052	105987	117049	141724	139057	174915	134498	157562
17547278	589392	118067	87729	135916	112862	114803	109274	106546	115594	118774
19140088	541567	97089	100140	113994	112588	92728	115219	157503	122420	139561
	551818	101177	112708	115372	111274					

TABLE TENNIS 9Mbit/s

GOP	1	2	3	4	5	6	7	8	9	10
					SNR_Y					
32.07	35.29	31.04	30.44	31.29	32.04	32.48	31.33	31.92	32.59	34.43
36.63	35.93	34.54	35.61	37.18	36.86	37.09	37.38	37.45	37.69	37.76
37.32	38.62	36.38	36.96	37.33	37.45	37.50	37.46	37.31	37.26	37.26
36.82	38.34	36.27	36.67	36.78	36.93	36.91	36.69	36.66	36.64	36.62
36.38	37.84	35.77	36.16	36.25	36.28	36.25	36.27	36.41	36.44	36.45
35.48	37.76	35.70	36.01	34.51	33.52	34.02	34.89	36.49	36.16	38.09
35.86	38.34	34.30	34.34	34.99	35.59	36.03	36.31	36.52	36.76	37.01
36.29	37.74	34.68	34.74	35.61	36.08	36.53	37.02	37.03	37.54	37.34
34.41	37.92	34.83	33.70	32.67	33.03	33.55	34.18	35.02	35.50	36.02
35.40	36.99	33.78	34.00	34.92	35.57	36.08	36.11	36.30	35.82	35.57
34.59	36.63	34.33	33.99	34.34	34.33	34.38	34.40	34.59	34.58	34.78
35.16	36.12	34.13	34.24	34.58	34.84	35.15	35.77	36.11	35.62	35.60
	36.83	34.69	34.62	34.77	34.95					
					SNR_DB					
36.96	39.15	36.20	36.04	36.14	36.34	36.49	36.23	37.65	37.90	38.84
40.60	39.88	39.83	40.05	40.74	40.64	40.76	40.91	41.03	41.17	41.28
41.21	41.82	40.90	40.99	41.19	41.26	41.24	41.27	41.19	41.13	41.13
40.91	41.80	41.02	41.01	40.93	40.93	40.91	40.73	40.65	40.62	40.59
40.56	41.41	40.60	40.55	40.51	40.48	40.44	40.41	40.42	40.41	40.44
39.53	41.31	40.59	40.41	38.55	38.29	38.32	38.67	39.84	39.71	40.88
39.96	41.48	39.33	39.27	39.46	39.71	39.90	40.05	40.14	40.25	40.41
40.24	41.11	39.51	39.49	39.81	40.00	40.25	40.52	40.53	40.79	40.74
38.08	41.30	39.58	37.34	37.09	37.09	37.25	37.53	38.08	38.40	38.80
39.05	39.85	38.41	38.42	38.75	39.01	39.26	39.31	39.38	39.21	39.09
38.56	39.83	38.57	38.38	38.43	38.45	38.40	38.38	38.42	38.40	38.50
39.00	39.50	38.58	38.57	38.68	38.76	38.92	39.20	39.44	39.28	39.22
	40.08	38.81	38.70	38.72	38.79					
					SNR_DR					
39.80	42.09	39.69	39.36	39.33	39.46	39.53	39.13	39.69	39.77	40.64
42.87	41.97	42.46	42.48	43.00	42.92	42.96	43.10	43.25	43.36	43.46
43.30	44.09	43.55	43.37	43.45	43.32	43.29	43.16	43.06	42.95	42.84
42.44	43.67	43.07	42.75	42.54	42.48	42.32	42.06	41.95	41.92	41.93
41.99	43.02	42.20	41.97	41.91	41.87	41.79	41.67	41.80	41.89	41.89
41.38	43.01	42.43	42.08	40.56	40.16	40.21	40.56	41.66	41.57	42.71
42.35	43.56	42.06	41.84	41.99	42.16	42.24	42.33	42.42	42.49	42.65
42.68	43.39	42.30	42.09	42.31	42.48	42.65	42.84	42.87	43.05	42.98
40.63	43.54	42.35	40.09	39.55	39.62	39.87	40.08	40.62	40.92	41.25
42.06	42.29	41.94	41.77	41.91	42.07	42.23	42.21	42.23	42.07	41.91
41.34	42.45	41.88	41.46	41.38	41.30	41.19	41.12	41.03	40.89	40.88
41.68	41.91	41.87	41.53	41.46	41.48	41.56	41.76	41.93	41.76	41.61
	42.40	41.95	41.64	41.47	41.30					
					BITS					
3383666	825441	443831	123387	217439	266031	438484	410027	204268	185066	269692
7024065	663858	144240	257663	408765	332309	348503	361812	359120	384402	379727
10645538	773160	180899	289100	322100	351560	347429	354096	326359	337227	339544
14262262	819520	196855	283295	306964	338001	347696	328724	329593	330497	335579
17828988	830608	218695	291605	316966	311506	310144	308234	328895	325137	324937
21583604	872197	208371	276112	857057	49565	98042	189231	401300	257981	544759
25020434	1054561	256559	150524	212598	249154	277959	285682	302093	316496	331206
28616656	995435	281048	159782	247366	257681	290015	332663	313180	381073	337979
32186816	1006635	301092	899139	59832	97342	143903	193129	274047	284425	310616
35867208	1059656	262546	148054	237560	282065	321508	314162	386613	347217	321008
39466952	1082699	333264	204271	288835	284792	275565	264516	280574	271018	314213
43053368	1048351	286291	227432	260835	272278	226759	276903	392189	297987	297390
	1012850	295359	246267	267380	283548					

MOBILE & CALENDER 4Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	12766	0.319148
NB_COEFF DB	2687	0.067174
NB_COEFF DR	1795	0.044883
ADD Y	63267	1.581687
ADD DB	5021	0.125536
ADD DR	4084	0.102110
COEFF Y	37076	0.926905
COEFF DB	4472	0.111810
COEFF DR	3863	0.096568
TOTAL Y	113110	2.827740
TOTAL DB	12181	0.304521
TOTAL DR	9742	0.243561
TOTAL Y+DB+DR	135033	3.375823
INTRA/INTER	1620	0.040510
VECTORS	21759	0.543974

INITIAL REGUL	Intra	Inter
	124	152

AVERAGE REGUL	Intra	Inter
	127	152

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	11.75	69.62

FLOWERGARDEN 4Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	9022	0.225548
NB_COEFF DB	2667	0.066684
NB_COEFF DR	1507	0.037682
ADD Y	58702	1.467557
ADD DB	6106	0.152639
ADD DR	3851	0.096280
COEFF Y	41889	1.047220
COEFF DB	5018	0.125455
COEFF DR	2913	0.072830
TOTAL Y	109613	2.740324
TOTAL DB	13791	0.344778
TOTAL DR	8272	0.206792
TOTAL Y+DB+DR	131676	3.291894
INTRA/INTER	1620	0.040506
VECTORS	25366	0.634142

INITIAL REGUL	Intra	Inter
	124	152

AVERAGE REGUL	Intra	Inter
	124	150

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	9.79	64.80

MOBILE & CALENDER 9Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	16400	0.409996
NB_COEFF DB	6765	0.169118
NB_COEFF DR	4576	0.114399
ADD Y	156357	3.908932
ADD DB	16508	0.412699
ADD DR	11789	0.294722
COEFF Y	102860	2.571499
COEFF DB	12378	0.309446
COEFF DR	10194	0.254860
TOTAL Y	275617	6.890425
TOTAL DB	35651	0.891263
TOTAL DR	26559	0.663981
TOTAL Y+DB+DR	337827	8.445671
INTRA/INTER	1620	0.040509
VECTORS	18477	0.461926

INITIAL REGUL	Intra	Inter
	106	130

AVERAGE REGUL	Intra	Inter
	107	134

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	10.21	71.31

FLOWERGARDEN 9Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	13328	0.333208
NB_COEFF DB	6768	0.169203
NB_COEFF DR	5761	0.144015
ADD Y	134598	3.364941
ADD DB	20630	0.515741
ADD DR	15031	0.375779
COEFF Y	114202	2.855039
COEFF DB	13648	0.341195
COEFF DR	8817	0.220416
TOTAL Y	262128	6.553187
TOTAL DB	41046	1.026139
TOTAL DR	29608	0.740210
TOTAL Y+DB+DR	332781	8.319536
INTRA/INTER	1620	0.040505
VECTORS	23480	0.587009

INITIAL REGUL	Intra	Inter
	106	130

AVERAGE REGUL	Intra	Inter
	106	130

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	9.08	62.05

TABLE TENNIS 4Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	11616	0.290403
NB_COEFF DB	3190	0.079758
NB_COEFF DR	2630	0.065746
ADD Y	58041	1.451020
ADD DB	5572	0.139299
ADD DR	5716	0.142906
COEFF Y	38873	0.971825
COEFF DB	4418	0.110445
COEFF DR	5015	0.125387
TOTAL Y	108530	2.713249
TOTAL DB	13180	0.329502
TOTAL DR	13362	0.334039
TOTAL Y+DB+DR	135072	3.376789
INTRA/INTER	1645	0.041134
VECTORS	28098	0.702442

INITIAL REGUL	Intra	Inter
	124	152

AVERAGE REGUL	Intra	Inter
	120	139

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	3.51	96.44

TABLE TENNIS 9Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	16517	0.412921
NB_COEFF DB	7322	0.183041
NB_COEFF DR	5685	0.142117
ADD Y	146367	3.659168
ADD DB	18018	0.450453
ADD DR	14375	0.359382
COEFF Y	105533	2.638315
COEFF DB	11208	0.280188
COEFF DR	11052	0.276300
TOTAL Y	268416	6.710404
TOTAL DB	36547	0.913682
TOTAL DR	31112	0.777799
TOTAL Y+DB+DR	336076	8.401891
INTRA/INTER	1644	0.041088
VECTORS	26603	0.665068

INITIAL REGUL	Intra	Inter
	106	130

AVERAGE REGUL	Intra	Inter
	101	121

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	6.39	90.25

POPPLE 9Mbit/s

BITRATES	Bits/Fr	Mbit/s
NB_COEFF Y	14562	0.364058
NB_COEFF DB	8031	0.200771
NB_COEFF DR	6306	0.157655
ADD Y	106803	2.670085
ADD DB	25943	0.648579
ADD DR	21911	0.547771
COEFF Y	86166	2.154145
COEFF DB	27268	0.681712
COEFF DR	25220	0.630497
TOTAL Y	207532	5.188288
TOTAL DB	61242	1.531062
TOTAL DR	53437	1.335922
TOTAL Y+DB+DR	322211	8.055273
INTRA/INTER	1621	0.040530
VECTORS	34078	0.851951

INITIAL REGUL	Intra	Inter
	106	130

AVERAGE REGUL	Intra	Inter
	100	130

BUFFER OCCUPANCY	MIN (%)	MAX (%)
	6.75	61.27

```
######## LS -L for bit_stream files after 239 fields and 249 fields ########

-r--------   1 mauj     20131124 Oct 12 04:27 fl4_bit_stream_249_fields
-r--------   1 mauj     20185854 Oct 12 07:37 mo4_bit_stream_249_fields
-r--------   1 mauj     20132436 Oct  8 08:47 tn4_bit_stream_249_fields

-r--------   1 mauj     19134928 Oct 12 04:27 fl4_bit_stream_239_fields
-r--------   1 mauj     19148942 Oct 12 07:37 mo4_bit_stream_239_fields
-r--------   1 mauj     19140088 Oct  8 08:47 tn4_bit_stream_239_fields

-r--------   1 mauj     45134708 Oct 12 11:06 fl9_bit_stream_249_fields
-r--------   1 mauj     45305292 Oct 12 23:54 mo9_bit_stream_249_fields
-r--------   1 mauj     45329256 Oct 12 15:23 po9_bit_stream_249_fields
-r--------   1 mauj     45158784 Oct 12 19:38 tn9_bit_stream_249_fields

-r--------   1 mauj     43024704 Oct 12 11:06 fl9_bit_stream_239_fields
-r--------   1 mauj     43069048 Oct 12 23:54 mo9_bit_stream_239_fields
-r--------   1 mauj     43085224 Oct 12 15:23 po9_bit_stream_239_fields
-r--------   1 mauj     43053368 Oct 12 19:38 tn9_bit_stream_239_fields
```

```
fl4 mean bit-rate after 249 fields: 4.042 Mbit/s
mo4 mean bit-rate after 249 fields: 4.053 Mbit/s
tn4 mean bit-rate after 249 fields: 4.043 Mbit/s

fl4 mean bit-rate after 239 fields: 4.003 Mbit/s
mo4 mean bit-rate after 239 fields: 4.006 Mbit/s
tn4 mean bit-rate after 239 fields: 4.004 Mbit/s

fl9 mean bit-rate after 249 fields: 9.063 Mbit/s
mo9 mean bit-rate after 249 fields: 9.097 Mbit/s
po9 mean bit-rate after 249 fields: 9.102 Mbit/s
tn9 mean bit-rate after 249 fields: 9.068 Mbit/s

fl9 mean bit-rate after 239 fields: 9.001 Mbit/s
mo9 mean bit-rate after 239 fields: 9.010 Mbit/s
po9 mean bit-rate after 239 fields: 9.014 Mbit/s
tn9 mean bit-rate after 239 fields: 9.007 Mbit/s
```

SNR_MEAN	Y	DB	DR
fl4	29.43	33.66	34.83
mo4	27.70	32.73	34.70
tn4	31.53	36.99	39.02
fl9	34.20	36.65	37.04
mo9	31.88	35.49	37.49
po9	34.33	37.16	37.58
tn9	35.29	39.36	41.77