

Title: **Proposed Amended H.264/MPEG-4 AVC Reference Software Manual**

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*Author(s) or
Contact(s):* Alexis Michael Tourapis
 Docomo Labs USA
 181 Metro Drive, Suite 300 +1 (408) 228-7983
 San Jose, CA, 95110 USA Tel: +49 30 31002-209
 Karsten Sühning +1 (425) 703-5308
 Image Processing
 Department
 Fraunhofer-Institute HHI
 Einsteinufer 37
 10587 Berlin, Germany alexismt@ieee.org
 Gary Sullivan Email: Karsten.Suehring@hhi.fraunhofer.de
 Microsoft Corporation garysull@microsoft.com
 One Microsoft Way
 Redmond, WA 98052 USA

Source: Docomo Labs USA, Fraunhofer-Institute HHI, Microsoft Corporation

**Joint Video Team (JVT) of ISO/IEC MPEG & ITU-T VCEG
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H.264/MPEG-4 AVC REFERENCE SOFTWARE MANUAL

January, 2005

Revision Sheet

Release No.	Date	Revision Description
Rev. 0	10/08/04	Initial version of Reference Software Manual
Rev. 1	01/12/05	Amendment to original document to reflect modified and new parameters
<u>Rev. 2</u>	<u>01/18/05</u>	<u>Ammendment based on meeting notes</u>

H.264/MPEG-4 AVC REFERENCE SOFTWARE MANUAL

TABLE OF CONTENTS

	<u>Page #</u>
1. GENERAL INFORMATION	1-1
1.0 SYSTEM OVERVIEW	1-1
1.1 PROJECT REFERENCES	1-1
1.2 AUTHORIZED USE PERMISSION	1-1
1.3 POINTS OF CONTACT.....	1-1
1.3.1 Information	1-1
1.3.2 Coordination.....	1-2
1.4 ORGANIZATION OF THE MANUAL.....	1-2
1.5 ACRONYMS AND ABBREVIATIONS	1-2
2. SYSTEM SUMMARY.....	1-2
2.1 SYSTEM CONFIGURATION	1-2
2.2 DATA FLOWS	1-2
3. INSTALLATION AND COMPILATION.....	2-1
3.1 WINDOWS USING MS VISUAL STUDIO 6	2-1
3.2 WINDOWS USING MS VISUAL STUDIO .NET	2-1
3.3 UNIX AND WINDOWS USING GCC (GNU COMPILER COLLECTION)	2-1
4. USING THE JM ENCODER MODULE.....	3-1
4.1 ENCODER SYNTAX	3-1
4.2 ENCODER OUTPUT	3-2
5. ENCODER PARAMETERS	4-1
5.1 FILE INPUT/OUTPUT RELATED PARAMETERS	4-1
5.1.1 InputFile	4-1
5.1.2 RGBInput	4-1
5.1.3 YUVFormat.....	4-1
5.1.4 BitDepthLuma.....	4-1
5.1.5 BitDepthChroma.....	4-2
5.1.6 InputHeaderLength.....	4-2
5.1.7 FrameRate	4-2
5.1.8 SourceWidth.....	4-2
5.1.9 SourceHeight	4-2
5.1.10 StartFrame.....	4-2
5.1.11 FramesToBeEncoded.....	4-2
5.1.12 OutputFile.....	4-3
5.1.13 ReconFile.....	4-3
5.1.14 TraceFile.....	4-3
5.1.15 ReportFrameStats	4-3
5.1.16 DisplayEncParams	4-3
5.2 PRIMARY CONTROL PARAMETERS	4-3
5.2.1 ProfileIDC	4-3
5.2.2 LevelIDC.....	4-4
5.2.3 IntraPeriod	4-4
5.2.4 IDRIntraEnable	4-4

5.2.5	QPISlice.....	4-4
5.2.6	QPPSlice.....	4-5
5.2.7	ChromaQPOffset.....	4-5
5.2.8	CbQPOffset.....	4-5
5.2.9	CrQPOffset.....	4-5
5.2.10	FrameSkip.....	4-5
5.2.11	UseHadamard.....	4-6
5.2.12	SearchRange.....	4-6
5.2.13	NumberReferenceFrames.....	4-6
5.2.14	PList0References.....	4-6
5.2.15	Log2MaxFrameNum.....	4-6
5.2.16	GenerateMultiplePPS.....	4-6
5.2.17	ResendPPS.....	4-6
5.2.18	PicOrderCntType.....	4-6
5.2.19	UseConstrainedIntraPred.....	4-7
5.2.20	MbLineIntraUpdate.....	4-7
5.2.21	RandomIntraMBRefresh.....	4-7
5.2.22	Inter/Intra Mode Prediction Control.....	4-7
5.2.22.1	InterSearch16x16.....	4-7
5.2.22.2	InterSearch16x8.....	4-7
5.2.22.3	InterSearch8x16.....	4-7
5.2.22.4	InterSearch8x8.....	4-7
5.2.22.5	InterSearch8x4.....	4-7
5.2.22.6	InterSearch4x8.....	4-7
5.2.22.7	InterSearch4x4.....	4-8
5.2.22.8	Intra4x4ParDisable.....	4-8
5.2.22.9	Intra4x4DiagDisable.....	4-8
5.2.22.10	Intra4x4DirDisable.....	4-8
5.2.22.11	Intra16x16ParDisable.....	4-8
5.2.22.12	Intra16x16PlaneDisable.....	4-8
5.2.22.13	IntraDisableInterOnly.....	4-8
5.2.22.14	ChromaIntraDisable.....	4-8
5.2.23	Loop Filter Control.....	4-8
5.2.23.1	LoopFilterParametersFlag.....	4-8
5.2.23.2	LoopFilterDisable.....	4-8
5.2.23.3	LoopFilterAlphaC0Offset.....	4-9
5.2.23.4	LoopFilterBetaOffset.....	4-9
5.2.24	Weighted Prediction Parameters.....	4-9
5.2.24.1	WeightedPrediction.....	4-9
5.2.24.2	WeightedBiprediction.....	4-9
5.2.24.3	UseWeightedReferenceME.....	4-9
5.2.25	LastFrameNumber.....	4-9
5.2.26	ChangeQPStart.....	4-9
5.2.27	ChangeQPI.....	4-9
5.2.28	ChangeQPP.....	4-10
5.2.29	ChangeQPB.....	4-10
5.2.30	ChangeQPBSRefOffset.....	4-10
5.3	SECONDARY LAYER PARAMETERS.....	4-10
5.3.1	NumberBFrames.....	4-10
5.3.2	QPBSlice.....	4-10
5.3.3	BRefPicQPOffset.....	4-10
5.3.4	DirectModeType.....	4-10
5.3.5	DirectInferenceFlag.....	4-10
5.3.6	BList0References.....	4-11
5.3.7	BList1References.....	4-11
5.3.8	BReferencePictures.....	4-11
5.3.9	BiPredMotionEstimation.....	4-11

5.3.10	BiPredMERefinements	4-11
5.3.11	BiPredMESearchRange	4-11
5.3.12	BiPredMESubPel	4-12
5.3.13	PyramidCoding	4-12
5.3.14	ExplicitPyramidFormat	4-13
5.3.15	PyramidRefReorder	4-14
5.3.16	PocMemoryManagement	4-15
5.4	ERROR RESILIENCY AND SLICE CONTROL	4-15
5.4.1	SliceMode	4-15
5.4.2	SliceArgument	4-15
5.4.3	num_slice_groups_minus1	4-16
5.4.4	slice_group_map_type	4-16
5.4.5	slice_group_change_direction_flag	4-16
5.4.6	slice_group_change_rate_minus1	4-16
5.4.7	SliceGroupConfigFileName	4-16
5.4.8	UseRedundantSlice	4-16
5.5	SP CODING SUPPORT	4-16
5.5.1	SPPicturePeriodicity	4-16
5.5.2	QPSPPicture	4-17
5.5.3	QPSP2Picture	4-17
5.6	OUTPUT CONTROL/ENTROPY CODING, NALS	4-17
5.6.1	SymbolMode	4-17
5.6.2	ContextInitMethod	4-17
5.6.3	FixedModelNumber	4-17
5.6.4	OutFileMode	4-17
5.6.5	PartitionMode	4-17
5.7	INTERLACE FORMAT HANDLING	4-17
5.7.1	PicInterlace	4-17
5.7.2	MBInterlace	4-18
5.7.3	IntraBottom	4-18
5.8	NON NORMATIVE ENCODER DECISIONS	4-18
5.8.1	RDOptimization	4-18
5.8.2	RDPictureDecision	4-19
5.8.3	RDPictureIntra	4-19
5.8.4	RDPSliceWeightOnly	4-19
5.8.5	RDBSliceWeightOnly	4-19
5.8.6	UseExplicitLambdaParams	4-19
5.8.7	LambdaWeightPslice	4-19
5.8.8	LambdaWeightBslice	4-20
5.8.9	LambdaWeightIslice	4-20
5.8.10	LambdaWeightSPslice	4-20
5.8.11	LambdaWeightRefBslice	4-20
5.8.12	OffsetMatrixPresentFlag	4-20
5.8.12.1	QOffsetMatrixFile	4-20
5.8.13	LossRateA	4-20
5.8.14	LossRateB	4-20
5.8.15	LossRateC	4-20
5.8.16	NumberOfDecoders	4-21
5.8.17	RestrictRefFrames	4-21
5.8.18	RestrictSearchRange	4-21
5.8.19	DisableThresholding	4-21
5.8.20	DisableBSkipRDO	4-21
5.8.21	SkipIntraInInterSlices	4-21
5.8.22	UseFME	4-21
5.8.23	Rate Control & HRD support	4-21

5.8.23.1	RateControlEnable	4-22
5.8.23.2	Bitrate	4-22
5.8.23.3	InitialQP	4-22
5.8.23.4	BasicUnit	4-22
5.8.23.5	ChannelType	4-22
5.8.23.6	ChannelType	4-22
5.8.23.7	NumberOfLeakyBuckets	4-22
5.8.23.8	LeakyBucketRateFile	4-22
5.8.23.9	LeakyBucketParamFile	4-22
5.9	OTHER SETTINGS	4-23
5.9.1	NumberFramesInEnhancementLayerSubSequence	4-23
5.9.2	NumberOfFrameInSecondIGOP	4-23
5.9.3	SparePictureOption	4-23
5.9.4	SparePictureDetectionThr	4-23
5.9.5	SparePicturePercentageThr	4-23
5.10	FREXT PROFILE PARAMETERS	4-23
5.10.1	Transform8x8Mode	4-23
5.10.2	ResidueTransformFlag	4-23
5.10.3	ScalingMatrixPresentFlag	4-23
5.10.3.1	QmatrixFile	4-24
5.10.3.2	ScalingListPresentFlag0	4-24
5.10.3.3	ScalingListPresentFlag1	4-24
5.10.3.4	ScalingListPresentFlag2	4-24
5.10.3.5	ScalingListPresentFlag3	4-25
5.10.3.6	ScalingListPresentFlag4	4-25
5.10.3.7	ScalingListPresentFlag5	4-25
5.10.3.8	ScalingListPresentFlag6	4-25
5.10.3.9	ScalingListPresentFlag7	4-26
5.10.4	QPPrimeYZeroTransformBypassFlag	4-26
6.	HARDCODED ENCODER PARAMETERS	5-1
6.1	DEFINES.H	5-1
6.2	GLOBAL.H	5-1
6.3	CONFIGFILE.H	5-1
6.4	BLOCK.H	5-1
6.5	MV_SEARCH.H	5-1
7.	USING THE JM DECODER MODULE	6-1
7.1	DECODER SYNTAX	6-1
7.2	DECODER CONFIGURATION FILE FORMAT	6-1
7.3	DECODER OUTPUT	6-2
8.	SYSTEM GENERATED REPORTS/OUTPUT	7-1
8.1	LOG.DAT	7-1
8.2	STATS.DAT	7-2

1. GENERAL INFORMATION

1. GENERAL INFORMATION

1.0 System Overview

This document contains a detailed description of the usage of the H.264/MPEG-4 AVC reference software. This includes information about the encoder and decoder input parameters, syntax, compilation issues, and additional information with regards to best usage and configuration of this software.

1.1 Project References

It is recommended that the users of this software obtain a copy of the ITU H.264/ ISO MPEG-4 AVC recommendation for full understanding of the capabilities and specifics of the standard. For further info, users may access the ITU web site at www.itu.int or the ISO web site at www.iso.int. A link to the ITU document-specific purchase page is <http://tinyurl.com/3u9ww>, while the equivalent ISO one is <http://tinyurl.com/6dnck>. Users may also register on the “3 free” program by visiting <http://ecs.itu.ch/cgi-bin/ebookshop> or by visiting <http://www.itu.int/publications/index.html> and download this recommendation for free. Some additional public references that could be useful in understanding this new standard and consequently the software are as follows:

- T. Wiegand, G.J. Sullivan, G. Bjontegaard, and A. Luthra, “Overview of the H.264/AVC Video Coding Standard,” in *the IEEE Transactions on Circuits and Systems for Video Technology*, July 2003
- G. Sullivan and T. Wiegand, “Video Compression - From Concepts to the H.264/AVC Standard,” in *Proceedings of the IEEE, Special Issue on Advances in Video Coding and Delivery*, December 2004
- D. Marpe, H. Schwarz, and T. Wiegand, “Context-Based Adaptive Binary Arithmetic Coding in the H.264/AVC Video Compression Standard,” in *the IEEE Transactions on Circuits and Systems for Video Technology*, July 2003
- G.J. Sullivan and T. Wiegand, “Rate-Distortion Optimization for Video Compression,” in *the IEEE Signal Processing Magazine*, vol. 15, no. 6, pp. 74-90, Nov. 1998

The reference software described in these pages can be downloaded from the following link:

- <http://iphome.hhi.de/suehring/tml/index.htm>

1.2 Authorized Use Permission

The software package contains a text file and source code header comments containing disclaimer text that describes the terms associated with the use of the software and clarifying its copyright and patent rights status.

1.3 Points of Contact

1.3.1 Information

For general inquiries with regards to the H.264/MPEG-4 AVC standard users may contact Dr. Gary Sullivan (garysull@windows.microsoft.com), Dr. Thomas Wiegand (wiegand@hhi.fraunhofer.de), and Dr. Ajay Luthra (aluthra@motorola.com) for further information. Certain information can also be provided through the ITU (www.itu.int) and ISO (www.iso.int) websites.

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1.3.2 Coordination

Software coordination is performed by Mr. Karsten Sühling (Karsten.Suehring@hhi.fraunhofer.de). Additional information about the software, and also this document could be provided by Dr. Alexis Michael Tourapis (alexismt@ieee.org). For further information on key contributors to the reference software implementation please check the files “contributors.h” within the reference software package.

1.4 Organization of the Manual

In Section 2.0 a brief summary of the reference software will be provided. This is followed by instructions of how to install and compile the reference software under different environments (i.e. Windows and Unix/Linux based platforms) in Section 3.0. The use of the encoder is described in Section 4.0, while all encoder specific parameters are analyzed in Sections 5.0 (runtime-based) and 6.0 (compilation-based). Section 7.0 presents the decoder syntax and parameters, while finally Section 8.0 presents some of the output reports generated by the different modules of this software distribution.

1.5 Acronyms and Abbreviations

- 1.5.1 **CABAC**: Context-based Adaptive Binary Arithmetic Coding
- 1.5.2 **CAVLC**: Context-based Adaptive Variable Length Coding
- 1.5.3 **CBR**: Constant Bit Rate
- 1.5.4 **DPB**: Decoded Picture Buffer
- 1.5.5 **HRD**: Hypothetical Reference Decoder
- 1.5.6 **IDR**: Instantaneous Decoding Refresh
- 1.5.7 **MB**: Macroblock
- 1.5.8 **MBAFF**: Macroblock-Adaptive Frame-Field Coding
- 1.5.9 **NAL**: Network Abstraction Layer
- 1.5.10 **VBR**: Variable Bit Rate

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<#>SYSTEM SUMMARY

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2. SYSTEM SUMMARY.

This section provides a general overview of the system written in non-technical terminology. The summary should outline the uses of the system in supporting the activities of the user and staff.

<#> System Configuration

There is currently no such description available.

<#> Data Flows

There is currently no such description available.

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2. INSTALLATION AND COMPILATION

2. INSTALLATION AND COMPILATION.

2.1 Windows using MS Visual Studio 6

带格式的: 项目符号和编号

The software package contains a Visual Studio 6 workspace named “tml.dsw”. This workspace includes three projects:

lencod H.264/AVC reference encoder
 ldecod H.264/AVC reference decoder
 rtpdump a tool for analyzing contents of RTP packets

Select the desired project and “Debug” or “Release” mode. Compilation will create the binaries “lencod.exe” or “ldecod.exe” in the “bin” directory. “rtpdump.exe” will be created in the rtpdump directory.

For compile time settings and options see section 5.

2.2 Windows using MS Visual Studio .NET

带格式的: 项目符号和编号

The software package contains a Visual Studio .NET workspace named “tml.sln”. This workspace includes three projects:

lencod H.264/AVC reference encoder
 ldecod H.264/AVC reference decoder
 rtpdump a tool for analyzing contents of RTP packets

Select the desired project and “Debug” or “Release” mode. Compilation will create the binaries “lencod.exe” or “ldecod.exe” in the “bin” directory. “rtpdump.exe” will be created in the rtpdump directory.

For compile time settings and options see section 5.

2.3 UNIX and Windows using gcc (GNU Compiler Collection)

带格式的: 项目符号和编号

After unpacking the software package run the “unixprep.sh” shell script. This will remove Windows line break characters and create directories necessary for compilation.

In most shell this should work with:

```
. unixprep.sh
```

or

```
chmod u+x unixprep.sh
./unixprep.sh
```

For compiling the encoder change to the “lencod” directory and type:

```
make
```


For compiling the decoder change to the “ldecod” directory and type:

```
make
```

Binaries named “lencod.exe” and “ldecod.exe” are created in the “bin” directory.

For compile time settings and options see section 5.

带格式的: 项目符号和编号



3. USING THE JM ENCODER MODULE

3. USING THE JM ENCODER MODULE

This section provides a detailed description of system usage.

带格式的: 项目符号和编号

3.1 Encoder Syntax

```
lencod [-h] [-p defenc.cfg] {[-f curenc1.cfg]...[-f curencN.cfg]}
      {[-p EncParam1=EncValue1]...[-p EncParamM=EncValueM]}
```

Options:	
-h	Prints parameter usage.
-d	Use <defenc.cfg> as default file for parameter initializations. If not used then file defaults to “encoder.cfg” in local directory.
-f	Read <curencM.cfg> for resetting selected encoder parameters. Multiple files could be used that set different parameters.
-p	Set parameter <EncParamM> to <EncValueM>.

See section 4 for a description of all parameters.

Supported video file formats:

RAW: .yuv,.rgb : YUV 4:0:0
 YUV 4:2:0
 YUV 4:2:2
 YUV 4:4:4
 RGB

Examples of usage:

```
lencod.exe

lencod.exe -h

lencod.exe -d default.cfg

lencod.exe -f curenc1.cfg

lencod.exe -f curenc1.cfg -p InputFile="e:\data\container_qcif_30.yuv"
               -p SourceWidth=176 -p SourceHeight=144

lencod.exe -f curenc1.cfg -p FramesToBeEncoded=30 \
               -p QPFirstFrame=28 -p QPRemainingFrame=28 -p QPBPicture=30
```

带格式的: 项目符号和编号

3.2 Encoder Output

When running the encoder, the encoder will display on screen rate/distortion statistics for every frame coded. Cumulative results will also be presented. The output information generated may look as follows:

```
Parsing Configfile encoder.cfg.....
.....

----- JM 9.0 (FRExt) -----
Input YUV file      : foreman_part_qcif.yuv
Output H.264 bitstream : test.264
Output YUV file     : test_rec.yuv
YUV Format          : YUV 4:2:0
Frames to be encoded I-P/B : 2/1
PicInterlace / MbInterlace : 0/0
Transform8x8Mode    : 0

-----
  Frame  Bit/pic  WP  QP   SnrY   SnrU   SnrV   Time(ms)  MET(ms)  Frm/Fld  I  D
-----
0000(NVB)      176
0000(IDR)  20968 0 28  37.443  41.168  43.008    485      0    FRM   99
0002(P)      8072 0 28  36.699  40.806  42.365    672    187    FRM   16
0001(B)      2440 0 30  36.092  41.113  42.866   1047    361    FRM    0 1
-----

Total Frames:  3 (2)
Leaky BucketRateFile does not have valid entries;
using rate calculated from avg. rate
Number Leaky Buckets: 8
  Rmin   Bmin   Fmin
157395  20968  20968
196740  20968  20968
236085  20968  20968
275430  20968  20968
314775  20968  20968
354120  20968  20968
393465  20968  20968
432810  20968  20968
-----

Freq. for encoded bitstream      : 15
Hadamard transform               : Used
Image format                     : 176x144
Error robustness                 : Off
Search range                     : 16
Total number of references       : 5
References for P slices          : 5
List0 references for B slices    : 5
List1 references for B slices    : 1
Total encoding time for the seq. : 2.204 sec
Total ME time for sequence       : 0.548 sec
Sequence type                    : IBPBP (QP: I 28, P 28, B 30)
Entropy coding method           : CABAC
Profile/Level IDC                : (100,40)
Search range restrictions        : none
RD-optimized mode decision       : used
Data Partitioning Mode          : 1 partition
Output File Format               : H.264 Bit Stream File Format
Residue Color Transform          : not used
----- Average data all frames -----
SNR Y(dB)                       : 36.74
SNR U(dB)                       : 41.03
SNR V(dB)                       : 42.75
Total bits                      : 31656 (I 20968, P 8072, B 2440 NVB 176)
Bit rate (kbit/s) @ 30.00 Hz    : 316.56
```



```

Bits to avoid Startcode Emulation : 0
Bits for parameter sets           : 176
-----
Exit 9 (FRExt) encoder ver 9.3

```

The generated statistics in the above list represent the following information:

<i>Name</i>	Format	Purpose
<i>Frame</i>	%04d(\$Type)	Frame Display Order and Type
<i>Bit/pic</i>	%8d	Allocated bits for current frame
<i>WP</i>	%1d	Weighted Prediction method
<i>QP</i>	%2d	Frame Quantization value
<i>SnrY</i>	%7.3f	Luminance Y PSNR
<i>SnrU</i>	%7.3f	Chrominance U PSNR
<i>SnrV</i>	%7.3f	Chrominance V PSNR
<i>Time(ms)</i>	%7d	Total encoding time for frame
<i>MET(ms)</i>	%5d	Total motion estimation time for frame
<i>Frm/Fld</i>	FLD FRM	Picture coding mode
<i>I</i>	%3d	Intra Coded Macroblocks
<i>D</i>	%1d	Direct mode (direct_spatial_mv_pred_flag)

带格式的: 项目符号和编号

4. ENCODER PARAMETERS

4. ENCODER PARAMETERS

...

4.1 File Input/Output Related Parameters

These parameters specify input/output control of the encoder, including input (source)/output (generated bitstreams or reconstructed sequence) file names, and file format.

4.1.1 InputFile

Class: Text
Description: Input sequence name. Name could include file path. Current software only supports concatenated input sources (i.e. all components and frames should be included in a single file)

Note: For Unix/Linux based systems directories should be separated using a backslash “\”, while for DOS\Windows systems, directories should be separated using a forward slash “/”.

Example 1 (DOS):

```
lencod.exe -p InputFile="f:\seq\420\176x144\foreman_176x144_30.yuv"
```

Example 2 (Unix/Linux):

```
lencod.exe -p InputFile="/vol/seq/420/176x144/foreman_176x144_30.yuv"
```

4.1.2 RGBInput

Class: Numeric (Integer)
Description: Sets YUV or RGB Input

Options:	
0	• GRB or YUV input (default)
1	• RGB Input

4.1.3 YUVFormat

Class: Numeric (Integer)
Description: YUV format

Options:	
0	4:0:0
1	4:2:0 (default)
2	4:2:2
3	4:4:4

4.1.4 BitDepthLuma

Class: Numeric (Integer)
Description: Specifies bit depth for Luminance component. Allowable values are in the range of 8 (default) through 12.

4.1.5 BitDepthChroma

Class: Numeric (Integer)

Description: Specifies bit depth for Chrominance component. Allowable values are in the range of 8 (default) through 12.

带格式的: 项目符号和编号

4.1.6 InputHeaderLength

Class: Numeric (Integer)

Description: Specifies inputfile header size in terms of bytes. For RAW data files (i.e. YUV) this is usually 0 (default).

带格式的: 项目符号和编号

4.1.7 FrameRate

Class: Numeric (Double)

Description: Input File Frame rate. Supports values in the range [0.0, 100.0]. Default value is 30.0.

Note: For interlace material (i.e. 60 or 50 fields), value should be set equal to FieldRate/2 (i.e. 30.0 and 25.0 respectively).

带格式的: 项目符号和编号

4.1.8 SourceWidth

Class: Numeric (Integer)

Description: Image width in Luminance Samples. Value must be a multiple of 16. Default is 176.

带格式的: 项目符号和编号

4.1.9 SourceHeight

Class: Numeric (Integer)

Description: Image height in Luminance Samples. Value must be a multiple of 16 if no Interlace tools are used. Otherwise values needs to be a multiple of 32. Default is 144.

带格式的: 项目符号和编号

4.1.10 StartFrame

Class: Numeric (Integer)

Description: Specifies initial frame for encoding. Default value is 0.

带格式的: 项目符号和编号

4.1.11 FramesToBeEncoded

Class: Numeric (Integer)

Description: Specifies number of frames to be coded excluding B slice coded frames. Default is set to 1. We shall call this as the *primary layer* of the bitstream. If B slices (or Explicit Coding Structure) are to be used (we will call this as the *secondary layer*) then:

带格式的: 项目符号和编号

$$\text{FramesToBeEncoded} = \text{int}((\text{TotalNumberOfFrames}-1)/(\text{NumberBFrames} + 1)) + 1$$

Example 1:

Code 10 frames using an IPPPP... assignment and sequential ordering

```
lencod.exe -p FramesToBeEncoded=10
```

Example 2:

Code 10 frames using an IBBPBBPBBP assignment. B slice coded frames are not accounted in this parameter, therefore based on above formula 4 frames need to be coded.

```
lencod.exe -p FramesToBeEncoded=4 -p FrameSkip=2 -p NumberBFrames=2
```

4.1.12 OutputFile

Class: Text
Description: Output bitstream name. Name could include file path.
Example:

```
lencod.exe -p InputFile="f:\seq\420\176x144\foreman_176x144_30.yuv" \  
-p OutputFile="foreman.264"
```

带格式的：项目符号和编号

4.1.13 ReconFile

Class: Text
Description: Output reconstructed name. Name could include file path. If empty, no output is generated.

带格式的：项目符号和编号

4.1.14 TraceFile

Class: Text
Description: Bitstream Tracefile. File is useful for debugging. To enable, code needs to be compiled by setting the define TRACE in defines.h to 1.

带格式的：项目符号和编号

Warning!!!
Enabling this option may result in the generation of very large files, while would also slow down encoding considerably. Enable with caution. Parameter recommended for debugging purposes.

4.1.15 ReportFrameStats

Class: Numeric (Integer)
Description: Allows the generation of a file (stat_frame.dat) containing statistical information such as number of intra/inter coded blocks, modes used etc. (0 (default): disabled, 1: enabled)

带格式的：项目符号和编号

4.1.16 DisplayEncParams

Class: Numeric (Integer)
Description: If enabled outputs all encoder parameters on screen, therefore capturing a snapshot of the encoder configuration. Default is 0 (disabled).

带格式的：项目符号和编号

4.2 Primary Control Parameters

This section described encoder parameters that are common for all profiles and essentially control encoder behavior, available test modes, Motion Estimation and Mode decision etc.

带格式的：项目符号和编号

4.2.1 ProfileIDC

Class: Numeric (Integer)
Description: Set bitstream Profile IDC. Default is 88.

带格式的：项目符号和编号

Note: Some profiles cannot support certain features. See MPEG-4 AVC for supported features for each profile. Reference software may perform tests for certain features for profile conformance, but it is possible that certain validations are missing. [See Annex A of H.264/AVC](#).

删除的内容: See Annex A

Options:	
66	Baseline
77	Main
88	Extended

100	High (FRExt)
110	High 10 (FRExt)
122	High 4:2:2 (FRExt)
144	High 4:4:4 (FRExt)

带格式的：项目符号和编号

4.2.2 LevelIDC

Class: Numeric (Integer)

Description: Set bitstream Level IDC. Default is 21.

Note: Similar with the ProfileIDC, LevelIDC sets certain restrictions during the encoding process, such as resolution supported, maximum number of references, frame rate etc. See Annex A [of H.264/AVC](#).

<i>Options:</i>	
10	1 (supports only QCIF format and below with 380160 samples/sec)
11	1.1 (CIF and below. 768000 samples/sec)
12	1.2 (CIF and below. 1536000 samples/sec)
13	1.3 (CIF and below. 3041280 samples/sec)
20	2 (CIF and below. 3041280 samples/sec)
21	2.1 (Supports HHR formats. Enables Interlace support. 5068800 samples/sec)
22	2.2 (Supports SD/4CIF formats. Enables Interlace support. 5184000 samples/sec)
30	3 (Supports SD/4CIF formats. Enables Interlace support. 10368000 samples/sec)
31	3.1 (Supports 720p HD format. Enables Interlace support. 27648000 samples/sec)
32	3.2 (Supports SXGA format. Enables Interlace support. 55296000 samples/sec)
40	4 (Supports 2Kx1K format. Enables Interlace support. 62914560 samples/sec)
41	4.1 (Supports 2Kx1K format. Enables Interlace support. 62914560 samples/sec)
42	4.2 (Supports 2Kx1K format. Frame coding only. 125829120 samples/sec)
50	5 (Supports 3672x1536 format. Frame coding only. 150994944 samples/sec)
51	5.1 (Supports 4096x2304 format. Frame coding only. 251658240 samples/sec)

带格式的：项目符号和编号

4.2.3 IntraPeriod

Class: Numeric (Integer)

Description: Period of I-frames compared to FramesToBeEncoded. i.e. frame will be coded using intra slices every IntraPeriod frames. 0 (default) implies that only first frame will be coded as intra.

Note: If field coding is enabled, depending on the value of parameter IntraBottom, only top field will be coded as intra.

带格式的：项目符号和编号

4.2.4 IDRIntraEnable

Class: Numeric (Integer)

Description: Code Intra as IDR. Values are only 0 (disable/default) and 1 (enable). Feature will be later enhanced to allow IDR spacing (i.e. not all intra will be IDR).

带格式的：项目符号和编号

4.2.5 QPISlice

Class: Numeric (Integer)

Description: Sets Quantization value for intra slices. Allowable values are in the range of 0 to 51. Default is 24.

4.2.6 QPPSlice

Class: Numeric (Integer)

Description: Sets Quantization value for all P slices. Allowable values are in the range of 0 to 51. Default is 24.

4.2.7 ChromaQPOffset

Class: Numeric (Integer)

Description: Sets the appropriate QP offset that will be used for coding Chroma components. Value can be both negative and positive (-51..51). Default is 0 (no offset).

4.2.8 CbQPOffset

Class: Numeric (Integer)

Description: Sets the appropriate QP offset that will be used for coding Cb components. Value can be both negative and positive (-51..51). Default is 0 (no offset).

Note: This is a FRExt only option

4.2.9 CrQPOffset

Class: Numeric (Integer)

Description: Sets the appropriate QP offset that will be used for coding Cr components. Value can be both negative and positive (-51..51). Default is 0 (no offset).

Note: This is a FRExt only option

4.2.10 FrameSkip

Class: Numeric (Integer)

Description: Number of frames to be skipped in input when encoding primary layer. This option allows encoding a sequence at a different layer, but also is needed to support B slices (i.e. if we wish to use 2 B slices, then this value needs to be set to 2). Default is 0.

Note: Name should be changed to correspond to actual usage of parameter. [\(Suggestion PrimaryLayerDistance?\)](#)

Example 1:

Reduce original framerate by half.

```
lencod.exe -p FrameSkip=1
```

Example 2:

Use an IBBPBBP... coding structure

```
lencod.exe -p FrameSkip=2 -p NumberBFrames=2
```

带格式的：项目符号和编号

带格式的：项目符号和编号

带格式的：项目符号和编号

带格式的：项目符号和编号

带格式的：项目符号和编号

4.2.11 UseHadamard*Class:* Numeric (Integer)*Description:* Enable (1) Hadamard transform for Motion Estimation and Integer decision. Disable (0) is the default.

带格式的: 项目符号和编号

4.2.12 SearchRange*Class:* Numeric (Integer)*Description:* Sets allowable search range for Motion Estimation.

带格式的: 项目符号和编号

Note: If Rate Distortion Optimization is enabled, Search window is centered around median predictor, not (0,0). Default is set to 16.**4.2.13 NumberReferenceFrames***Class:* Numeric (Integer)*Description:* Sets maximum number of references stored in buffer (DPB) for motion estimation compensation. Essentially sets **num_ref_frames** in the sequence parameter sets. Default is set to 1.

带格式的: 项目符号和编号

Note: Parameter needs to conform to level constraints for number of references allowed. See Annex A.**4.2.14 PList0References***Class:* Numeric (Integer)*Description:* Override of allowable references used for predicting P slices (basically sets **num_ref_idx_l0_active_minus1**). 0 (default) sets number to be equal to NumberReferenceFrames. Value needs to be smaller or equal to NumberReferenceFrames.

带格式的: 项目符号和编号

4.2.15 Log2MaxFrameNum*Class:* Numeric (Integer)*Description:* Parameter sets **log2_max_frame_num_minus4** which impacts the value of **frame_num** in each slice. If 0 (default) or below 4 value is computed based on FramesToBeEncoded and number of B coded frames. Otherwise **log2_max_frame_num_minus4** = $\text{Log2MaxFrameNum} - 4$.

带格式的: 项目符号和编号

4.2.16 GenerateMultiplePPS*Class:* Numeric (Integer)*Description:* Parameter enabled the transmission of 3 different picture parameter sets (PPS). These PPSs allow the combination of weighted and non weighted prediction for P and B slices. Option can be combined with parameter RDPictureDecision to perform an RD optimal decision between picture coding modes. (0: disabled/default, 1: enabled)

带格式的: 项目符号和编号

4.2.17 ResendPPS*Class:* Numeric (Integer)*Description:* Enables retransmission of Picture Parameter sets for every picture. This could be useful if the encoder decides for various reasons to update the PPS, i.e for use of a different WP method, different chroma offsets, different weighted matrices/transform, deblocking etc. (0: disabled/default, 1: enabled)

带格式的: 项目符号和编号

4.2.18 PicOrderCntType*Class:* Numeric (Integer)*Description:* Parameter sets **pic_order_cnt_type** in SPS.

带格式的: 项目符号和编号

Options:	
0	POC mode 0. Recommended mode (default).
1	POC mode 1, Not fully supported in software.
2	POC mode 2. Not for use with out of order coding. i.e. all pictures need to be in sequential order.

带格式的：项目符号和编号

4.2.19 UseConstrainedIntraPred*Class:* Numeric (Integer)*Description:* If set, disallows inter pixels from being used for Intra prediction. Default is 0.

带格式的：项目符号和编号

4.2.20 MbLineIntraUpdate*Class:* Numeric (Integer)*Description:* Enables Error robustness by performing extra intra macro block updates. 0 (default) off, N: One GOB every N frames are intra coded.

带格式的：项目符号和编号

4.2.21 RandomIntraMBRefresh*Class:* Numeric (Integer)*Description:* Forced intra MBs per picture. Default is 0.

带格式的：项目符号和编号

4.2.22 Inter/Intra Mode Prediction Control*Description:* The following parameters essentially control which inter or intra prediction modes could be used for encoding purposes.

带格式的：项目符号和编号

4.2.22.1 InterSearch16x16*Class:* Numeric (Integer)*Description:* Enable 16x16 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的：项目符号和编号

4.2.22.2 InterSearch16x8*Class:* Numeric (Integer)*Description:* Enable 16x8 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的：项目符号和编号

4.2.22.3 InterSearch8x16*Class:* Numeric (Integer)*Description:* Enable 8x16 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的：项目符号和编号

4.2.22.4 InterSearch8x8*Class:* Numeric (Integer)*Description:* Enable 8x8 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的：项目符号和编号

4.2.22.5 InterSearch8x4*Class:* Numeric (Integer)*Description:* Enable 8x4 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的：项目符号和编号

4.2.22.6 InterSearch4x8*Class:* Numeric (Integer)*Description:* Enable 4x8 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

4.2.22.7 InterSearch4x4*Class:* Numeric (Integer)*Description:* Enable 8x4 Inter Prediction & Motion Compensation (0= disable/default, 1= enable).

带格式的: 项目符号和编号

4.2.22.8 Intra4x4ParDisable*Class:* Numeric (Integer)*Description:* Disable I4x4 Vertical and Horizontal prediction modes (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.22.9 Intra4x4DiagDisable*Class:* Numeric (Integer)*Description:* Disable I4x4 Diagonal Down-Left and Diagonal Down-Right prediction modes (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.22.10 Intra4x4DirDisable*Class:* Numeric (Integer)*Description:* Disable I4x4 Vertical Right, Vertical Left, Horizontal Down, and Horizontal Up prediction modes (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.22.11 Intra16x16ParDisable*Class:* Numeric (Integer)*Description:* Disable I16x16 Vertical and Horizontal prediction modes (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.22.12 Intra16x16PlaneDisable*Class:* Numeric (Integer)*Description:* Disable I16x16 plane prediction mode (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.22.13 IntraDisableInterOnly*Class:* Numeric (Integer)*Description:* Disable Intra prediction modes (in sections 4.2.22.8 through 4.2.22.12) only for Inter slices (0: all slice types/default, 1: inter slice types).

带格式的: 项目符号和编号

4.2.22.14 ChromaIntraDisable*Class:* Numeric (Integer)*Description:* Disable all Intra Chroma prediction modes except DC (0: off/default, 1: on).

带格式的: 项目符号和编号

4.2.23 Loop Filter Control

Parameters to set In-loop filter behavior.

带格式的: 项目符号和编号

4.2.23.1 LoopFilterParametersFlag*Class:* Numeric (Integer)*Description:* Sets `deblocking_filter_control_present_flag`.

带格式的: 项目符号和编号

Note: Although currently encoder supports multiple PPS this parameter still sets the same Loop filter for all coded pictures. Default is 0.**4.2.23.2 LoopFilterDisable***Class:* Numeric (Integer)

带格式的: 项目符号和编号

Description: Sets **disable_deblocking_filter_idc** and disables deblocking. Default is 0. Requires LoopFilterParametersFlag to be set.

带格式的：项目符号和编号

4.2.23.3 LoopFilterAlphaC0Offset

Class: Numeric (Integer)

Description: Sets **slice_alpha_c0_offset_div2**. Requires LoopFilterParametersFlag to be set and LoopFilterDisable to be zero. Allowable values are in the range {-6, -5, ... 0, +1, .. +6}. Default is 0.

带格式的：项目符号和编号

4.2.23.4 LoopFilterBetaOffset

Class: Numeric (Integer)

Description: Sets **slice_beta_offset_div2**. Requires LoopFilterParametersFlag to be set and LoopFilterDisable to be zero. Allowable values are in the range {-6, -5, ... 0, +1, .. +6}. Default is 0.

带格式的：项目符号和编号

4.2.24 Weighted Prediction Parameters

The following parameters enable weighted prediction.

带格式的：项目符号和编号

4.2.24.1 WeightedPrediction

Class: Numeric (Integer)

Description: Sets **weighted_pred_flag** and enables explicit weighted prediction for P slices. A simple model, based on picture DC values is used for estimating weights. Default is 0.

带格式的：项目符号和编号

4.2.24.2 WeightedBiprediction

Class: Numeric (Integer)

Description: Sets **weighted_bipred_idc** for weighted prediction in B slices.

Options:	
0	Disabled (default).
1	Explicit Weighted Prediction.
2	Implicit Weighted Prediction. Weights are based on POC distances.

带格式的：项目符号和编号

4.2.24.3 UseWeightedReferenceME

Class: Numeric (Integer)

Description: Use weighted reference for ME (0=off/default, 1=on).

带格式的：项目符号和编号

4.2.25 LastFrameNumber

Class: Numeric (Integer)

Description: Overwrites FramesToBeEncoded parameter. Parameter possibly broken when used with B coded frames. Default is 0.

带格式的：项目符号和编号

4.2.26 ChangeQPStart

Class: Numeric (Integer)

Description: Allows the use of a secondary QP set from frame at temporal frame position ChangeQPStart. Default is 0.

带格式的：项目符号和编号

4.2.27 ChangeQPI

Class: Numeric (Integer)

Description: Sets secondary Quantization value for intra coded pictures to be used from frame ChangeQPStart and beyond. Allowable values are in the range of 0 to 51. Default is 24.

4.2.28 ChangeQPP

Class: Numeric (Integer)

Description: Sets secondary Quantization value for inter P coded pictures to be used from frame ChangeQPStart and beyond. Allowable values are in the range of 0 to 51. Default is 24.

带格式的：项目符号和编号

4.2.29 ChangeQPB

Class: Numeric (Integer)

Description: Sets secondary Quantization value for non reference inter B coded pictures to be used from frame ChangeQPStart and beyond. Allowable values are in the range of 0 to 51. Default is 24.

带格式的：项目符号和编号

4.2.30 ChangeQPBSRefOffset

Class: Numeric (Integer)

Description: Sets quantization offset for reference inter B coded pictures to be used from frame ChangeQPStart and beyond. Allowable values are in the range of -51 to 51. Default is 0.

带格式的：项目符号和编号

4.3 Secondary Layer Parameters

Parameters for controlling secondary(enhancement) layer such as B slice usage, pyramidal structure, etc.

带格式的：项目符号和编号

4.3.1 NumberBFrames

Class: Numeric (Integer)

Description: Number of B slice coded frames used. Value has to be smaller or equal to FrameSkip (4.2.10). Parameter is overwritten if the GOPPyramid (4.3.13) parameter is set to 3. Default is 0.

带格式的：项目符号和编号

4.3.2 QPBSlice

Class: Numeric (Integer)

Description: Quantization parameter used for non stored B slices. Should be in the range [0-51]. Usually these quantizer can be set slightly higher than the quantizer for stored pictures. Default is 24.

带格式的：项目符号和编号

4.3.3 BRefPicQPOffset

Class: Numeric (Integer)

Description: Quantization offset parameter used for stored B slices. Should be in the range [-51..51]. Default is 0.

带格式的：项目符号和编号

4.3.4 DirectModeType

Class: Numeric (Integer)

Description: Sets **direct_spatial_mv_pred_flag** which controls the direct mode type to be used. 0 is temporal direct, while 1 is spatial direct. Default is 0 (temporal).

带格式的：项目符号和编号

4.3.5 DirectInferenceFlag

Class: Numeric (Integer)

Description: Sets **direct_8x8_inference_flag** in the SPS which affects semantics of Direct Mode. Value is related to the level used (i.e. for any level above or equal to 3 parameter needs to be set to 1), and should be set appropriately even if no B slices are to be used. Default is 0.

带格式的：项目符号和编号

4.3.6 BList0References

Class: Numeric (Integer)

Description: Override of allowable references used for predicting B slices using List0 (basically sets **num_ref_idx_l0_active_minus1**). 0 (default) sets number to be equal to NumberReferenceFrames. Value needs to be smaller or equal to NumberReferenceFrames.

Note: Under most cases, setting this value to 2 should be sufficient (i.e. in terms of performance), while having a significant reduction in terms of complexity.

带格式的: 项目符号和编号

4.3.7 BList1References

Class: Numeric (Integer)

Description: Override of allowable references used for predicting B slices using List1 (basically sets **num_ref_idx_l1_active_minus1**). 0 (default) sets number to be equal to NumberReferenceFrames. Value needs to be smaller or equal to NumberReferenceFrames.

Note: Under most cases, setting this value to 1 should lead to better performance (i.e. since no bits are spend for coding the reference index more bits can be allocated to code mv's or residual). If GOPPyramid is used nevertheless, a larger value might be better.

带格式的: 项目符号和编号

4.3.8 BReferencePictures

Class: Numeric (Integer)

Description: Use B coded pictures as references (overwritten by GOPPyramid). Default is 0.

Note: Mainly available for testing purposes.

带格式的: 项目符号和编号

4.3.9 BiPredMotionEstimation

Class: Numeric (Integer)

Description: Enables Multihypothesis based Motion Estimation for B slice coding. Option currently only supports 16x16 block sizes and the first list 0 and list 1 references. Option also considers weights if necessary. Default is disabled (0). For further information on such ME algorithms check the following papers.

- S.W. Wu and A. Gersho, "Joint estimation of forward and backward motion vectors for interpolative prediction of video," in *IEEE Transactions on Image Processing*, Vol.3, Iss.5, pp.684=7, Sept.'94.
- Markus Flierl, Thomas Wiegand, and Bernd Girod, "A Locally Optimal Design Algorithm for Block-Based Multi-Hypothesis Motion-Compensated Prediction", *Proceedings of the Data Compression Conference*, Snowbird, USA, April 1998

带格式的: 项目符号和编号

4.3.10 BiPredMERefinements

Class: Numeric (Integer)

Description: Enables additional ME refinements for Multihypothesis based ME. Only considered if BiPredMotionEstimation is used. Possible values are [0-5]. Default is 0 (only initial step is performed).

带格式的: 项目符号和编号

4.3.11 BiPredMESearchRange

Class: Numeric (Integer)

Description: Specifies search range for BiPredMotionEstimation. However, if BiPredMERefinements are used then search range is decreased by half for every additional refinement. Default is set to 8.

带格式的: 项目符号和编号

4.3.12 BiPredMESubPel

Class: Numeric (Integer)
Description: Controls subpixel refinement for BiPredMotionEstimation.

Options:	
0	Disabled. No Subpel refinement is performed (default)
1	Subpel refinement is performed only for first list.
2	Subpel refinement is performed for both lists

4.3.13 PyramidCoding

Class: Numeric (Integer)
Description: Enables the use of advanced coding orders for the secondary layer. This includes the use of a pyramid type order, or explicit frame coding types/ordering.

Options:	
0	Disabled (default). Use default coding types.
1	Use double layer approach. More specifically, if N number of B coded frames are used, all B coded frames at odd positions (starting from 0) will be coded first and stored and used as references, while even ones will follow and be coded as non reference.
2	Use Pyramid layer approach with multiple levels. Basically a power of two approach is used, where each level is assigned a different priority.
3	Explicit Coding type & order. Requires presence of ExplicitPyramidFormat parameter.

Example 1:
We would like to encode video with the following coding order I0-P8-Bs4-Bs2-Bs6-B1-B3-B5-B7-P16...
We would also like to assign QP values of 24 to referenced B coded frames, and 26 to non reference frames. Also, although we will like to have 5 total references, only one reference should be used for list0 and list1 for B slices. Note that the above structure looks as follows:

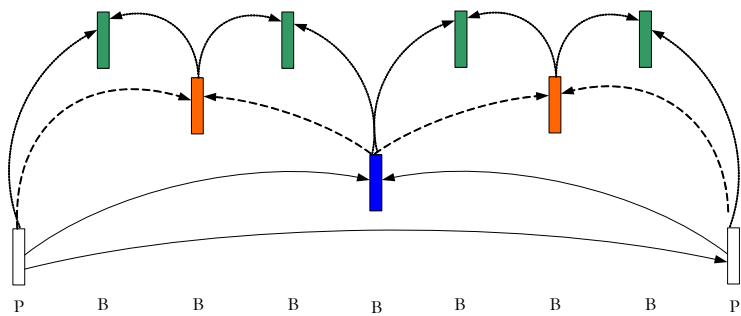


Figure 1. 4 Level Pyramid structure.

The above could be easily done using PyramidCoding mode 2 which automatically generates this pyramid. An alternative way would be to use PyramidCoding mode 3, and to appropriately set the necessary params using the ExplicitPyramidFormat parameter.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 \
-p PyramidCoding=2 -p QPBSlice=26 -p BRefPicQPOffset=-2 \
-p BList0References=1 -p BList1References=1
```

Example 2:

Lets assume that for the previous example we would prefer having only 3 pyramid levels, and that each level follows a sequential coding order. More specifically we would like the coding order to be as I0-P8-Bs2-Bs4-Bs6-B1-B3-B5-B7-P16... Note that this structure would now look as follows (i.e. we observe that now references are differently organized than in the previous case):

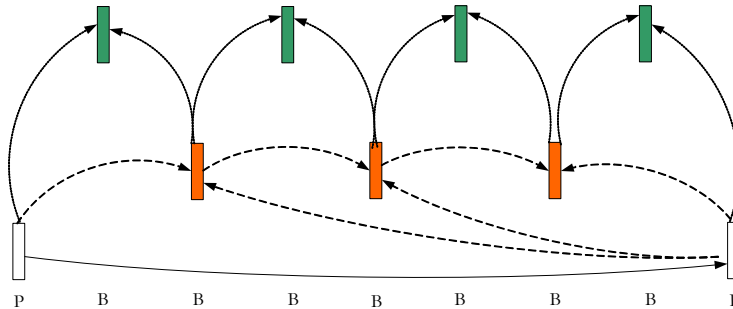


Figure 2. 3 Level Pyramid structure.

The above could be easily done using PyramidCoding mode 1 which automatically generates this pyramid. PyramidCoding mode 3 could also be used.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 \
-p PyramidCoding=1 -p QPBSlice=26 -p BRefPicQPOffset=-2 \
-p BList0References=1 -p BList1References=1
```

带格式的：项目符号和编号

4.3.14 ExplicitPyramidFormat

Class: Text

Description: Parameter used with PyramidCoding==3 and specifies coding method (i.e. type, quantizer, coding order etc) of a frame. Parameter also overwrites use of NumberBFrames, although frames specified in parameter need to be fewer than FrameSkip.

Syntax:

[TypeFrame0][OrderFrame0][ReferenceFrame0][QPFrame0][TypeFrame1][OrderFrame1][ReferenceFrame1][QPFrame1]... [TypeFrameN][OrderFrameN][ReferenceFrameN][QPFrameN]

Allowed entries:

[TypeFrameN]	I/i (Intra coded frame)
	P/p (P type coded frame)
	B/b (B type coded frame)
[OrderFrameN]	0-FrameSkip (specifies display order of coded frame. No duplicates are allowed)
[ReferenceFrameN]	R/r (Reference)
	E/e (Non Reference/Disposable)
[QPFrameN]	Frame QP

Example 1:

We would like to encode video using 5 references and the following coding order I0-P8-Bs4-Bs2-B1-B3-Bs6-B5-B7-P16... We would also like to assign QP values of 24 to referenced B coded frames, and 26 to non reference frames.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 -p PyramidCoding=3 \
-p ExplicitPyramidFormat="B4r24B2r24B1e26B3e26B6r24B5e26B7e26"
```

Example 2:

In the previous example, we would like to replace Bs6 with a P coded frame, while B7 is coded in intra mode with a QP of 40. Regardless of the slice type used, note that frame 7 will still not be used as a reference.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 -p PyramidCoding=3 \
-p ExplicitPyramidFormat="B4r24B2r24B1e26B3e26P6r24B5e26I7e40"
```

Example 3:

We would like to encode a video sequence using a relatively similar coding structure as in example 1, with the difference that we would like to code all non reference frames last, i.e. I0-P8-Bs4-Bs2-Bs6-B1-B3-B5-B7-P16... In this case we may use PyramidCoding=2 also which would create this structure automatically.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 -p PyramidCoding=2
```

带格式的：项目符号和编号

4.3.15 PyramidRefReorder

Class: Numeric (Integer)

Description: Performs reference reordering for P coded frames based on POC values, if PyramidCoding is used. This essentially places references according to temporal correlation instead of coding order. Not supported for interlace coding modes. Default is 0 (disabled).

Example:

In example 1 of 4.3.14 the default coding order that will be used for coding frame 16 will be {Bs6, Bs2, Bs4, P8, I0}. Nevertheless, temporally frame 8 is much closer to frame 16 and therefore this coding mode may not be as efficient. Instead, we want to use reordering commands to consider references according to their display order.


```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 \
           -p PyramidCoding=3 -p PyramidRefReorder=1 \
           -p ExplicitPyramidFormat="B4r24B2r24B1e26B3e26P6r24B5e26I7e40"
```

Note: PyramidRefReorder is not supported for interlace coding modes.

带格式的：项目符号和编号

4.3.16 PocMemoryManagement

Class: Numeric (Integer)
Description: Performs memory management control based on POC values, if PyramidCoding is used. Basically allows better memory management for “arbitrary” or pyramid type coding methods if only a certain number of references are allowed due to level limitations. Not supported for interlace coding methods. Default is 0 (disabled)

Example:
Lets assume that for the first example in 4.3.14, only a maximum of 4 references can be used. Unfortunately this would result, according to the default memory management behavior, in frame 8 being removed from the reference buffer immediately after adding frame 16, since this has the smallest frame_num in the list. It would be preferable to remove frame 2 instead, since this frame would most likely not be very useful for predicting any future frames.

```
lencod.exe -p NumberReferenceFrames=5 -p FrameSkip=7 \
           -p PyramidCoding=3 -p PyramidRefReorder=1 \
           -p PocMemoryManagement=1 \
           -p ExplicitPyramidFormat="B4r24B2r24B1e26B3e26P6r24B5e26I7e40"
```

带格式的：英语(美国)

Note: PocMemoryManagement is not supported for interlace coding modes.

带格式的：项目符号和编号

4.4 Error Resiliency and Slice control

4.4.1 SliceMode

Class: Numeric (Integer)
Description: Sets slice mode.

Options:	
0	Disabled (default)
1	Fixed number of MBs per slice
2	Fixed number of Bytes per slice
3	Use Callback
4	FMO

带格式的：项目符号和编号

4.4.2 SliceArgument

Class: Numeric (Integer)
Description: Slice arguments for modes 1 (number of MBs) and 2 (bytes). Default is 0.

4.4.3 num_slice_groups_minus1*Class:* Numeric (Integer)*Description:* Number of Slice Groups Minus 1, 0 == no FMO (default), 1 == two slice groups, etc.

带格式的: 项目符号和编号

4.4.4 slice_group_map_type*Class:* Numeric (Integer)*Description:* Specifies slice group map type.

带格式的: 项目符号和编号

<i>Options:</i>	
0	Interleave mode (default)
1	Dispersed Mode
2	Foreground with left-over
3	Box-out
4	Raster Scan
5	Wipe
6	Explicit, slice_group_id read from SliceGroupConfigFileName

带格式的: 项目符号和编号

4.4.5 slice_group_change_direction_flag*Class:* Numeric (Integer)*Description:* sets slice_group_change_direction_flag.

<i>Options:</i>	
0	box-out clockwise, raster scan or wipe right (default)
1	box-out counter clockwise, reverse raster scan or wipe left

带格式的: 项目符号和编号

4.4.6 slice_group_change_rate_minus1*Class:* Numeric (Integer)*Description:* Sets slice_group_change_rate_minus1. Default is 0.

带格式的: 项目符号和编号

4.4.7 SliceGroupConfigFileName*Class:* Text*Description:* Slice configuration file used for slice group map types 0, 2, and 6.

带格式的: 项目符号和编号

4.4.8 UseRedundantSlice*Class:* Numeric (Integer)*Description:* Enables the use of redundant slices. Currently supports only a single redundant slice per slice. Default is 0 (disabled)

带格式的: 项目符号和编号

4.5 SP coding support**4.5.1 SPPicturePeriodicity***Class:* Numeric (Integer)*Description:* Sets period of SP coded frames. 0: no SP used (default), N>0: SP coded frames inserted every N frames.

Note: SP coding might be broken in current implementation

4.5.2 QSPPicture

Class: Numeric (Integer)
Description: Quantization parameter of SP coded pictures for prediction Error (0-51). Default is 24.

4.5.3 QSP2Picture

Class: Numeric (Integer)
Description: Quantization parameter of SP coded pictures for Predicted Blocks (0-51). Default is 24.

4.6 Output Control/Entropy Coding, NALs

The following parameters control the entropy coding method that is to be used, and other output related control options.

4.6.1 SymbolMode

Class: Numeric (Integer)
Description: Entropy Coding method (0: CAVLC, 1: CABAC). Default is 0.

4.6.2 ContextInitMethod

Class: Numeric (Integer)
Description: Cabac Context Initialization (0: fixed, 1: enabled). Default is 0.

4.6.3 FixedModelNumber

Class: Numeric (Integer)
Description: Model number for fixed decision in inter slices of Cabac Context Initialization (0-default, 1, or 2).

4.6.4 OutFileMode

Class: Numeric (Integer)
Description: Output File mode. Supported formats are 0: Default based on Annex B, 1: RTP.

4.6.5 PartitionMode

Class: Numeric (Integer)
Description: Enable partitioning. Possible values 0: 4. (0: No Data Partitioning/default, 1:3 number of partitions per slice).

4.7 Interlace Format Handling

Options enable interlace coding modes such as field coding, Picture and Macroblock adaptive Field/Frame coding etc.

4.7.1 PicInterlace

Class: Numeric (Integer)
Description: Enables adaptive field/frame coding support at the frame level.

Options:	
0	Use Frame picture coding mode only. Default.

带格式的: 项目符号和编号

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1	Use field picture coding mode only
2	Use adaptive frame/field picture coding mode. Decision is based on lagrangian RDO of the form $J = Distortion + \lambda \times Rate$ where <i>Distortion</i> is the SSE distortion of the entire reconstructed frame (or both fields), λ is the lagrangian parameter, and <i>Rate</i> is the allotted bits for coding the frame (or fields respectively).

Note: Decision is suboptimal, but works well under certain conditions.

带格式的: 项目符号和编号

4.7.2 MBInterlace

Class: Numeric (Integer)

Description: Enables adaptive field/frame coding support at the macroblock level.

Options:	
0	Use Frame coding mode only (mb_adaptive_frame_field_flag=0). Default.
1	Set mb_adaptive_frame_field_flag =1 but code all macroblocks in frame in field mode. Mainly useful for testing purposes
2	Performs RD optimal decision between frame coded super macroblocks and field coded supermacroblocks.
3	Set mb_adaptive_frame_field_flag =1 but code all macroblocks in frame in frame mode. Mainly useful for testing purposes. (<i>Note method seems not to be integrated but should</i>)

Note: Decision is suboptimal, but works well under certain conditions.

Example 1:

To encode a sequence using field/frame adaptive coding at both frame and macroblock level encoder should be set as follows:

```
lencod.exe -p PicInterlace=2 -p MBInterlace=2
```

Example 2:

Use only field/frame adaptive coding at the frame level:

```
lencod.exe -p PicInterlace=2 -p MBInterlace=0
```

带格式的: 项目符号和编号

4.7.3 IntraBottom

Class: Numeric (Integer)

Description: Forces Intra slice coding for bottom fields at intra periods. By default (0), if field coding, bottom field is coded always as inter.

带格式的: 项目符号和编号

4.8 Non Normative Encoder Decisions

4.8.1 RDOptimization

Class: Numeric (Integer)

Description: Enable Lagrangian based Rate distortion optimized mode decision.

<i>Options:</i>	
0	Use simplified model (default)
1	Enable Complex model
2	RDO consideration with losses (<i>not supported</i>)

Note: According to common condition, option should be set to 1 when evaluating algorithmic performance.

带格式的：项目符号和编号

4.8.2 RDPictureDecision

Class: Numeric (Integer)

Description: If parameter is enabled the same picture is coded in up to 3 different modes and the one yielding the best Lagrangian cost is selected as the final coding mode for this picture. Default is 0 (disabled).

Notes: If GenerateMultiplePPS is enabled, then coding mode considers all different WP methods supported by a slice. This includes normal, weights, offsets for P slices, and normal, implicit, and explicit modes for B slices. If RDPictureIntra intra slices are also coded multiple times by considering different Quantizers. If the GenerateMultiplePPS parameter is not set then all slice types are considered using 3 different Quantizers. Concept also can perform a “switch to I slice) decision for P slices if number of Intra MBs in a P slice is too high, or consideration of different QPs if Weighted Prediction is not recommended (i.e. weights are identical to default values). Currently tends to increase complexity significantly but will be improved through the consideration of Fast Motion Estimation and decision schemes.

带格式的：项目符号和编号

4.8.3 RDPictureIntra

Class: Numeric (Integer)

Description: Enables RDPictureDecision for Intra slices based on different Quantizers. Default is 0 (disabled).

带格式的：项目符号和编号

4.8.4 RDPSliceWeightOnly

Class: Numeric (Integer)

Description: Performs RD Picture Decision for P slices only if explicit weights are available, or if number of Intra macroblocks is high. Default is 1 (enabled).

带格式的：项目符号和编号

4.8.5 RDBSliceWeightOnly

Class: Numeric (Integer)

Description: Skips RD Picture Decision for B slices for explicit weighted prediction if explicit weights are not available without testing an alternative QP. Otherwise (if flag 0 and explicit WP is not available) a QP + 1 for non reference B, and QP – 1 for reference B will be tested as well. Default is 0 (disabled).

带格式的：项目符号和编号

4.8.6 UseExplicitLambdaParams

Class: Numeric (Integer)

Description: Enables the user to explicitly set the Lagrangian parameters, instead of using the equation based approach within the reference software. Default is 0 (disabled).

带格式的：项目符号和编号

4.8.7 LambdaWeightPslice

Class: Numeric (Double)

Description: Sets value of Lagrangian multiplier for P slices if UseExplicitLambdaParams is set. Default is 0.68.

4.8.8 LambdaWeightBslice

Class: Numeric (Double)

Description: Sets value of Lagrangian multiplier for B slices if UseExplicitLambdaParams is set. Default is 2.00.

4.8.9 LambdaWeightIslice

Class: Numeric (Double)

Description: Sets value of Lagrangian multiplier for I slices if UseExplicitLambdaParams is set. Default is 0.65.

4.8.10 LambdaWeightSPslice

Class: Numeric (Double)

Description: Sets value of Lagrangian multiplier for SP slices if UseExplicitLambdaParams is set. Default is 1.50.

4.8.11 LambdaWeightRefBslice

Class: Numeric (Double)

Description: Sets value of Lagrangian multiplier for Referenced B slices if UseExplicitLambdaParams is set. Default is 1.50.

4.8.12 OffsetMatrixPresentFlag

Class: Numeric (Integer)

Description: Enable explicit Quantization offset support. Default is 0 (disabled).

4.8.12.1 QOffsetMatrixFile

Class: Text

Description: File specifying the values of the explicit quantization offset matrices.

Example: Specify specific Q offset matrices for all blocks from file q_offset_matrix.cfg

```
lencod.exe -p OffsetMatrixPresentFlag=1 \
           -p QOffsetMatrixFile="q_offset_matrix.cfg"
```

4.8.13 LossRateA

Class: Numeric (Integer)

Description: Expected packet loss rate of the channel for the first partition. Only valid if RDOptimization is set to 2. Default is 0.

4.8.14 LossRateB

Class: Numeric (Integer)

Description: Expected packet loss rate of the channel for the second partition. Only valid if RDOptimization is set to 2. Default is 0.

4.8.15 LossRateC

Class: Numeric (Integer)

带格式的：项目符号和编号

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带格式的：项目符号和编号

Description: Expected packet loss rate of the channel for the third partition. Only valid if RDOptimization is set to 2. Default is 0.

带格式的: 项目符号和编号

4.8.16 NumberOfDecoders

Class: Numeric (Integer)

Description: Numbers of decoders used to simulate the channel. Only valid if RDOptimization is set to 2. Default is 0.

带格式的: 项目符号和编号

4.8.17 RestrictRefFrames

Class: Numeric (Integer)

Description: Doesnt allow reference to areas that have been intra updated in a later frame. Default is 0.

带格式的: 项目符号和编号

4.8.18 RestrictSearchRange

Class: Numeric (Integer)

Description: Reduces Search range for motion estimation based on references and/or block types.

<i>Options:</i>	
0	Based on Block Type and Reference. Default.
1	Based on reference (i.e. divide by 2^reference_index)
2	No restrictions (should be used for common conditions)

带格式的: 项目符号和编号

4.8.19 DisableThresholding

Class: Numeric (Integer)

Description: Disable Thresholding of Transform Coefficients (0:off/default, 1: on)

Note: Thresholding is usually more appropriate for low to medium bitrates, while this could result in loss of details under certain situations.

带格式的: 项目符号和编号

4.8.20 DisableBSkipRDO

Class: Numeric (Integer)

Description: Disable B Skip Mode consideration from the RDO based mode decision (0:off/default, 1: on)

带格式的: 项目符号和编号

4.8.21 SkipIntraInInterSlices

Class: Numeric (Integer)

Description: Avoids testing Intra modes in Inter slices if best mode is P_SKIP or B_SKIP. (0:off/default, 1: on)

带格式的: 项目符号和编号

4.8.22 UseFME

Class: Numeric (Integer)

Description: Enable Fast motion estimation based on JVT-F0xx,doc (0: disabled/default, 1: enabled).

Note: Algorithm should be used as a reference only.

带格式的: 项目符号和编号

4.8.23 Rate Control & HRD support

Parameters for rate control support.

4.8.23.1 RateControlEnable

Class: Numeric (Integer)

Description: Enable simple CBR Rate Control that conforms to the HRD. See JVT-F0xx.doc for more details. (0: disabled/default, 1: enabled). No VBR rate control is currently supported.

Example: Encode a sequence at 100kbps, with an initial QP of 32, while performing adaptation at the frame level.

```
lencod.exe -p RateControlEnable=1 -p Bitrate=100000 \  
           -p InitialQP=32 -p BasicUnit=99
```

Note: Algorithm should be used as a reference only. Has not been verified when coding field pictures or with the use of Macroblock Adaptive Frame/Field Coding.

4.8.23.2 Bitrate

Class: Numeric (Integer)

Description: Set bitrate target in bits per second for HRD conforming Rate Control. **Default is 0.**

4.8.23.3 InitialQP

Class: Numeric (Integer)

Description: Set the initial quantization parameter for the HRD conforming Rate Control. Parameter should be selected based on bitrate goal, GOP length/type, and image spatiotemporal characteristics. **Default is 0.**

4.8.23.4 BasicUnit

Class: Numeric (Integer)

Description: Number of Macroblocks in rate control basic unit. Value needs to be a factor of the total number of MBs in a frame. **Default is 0.**

4.8.23.5 ChannelType

Class: Numeric (Integer)

Description: Type of Channel. 0 (default) assumes a constant channel, 1 is a time varying channel.

4.8.23.6 ChannelType

Class: Numeric (Integer)

Description: Type of Channel. 0 (default) assumes a constant channel, 1 is a time varying channel.

4.8.23.7 NumberofLeakyBuckets

Class: Numeric (Integer)

Description: Number of Leaky Bucket values. Default is set to 2.

4.8.23.8 LeakyBucketRateFile

Class: Text

Description: File from which encoder derives rate values

4.8.23.9 LeakyBucketParamFile

Class: Text

带格式的：项目符号和编号

带格式的：项目符号和编号

带格式的：项目符号和编号

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带格式的：项目符号和编号

带格式的：项目符号和编号

Description: File where encoder stores leakybucketparams

带格式的：项目符号和编号

4.9 Other settings

4.9.1 NumberFramesInEnhancementLayerSubSequence

Class: Numeric (Integer)
Description: number of frames in the Enhanced Scalability Layer. 0 (default) means that no Enhancement Layer is used.

带格式的：项目符号和编号

4.9.2 NumberOfFrameInSecondIGOP

Class: Numeric (Integer)
Description: Number of frames to be coded in the second IGOP. Default is 0.

带格式的：项目符号和编号

4.9.3 SparePictureOption

Class: Numeric (Integer)
Description: (0: no spare picture info/default, 1: spare picture available)

带格式的：项目符号和编号

4.9.4 SparePictureDetectionThr

Class: Numeric (Integer)
Description: Threshold for spare reference pictures detection. Default is 0.

带格式的：项目符号和编号

4.9.5 SparePicturePercentageThr

Class: Numeric (Integer)
Description: Threshold for the spare macroblock percentage. Default is 0.

带格式的：项目符号和编号

4.10 FRExt profile parameters

In this section all FRExt specific parameters are described, including scaling matrices, 8x8 transform usage, lossless coding etc.

带格式的：项目符号和编号

4.10.1 Transform8x8Mode

Class: Numeric (Integer)
Description: Enables 8x8 Transforms

Options:	
0	Disabled. Only 4x4 transforms are used (default).
1	Allows the additional use of 8x8 transform. Results in <i>optimal</i> RD performance since it considers all possible modes
2	Consider only 8x8 transform modes (i.e. disables 4x4 transform)

带格式的：项目符号和编号

4.10.2 ResidueTransformFlag

Class: Numeric (Integer)
Description: Enables use of residue color transform (0: disabled/default 1: enabled)

带格式的：项目符号和编号

4.10.3 ScalingMatrixPresentFlag

Class: Numeric (Integer)
Description: Enable Quantization matrix support.

Options:	
0	Not Present – Disabled (Default)
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的: 项目符号和编号

4.10.3.1 QmatrixFile*Class:* Text*Description:* File specifying the values of the quantization scaling matrices. Used only if values are explicitly transmitted either at the SPS or PPS level. Otherwise default values are used.*Example:* Specify specific Qmatrix for intra4x4 luma blocks. Use default for all other modes.

```
lencod.exe -p ScalingMatrixPresentFlag=1-p QmatrixFile="q_matrix.cfg" \
-p ScalingListPresentFlag0=1
```

带格式的: 项目符号和编号

4.10.3.2 ScalingListPresentFlag0*Class:* Numeric (Integer)*Description:* Select scaling matrix for Intra4x4 Luminance Component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的: 项目符号和编号

4.10.3.3 ScalingListPresentFlag1*Class:* Numeric (Integer)*Description:* Select scaling matrix for Intra4x4 Chrominance U component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的: 项目符号和编号

4.10.3.4 ScalingListPresentFlag2*Class:* Numeric (Integer)*Description:* Select scaling matrix for Intra4x4 Chrominance V component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS

2	Present only in PPS
3	Present in both SPS and PPS

带格式的：项目符号和编号

4.10.3.5 ScalingListPresentFlag3*Class:* Numeric (Integer)*Description:* Select scaling matrix for Inter4x4 Luminance component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的：项目符号和编号

4.10.3.6 ScalingListPresentFlag4*Class:* Numeric (Integer)*Description:* Select scaling matrix for Inter4x4 Chrominance U component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的：项目符号和编号

4.10.3.7 ScalingListPresentFlag5*Class:* Numeric (Integer)*Description:* Select scaling matrix for Intrer4x4 Chrominance V component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的：项目符号和编号

4.10.3.8 ScalingListPresentFlag6*Class:* Numeric (Integer)*Description:* Select scaling matrix for Intra8x8 Luminance component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

4.10.3.9 ScalingListPresentFlag7

Class: Numeric (Integer)
Description: Select scaling matrix for Inter8x8 Luminance component

Options:	
0	Not Present - Use default values if ScalingMatrixPresentFlag is not 0
1	Present only in SPS
2	Present only in PPS
3	Present in both SPS and PPS

带格式的: 项目符号和编号


4.10.4 QPPrimeYZZeroTransformBypassFlag

Class: Numeric (Integer)
Description: Enable lossless coding when qpprime_y is zero (0: disabled, 1: enabled)

Note: Better explanation is needed for this parameter

带格式的: 项目符号和编号

带格式的: 项目符号和编号



5. HARDCODED ENCODER PARAMETERS

5. HARDCODED ENCODER PARAMETERS

Although encoder behavior is mainly controlled through the parameters provided in section 4, additional hardcoded parameters within the reference software could also modify its behavior. This includes the generation of tracing and output information, and algorithmic considerations.

5.1 defines.h

TRACE:	Enables tracefile generation
ZEROSNR:	Definition avoids generation of infinite SNR by always forcing at least one difference sample.
_FAST_FULL_ME_:	Enables blocktype based fast full search scheme
_LUMA_COEFF_COST_:	8x8 block Luminance coefficient threshold cost.
_CHROMA_COEFF_COST_:	Chrominance coefficient threshold cost.
_LUMA_MB_COEFF_COST_:	Macroblock luminance coefficient threshold cost.
_LUMA_8x8_COEFF_COST_:	Threshold for P8x8 sub-macroblocks.

带格式的: 项目符号和编号

5.2 global.h

```
#define pel_t    byte
#define imgpel  byte
```

Sets data type for luma samples. Use byte type for 8 bit content, otherwise unsigned short.

带格式的: 项目符号和编号

5.3 configfile.h

DEFAULTCONFIGFILENAME : Sets default encoder configuration file.

带格式的: 项目符号和编号

5.4 block.h

COEFF_COST : Array used for expensive coefficient thresholding. Currently supports two possible modes, 0 (default) enables thresholding, while 1 disables it by setting cost of all coefficients to 9. Selection is based on the value of **DisableThresholding** parameter. Values could be further modified by modifying the values in the array in block.h


带格式的: 项目符号和编号

5.5 mv_search.h

QP2QUANT: Sets cost for low complexity encoder mode ...

带格式的: 项目符号和编号

带格式的: 项目符号和编号



6. USING THE JM DECODER MODULE

6. USING THE JM DECODER MODULE

6.1 Decoder Syntax

带格式的: 项目符号和编号

```
ldecod [-h] {[defdec.cfg] | {[-i bitstream.264]...[-o output.yuv]
[-r reference.yuv] [-uv]}}
```

Options:

<i>-h</i>	Prints parameter usage.
<i>[defdec.cfg]</i>	Optional decoder config file containing all decoder information.
<i>-i</i>	Decode file <bitstream.264>. Default is set to test.264.
<i>-o</i>	Reconstructed file name is set to <output.yuv>. Default is test_dec.yuv
<i>-r</i>	Reference sequence file for PSNR computation is set to <reference.yuv>. Default is test_rec.yuv
<i>-uv</i>	Output 400 content with gray chroma components (i.e. values 128), to allow viewing of output on 420 YUV players.

Examples of usage:

```
ldecod.exe
ldecod.exe -h
ldecod.exe default.cfg
ldecod.exe -i bitstream.264
ldecod.exe -i bitstream.264 -o output.yuv -r reference.yuv
ldecod.exe -i bitstream420.264 -uv
```

带格式的: 项目符号和编号

6.2 Decoder Configuration File Format

Decoder parameters need to be placed in a specific order for the decoder to work correctly. Parameters allowed are as follows:

Decoder Parameters:	
<i>bitstream.264</i>	H.26L coded bitstream
<i>output.yuv</i>	Output file in RAW format. Format is based on appropriate parameters in Sequence bitstream SPS.
<i>input.yuv</i>	Ref sequence (for SNR)
<i>l0</i>	Decoded Picture Buffer size <i>Note:</i> parameter is obsolete and has no impact in decoding. Buffer is allocated based on Profile/Level and number of references according to

	SPS num_ref_frames.
0	NAL mode (0=Annex B, 1: RTP packets)
3	SNR computation offset (parameter useful for computing PSNR compared to reference if encoding does not start from frame 0).
1	Poc Scale (allowable values >0) . Scales poc for SNR purposes. System does not compute SNR correctly currently if poc resets to zero (this could happen in current encoder if IDRs are used).
500000	Rate Decoder (HRD conformance)
104000	B decoder
73000	F decoder
leakybucketparam.cfg	LeakyBucket Params

带格式的：项目符号和编号

6.3 Decoder Output

When running the decoder, the decoder will display on screen rate/distortion statistics for every frame coded. Cumulative results will also be presented. The output information generated may look as follows:

```

----- JM 9.2 (FRExt) -----
Decoder config file           : decoder.cfg
-----
Input H.264 bitstream         : test.264
Output decoded YUV            : test_dec.yuv
Output status file            : log.dec
Input reference file           : test_rec.yuv
-----
POC must = frame# or field# for SNRs to be correct
-----
  Frame      POC    Pic#   QP   SnrY   SnrU   SnrV   Y:U:V   Time(ms)
-----
0000(I)      0      0    28  0.0000  0.0000  0.0000  4:2:0    16
0006(P)     12      1    28  0.0000  0.0000  0.0000  4:2:0     0
0004(RB)      8      2    28  0.0000  0.0000  0.0000  4:2:0    15
0002(RB)      4      3    28  0.0000  0.0000  0.0000  4:2:0    16
-----
Average SNR all frames -----
SNR Y(dB)      : 0.00
SNR U(dB)      : 0.00
SNR V(dB)      : 0.00
Total decoding time : 0.062 sec
-----
Exit JM 9 (FRExt) decoder, ver 9.2


```

The generated statistics in the above list represent the following information:

Name	Format	Purpose
Frame	%3d(\$Type)	Frame Display Order and Type
POC	%3d	Frame/Field POC number
Pic#	%3d	Frame_num associated with current frame
QP	%5d	Frame Quantization value
SnrY	%7.4f	Luminance Y PSNR. If value is equal to 0.000 then reference is

		either not available or is identical to reconstructed.
<i>SnrU</i>	%7.4f	Chrominance U PSNR. If value is equal to 0.000 then reference is either not available or is identical to reconstructed.
<i>SnrV</i>	%7.4f	Chrominance V PSNR. If value is equal to 0.000 then reference is either not available or is identical to reconstructed.
<i>Y:U:V</i>	X:Y:Z	Color format
<i>Time(ms)</i>	%5d	Total decoding time for frame

带格式的: 项目符号和编号



7. SYSTEM GENERATED REPORTS/OUTPUT

7. SYSTEM GENERATED REPORTS/OUTPUT

The Encoder and decoder generate several reports that could be used later for analysis of a simulation.

带格式的：项目符号和编号

7.1 log.dat

File provides summary statistics for all simulations initiated within the current directory. This includes certain input parameters, PSNR values, bitrate, encoding duration etc. In more detail, the parameters shown in this file are:

<i>Name</i>	<i>Format</i>	<i>Purpose</i>
<i>Ver</i>	W.X/Y.Z	Encoder Version (W.X main branch, Y.Z FRExt)
<i>Date</i>	MM/DD	Simulation End Date
<i>Time</i>	HH:MM	Simulation End Time
<i>Sequence</i>	%20.20s	Sequence Name
<i>#Img</i>	%5d	Coded Primary Frames (excluding B or PyramidStructure)
<i>P/MbInt</i>	%d/%d	Picture level AFF/ Macroblock level AFF
<i>QPI</i>	%-3d	I slice Quantizer
<i>QPP</i>	%-3d	P slice Quantizer
<i>QPB</i>	%-3d	B slice Quantizer
<i>Format</i>	%4dx%4d	Width x Height
<i>Iperiod</i>	%3d	Intra Period
<i>#B</i>	%3d	Number of B coded frames
<i>Hdmd</i>	ON OFF	Hadamard Use
<i>S.R</i>	%3d	Maximum Search Range (around predictor for RDOPT ON)
<i>#Ref</i>	%2d	Maximum number of references (num_ref_frames)
<i>Freq</i>	%3d	Coded Video Frame Rate
<i>Coding</i>	CABAC CAVLC	Entropy Mode Used
<i>RD-opt</i>	%d	Rate Distortion Optimization Option
<i>Intra upd</i>	ON OFF	Use of MbLineIntraUpdate. Note that this incorrectly reports that this is off if MbLineIntraUpdate is larger than 1.
<i>8x8Tr</i>	%d	Mode usage of 8x8 transform
<i>SNRY I</i>	%-5.3f	luminance PSNR for first frame in sequence Note: How useful is this? Should it be maybe PSNR of I coded frames?
<i>SNRU I</i>	%-5.3f	Chrominance U PSNR for first frame in sequence Note: Same issue as with luma.
<i>SNRV I</i>	%-5.3f	Chrominance V PSNR for first frame in sequence Note: Same issue as with luma.
<i>SNRY N</i>	%-5.3f	Luminance PSNR for entire sequence
<i>SNRU N</i>	%-5.3f	Chrominance U PSNR for entire sequence
<i>SNRV N</i>	%-5.3f	Chrominance V PSNR for entire sequence
<i>#Bitr I</i>	%6.0f	Bitrate (not bits) assigned to I coded frames

#Bitr P	%6.0f	Bitrate (not bits) assigned to P coded frames
#Bitr B	%6.0f	Bitrate (not bits) assigned to B coded frames
#Bitr IPB	%6.0f	Sequence Bitrate including overheads
Total Time	%12d	Encoding Time in ms
Me Time	%12d	Motion Estimation only time in ms

带格式的: 项目符号和编号

7.2 stats.dat

This file contains information about the encoded sequence, such as statistics about the macroblock types used for each different slice type, distortion information, the last encoded sequence. An example stat.dat file could look as follows:

This file contains statistics for the last encoded sequence

Sequence : foreman_part_qcif.yuv
No.of coded pictures : 3
Freq. for encoded bitstream : 30
BaseLayer Bitrate(kb/s) : 292.16
EnhancedLayer Bitrate(kb/s) : 24.40
Hadamard transform : Used
Image format : 176x144
Error robustness : Off
Search range : 16
Total number of references : 5
References for P slices : 5
List0 refs for B slices : 5
List1 refs for B slices : 1
Entropy coding method : CABAC
Profile/Level IDC : (100,40)
Search range restrictions : none
RD-optimized mode decision : used

Item	Intra	All frames
SNR Y(dB)	37.44	36.74
SNR U/V (dB)	41.17/43.01	41.03/42.75
Average quant	28	28.00

SNR	I	P	B
SNR Y(dB)	37.439	37.439	37.439
SNR U(dB)	41.170	41.170	41.170
SNR V(dB)	43.010	43.010	43.010

Intra	Mode used
Mode 0 intra 4x4	93
Mode 1+ intra 16x16	6

Inter	Mode used	MotionInfo bits
Mode 0 (copy)	21	0.00
Mode 1 (16x16)	20	170.00
Mode 2 (16x8)	3	56.00
Mode 3 (8x16)	18	227.00

Mode 4 (8x8)	25	1214.00	
Mode 5 intra 4x4	15	-----	
Mode 7 intra 8x8	0		
Mode 6+ intra 16x16	1		

B frame	Mode used	MotionInfo bits	

Mode 0 (copy)	47	0.00	
Mode 1 (16x16)	33	346.00	
Mode 2 (16x8)	4	92.00	
Mode 3 (8x16)	7	156.00	
Mode 4 (8x8)	8	346.00	
Mode 5 intra 4x4	0	-----	
Mode 7 intra 8x8	0		
Mode 6+ intra 16x16	0		

Bit usage:	Intra	Inter	B frame

Header	32.00	32.00	32.00
Mode	62.00	436.00	385.00
Motion Info	./.	1667.00	940.00
CBP Y/C	342.00	257.00	157.00
Coeffs. Y	18898.00	5259.00	836.00
Coeffs. C	1571.00	358.00	30.00
Delta quant	12.00	6.00	4.00
Stuffing Bits	14.00	10.00	4.00

average bits/frame	20931.00	8025.00	2388.00

NOTE

Statistics are not collected correctly when Picture or Macroblock Level Field/Frame coding is enabled.