MPEG4 Simple Profile Encoder on DM6446

User's Guide

Literature Number: SPRUEA2F
October 2009

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Preface

Read This First

About This Manual

This document describes how to install and work with Texas Instruments' (TI) MPEG4 Simple Profile Encoder implementation on the DM6446 platform. It also provides a detailed Application Programming Interface (API) reference and information on the sample application that accompanies this component.

TI's codec implementations are based on the eXpressDSP Digital Media (XDM) standard. XDM is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS).

Intended Audience

This document is intended for system engineers who want to integrate TI's codecs with other software to build a multimedia system based on the DM6446 platform.

This document assumes that you are fluent in the C language, have a good working knowledge of Digital Signal Processing (DSP), digital signal processors, and DSP applications. Good knowledge of eXpressDSP Algorithm Interface Standard (XDAIS) and eXpressDSP Digital Media (XDM) standard will be helpful.

How to Use This Manual

This document includes the following chapters:

- **Chapter 1 - Introduction**, provides a brief introduction to the XDAIS and XDM standards. It also provides an overview of the codec and lists its supported features.
- **Chapter 2 - Installation Overview**, describes how to install, build, and run the codec.
- **Chapter 3 - Sample Usage**, describes the sample usage of the codec.
- **Chapter 4 - API Reference**, describes the data structures and interface functions used in the codec.
- **Chapter 5 - Frequently Asked Questions,** provides answers to few frequently asked questions related to using this Encoder.

- **Appendix A – Motion Vector Access API**, provides information about the Motion Vector Access API used by the application to encode a frame.
- **Appendix B – Revision History**, highlights the changes made to the SPRUEA2E codec specific user guide to make it SPRUEA2F.

Related Documentation From Texas Instruments

The following documents describe TI's DSP algorithm standards such as, XDAIS and XDM. To obtain a copy of any of these TI documents, visit the Texas Instruments website at www.ti.com.

- *TMS320 DSP Algorithm Standard Rules and Guidelines* (literature number SPRU352) defines a set of requirements for DSP algorithms that, if followed, allow system integrators to quickly assemble production-quality systems from one or more such algorithms.
- *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360) describes all the APIs that are defined by the TMS320 DSP Algorithm Interface Standard (also known as XDAIS) specification.
- *Technical Overview of eXpressDSP - Compliant Algorithms for DSP Software Producers* (literature number SPRA579) describes how to make algorithms compliant with the TMS320 DSP Algorithm Standard which is part of TI's eXpressDSP technology initiative.
- *Using the TMS320 DSP Algorithm Standard in a Static DSP System* (literature number SPRA577) describes how an eXpressDSP-compliant algorithm may be used effectively in a static system with limited memory.
- *DMA Guide for eXpressDSP-Compliant Algorithm Producers and Consumers* (literature number SPRA445) describes the DMA architecture specified by the TMS320 DSP Algorithm Standard (XDAIS). It also describes two sets of APIs used for accessing DMA resources: the IDMA2 abstract interface and the ACPY2 library.
- *eXpressDSP Digital Media (XDM) Standard API Reference* (literature number SPRUEC8)

The following documents describe TMS320 devices and related support tools:

- *Design and Implementation of an eXpressDSP-Compliant DMA Manager for C6X1X* (literature number SPRA789) describes a C6x1x-optimized (C6211, C6711) ACPY2 library implementation and DMA Resource Manager.
- *TMS320C64x+ Megamodule* (literature number SPRAA68) describes the enhancements made to the internal memory and describes the new features which have been added to support the internal memory architecture's performance and protection.
- *TMS320C64x+ DSP Megamodule Reference Guide* (literature number SPRU871) describes the C64x+ megamodule peripherals.

- *TMS320C64x to TMS320C64x+ CPU Migration Guide* (literature number SPRAA84) describes migration from the Texas Instruments TMS320C64x™ digital signal processor (DSP) to the TMS320C64x+™ DSP.
- *TMS320C6000 Optimizing Compiler v 6.0 Beta User's Guide* (literature number SPRU187N) explains how to use compiler tools such as compiler, assembly optimizer, standalone simulator, library-build utility, and C++ name demangler.
- *TMS320C64x/C64x+ DSP CPU and Instruction Set Reference Guide* (literature number SPRU732) describes the CPU architecture, pipeline, instruction set, and interrupts of the C64x and C64x+ DSPs.
- *TMS320DM6446 Digital Media System-on-Chip* (literature number SPRS283)
- *TMS320DM6446 Digital Media System-on-Chip Errata (Silicon Revision 1.0)* (literature number SPRZ241) describes the known exceptions to the functional specifications for the TMS320DM6446 Digital Media System-on-Chip (DMSoC).
- *TMS320DM6443 Digital Media System-on-Chip* (literature number SPRS282)
- *TMS320DM6443 Digital Media System-on-Chip Errata (Silicon Revision 1.0)* (literature number SPRZ240) describes the known exceptions to the functional specifications for the TMS320DM6443 Digital Media System-on-Chip (DMSoC).
- *TMS320DM644x DMSoC DSP Subsystem Reference Guide* (literature number SPRUE15) describes the digital signal processor (DSP) subsystem in the TMS320DM644x Digital Media System-on-Chip (DMSoC).
- *TMS320DM644x DMSoC ARM Subsystem Reference Guide* (literature number SPRUE14) describes the ARM subsystem in the TMS320DM644x Digital Media System on a Chip (DMSoC).
- *DaVinci Technology - Digital Video Innovation Product Bulletin (Rev. A)* (literature number SPRT378a)
- *The DaVinci Effect: Achieving Digital Video Without Complexity White Paper* (literature number SPRY079)
- *DaVinci Benchmarks Product Bulletin* (literature number SPRT379)
- *DaVinci Technology for Digital Video White Paper* (literature number SPRY067)
- *The Future of Digital Video White Paper* (literature number SPRY066)

Related Documentation

You can use the following documents to supplement this user guide:

- *ISO/IEC 11172-2 Information Technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1.5Mbits/s -- Part 2: Video* (MPEG-1 video standard)

- *ISO/IEC 14496-2:2004, Information technology -- Coding of audio-visual objects -- Part 2: Visual* (Approved in 2004-05-24)
- *H.263 ITU-T Standard – Video Coding for low bit rate communication*

Abbreviations

The following abbreviations are used in this document.

Table 1-1. List of Abbreviations

Abbreviation	**Description**
CBR	Constant Bit Rate
CIF	Common Intermediate Format
CSL	Chip Support Library
DCT	Discrete Cosine Transform
DMA	Direct Memory Access
DMAN3	DMA Manager
EVM	Evaluation Module
GOB	Group of Blocks
GOV	Group of VOP
HEC	Header Extension Code
HPI	Half Pel Interpolation
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ITU	International Telecommunications Union
MPEG	Moving Pictures Experts Group
QCIF	Quarter Common Intermediate Format
QP	Quantization Parameter
QVGA	Quarter Video Graphics Array
SP	Simple Profile
SQCIF	Sub Quarter Common Intermediate Format
TM5	Test Model 5

Abbreviation	Description
TMN	Test Model Near term
TMN5	Test Model Near term, Version 5
VBR	Variable Bit Rate
VBV	Video rate Buffer Verifier
VM4	Verification Model 4
VOL	Video Object Layer
VOP	Video Object Plane
VOS	Video Object Sequence
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media

Text Conventions

The following conventions are used in this document:

- Text inside back-quotes (‘‘) represents pseudo-code.
- Program source code, function and macro names, parameters, and command line commands are shown in a `mono-spaced` font.

Product Support

When contacting TI for support on this codec, please quote the product name (MPEG4 Simple Profile Encoder on DM6446) and version number. The version number of the codec is included in the title of the release notes that accompanies this codec.

Trademarks

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Chapter 1

Introduction

This chapter provides a brief introduction to XDAIS and XDM. It also provides an overview of TI's implementation of the MPEG4 Simple Profile Encoder on the DM6446 platform and its supported features.

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1.1 Overview of XDAIS and XDM

TI's multimedia codec implementations are based on the eXpressDSP Digital Media (XDM) standard. XDM is an extension of the eXpressDSP Algorithm Interface Standard (XDAIS).

1.1.1 XDAIS Overview

An eXpressDSP-compliant algorithm is a module that implements the abstract interface IALG. The IALG API takes the memory management function away from the algorithm and places it in the hosting framework. Thus, an interaction occurs between the algorithm and the framework. This interaction allows the client application to allocate memory for the algorithm and also share memory between algorithms. It also allows the memory to be moved around while an algorithm is operating in the system. In order to facilitate these functionalities, the IALG interface defines the following APIs:

- `algAlloc()`
- `algInit()`
- `algActivate()`
- `algDeactivate()`
- `algFree()`

The `algAlloc()` API allows the algorithm to communicate its memory requirements to the client application. The `algInit()` API allows the algorithm to initialize the memory allocated by the client application. The `algFree()` API allows the algorithm to communicate the memory to be freed when an instance is no longer required.

Once an algorithm instance object is created, it can be used to process data in real-time. The `algActivate()` API provides a notification to the algorithm instance that one or more algorithm processing methods is about to be run zero or more times in succession. After the processing methods have been run, the client application calls the `algDeactivate()` API prior to reusing any of the instance's scratch memory.

The IALG interface also defines three more optional APIs `algControl()`, `algNumAlloc()`, and `algMoved()`. For more details on these APIs, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

1.1.2 XDM Overview

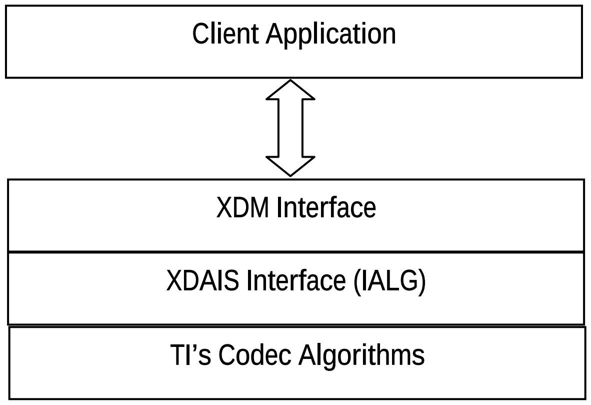
In the multimedia application space, you have the choice of integrating any codec into your multimedia system. For example, if you are building a video decoder system, you can use any of the available video decoders (such as MPEG4, H.263, or H.264) in your system. To enable easy integration with the client application, it is important that all codecs with similar functionality use similar APIs. XDM was primarily defined as an extension to XDAIS to ensure uniformity across different classes of codecs (for example audio, video, image, and speech). The XDM standard defines the following two APIs:

- `control()`
- `process()`

The `control()` API provides a standard way to control an algorithm instance and receive status information from the algorithm in real-time. The `control()` API replaces the `algControl()` API defined as part of the IALG interface. The `process()` API does the basic processing (encode/decode) of data.

Apart from defining standardized APIs for multimedia codecs, XDM also standardizes the generic parameters that the client application must pass to these APIs. The client application can define additional implementation specific parameters using extended data structures.

The following figure depicts the XDM interface to the client application.



As depicted in the figure, XDM is an extension to XDAIS and forms an interface between the client application and the codec component. XDM insulates the client application from component-level changes. Since TI's multimedia algorithms are XDM compliant, it provides you with the flexibility to use any TI algorithm without changing the client application code. For example, if you have developed a client application using an XDM-compliant MPEG4 video decoder, then you can easily replace MPEG4 with another XDM-compliant video decoder, say H.263, with minimal changes to the client application.

For more details, see *eXpressDSP Digital Media (XDM) Standard API Reference* (literature number SPRUEC8).

1.2 Overview of MPEG4 Simple Profile Encoder

MPEG4 is the ISO/IEC recommended standard for video compression. Figure 1-1 depicts the working of the MPEG4 Encoder algorithm.

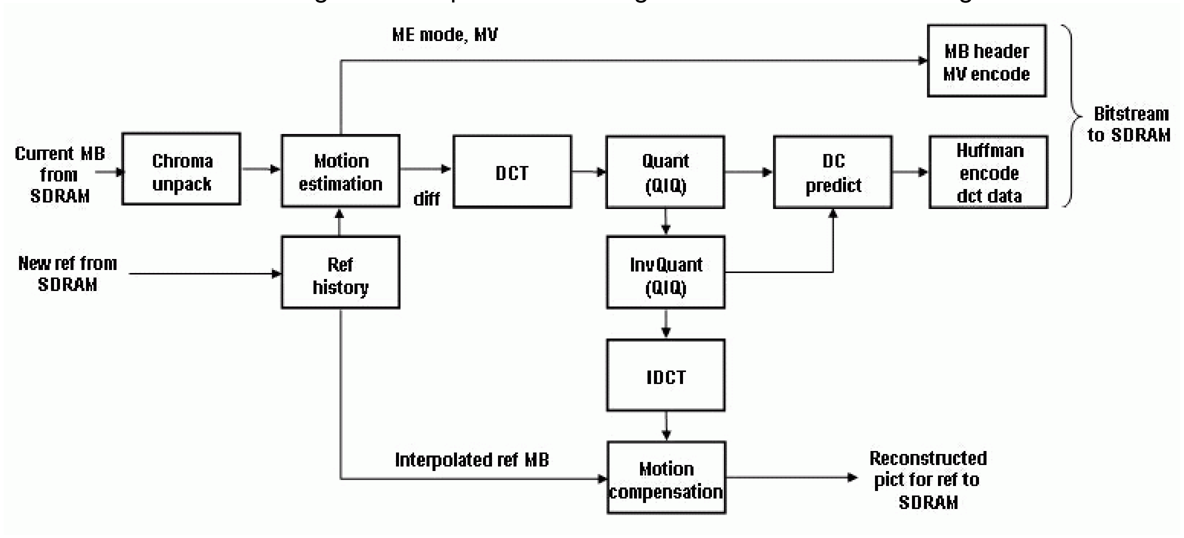


Figure 1-1. Working of MPEG4 Video Encoder

An input video sequence for a MPEG4 Encoder consists of frames and accepts the input frames in YUV format. Video coding aims at providing a compact representation of the information in the video frames by removing spatial redundancies that exist within the frames and temporal redundancies that exist between successive frames.

The MPEG4 standard is based on using the Discrete Cosine Transform (DCT) to remove spatial redundancies. Motion estimation and compensation is used to remove temporal redundancies.

All frames in a video sequence are categorized as either I-frames or P-frames. I-frames called as intra-frames are encoded without reference to any other frame in the sequence, same as a still image would be encoded. In contrast, P-frames called as predicted frames or inter-frames depend on information from a previous frame for its encoding. The video frames that are close in time are similar. When encoding a video frame, you can use the information presented in a previously encoded frame.

One approach to achieve this goal is to consider the difference between the current frame and a previous reference frame, and encode the difference or residual. When two frames are very similar, the difference will be much more efficient to encode than encoding the original frame.

A more sophisticated approach to increase coding efficiency is to work at the macro block level in the current frame, instead of processing the whole frame all at once. This process is called motion compensation, or more precisely, motion compensated prediction. This is based on the assumption that most of the motion that the macro blocks undergo between frames is a translational motion.

Quantization is a significant source of compression in the encoder bit stream. The basic idea of quantization is to eliminate as many of the non-zero DCT co-efficients corresponding to high frequency components. The quantized co-efficients are rounded to the nearest integer value. The net effect of the quantization is usually a reduced variance between the original DCT co-efficients as compared to the variance between the original DCT co-efficients.

The reference frames in the encoder produces the output bit stream in the compressed format as a sequence of data bits. With the help of a display driver, these bits are decoded and the output image can be seen on a display device such as a TV.

From this point onwards, all references to MPEG4 Encoder means MPEG4 Simple Profile Encoder only.

1.3 Supported Services and Features

This user guide accompanies TI's implementation of MPEG4 Encoder on the DM6446 platform.

This version of the codec has the following supported features of the standard:

- Compliant with the MPEG4 simple profile levels 0, 1, 2, 3, 4A, and 5
- Supports H.263 baseline profile levels 10, 20, 30, and 45
- Supports standard TM5 rate control algorithm
- Generates bit streams that are compliant with the Video Buffering Verifier as per MPEG4 standard
- Supports Data Partitioning (DP) and Reversible Variable Length Code (RVLC)
- Supports AC prediction
- Supports Adaptive and Mandatory Intra refresh
- Supports image width and height which are non-multiple of 16
- Supports Unrestricted Motion Vectors (UMV) for both MPEG4 and H.263 Annexure D. UMV can be switched on/off at run-time
- Supports addition of Video Sequence End code in the bit stream

The other explicit features that TI's MPEG4 Encoder provides are:

- Supports TI's proprietary rate control algorithms
- Supports TI's proprietary content adaptive motion estimation
- Supports resolutions up to PAL D1(720 x 576), including standard image sizes such as SQCIF, QCIF, CIF, QVGA,VGA, and D1
- Supports Half Pel Interpolation (HPI) for motion estimation
- Supports setting of Quantization Parameter (QP) for I-frames and P-frames

- Supports I-frame insertion and changing the size of video packets at run-time
- Supports 422i or 420 input formats for the frames
- Supports only HEADER encoding (VOL Header)
- Supports motion vector access
- Provides high speed/high quality encoding options
- eXpressDSP Digital Media (XDM 1.0 IVIDENC1) compliant

Chapter 2

Installation Overview

This chapter provides a brief description on the system requirements and instructions for installing the codec component. It also provides information on building and running the sample test application.

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2.1 System Requirements

This section describes the hardware and software requirements for the normal functioning of the codec component.

2.1.1 Hardware

This codec has been built and tested on the DM6446 EVM with XDS560 JTAG emulator.

This codec can be used on any of TI's C64x+ based platforms.

2.1.2 Software

The following are the software requirements for the normal functioning of the codec:

- **Development Environment:** This project is developed using Code Composer Studio version 3.2.39.4.
- **Code Generation Tools:** This project is compiled, assembled, archived, and linked using the code generation tools version 6.0.14.

2.2 Installing the Component

The codec component is released as a compressed archive. To install the codec, extract the contents of the zip file onto your local hard disk. The zip file extraction creates a top-level directory called 100_V_MPEG4_E_2_02, under which another directory named DM6446_SP_001 is created.

Figure 2-2 shows the sub-directories created in the DM6446_SP_001 directory.

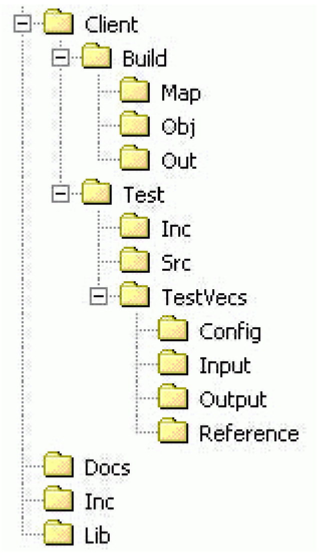

Figure 2-2. Component Directory Structure

Note:

If you are installing an evaluation version of this codec, the directory name will be 100E_V_MPEG4_E_2_02.

Table 2-1 provides a description of the sub-directories created in the DM6446_SP_001 directory.

Table 2-1. Component Directories

Sub-Directory	Description
\Inc	Contains XDM related header files which allow interface to the codec library
\Lib	Contains the codec library file
\Docs	Contains user guide and datasheet
\Client\Build	Contains the sample test application project (.pjt) file
\Client\Build\Map	Contains the memory map generated on compilation of the code
\Client\Build\Obj	Contains the intermediate .asm and/or .obj file generated on compilation of the code
\Client\Build\Out	Contains the final application executable (.out) file generated by the sample test application
\Client\Test\Src	Contains application C files
\Client\Test\Inc	Contains header files needed for the application code
\Client\Test\TestVecs\Input	Contains input test vectors
\Client\Test\TestVecs\Output	Contains output generated by the codec
\Client\Test\TestVecs\Reference	Contains read-only reference output to be used for verifying against codec output
\Client\Test\TestVecs\Config	Contains configuration parameter files

2.3 Before Building the Sample Test Application

This codec is accompanied by a sample test application. To run the sample test application, you need DSP/BIOS and TI Framework Components (FC).

This version of the codec has been validated with DSP/BIOS version 5.31.08 and Framework Component (FC) version 2.20.01.

2.3.1 Installing DSP/BIOS

You can download DSP/BIOS from the TI external website:

https://www-a.ti.com/downloads/sds_support/targetcontent/bios/index.html

Install DSP/BIOS at the same location where you have installed Code Composer Studio. For example:

<install directory>\CCStudio_v3.2

The sample test application uses the following DSP/BIOS files:

- ❑ Header file, bcache.h available in the <install directory>\CCStudio_v3.2\<bios_directory>\packages \ti\bios\include directory.
- ❑ Library file, biosDM420.a64P available in the <install directory>\CCStudio_v3.2\<bios_directory>\packages \ti\bios\lib directory.

2.3.2 Installing Framework Component (FC)

You can download FC from the TI external website:

https://www-a.ti.com/downloads/sds_support/targetcontent/FC/index.html

Extract the FC zip file to the same location where you have installed Code Composer Studio. For example:

<install directory>\CCStudio_v3.2

The test application uses the following DMAN3 files:

- ❑ Library file, dman3.a64P available in the <install directory>\CCStudio_v3.2\<fc_directory>\packages \ti\sdo\fc\dman3 directory.
- ❑ Header file, dman3.h available in the <install directory>\CCStudio_v3.2\<fc_directory>\packages \ti\sdo\fc\dman3 directory.
- ❑ Header file, idma3.h available in the <install directory>\CCStudio_v3.2\<fc_directory>\fctools\packages \ti\xdais directory.

2.4 Building and Running the Sample Test Application

The sample test application that accompanies this codec component will run in TI's Code Composer Studio development environment. To build and run the sample test application in Code Composer Studio, follow these steps:

1) Verify that you have an installation of TI's Code Composer Studio version 3.2.39.4 and code generation tools version 6.0.14.

2) Verify that the codec object library mp4venc_ti.l64P exists in the \Lib sub-directory.

3) Open the test application project file, TestAppEncoder.pjt in Code Composer Studio. This file is available in the \Client\Build sub-directory.

4) Select **Project > Build** to build the sample test application. This creates an executable file, TestAppEncoder.out in the \Client\Build\Out sub-directory.

5) Select **File > Load**, browse to the \Client\Build\Out sub-directory, select the codec executable created in step 4, and load it into Code Composer Studio in preparation for execution.

6) Select **Debug > Run** to execute the sample test application.

Note:

The algorithm library is a partially linked library with the code placed in a single section and only the encoder APIs are exposed as global symbols. See the linker command file mp4vencapp.cmd in the Client\Build directory for the details of memory sections.

The main sections are:

- MP4VENC_TI_cSect1: algorithm code section: Has to be aligned at 64 K-bytes
- MP4VENC_TI_dSect1: algorithm initialized-const data section: aligned at 32 bytes
- MP4VENC_TI_uSect1: algorithm uninitialized data section: Has to be aligned at 32 bytes

The sample test application takes the input files stored in the \Client\Test\TestVecs\Input sub-directory, runs the codec, and uses the reference files stored in the \Client\Test\TestVecs\Reference sub-directory to verify that the codec is functioning as expected.

7) On successful completion, the application displays one of the following messages for each frame:

   - "Encoder compliance test passed for this configuration or Encoder compliance test failed for this frame." (for compliance check mode)
   - "Encoder output dump completed" (for output dump mode)

2.5 Configuration Files

This codec is shipped along with:

- A generic configuration file (TestVecs.cfg) – specifies input and reference files for the sample test application.
- An Encoder configuration file (Testparams.cfg) – specifies the configuration parameters used by the test application to configure the Encoder.

2.5.1 Generic Configuration File

The sample test application shipped along with the codec uses the configuration file, TestVecs.cfg for determining the input and reference files for running the codec and checking for compliance. The TestVecs.cfg file is available in the \Client\Test\TestVecs\Config sub-directory.

The format of the TestVecs.cfg file is:

```
X
Config
Input
Output/Reference
```

where:

- `X` may be set as:
  - 1 - for compliance checking, no output file is created
  - 0 - for writing the output to the output file
- `Config` is the Encoder configuration file. For details, see Section 2.5.2.
- `Input` is the input file name (use complete path).
- `Output/Reference` is the output file name (if `X` is 0) or reference file name (if `X` is 1).

A sample TestVecs.cfg file is as shown:

```
0
..\..\Test\TestVecs\Config\Testparams.cfg
..\..\Test\TestVecs\Input\foreman_vga_422.yuv
..\..\Test\TestVecs\Output\foreman_vga_422.bits
```

2.5.2 Encoder Configuration File

The encoder configuration file, Testparams.cfg contains the configuration parameters required for the encoder. The Testparams.cfg file is available in the \Client\Test\TestVecs\Config sub-directory.

A sample Testparams.cfg file is as shown.

```
# Input File Format is as follows
# <ParameterName> = <ParameterValue> # Comment
#
###########################################################
Parameters
###########################################################
EncodingPreset      = 1          # 0:XDM_DEFAULT,
                                   1: XDM_HIGH_QUALITY,
                                   2: XDM_HIGH_SPEED,
                                   3: XDM_USER_DEFINED
ImageWidth          = 640         # Image width in Pels
ImageHeight         = 480         # Image height in Pels
FrameRate           = 30000       # Frame Rate per
                                    second*1000 (1-30)
Bitrate             = 4000000     # Bitrate(bps) #if
                                    ZERO=>> RC is OFF
ChromaFormat        = 4           # 1 => XDM_YUV_420P,
                                   3 => XDM_YUV_422IBE,
                                   4 => XDM_YUV_422ILE
IntraPeriod         = 30          # Period of I-Frames
                                 #(Insertion of I-frame when
                                   changed runtime)
FramesToEncode      = 10          # Number of frames to be
                                    coded
RateControlPreset   = 5           # rateControlPreset,
                                    1: LOW_DELAY,
                                    2: STORAGE,
                                    3: TWOPASS,
                                    4: NONE,
                                    5:USER_DEFINED
EncodeMode          = 1           # Encoding mode,
                                    0: H.263 mode,
                                    1 : MPEG4 mode
LevelIdc            = 5           # Profile level
                                    indication for MPEG4,
                                    set to a minimum value
                                    of zero or a maximum
                                    value of 5 based on
                                    MPEG4 standard
RateControlMethod   = 4           # Rate Control Method,
                                    0:disable rate control,
                                    1-TM5,
                                    2-Not supported,
                                    3-PLR1,
                                    4-PLR3,
                                    5-Not supported,
                                    6:Not supported,
                                    7:Constrained VBR
                                    8:PLR4
VBVBufSize          = 112         # vbv_buffer_size (in
                                    multiples of 16 kbits)
MaxDelay            = 300         # Maximum allowable delay
                                   (Only applicable for
                                    RateControlMethod= 7
                                    ignored for other RC
                                    methods)
UseVOS              = 0           # VOS header insertion,
                                    0 = off,
                                    1 = on
UseGOV              = 0           # GOV header insertion,
                                    0 = off,
                                    1 = on
DPEnable            = 0          # Data partioning,
                                   0 = off,
                                   1 = on
RVLCEnable          = 0          # RVLC,
                                    0 = off,
                                    1 = on,
ResyncInterval      = 2000       # Insert resync marker
                                   (RM) after given
                                   specified bits,
                                   0 implies do not insert
HECInterval         = 0          # Insert HEC after given
                                    specified packets
                                    insertion, 0 means do
                                    not insert
AIRRate             = 0          # Adaptive intra refresh
                                   rate in MB’s per frame
MIRRate             = 0          # Mandatory intra refresh
                                    rate in MB’s per frame
QpIntra             = 8          # Default QP for
                                    I frame : QPI,
                                    range 1 to 31
QpInter             = 8          # Default QP for
                                    P frame : QPI,
                                    range 1 to 31
Fcode               = 5          # f_code: ME search
                                    area = 1<<f_code-1,
                                    set to 1 in case of
                                    H.263
UseHpi              = 0          # Half pixel
                                    interpolation,
                                    0 : off,
                                    1 = on
UseAcPred           = 0          # AC prediction
                                    enable/disable
                                    0: off,
                                    1 = on
LatFrameFlag        = 0          # Last frame flag,
                                    1 = Last Frame,
                                    0 = Not Last Frame.
                                    This need to be
                                    dynamically set: only
                                    for the last frame
EncodeHeaderOnly    = 0          # Generate only header,
                                   1 = generates VOL
                                       header,
                                   0 = Normal Encoding
EnableMVAccess      = 1          # Enable Motion vector
                                   access,
                                   0: Disable,
                                   1: Enable
EnableUMV          = 1          #Enable UMV flag
                                   0:Disable
                                   1:Enable
enableSCD          = 0         # Enable Scene Change
                                  Detector
                                  0:Disable
                                  1:Enable

QpMax              = 18           #The upper threshold
                                   for Quantisation
                                   Parameter
```

```
QpMin            = 2          #The lower threshold
                              for Quantisation
                              Parameter
```

Any field in the `IVIDENC1 _Params` structure (see Section 4.2.1.9) can be set in the Testparams.cfg file using the syntax shown above. If you specify additional fields in the Testparams.cfg file, ensure to modify the test application appropriately to handle these fields.

2.6 Standards Conformance and User-Defined Inputs

To check the conformance of the codec for the default input file shipped along with the codec, follow the steps as described in Section 2.4.

To check the conformance of the codec for other input files of your choice, follow these steps:

1) Copy the input files to the \Client\Test\TestVecs\Inputs sub-directory.

2) Copy the reference files to the \Client\Test\TestVecs\Reference sub-directory.

3) Edit the configuration file, TestVecs.cfg available in the \Client\Test\TestVecs\Config sub-directory. For details on the format of the TestVecs.cfg file, see Section 2.5.1.

4) Execute the sample test application. On successful completion, the application displays one of the following messages for each frame:

   o “Encoder compliance test failed for this frame” or “Encoder compliance test passed for this configuration “ (if `X` is 1)

   o “Encoder output dump completed” (if `X` is 0)

If you have chosen the option to write to an output file (`X` is 0), you can use any standard file comparison utility to compare the codec output with the reference output and check for conformance.

2.7 Uninstalling the Component

To uninstall the component, delete the codec directory from your hard disk.

2.8 Evaluation Version

If you are using an evaluation version of this codec a Texas Instruments logo will be visible in the output.

Note:

Compliance test succeeds only for sample input file, provided with evaluation package, due to presence of Texas instruments logo in the encoded file. It should not be checked for other inputs.

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Chapter 3

Sample Usage

This chapter provides a detailed description of the sample test application that accompanies this codec component.

3.1 Overview of the Test Application

The test application exercises the IMP4VENC extended and base class of the MPEG4 Encoder library. The main test application files are TestAppEncoder.c and TestAppEncoder.h. These files are available in the \Client\Test\Src and \Client\Test\Inc sub-directories respectively.

Figure 3-1 depicts the sequence of APIs exercised in the sample test application.

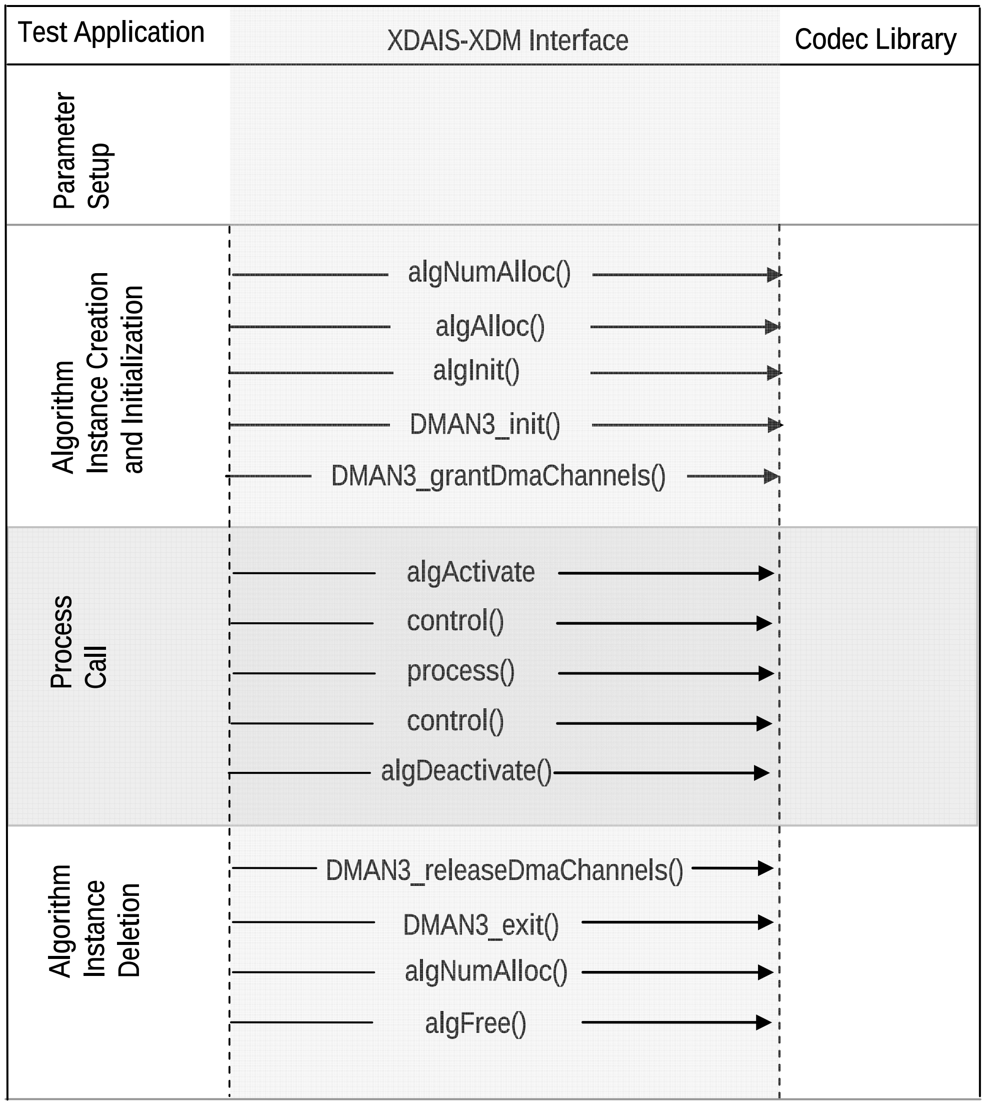

Figure 3-1. Test Application Sample Implementation

The test application is divided into four logical blocks:

- ❑ Parameter setup
- ❑ Algorithm instance creation and initialization
- ❑ Process call
- ❑ Algorithm instance deletion

3.1.1 Parameter Setup

Each codec component requires various codec configuration parameters to be set at initialization. For example, a video codec requires parameters such as video height, video width, and so on. The test application obtains the required parameters from the Encoder configuration files.

In this logical block, the test application performs the following:

1) Opens the generic configuration file, TestVecs.cfg and reads the compliance checking parameter, Encoder configuration file name (Testparams.cfg), input file name, and output/reference file name.

2) Opens the Encoder configuration file, (Testparams.cfg) and reads the various configuration parameters required for the algorithm.

   For more details on the configuration files, see Section 2.5.

3) Sets the `IMP4VENC_Params` structure based on the values it reads from the Testparams.cfg file.

4) Initializes the various DMAN3 parameters.

5) Reads the input YUV frame into the application input buffer.

After successful completion of the above steps, the test application does the algorithm instance creation and initialization.

3.1.2 Algorithm Instance Creation and Initialization

In this logical block, the test application accepts the various initialization parameters and returns an algorithm instance pointer. The following APIs are called in sequence:

1) `algNumAlloc()` - To query the algorithm about the number of memory records it requires.

2) `algAlloc()` - To query the algorithm about the memory requirement to be filled in the memory records.

3) `algInit()` - To initialize the algorithm with the memory structures provided by the application.

A sample implementation of the create function that calls `algNumAlloc()`, `algAlloc()`, and `algInit()` in sequence is provided in the `ALG_create()` function implemented in the alg_create.c file.

After successful creation of the algorithm instance, the test application does DMA resource allocation for the algorithm. This requires initialization of DMA Manager Module and grant of DMA resources. This is implemented by calling DMAN3 interface functions in the following sequence:

1) `DMAN3_init()` - To initialize the DMAN module.

2) `DMAN3_grantDmaChannels()` - To grant the DMA resources to the algorithm instance.

Note:

DMAN3 function implementations are provided in dman3.a64P library.

3.1.3 Process Call

After algorithm instance creation and initialization, the test application performs the following:

1) Sets the dynamic parameters (if they change during run-time) by calling the `control()` function with the XDM_SETPARAMS command.

2) Sets the input and output buffer descriptors required for the `process()` function call. The input and output buffer descriptors are obtained by calling the `control()` function with the XDM_GETBUFINFO command.

3) Calls the `process()` function to encode/decode a single frame of data. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 4.2.1.10). The inputs to the process function are input and output buffer descriptors, pointer to the `IVIDENC1_InArgs` and `IVIDENC1_OutArgs` structures.

The `control()` and `process()` functions should be called only within the scope of the `algActivate()` and `algDeactivate()` XDAIS functions which activate and deactivate the algorithm instance respectively. Once an algorithm is activated, there could be any ordering of `control()` and `process()` functions. The following APIs are called in sequence:

1) `algActivate()` - To activate the algorithm instance.

2) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters etc., using the six available control commands.

3) `process()` - To call the Encoder with appropriate input/output buffer and arguments information.

4) `control()` (optional) - To query the algorithm on status or setting of dynamic parameters and so on, using the six available control commands.

5) `algDeactivate()` - To deactivate the algorithm instance.

The do-while loop encapsulates frame level `process()` call and updates the input buffer pointer every time before the next call. The do-while loop breaks off either when an error condition occurs or when the input buffer exhausts. It also protects the `process()` call from file operations by placing appropriate calls for cache operations as well. The test application does a cache invalidate for the valid input buffers before `process()` and a cache write back invalidate for output buffers after `process()`.

In the sample test application, after calling `algDeactivate()`, the output data is either dumped to a file or compared with a reference file.

3.1.4 Algorithm Instance Deletion

Once decoding/encoding is complete, the test application must release the DMA channels granted by the DMA Manager interface and delete the current algorithm instance. The following APIs are called in sequence:

1) `DMAN3_releaseDmaChannels()` - To remove logical channel resources from an algorithm instance.

2) `DMAN3_exit()` - To free DMAN3 memory resources.

3) `algNumAlloc()` - To query the algorithm about the number of memory records it used.

4) `algFree()` - To query the algorithm to get the memory record information.

A sample implementation of the delete function that calls `algNumAlloc()` and `algFree()` in sequence is provided in the `ALG_delete()` function implemented in the alg_create.c file.

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Chapter 4

API Reference

This chapter provides a detailed description of the data structures and interfaces functions used in the codec component.

Topic	Page
4.1 Symbolic Constants and Enumerated Data Types	4-2
4.2 Data Structures	4-8
4.3 Interface Functions	4-26

4.1 Symbolic Constants and Enumerated Data Types

This section summarizes all the symbolic constants specified as either #define macros and/or enumerated C data types. For each symbolic constant, the semantics or interpretation of the same is also provided.

Table 4-1. List of Enumerated Data Types

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
`IVIDEO_FrameType`	`IVIDEO_NA_FRAME`	Frame type not available.
	`IVIDEO_I_FRAME`	Intra coded frame
	`IVIDEO_P_FRAME`	Forward inter coded frame. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_B_FRAME`	Bi-directional inter coded frame. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_IDR_FRAME`	Intra coded frame that can be used for refreshing video content. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_II_FRAME`	Interlaced frame, both fields are I frames. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_IP_FRAME`	Interlaced frame, first field is an I frame, second field is a P frame. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_IB_FRAME`	Interlaced frame, first field is an I frame, second field is a B frame. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_PI_FRAME`	Interlaced frame, first field is a P frame, second field is an I frame. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_PP_FRAME`	Interlaced frame, both fields are P frames. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_PB_FRAME`	Interlaced frame, first field is a P frame, second field is a B frame. Not supported in this version of MPEG4 Encoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_BI_FRAME	Interlaced frame, first field is a B frame, second field is an I frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_BP_FRAME	Interlaced frame, first field is a B frame, second field is a P frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_BB_FRAME	Interlaced frame, both fields are B frames. Not supported in this version of MPEG4 Encoder.
	IVIDEO_MBAFF_I_FRAME	Intra coded MBAFF frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_MBAFF_P_FRAME	Forward inter coded MBAFF frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_MBAFF_B_FRAME	Bi-directional inter coded MBAFF frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_MBAFF_IDR_FRAME	Intra coded MBAFF frame that can be used for refreshing video content. Not supported in this version of MPEG4 Encoder.
	IVIDEO_FRAMETYPE_DEFAULT	Default value is set to IVIDEO_I_FRAME
IVIDEO_ContentType	IVIDEO_CONTENTTYPE_NA	-1, Frame type is not available.
	IVIDEO_PROGRESSIVE	0, Progressive frame
	IVIDEO_PROGRESSIVE_FRAME	Is equal to IVIDEO_PROGRESSIVE
	IVIDEO_INTERLACED	1, Interlaced frame. Not supported in this version of MPEG4 Encoder.
	IVIDEO_INTERLACED_FRAME	IVIDEO_INTERLACED. Not supported in this version of MPEG4 Encoder.
	IVIDEO_INTERLACED_TOPFIELD	2, Interlaced picture, top field. Not supported in this version of MPEG4 Encoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	`IVIDEO_INTERLACED_BOTTOMFIELD`	3, Interlaced picture, bottom field. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_CONTENTTYPE_DEFAULT`	`IVIDEO_PROGRESSIVE`
`IVIDEO_RateControlPreset`	`IVIDEO_NONE`	No rate control is used
	`IVIDEO_LOW_DELAY`	Constant Bit Rate (CBR) control for video conferencing (default value.)
	`IVIDEO_STORAGE`	Variable Bit Rate (VBR) control for local storage (DVD) recording.
	`IVIDEO_TWOPASS`	Two pass rate control for non real time applications. Not supported in this version of MPEG4 Encoder.
	`IVIDEO_USER_DEFINED`	User defined configuration using advanced parameters (extended parameters).
	`IVIDEO_RATECONTROLPRESET_DEFAULT`	`IVIDEO_LOW_DELAY` is default value
`IVIDEO_SkipMode`	`IVIDEO_FRAME_ENCODED`	Input content encoded
	`IVIDEO_FRAME_SKIPPED`	Input content skipped, that is, not encoded.
	`IVIDEO_SKIPMODE_DEFAULT`	`IVIDEO_FRAME_ENCODED` is default
`XDM_DataFormat`	`XDM_BYTE`	Big endian stream
	`XDM_LE_16`	16-bit little endian stream. Not supported in this version of MPEG4 Encoder.
	`XDM_LE_32`	32-bit little endian stream. Not supported in this version of MPEG4 Encoder.
	`XDM_LE_64`	64-bit little endian stream. Not supported in this version of MPEG4 Encoder.
	`XDM_BE_16`	16-bit big endian stream. Not supported in this version of MPEG4 Encoder.
	`XDM_BE_32`	32-bit big endian stream. Not supported in this version of MPEG4 Encoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	`XDM_BE_64`	64-bit big endian stream. Not supported in this version of MPEG4 Encoder.
`XDM_ChromaFormat`	`XDM_CHROMA_NA`	Chroma format not applicable
	`XDM_CHROMAFORMAT_DEFAULT`	Default value is set to `XDM_YUV_422ILE`
	`XDM_YUV_420P`	YUV 4:2:0 planar
	`XDM_YUV_422P`	YUV 4:2:2 planar. Not supported in this version of MPEG4 Encoder.
	`XDM_YUV_422IBE`	YUV 4:2:2 interleaved (big endian)
	`XDM_YUV_422ILE`	YUV 4:2:2 interleaved (little endian)
	`XDM_YUV_444P`	YUV 4:4:4 planar. Not supported in this version of MPEG4 Encoder.
	`XDM_YUV_411P`	YUV 4:1:1 planar. Not supported in this version of MPEG4 Encoder.
	`XDM_GRAY`	Gray format. Not supported in this version of MPEG4 Encoder.
	`XDM_RGB`	RGB color format. Not supported in this version of MPEG4 Encoder.
`XDM_CmdId`	`XDM_GETSTATUS`	Query algorithm instance to fill Status structure
	`XDM_SETPARAMS`	Set run-time dynamic parameters through the DynamicParams structure
	`XDM_RESET`	Reset the algorithm
	`XDM_SETDEFAULT`	Initialize all fields in Params structure to default values specified in the library.
	`XDM_FLUSH`	Handle end of stream conditions. This command forces algorithm instance to output data without additional input.
	`XDM_GETBUFINFO`	Query algorithm instance regarding the properties of input and output buffers.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_GETVERSION	Query the algorithm's version. The result will be returned in the @c data field of the respective _Status structure.
	XDM_GETCONTEXTINFO	Query a split codec part for its context needs. Not supported in this version of MPEG4 Encoder.
XDM_EncodingPreset	XDM_DEFAULT	Default setting of the algorithm specific creation time parameters. This uses XDM_HIGH_QUALITY settings.
	XDM_HIGH_QUALITY	Set algorithm specific creation time parameters for high quality (default setting).
	XDM_HIGH_SPEED	Set algorithm specific creation time parameters for high speed. Not supported in this version of MPEG4 Encoder.
	XDM_USER_DEFINED	User defined configuration using advanced parameters. This uses XDM_HIGH_QUALITY settings.
XDM_EncMode	XDM_ENCODE_AU	Encode entire access unit. Default value.
	XDM_GENERATE_HEADER	Encode only header.
XDM_ErrorBit	XDM_PARAMSCHANGE	Bit 8 ❑ 1 - Sequence Parameters Change ❑ 0 - Ignore
	XDM_APPLIEDCONCEALMENT	Bit 9 ❑ 1 - Applied concealment ❑ 0 - Ignore
	XDM_INSUFFICIENTDATA	Bit 10 ❑ 1 - Insufficient data ❑ 0 - Ignore
	XDM_CORRUPTEDDATA	Bit 11 ❑ 1 - Data problem/corruption ❑ 0 - Ignore
	XDM_CORRUPTEDHEADER	Bit 12 ❑ 1 - Header problem/corruption ❑ 0 - Ignore

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	`XDM_UNSUPPORTEDINPUT`	Bit 13 ❑ 1 - Unsupported feature/parameter in input ❑ 0 - Ignore
	`XDM_UNSUPPORTEDPARAM`	Bit 14 ❑ 1 - Unsupported input parameter or configuration ❑ 0 - Ignore
	`XDM_FATALERROR`	Bit 15 ❑ 1 - Fatal error (stop encoding) ❑ Recoverable error
`IMP4VENC_ErrorBit`	`IMP4VENC_OUTBUFOVERFLOW`	Bit 0 ❑ 1 – Output buffer overflow ❑ 0 - Ignore

Note:

The remaining bits that are not mentioned in `XDM_ErrorBit` are interpreted as:

- Bit 16-32: Reserved
- Bit 0-7: Codec and implementation specific

The algorithm can set multiple bits to 1 depending on the error condition.

The codec uses only bit 0 of the codec specific error bits to indicate the output buffer (stream buffer) overflow. If bit 0 of the `extendedError` is set to 1, it means that allocated output buffer is insufficient for the current frame. In this case, the process call returns failure.

4.2 Data Structures

This section describes the XDM defined data structures that are common across codec classes. These XDM data structures can be extended to define any implementation specific parameters for a codec component.

4.2.1 Common XDM Data Structures

This section includes the following common XDM data structures:

- `XDM_BufDesc`
- `XDM1_BufDesc`
- `XDM_SingleBufDesc`
- `XDM1_SingleBufDesc`
- `XDM_AlgBufInfo`
- `IVIDEO1_BufDesc`
- `IVIDEO1_BufDescIn`
- `IVIDENC1_Fxns`
- `IVIDENC1_Params`
- `IVIDENC1_DynamicParams`
- `IVIDENC1_InArgs`
- `IVIDENC1_Status`
- `IVIDENC1_OutArgs`

4.2.1.1 XDM_BufDesc

|| Description

This structure defines the buffer descriptor for input and output buffers.

|| Fields

Field	Data Type	Input/ Output	Description
`**bufs`	`XDAS_Int8`	Input	Pointer to the vector containing buffer addresses
`numBufs`	`XDAS_Int32`	Input	Number of buffers
`*bufSizes`	`XDAS_Int32`	Input	Size of each buffer in bytes

4.2.1.2 XDM1_BufDesc

|| Description

This structure defines the buffer descriptor for input and output buffers.

|| Fields

Field	Data Type	Input/ Output	Description
`numBufs`	`XDAS_Int32`	Input	Number of buffers
`descs[XDM_MAX _IO_BUFFERS}`	`XDM1_Sungl eBufDesc`	Input	Array of buffer descriptor

4.2.1.3 XDM_SingleBufDesc

|| Description

This structure defines the buffer descriptor for single input and output buffers.

|| Fields

Field	Data Type	Input/ Output	Description
`*buf`	`XDAS_Int8`	Input	Pointer to the buffer
`bufSize`	`XDAS_Int32`	Input	Size of buffer in bytes

4.2.1.4 XDM1_SingleBufDesc

|| Description

This structure defines the buffer descriptor for single input and output buffers.

|| Fields

Field	Data Type	Input/ Output	Description
`*buf`	`XDAS_Int8`	Input	Pointer to the buffer
`bufSize`	`XDAS_Int32`	Input	Size of buffer in bytes
`accessMask`	`XDAS_Int32`	Output	If the buffer was not accessed by the algorithm processor (for example, it was filled by DMA or other hardware accelerator that does not write through the algorithm's CPU), then bits in this mask should not be set.

4.2.1.5 XDM_AlgBufInfo

|| Description

This structure defines the buffer information descriptor for input and output buffers. This structure is filled when you invoke the `control()` function with the `XDM_GETBUFINFO` command.

|| Fields

Field	Data Type	Input/ Output	Description
`minNumInBufs`	`XDAS_Int32`	Output	Number of input buffers
`minNumOutBufs`	`XDAS_Int32`	Output	Number of output buffers
`minInBufSize[XDM_MAX_IO_BUFFERS]`	`XDAS_Int32`	Output	Size in bytes required for each input buffer
`minOutBufSize[XDM_MAX_IO_BUFFERS]`	`XDAS_Int32`	Output	Size in bytes required for each output buffer

Note:

For MPEG4 Encoder, the buffer details are:

- Number of input buffer required is 1 for `YUV 422ILE` and 3 for `YUV 420P`
- Number of output buffer required is 1
- The input buffer sizes (in bytes) for worst case PAL D1 (720 x 576) format are:
  - For YUV 420P:
    Y buffer = 720 * 576
    U buffer = 360 * 288
    V buffer = 360 * 288
  - For YUV 422ILE:
    Buffer = 720 * 576 * 2
- There is no restriction on output buffer size except that it should be enough to store one frame of encoded data.The output buffer size returned by the `XDM_GETBUFINFO` command assumes the worst case output buffer size 4*(frameHeight*frameWidth). Based on the content type and resolution, the application can also set the output buffer size to a smaller value (this is optional, can be done to save memory). If the buffer size set by the application is not sufficient, the encoder returns buffer overdlow error. See `IMP4VENC_ErrorBit` in Table 4-1.
- When motion vector access is enabled, the size of the output buffer required to store the motion vector data is (8*number of MBs in a frame).

4.2.1.6 IVIDEO1_BufDesc

|| Description

This structure defines the buffer descriptor for input and output buffers.

|| Fields

Field	Data Type	Input/ Output	Description
`numBufs`	`XDAS_Int32`	Input	Number of buffers
`frameWidth`	`XDAS_Int32`	Input	Width of the video frame
`frameHeight`	`XDAS_Int32`	Input	Height of the video frame
`framePitch`	`XDAS_Int32`	Input	Frame pitch use to store the frame
`bufDesc[IVIDEO_MAX_YUV_BUFFERS]`	`XDM1_SingleBufDesc`	Input	Pointer to the vector containing buffer addresses
`extendedError`	`XDAS_Int32`	Input	Extended error field. Not supported for `recon bufs`.
`frameType`	`XDAS_Int32`	Input	Indicates the decoded frame type as `IVIDEO_FrameType` enumerator type
`topFieldFirstFlag`	`XDAS_Int32`	Input	Flag to indicate when the application should display the top field first. Not supported in this version of MPEG4 Encoder.
`repeatFirstFieldFlag`	`XDAS_Int32`	Input	Flag to indicate when the first field should be repeated. Not supported in this version of MPEG4 Encoder.
`frameStatus`	`XDAS_Int32`	Input	Frame status of `IVIDEO_Output`. This field does not apply to encoder `recon bufs`.
`repeatFrame`	`XDAS_Int32`	Input	Number of times the display process needs to repeat the display progressive frame. This field does not apply to encoder `recon bufs`.
`contentType`	`XDAS_Int32`	Input	Content type of the buffer
`chromaFormat`	`XDAS_Int32`	Input	`XDM_Chroma` buffer

4.2.1.7 IVIDEO1_BufDescIn

|| Description

Buffer descriptor for input video buffers.

|| Fields

Field	Data Type	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers in bufDesc[]
frameWidth	XDAS_Int32	Input	Width of the video frame
frameHeight	XDAS_Int32	Input	Height of the video frame
framePitch	XDAS_Int32	Input	Frame pitch used to store the frame.
bufDesc[XDM_MAX_IO_BUFFERS]	XDM1_SingleBufDesc	Input	Picture buffers

4.2.1.8 IVIDENC1_Fxns

|| Description

This structure contains pointers to all the XDAIS and XDM interface functions.

|| Fields

Field	Data Type	Input/ Output	Description
ialg	IALG_Fxns	Input	Structure containing pointers to all the XDAIS interface functions. For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).
*process	XDAS_Int32	Input	Pointer to the process() function.
*control	XDAS_Int32	Input	Pointer to the control() function.

4.2.1.9 IVIDENC1_Params

|| Description

This structure defines the creation parameters for an algorithm instance object. Set this data structure to `NULL`, if you are not sure of the values to be specified for these parameters.

|| Fields

Field	Data Type	Input/ Output	Description
`size`	`XDAS_Int32`	Input	Size of the basic or extended (if being used) data structure in bytes.
`encodingPreset`	`XDAS_Int32`	Input	Encoding preset. Minimum value = 0 Maximum value =See `XDM_EncodingPreset` enumeration for details. Default value = `XDM_DEFAULT`
`rateControlPreset`	`XDAS_Int32`	Input	Rate control preset: See `IVIDEO_RateControlPreset` enumeration for details. 1,2,4,5 supported. Minimum value = 1 Maximum value = 5 Default value = See `IVIDEO_RATECONTROLPRESET_DEFAULT`
`maxHeight`	`XDAS_Int32`	Input	Maximum video height to be supported in pixels. Minimum value = 1 Maximum value = 720 Default value = 576
`maxWidth`	`XDAS_Int32`	Input	Maximum video width to be supported in pixels. Minimum value = 1 Maximum value = 1280 Default value = 720
`maxFrameRate`	`XDAS_Int32`	Input	Maximum frame rate in fps * 1000 to be supported. Minimum value = 1*1000 Maximum value = 120*1000 Default value = 30*1000
`maxBitRate`	`XDAS_Int32`	Input	Maximum bit-rate to be supported in bits per second. Minimum value = >0 Maximum value = 20000000 Default value = 4000000

Field	Data Type	Input/ Output	Description
dataEndianness	XDAS_Int32	Input	Endianness of input data. See XDM_DataFormat enumeration for details. Minimum value = XDM_BYTE Maximum value = XDM_BYTE Default value = XDM_BYTE
maxInterFrameInterval	XDAS_Int32	Input	Distance from I-frame to P-frame: ❑ 1 - If no B-frames ❑ 2 - To insert one B-frame. Not supported in this version of MPEG4 Encoder. Minimum value = 1 Maximum value = 1 Default value = 1
inputChromaFormat	XDAS_Int32	Input	Input chroma format. See XDM_ChromaFormat enumeration for details. Values supported = 1, 3 , and 4 Minimum value = 1 Maximum value = 4 Default value = XDM_CHROMAFORMAT_DEFAULT
inputContentType	XDAS_Int32	Input	Input content type. See IVIDEO_ContentType enumeration for details. Minimum value = IVIDEO_PROGRESSIVE Maximum value = IVIDEO_PROGRESSIVE Default value = IVIDEO_CONTENTTYPE_DEFAULT
reconChromaFormat	XDAS_Int32	Input	Chroma formats for the reconstruction buffers. Default value = XDM_CHROMA_NA Not supported in this version of MPEG4 Encoder.

Note:

The maximum video height and width supported are 576 and 720 pixels respectively.

The maximum bit-rate supported is 20 mbps.

For the supported maxBitRate values, see Annex N in *ISO/IEC 14496-2*. The following fields of IVIDENC1_Params data structure are level dependent:

❑ maxHeight

❑ maxWidth

❑ maxFrameRate

❑ maxBitRate

The maxFrameRate is calculated based on maximum MB/sec. See Annex N in *ISO/IEC 14496-2* for details.

For CIF, if maximum MB/sec is 11880, this implies `maxFrameRate` is 30 fps as CIF has 396 MB/frame.

- For `rateControlPreset`, `IVIDEO_TWOPASS` is not supported in this version of MPEG4 Encoder.
- For `encodingPreset`, the following options are supported:
  - The `XDM_HIGH_SPEED` option will have better speed (MHz)
  - The `XDM_HIGH_QUALITY` option will have better quality (lesser speed)
- The `XDM_USER_DEFINED` and `XDM_DEFAULT` options are mapped `to XDM_HIGH_QUALITY`.

4.2.1.10 IVIDENC1_DynamicParams

|| Description

This structure defines the run-time parameters for an algorithm instance object. Set this data structure to `NULL,` if you are not sure of the values to be specified for these parameters.

|| Fields

Field	Data Type	Input/ Output	Description
`size`	`XDAS_Int32`	Input	Size of the basic or extended (if being used) data structure in bytes.
`inputHeight`	`XDAS_Int32`	Input	Height of input frame in pixels. Minimum value = 1 Maximum value = 576 Default value = 576
`inputWidth`	`XDAS_Int32`	Input	Width of input frame in pixels. Minimum value = 1 Maximum value = 720 Default value = 720
`refFrameRate`	`XDAS_Int32`	Input	Reference or input frame rate in fps * 1000. For example, if the frame rate is 30, set this field to 30000. Minimum value = 1* 1000 Maximum value = 120 * 1000 Default value = 30000
`targetFrameRate`	`XDAS_Int32`	Input	Target frame rate in fps * 1000. For example, if the frame rate is 30, set this field to 30000. Minimum value = 1* 1000 Maximum value = 120 * 1000 Default value = 30000

Field	**Data Type**	**Input/ Output**	**Description**
`targetBitRate`	`XDAS_Int32`	Input	Target bit-rate in bits per second. For example, if the bit-rate is 2 mbps, set this field to 2097152. Minimum value = 1* 1000 Maximum value = 20000000 Default value = 4000000
`intraFrameInterval`	`XDAS_Int32`	Input	Interval between two consecutive intra frames. ❑ 0 - Only first I frame followed by all P frames ❑ 1 - No inter frames (all intra frames) ❑ 2 - Consecutive IP sequence (if no B frames) ❑ N - N-1 P sequences between I-frames. Minimum value = 0 Default value = 30
`generateHeader`	`XDAS_Int32`	Input	Encode entire access unit or only header. See `XDM_EncMode` enumeration for details. Minimum value = 0 Maximum value = 1 Default value = `XDM_ENCODE_AU`
`captureWidth`	`XDAS_Int32`	Input	If the field is set to: ❑ 0 - Encoded image width is used as pitch. ❑ Greater than image width with even value only. capture width is used as pitch. Minimum value = 0 Maximum value = 0 Default value = 0 Note: Non zero value is not supported.
`forceFrame`	`XDAS_Int32`	Input	Force current (immediate) frame to be encoded as specific frame type. See `IVIDEO_FrameType` for details. Minimum value = `IVIDEO_NA_FRAME` Maximum value = `IVIDEO_I_FRAME` Default value = `IVIDEO_FRAMETYPE_DEFAULT`
`interFrameInterval`	`XDAS_Int32`	Input	Number of B frames between two reference frames. Default value = 1 Not supported in this version of MPEG4 Encoder.
`mbDataFlag`	`XDAS_Int32`	Input	Flag to indicate that the algorithm should use MB data supplied in additional buffer within `inBufs`. Not supported in this version of MPEG4 Encoder. Default value = 0

Note:

The following are the limitations on the parameters of `IVIDENC1_DynamicParams` data structure:

- ❑ `inputHeight` <= `maxHeight`
- ❑ `inputWidth` <= `maxWidth`
- ❑ `refFrameRate` <= `maxFrameRate`
- ❑ `targetFrameRate` <= `maxFrameRate`
  - o The value of the `refFrameRate` and `targetFrameRate` should be the same.
- ❑ `targetBitRate` <= `maxBitRate`
- ❑ The `inputHeight` and `inputWidth` must be multiples of two.
- ❑ Non-zero value of `captureWidth` field is not supported in this version of MPEG4 Encoder.
- ❑ Generate header should be called only once at the start of encode and cannot be modified during run-time.
- ❑ Insertion of I -frame when run-time intra interval is changed.

4.2.1.11 IVIDENC1_InArgs

|| Description

This structure defines the run-time input arguments for an algorithm instance object.

|| Fields

Field	Data Type	Input/ Output	Description
`size`	`XDAS_Int32`	Input	Size of the basic or extended (if being used) data structure in bytes.
`inputID`	`XDAS_Int32`	Input	Identifier to attach with the corresponding encoded bit-stream frames. This is useful when frames require buffering (for example, B frames), and to support buffer management. When there is no re-ordering, `IVIDENC1_OutArgs::outputID` will be same as this `inputID` field.
`topFieldFirstFlag`	`XDAS_Int32`	Input	Flag to indicate the field order in interlaced content. . This field is only applicable for interlaced content (not progressive). Not supported in this version of MPEG4 Encoder.

4.2.1.12 IVIDENC1_Status

|| Description

This structure defines parameters that describe the status of an algorithm instance object.

|| Fields

Field	Data Type	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
extendedError	XDAS_Int32	Output	Extended error code. See XDM_ErrorBit and. See the IMP4VENC_ErrorBit enumeration for details.
bufInfo	XDM_AlgBufInfo	Output	Input and output buffer information. See XDM_AlgBufInfo data structure for details. This field provides the application with the algorithm's buffer requirements.
data	XDM1_SingleBuf Desc	Input	Buffer descriptor for data passing.

4.2.1.13 IVIDENC1_OutArgs

|| Description

This structure defines the run-time output arguments for an algorithm instance object.

|| Fields

Field	Data Type	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
extendedError	XDAS_Int32	Output	Extended error code. See XDM_ErrorBit and. See the IMP4VENC_ErrorBit enumeration for details.
bytesGenerated	XDAS_Int32	Output	The number of bytes generated.
encodedFrameType	XDAS_Int32	Output	Frame types for video. See IVIDEO_FrameType enumeration for details.
inputFrameSkip	XDAS_Int32	Output	Frame skipping modes for video. See IVIDEO_SkipMode enumeration for details.
reconBufs	IVIDEO_BufDesc	Output	Pointer to reconstruction buffer descriptor.

Field	Data Type	Input/ Output	Description
`outputID`	`XDAS_Int32`	Output	Output ID corresponding to the encoded buffer. This is also used to free up the corresponding image buffer for further use by client application code.
`encodedBuf`	`XDM1_SingleBuf Desc`	Output	The encoder fills the buffer with the encoded bit-stream. In case of sequences with only I and P frames, these values are identical to @c `outBufs` assed in `IVIDENC1_Fxns::process()`.

Note:

The recon buffers are always padded by 2*`UMV_PAD` pixels in horizontal and vertical dimensions. The `UMV_PAD` value is 16.

4.2.2 MPEG4 Encoder Data Structures

This section includes the following MPEG4 Encoder specific extended data structures:

- `IMP4VENC_Params`
- `IMP4VENC_DynamicParams`
- `IMP4VENC_InArgs`
- `IMP4VENC_Status`
- `IMP4VENC_OutArgs`

4.2.2.1 IMP4VENC_Params

|| Description

This structure defines the creation parameters and any other implementation specific parameters for the MPEG4 Encoder instance object. The creation parameters are defined in the XDM data structure, `IVIDENC1_Params`.

|| Fields

Field	Data Type	Input/ Output	Description
`videnc_params`	`IVIDENC1_Params`	Input	See `IVIDENC1_Params` data structure for details.
`EncodeMode`	`XDAS_Int32`	Input	Encoding mode: ❑ 1 - MPEG4 mode ❑ 0 - H.263 mode Minimum value = 0 Maximum value = 1 Default value = 1
`LevelIdc`	`XDAS_Int32`	Input	Profile level indication for MPEG4. ❑ Level 0-5 - Data is set to a minimum value of zero or a maximum value of 5 based on MPEG4 standards. This field has no significance for H.263 encode mode. Minimum value = 0 Maximum value = 5 Default value =5
`NumFrames`	`XDAS_Int32`	Input	Number of frames to be encoded. This parameter is used only for VM4 rate control inside encoder. Minimum value = 1 Default value =0x7fffffff

Field	Data Type	Input/ Output	Description
RcAlgo	XDAS_Int32	Input	Rate control method: ❑ 0 - Disable rate control ❑ 1 - TM5 ❑ 2 - Not supported ❑ 3 - PLR1 ❑ 4 - PLR3 ❑ 5 - Not supported ❑ 6 - Not supported ❑ 7 - Constrained VBR. This RC algorithm is used for low delay applications. ❑ 8 - PLR4 Minimum value = 0 Maximum value = 8 Default value = 8
VbvBufferSize	XDAS_Int32	Input	Size of VBV buffer for bit stream (in multiples of 16 kbits) depending on profile and level. Minimum value to be set is 2. **Note:** VBV overflow/underflow may occur while encoding at 1 fps with I frame periodicity set to 1. Minimum value = 2 Default value = 112
UseVOS	XDAS_Int32	Input	VOS header insertion: ❑ 1 - On ❑ 0 – Off ❑ Minimum value = 0 Maximum value = 1 Default value = 1
UseGOV	XDAS_Int32	Input	GOV header insertion: ❑ 1 - On ❑ 0 - Off Minimum value = 0 Maximum value = 1 Default value = 0
useDataPartition	XDAS_Int32	Input	Data partitioning: ❑ 1 - On ❑ 0 - Off Minimum value = 0 Maximum value = 1 Default value = 0
useRVLC	XDAS_Int32	Input	Reversible variable length code: ❑ 1 - On ❑ 0 - Off Minimum value = 0 Maximum value = 1 Default value = 0
maxDelay	XDAS_Int32	Input	Maximum delay for rate control in milliseconds. Minimum value = 100 Maximum value = 30000 Default value = 1000

Field	Data Type	Input/ Output	Description
`enableSCD`	`XDAS_Int32`	Input	Scene Change Detection : ❑ 1 - On ❑ 0 - Off Minimum value = 0 Maximum value = 1 Default value = 0

Note:

- If the size field in `IVIDENC1_Params` structure is set to `BASIC`, then the default values are used for `IMP4VENC_Params` structure.
- The `maxDelay` field is applicable only for `RateControlMethod = 7`, and is ignored for other rate control methods. The delay value is in milliseconds and the recommended value for low delay applications is 300 ms.
- The following are the limitations on the `maxDelay` parameter of `IMP4VENC_Params` data structure:
  - `maxDelay` >= 100
  - `maxDelay` <= 30000
- `RateControlMethod` = 7 is tuned for low delay applications (for example, video tele conferencing), where periodic I frames are not used (to maintain low bit-rate).
- `RateControlMethod` = 8 (PLR4) is a version of PLR3 which does not skip frames. This rate control is recommended for storage applicatons. This rate control is also chosen when `RateControlPreset` is set to `IVIDEO_STORAGE`.
- `RateControlMethod` = 4 (PLR3) is chosen when `RateControlPreset` is set to `IVIDEO_LOW_DELAY`.
- This version does not support VM4, TMN5, and modified TM5 rate control algorithms. The following algorithms are recommended instead:
  - TMN5 - Use PLR3
  - VM4 - Use PLR4
  - Modified TM5 - Use TM5
- Due to restrictions put by MPEG4 standard on level0, the following applies to simple profile level0:
  - If AC prediction is enabled, then rate control algorithm should not be used.That is, rcAlgo = 0 (constant QP).
  - `QPinter` value has no impact when RC algo is disabled (`rcAlgo` = 0) and all frames encoded with `QPIntra` value. `Qpinter = qpintra when rcalgo =0.`
  - If `enableSCD` is 1, then it detects the scene change and inducts an I frame there.

4.2.2.2 IMP4VENC_DynamicParams

|| Description

This structure defines the run-time parameters and any other implementation specific parameters for an MPEG4 Encoder instance object. The run-time parameters are defined in the XDM data structure, `IVIDENC1_DynamicParams`..

|| Fields

Field	Data Type	Input/Output	Description
`videnc_dynamicparams`	`IVIDENC1_DynamicParams`	Input	See `IVIDENC1_DynamicParams` data structure for details.
`resyncInterval`	`XDAS_Int32`	Input	Insert Resync Marker (RM) after given specified number of bits. A value of zero implies do not insert. Minimum value = 0 Maximum value = 65535 Default value = 0
`hecInterval`	`XDAS_Int32`	Input	Insert Header Extension Code (HEC) after given specified number of packets. A value of zero implies do not insert. Minimum value = 0 Maximum value = 65536 Default value = 0
`airRate`	`XDAS_Int32`	Input	Adaptive intra refresh in MBs per frame. This indicates the maximum number of MBs (per frame) that can be refreshed using AIR. Minimum value = 0 Maximum value = Number of MBs - 1 Default value = 0
`mirRate`	`XDAS_Int32`	Input	Mandatory intra refresh rate for MPEG4 in MBs per frame. This indicates the number of MB's (per frame) that should be refreshed using MIR. Minimum value = 0 Maximum value = Number of MBs - 1 Default value = 0
`qpIntra`	`XDAS_Int32`	Input	Default Quantization Parameter (QP) for I frame. Minimum value = 1 Maximum value = 31 Default value = 8
`qpInter`	`XDAS_Int32`	Input	Quantization parameter for P frame Minimum value = 1 Maximum value = 31 Default value = 8

Field	Data Type	Input/Output	Description
FCode	XDAS_Int32	Input	`f_code`. As in MPEG4 specifications, the maximum MV length is `1 << f_code-1`. This field has no significance for H.263 encode mode. Minimum value = 1 Maximum value = 7 Default value = 3
UseHpi	XDAS_Int32	Input	Half pixel interpolation: ❑ 1 - On (Must be on only) Minimum value = 1 Maximum value = 1 Default value = 1
useAcPred	XDAS_Int32	Input	AC prediction enable flag: ❑ 1 - On ❑ 0 - Off Minimum value = 0 Maximum value = 1 Default value = 0
lastFrame	XDAS_Int32	Input	Last frame flag ❑ 1 - Last frame ❑ 0 - Not last frame Minimum value = 0 Maximum value = 1 Default value = 0
MVDataEnable	XDAS_Int32	Input	Flag to enable Motion Vector access ❑ 1 - Enable ❑ 0 - Disable Minimum value = 0 Maximum value = 1 Default value = 0
useUMV	XDAS_Int32	Input	Flag to enable/disable use of Unrestricted Motion Vector (UMV) ❑ 0 - Off ❑ 1 - On Minimum value = 0 Maximum value = 1 Default value = 1
qpMax	XDAS_Int32	Input	Maximum value of the Quantization Parameter Range is 2≤qpMax≤ 31 Default value is 18
qpMin	XDAS_Int32	Input	Minimum value of the Quantization Parameter Range is 2≤qpMin≤ 31 Default value is 2

Note:

- If the size field in `IVIDENC1_DynamicParams` structure is set to `BASIC`, then the default values are used for `IMP4VENC_DynamicParams` structure.
- When `lastFrame = 1`, video sequence end code is inserted into the bit stream.
- For H.263 (short header) mode, the minimum QP value allowed for `qpInter` and `qpIntra` is 4. Any QP value less than 4 is clipped to 4. This is due to the 8-bit quantization used in H.263.
- For MPEG4, the minimum QP value used is 2 (any value less than 2 is clipped to 2).
- Only `qpIntra` is used to set the initial QP values for both I and P frames. `qpInter` value is not used.
- `qpMax` value can provide trade-off between higher quality and required bit-rate. Lower `qpMax` value results in better quality while higher `qpMax` value reduces the bit-rate deviation. Any sharp bit-rate deviation can be mitigated with higher `qpMax` value The default value of 18 provides better quality.
- The parameter ranges for some of the parameters listed above are as follows:
  - `resyncInterval` - Range is 0 to 65535 in bits. If the value is greater than the compressed frame size in bits, then it does not insert any resync marker. It is the number of bits after which resync marker is to be inserted. This decides the packet size.
  - `hecInterval` - Range is 0 to 65536 in packets. The number of packets is decided by how many resync markers are present. For example, a value of `hecInterval = 10` means insert HEC after 10 packets.
  - `airRate` - Range is 0 to number of MBs in a frame - 1. This indicates the maximum number of MBs to be refreshed as intra macro blocks in a P frame. For example, a value of `airRate` = 5 means that at most 5 MBs can be refreshed per frame through adaptive intra refresh.
  - `mirRate` - Range is 0 to number of MBs in a frame - 1. This indicates the number of MBs that must be refreshed as intra macro blocks in a P frame. For example, a value of `mirRate` = 5 means that 5 MBs must be refreshed per frame through intra refresh.
  - `vbvBufferSize` - The range of VBV buffer sizes for different resolutions is available in MPEG4 standard.

4.2.2.3 IMP4VENC_InArgs

‖ Description

This structure defines the run-time input arguments for MPEG4 Encoder instance object. It uses the basic XDM data structure.

‖ Fields

Field	Data Type	Input/ Output	Description
`videnc_InArgs`	`IVIDENC1_InArgs`	Input	See `IVIDENC1_InArgs` data structure for details.

4.2.2.4 IMP4VENC_Status

‖ Description

This structure defines parameters that describe the status of the MPEG4 Encoder and any other implementation specific parameters. The status parameters are defined in the XDM data structure, `IVIDENC1_Status`.

‖ Fields

Field	Data Type	Input/ Output	Description
`videnc_status`	`IVIDENC1_Status`	Output	See `IVIDENC1_Status` data structure for details.

4.2.2.5 IMP4VENC_OutArgs

‖ Description

This structure defines the run-time output arguments for the MPEG4 Encoder instance object.

‖ Fields

Field	Data Type	Input/ Output	Description
`videnc_OutArgs`	`IVIDENC1_OutArgs`	Output	See `IVIDENC1_OutArgs` data structure for details.
`mvDataSize`	`XDAS_Int32`	Output	Size of the motion data array in bytes.

Note:

Use the field `mvDataSize` only when `MVDataEnable` parameter in `IMP4VENC_DynamicParams` is set to 1.

4.3 Interface Functions

This section describes the Application Programming Interfaces (APIs) used in the MPEG4 Encoder. The APIs are logically grouped into the following categories:

- **Creation** – `algNumAlloc()`, `algAlloc()`
- **Initialization** – `algInit()`
- **Control** – `control()`
- **Data processing** – `algActivate()`, `process()`, `algDeactivate()`
- **Termination** – `algFree()`

You must call these APIs in the following sequence:

1) `algNumAlloc()`
2) `algAlloc()`
3) `algInit()`
4) `algActivate()`
5) `process()`
6) `algDeactivate()`
7) `algFree()`

`control()` can be called any time after calling the `algInit()` API.

`algNumAlloc()`, `algAlloc()`, `algInit()`, `algActivate()`, `algDeactivate()`, and `algFree()` are standard XDAIS APIs. This document includes only a brief description for the standard XDAIS APIs. For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

4.3.1 Creation APIs

Creation APIs are used to create an instance of the component. The term creation could mean allocating system resources, typically memory.

‖ Name

`algNumAlloc()` – determine the number of buffers that an algorithm requires

‖ Synopsis

```
XDAS_Int32 algNumAlloc(Void);
```

‖ Arguments

```
Void
```

‖ Return Value

```
XDAS_Int32; /* number of buffers required */
```

‖ Description

`algNumAlloc()` returns the number of buffers that the `algAlloc()` method requires. This operation allows you to allocate sufficient space to call the `algAlloc()` method.

`algNumAlloc()` may be called at any time and can be called repeatedly without any side effects. It always returns the same result. The `algNumAlloc()` API is optional.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

‖ See Also

`algAlloc()`

‖ Name

`algAlloc()` – determine the attributes of all buffers that an algorithm requires

‖ Synopsis

```
XDAS_Int32 algAlloc(const IALG_Params *params, IALG_Fxns
**parentFxns, IALG_MemRec memTab[]);
```

‖ Arguments

```
IALG_Params *params; /* algorithm specific attributes */

IALG_Fxns **parentFxns;/* output parent algorithm
functions */

IALG_MemRec memTab[]; /* output array of memory records */
```

‖ Return Value

```
XDAS_Int32 /* number of buffers required */
```

‖ Description

`algAlloc()` returns a table of memory records that describe the size, alignment, type, and memory space of all buffers required by an algorithm. If successful, this function returns a positive non-zero value indicating the number of records initialized.

The first argument to `algAlloc()` is a pointer to a structure that defines the creation parameters. This pointer may be `NULL;` however, in this case, `algAlloc()` must assume default creation parameters and must not fail.

The second argument to `algAlloc()` is an output parameter. `algAlloc()` may return a pointer to its parent's IALG functions. If an algorithm does not require a parent object to be created, this pointer must be set to `NULL`.

The third argument is a pointer to a memory space of size `nbufs * sizeof(IALG_MemRec)` where, `nbufs` is the number of buffers returned by `algNumAlloc()` and `IALG_MemRec` is the buffer-descriptor structure defined in ialg.h.

After calling this function, `memTab[]` is filled up with the memory requirements of an algorithm.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

‖ See Also

`algNumAlloc(), algFree()`

4.3.2 Initialization API

Initialization API is used to initialize an instance of the algorithm. The initialization parameters are defined in the `Params` structure (see Data Structures section for details).

|| Name

`algInit()` – initialize an algorithm instance

|| Synopsis

```
XDAS_Int32 algInit(IALG_Handle handle, IALG_MemRec
memTab[], IALG_Handle parent, IALG_Params *params);
```

|| Arguments

```
IALG_Handle handle; /* algorithm instance handle*/

IALG_memRec memTab[]; /* array of allocated buffers */

IALG_Handle parent; /* handle to the parent instance */

IALG_Params *params; /* algorithm initialization
parameters */
```

|| Return Value

```
IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */
```

|| Description

`algInit()` performs all initialization necessary to complete the run-time creation of an algorithm instance object. After a successful return from `algInit()`, the instance object is ready to be used to process data.

The first argument to `algInit()` is a handle to an algorithm instance. This value is initialized to the base field of `memTab[0]`.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers allocated for an algorithm instance. The number of initialized records is identical to the number returned by a prior call to `algAlloc()`.

The third argument is a handle to the parent instance object. If there is no parent object, this parameter must be set to `NULL`.

The last argument is a pointer to a structure that defines the algorithm initialization parameters. See `IMP4VENC_Params` and `IVIDENC1_Params` for details. If this argument is set to NULL, API will take default values for

all the parameters.

> **Note:**
>
> `algInit()` must assume default creation parameters and must not fail when params pointer is made NULL.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

`algAlloc()`, `algMoved()`

4.3.3 Control API

Control API is used for controlling the functioning of the algorithm instance during run-time. This is done by changing the status of the controllable parameters of the algorithm during run-time. These controllable parameters are defined in the `Status` data structure (see Data Structures section for details).

|| Name

`control()` – change run-time parameters and query the status

|| Synopsis

```
XDAS_Int32 (*control) (IVIDENC1_Handle handle,
IVIDENC1_Cmd id, IVIDENC1_DynamicParams *params,
IVIDENC1_Status *status);
```

|| Arguments

```
IVIDENC1_Handle handle; /* algorithm instance handle */
```

```
IVIDENC1_Cmd id; /* algorithm specific control commands*/
```

```
IVIDENC1_DynamicParams *params /* algorithm run-time
parameters */
```

```
IVIDENC1_Status *status /* algorithm instance status
parameters */
```

|| Return Value

```
IALG_EOK; /* status indicating success */
```

```
IALG_EFAIL; /* status indicating failure */
```

|| Description

This function changes the run-time parameters of an algorithm instance and queries the algorithm's status. `control()` must only be called after a successful call to `algInit()` and must never be called after a call to `algFree()`.

The first argument to `control()` is a handle to an algorithm instance.

The second argument is an algorithm specific control command. See `XDM_CmdId` enumeration for details.

The third and fourth arguments are pointers to the `IVIDENC1_DynamicParams` and `IVIDENC1_Status` data structures respectively.

Note:

If you are using extended data structures, the third and fourth arguments must be pointers to the extended `DynamicParams` and `Status` data structures respectively. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters.

‖ Preconditions

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- ❑ `control()` can only be called after a successful return from `algInit()` and `algActivate()`.
- ❑ If algorithm uses DMA resources, `control()` can only be called after a successful return from `DMAN3_init()`.
- ❑ `handle` must be a valid handle for the algorithm's instance object.

‖ Post conditions

The following conditions are true immediately after returning from this function.

- ❑ If the control operation is successful, the return value from this operation is equal to `IALG_EOK;` otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value.
- ❑ If the control command is not recognized, the return value from this operation is not equal to `IALG_EOK`.

‖ Example

See test application file, TestAppEncoder.c available in the \Client\Test\Src sub-directory.

‖ See Also

`algInit()`, `algActivate()`, `process()`

4.3.4 Data Processing API

Data processing API is used for processing the input data.

‖ Name

`algActivate()` – initialize scratch memory buffers prior to processing.

‖ Synopsis

```
Void algActivate(IALG_Handle handle);
```

‖ Arguments

```
IALG_Handle handle; /* algorithm instance handle */
```

‖ Return Value

```
Void
```

‖ Description

`algActivate()` initializes any of the instance's scratch buffers using the persistent memory that is part of the algorithm's instance object.

The first (and only) argument to `algActivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be initialized prior to calling any of the algorithm's processing methods.

For more details, see *TMS320 DSP Algorithm Standard API Reference.* (literature number SPRU360).

‖ See Also

`algDeactivate()`

‖ Name

`process()` – basic encoding/decoding call

‖ Synopsis

```
XDAS_Int32 (*process)(IVIDENC1_Handle handle,
IVIDEO1_BufDescIn *inBufs, XDM_BufDesc *outBufs,
IVIDENC1_InArgs *inargs, IVIDENC1_OutArgs *outargs);
```

‖ Arguments

```
IVIDENC1_Handle handle; /* algorithm instance handle */

IVIDEO1_BufDescIn *inBufs; /* algorithm input buffer
descriptor */

XDM_BufDesc *outBufs; /* algorithm output buffer descriptor
*/

IVIDENC1_InArgs *inargs /* algorithm runtime input arguments
*/

IVIDENC1_OutArgs *outargs /* algorithm runtime output
arguments */
```

‖ Return Value

```
IALG_EOK; /* status indicating success */

IALG_EFAIL; /* status indicating failure */
```

‖ Description

This function does the basic encoding/decoding. The first argument to `process()` is a handle to an algorithm instance.

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `XDM_BufDesc` data structure for details).

The fourth argument is a pointer to the `IVIDENC1_InArgs` data structure that defines the run-time input arguments for an algorithm instance object.

The last argument is a pointer to the `IVIDENC1_OutArgs` data structure that defines the run-time output arguments for an algorithm instance object.

Note:

If you are using extended data structures, the fourth and fifth arguments must be pointers to the extended `InArgs` and `OutArgs` data structures respectively. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters.

‖ Preconditions

The following conditions must be true prior to calling this function; otherwise, its operation is undefined.

- ❑ `process()` can only be called after a successful return from `algInit()` and `algActivate()`.
- ❑ If algorithm uses DMA resources, `process()` can only be called after a successful return from `DMAN3_init()`.

- `handle` must be a valid handle for the algorithm's instance object.
- Buffer descriptor for input and output buffers must be valid.
- Input buffers must have valid input data.

|| Post conditions

The following conditions are true immediately after returning from this function.

- If the process operation is successful, the return value from this operation is equal to `IALG_EOK;` otherwise it is equal to either `IALG_EFAIL` or an algorithm specific return value.
- After successful return from `process()` function, `algDeactivate()` can be called.

|| Example

See test application file, TestAppEncoder.c available in the \Client\Test\Src sub-directory.

|| See Also

`algInit(), algDeactivate(), control()`

Note:

- A video encoder or decoder cannot be preempted by any other video encoder or decoder instance. That is, you cannot perform task switching while encode/decode of a particular frame is in progress. Pre-emption can happen only at frame boundaries and after `algDeactivate()` is called.
- The input data can be either in 8-bit YUV 4:2:0 or 8-bit 4:2:2 format. The encoder output is MPEG-4 encoded bit stream.
- For more details on motion vector access API, see Appendix A.

‖ Name

`algDeactivate()` – save all persistent data to non-scratch memory

‖ Synopsis

```
Void algDeactivate(IALG_Handle handle);
```

‖ Arguments

```
IALG_Handle handle; /* algorithm instance handle */
```

‖ Return Value

```
Void
```

‖ Description

`algDeactivate()` saves any persistent information to non-scratch buffers using the persistent memory that is part of the algorithm's instance object.

The first (and only) argument to `algDeactivate()` is an algorithm instance handle. This handle is used by the algorithm to identify various buffers that must be saved prior to next cycle of `algActivate()` and processing.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

‖ See Also

`algActivate()`

4.3.5 Termination API

Termination API is used to terminate the algorithm instance and free up the memory space that it uses.

|| Name

`algFree()` – determine the addresses of all memory buffers used by the algorithm

|| Synopsis

```
XDAS_Int32 algFree(IALG_Handle handle, IALG_MemRec
memTab[]);
```

|| Arguments

```
IALG_Handle handle; /* handle to the algorithm instance */

IALG_MemRec memTab[]; /* output array of memory records */
```

|| Return Value

```
XDAS_Int32; /* Number of buffers used by the algorithm */
```

|| Description

`algFree()` determines the addresses of all memory buffers used by the algorithm. The primary aim of doing so is to free up these memory regions after closing an instance of the algorithm.

The first argument to `algFree()` is a handle to the algorithm instance.

The second argument is a table of memory records that describe the base address, size, alignment, type, and memory space of all buffers previously allocated for the algorithm instance.

For more details, see *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360).

|| See Also

`algAlloc()`

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Chapter 5

Frequently Asked Questions

This chapter provides answers to few frequently asked questions related to using this encoder.

Table 5-1. FAQs for MPEG4 Encoder on DM6446.

Question	**Answer**
MPEG4 Encoder general queries	
What profiles are supported in this version of MPEG4 Encoder?	Only simple profile encoding is supported.
What is the maximum resolution supported this version of MPEG4 Encoder?	The maximum resolution supported is D1 (NTSC/PAL).
Does MPEG4 Encoder support non-multiple of 16 frame height and width?	Yes, the MPEG4 Encoder supports encoding of video with non-multiple of 16 resolutions. The only constraint is that the height and width should be multiple of 2 (this comes from the YUV 420 chroma format requirements).
What are the recommended buffer sizes for input and output buffers?	**Input Buffer:** The input (YUV input) buffer size is fixed based on the input resolution needed. It is height*width*1.5 for YUV 420 and height*width*2 for YUV 422 inputs. **Output Buffer:** The output buffer (stream buffer) size is based on the worst-case compression ratio (which depends on how though the content is for encoding). For typical streams the recommend output buffer size of height*width/2 (this assumes worst-case compression ratio of 1:3).
What are the input formats supported ?	The encoder supports the following chroma formats : ❑ YUV420 planar ❑ YUV422 interleaved little endian (UYVY…) ❑ YUV422 interleaved BIG endian (YVYU..)
What are the output formats supported?	The encoder supports only `XDM_BYTE` Format

Question	Answer
What are the error resiliency tools supported by MPEG4 Encoder ?	The encoder supports the following Error resiliency tools: ❑ DP (Data Partitioning) ❑ RVLC(Reversible VLC) ❑ Resync Markers ❑ MIR (Mandatory intra refresh) ❑ HEC(Header extension code)
Does the encoder use H263 encoding?	Yes, the encoder supports short header format encoding (by setting the `encodingMode` parameter to 0). This generates bit stream compliant to H263 standard.
What are the levels supported for H263?	The encoder supports H263 Baseline profile, level 10/20/30/45.
The encoder returns error when creating the algorithm instance, what could be the reason?	Typically the encoder returns an error if any of the create time parameters given is not supported or a parameter is set to a value outside the allowed range.
The process call (encode call) returns error, what could be the cause?	❑ Check if any of the dynamic parameter is set to a wrong value (un supported value or value outside the allowed range). ❑ Check if the input and output buffer pointers are valid and non NULL.
The encoder gives out corrupted stream for a given YUV, what could be the reason?	Check the output buffer size. The buffer size may not be sufficient. Increase it and check.
Does the encoder support `XDM_GENERATE_HEADER` feature?	If the parameter `generateHeader` is set to `XDM_GENERATE_HEADER`, then the encoder can generate only the VOL/VOSS header (the data will not be encoded). Setting this flag to `XDM_ENCODE_AU` will generate the encoded stream with both headers and compressed data.
What are the additional features supported by the MPEG4 Encoder?	❑ Motion vector access: The MPEG4 Encoder optionally allows the access to the motion vectors and SSE (or SAD) for each MB in a frame (through `MVDataEnable` flag). If enabled, the encoder expectes a buffer pointer (as input) to store the Motion vector data (MVx, MVy and SSE). ❑ Insertion of End of sequence: The MPEG4 encoder can optionally insert EOS (end of sequence) into the bit–stream (to signal the sequence end) if `lastFrame` flag is enabled.
Does the encoder support interlaced content?	No. the encoder supports only progressive content.
Does the encoder support AC prediction	Yes, this AC prediction can be turned on optionally.
How does the encoder support packetization?	The packaetization is supported through `resyncInterval` parameter. The packet size is <= `resyncInterval`. `resyncInterval` indicates number of bits per packet. This parameter can be changed run-time.

Question	**Answer**
Does the encoder support sub-frame level encode call/API's?	No, the encoder support only frame level encode API's
Does the encoder support any pre or post processing algorithms?	No, the encoder does not support any pre or post processing algorithms.
How does setting/changing the target fps at run-time affect encoding? If target fps is set to 15 fps but data is sent at 30 fps will the behavior be any different than if the target fps was set to 30 fps?	The encoder expects the same input frame rate and target frame rate. Otherwise, it gives an error. This means that the fps in the example should be same for input and target frame rate. The encoder does not support any frame rate conversion. However, the frame rate can be changed dynamically at run time (with the condition that input and target frame rate should be same).
MPEG4 Encoder video quality related queries	
What are the parameters that affect the encoder quality?	There are many parameters that affect the encoded video quality. The main parameters are: Bit rate, frame rate, search range, UMV, sub-pixel (half-pel) ME, rate control algorithm. There are other parameters such as I frame interval that affect the quality.
What is `encodingPreset` and how it should be set?	Encoding preset is a create-time option in the video encoder. Typically, there are two presets in the codec (Not available in all platforms). ❑ High Quality – This setting offers the best possible encoding. It also has the highest complexity. ❑ High Speed – This setting has lower complexity than the high quality setting. Reduced complexity is achieved by making compromises in the encoder search operations. The high-speed version is available only on 64x+ MPEG4 Encoder. The default is the high quality setting. For other versions of the encoder, only the default value of `HIGH_QUALITY` is supported.

Question	Answer
How is the GOP(group of picture) Structure configured?	The encoder offers the ability to choose the GOP size using a parameter called `IntraFrameInterval`. Using `IntraFrameInterval` = N > 1: This generates GOPs with the structure IPPPPPP (P repeated N-1 times). The advantage of this structure is that there are periodic sync points at the I-frames. Hence, a decoder can start decoding a sequence within N-frames of any desired seek point. One disadvantage in this method is that there are high bit-rate variations (maximum/average). In general, the recommended value of N is equivalent of 1 sec (for example, 30 if the stream is at 30fps). Using `IntraFrameInterval` = 0 implies that the encoder should generate only one I-frame in the beginning of sequence. In addition to this, while encoding it is also possible to force a frame to be an I frame by setting the `forceIFrame` flag to 1.
What rate control algorithms are supported?	The rate control algorithm used in the encoder can be chosen in two ways. The base class parameter `RateControlPreset` or `rcAlgo` option (available via extended class). ❑ Low delay (CBR): Uses an algorithm called PLR3. In this mode, frames may be dropped when the bit-rate is less and the content and buffer conditions demand it. ❑ Storage (VBR): Uses an algorithm called PLR4. This does not skip frames and is suitable for storage kind of applications. The rate control can also be chosen via. `rcAlgo` parameter.
What are the parameters affecting the motion estimation?	The search range is derived from `fCode` parameter. The `enableUMV` parameter allows ME search outside the picture boundary. Enabling half-pel motion estimation, some platforms have the flexibility to switch on/off the half-pel motion estimation (only available in 64x+ MPEG4 Encoder. Other versions have half-pel estimation enabled by default). Intra-frame interval of 1 sec is also recommended for good quality.
The encoded content looks blocky, what could be the reason?	Typically, this is due to insufficient bit rate. Tough to encode content with many scene changes or with a lot of details in it needs higher bit rate for better quality.

Appendix A

Motion Vector Access API

A.1 Description

The Motion Vector Access API is part of the XDM `process()` call, used by the application to encode a frame. A run-time parameter `MVDataEnable` is provided as a part of dynamic parameters, which can be set or reset at a frame level at run-time. Setting this flag to 1 indicates that the motion vectors access is needed. When this parameter is set to 1, the `process()` call returns the motion vector data in the buffer provided by the application.

For every macro block, the data returned is 8 bytes, a signed horizontal displacement component (signed 16-bit integer) and a vertical displacement component (signed 16-bit integer) and signed SSE, as shown below:

Motion vector horizontal displacement (HD)	Signed 16 - bit integer
Motion vector vertical displacement (VD)	Signed 16 - bit integer
SSE	Signed 32 - bit integer

The API returns the motion vector data in a single buffer with these three values interleaved in contiguous memory as shown in figure.

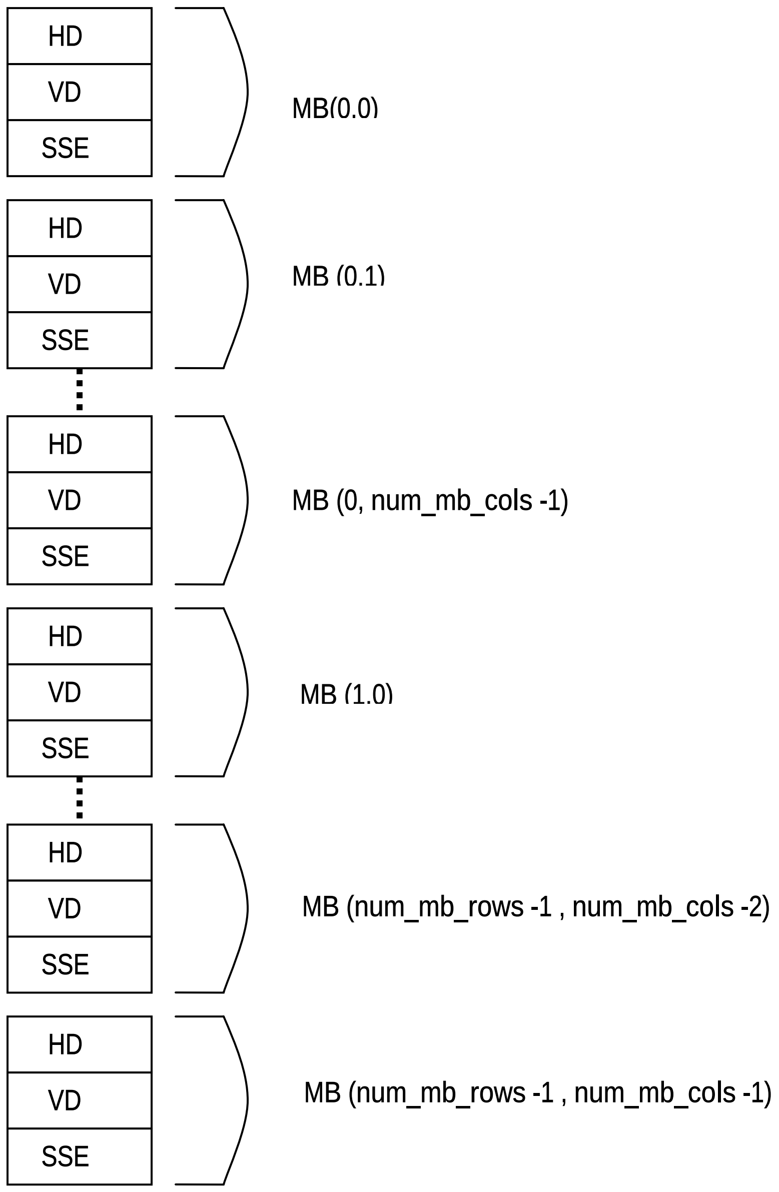
HD
VD
SSE
MB(0.0)
MB (0.1)
MB (0, num_mb_cols -1)
MB (1.0)
MB (num_mb_rows -1 , num_mb_cols -2)
MB (num_mb_rows -1 , num_mb_cols -1)

Figure A-1. Motion Vector and SSE Buffer Organization.

The following sequence should be followed for motion vector access:

1) In the dynamic parameters, set the flag to access MV data.

   ```
   /* This structure defines the run-time parameters for
   MP4VEnc object */

   MP4VENC_DynamicParams   ext_dynamicParams;

   /* Enable MV access */

   ext_dynamicParams ->MVDataEnable = 1;

   /* Control call to set the dynamic parameters */

   control(.., XDM_SETPARAMS,..)
   ```

2) Allocate output buffers and define the output buffer descriptors

   ```
   /* Output Buffer Descriptor variables */

   XDM_BufDesc  outputBufDesc;

   /* Get the input and output buffer requirements for the
   codec */

   control(.., XDM_GETBUFINFO, extn_dynamicParams, ..);
   ```

   If MV access is enabled in step1, this call will return the output buffer info as numBufs =2, along with the minimal buffer sizes.

   ```
   /* Initialize the output buffer descriptor */

   outputBufDesc.numBufs = 2;

   /* Stream Buffer */

   outputBufDesc.bufs[0]     =  streamDataPtr; //pointer
   to mpeg4 bit stream

   outputBufDesc.bufSizes[0] =
   status.bufInfo.minOutBufSize[0];

   /* MV Buffer */

   outputBufDesc.bufs[1]     =  mvDtataPtr; //pointer to
   MV data

   outputBufDesc.bufSizes[1] =
   status.bufInfo.minOutBufSize[1];
   ```

3) Call frame encode API

   ```
   /* Process call to encode 1 frame */

   process(..  ,..  , outputBufDesc, .. );
   ```

   After this call, the buffer `outputBufDesc.bufs[1]` will have the Motion vector data. This API will return the size of the MV array in `outArgs.mvDataSize`.

As shown in Figure A-1, the API uses a single buffer to store the motion vector data. The buffer will have the three values (HD, VD, SSE) interleaved in contiguous memory.

Define a structure:

```
struct motion_mbdata
{
       short MVx;
       short MVy;
       int SSE;
} ;
motion_mbdata  *mbMV_data =  outarg. mvBufPtr;

num_mb_rows = frameRows / 16;
num_mb_cols  = frameCols / 16;

for (i = 0; i < num_mb_rows; i++)
{
      for (j = 0; j < num_mb_cols; j++)
     {
       HD for mb(i, j) = mbMV_data ->MVx;
       VD for mb(i, j) = mbMV_data ->MVy;
       SSE for mb(i,j) = mbMV_data ->SSE;
       mbMV_data ++;
       }
}
```

Note:

- The motion vectors are with fullpel (integer pel) resolution.
- SSE = (Ref(i,j) – Src(i,j)) ^{2} where, Ref is the macro block of the reference region and Src is the macro block of the source image.
- The motion vectors seen in the encoded stream are based on the best coding decision which is a combination of motion estimation and mode decission. The MV buffer returns the results of the motion estimation in fullpel resolution (lowest SSE) and this maybe different from the motion vectors seen in the bit stream. More details are given below:
  - o Some macro blocks in a P-frame may be coded as Intra macro blocks based on the post motion estimation decisions. In this case, the motion vectors computed in the motion estimation stage (assuming that this macro block is inter) will be returned.
  - o Due to the post motion estimation decisions for some macro blocks, the actual motion vector encoded might be forced to

(0,0). In this case, the non-zero motion vector available after the motion estimation is returned.

- o Some inter macroblocks may be *not coded* due to zero residual. In this case, the full pel motion vectors computed in the motion estimation stage are returned.
- o For I-frames, motion vectors are not returned and `outArgs.mvDataSize` = 0.

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Appendix B

Revision History

This user guide revision history highlights the changes made to SPRUEA2E codec specific user guide to make it SPRUEA2F.

Table B-1. Revision History of MPEG4 Simple Profile Encoder on DM6446.

Section	Additions/Modifications/Deletions
Global	❑ Modified Codec version to 02.02.04 Note: There are no changes in user guide and datasheet for this relases