# H.264 High Profile Decoder 2.0 on HDVICP2 and Media Controller based platform

# User's Guide

Texas Instruments

Literature Number: SPRUHF9
July 2012

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Preface

# Read This First

## *About This Manual*

This document describes how to install and work with Texas Instruments' (TI) H.264 High Profile Decoder implementation on the HDVICP2 and Media Controller based 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 HDVICP2  based 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,** answers few frequently asked questions related to using H.264 High Profile Decoder on HDVICP2 and Media Controller Based Platform.

- **Appendix A- Picture Format,** Provides information on format of YUV buffers provided to decoder.
- **Appendix B - Meta Data Support,** Provides information on writing out the parsed SEI, VUI data and MB Info data into application provided buffers.
- **Appendix C - Error Handling,** Provides information on handling of erroneous situations while decoding.
- **Appendix D - Parse Header Support,** Provides information on Parse Header Support FOR H264 bit-streams.
- **Appendix E - Skip Support ,** Provides information on support for skipping of decoding non-reference frames
- **Appendix F - Support for Display Delay and Low DDR Memory Footprint,** Provides information on configuration of decoder to achieve desired display delay and low DDR footprint (Operate with lesser number of YUV frames)
- **Appendix G – Support for Dynamic Change in Resolution,** Provides information on procedure to be followed in case of change in resolution
- **Appendix H – Support for Debug Trace,** Provides information on enabling decoder to dump debug trace and collection procedure by Application
- **Appendix I – Low Latency / Sub Frame Level Synchronization,** Provides information on procedure to be followed in case of sub-frame level data exchange between Application and Decoder
- **Appendix J – Support for Scalable Video Decoding,** Provides information on supported SVC features
- **Appendix K – Support for Dual YUV Output,** Provides information on procedure to be followed in case of dual YUV output from Decoder
- **Appendix L – Support for Watermarking,** Provides information on the support for watermarking in this decoder
- **Appendix M – Support for N Channel Process Call,** Provides information on the support for decoding N channels in a single process call in this decoder

## *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 Inteface 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.
- 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 14496-10:2005 (E) Rec.- Information technology* – Coding of audio-visual objects – H.264 (E) ITU-T Recommendation

## Abbreviations

The following abbreviations are used in this document.

*Table 1-1. List of Abbreviations*

| **Abbreviation** | **Description** |
|---|---|
| ASO | Arbitrary Slice Ordering |
| AVC | Advanced Video Coding |
| BIOS | TI’s simple RTOS for DSPs |
| CABAC | Context Adaptive Binary Arithmetic Coding |
| CAVLC | Context Adaptive Variable Length Coding |
| CPB | Coded Picture Buffer |
| CSL | Chip Support Library |
| D1 | 720x480 or 720x576 resolutions in progressive scan |
| DCT | Discrete Cosine Transform |
| DMA | Direct Memory Access |
| DMAN | DMA Manager |
| DPB | Decoded Picture Buffer |
| EVM | Evaluation Module |
| FMO | Flexible Macroblock Ordering |
| HDTV | High Definition Television |
| IPCM | Intra-frame Pulse Code Modulation |
| IDR | Instantaneous Decoding Refresh |
| IRES | Interface standard to request and receive handles to resources |
| ITU-T | International Telecommunication Union |

| Abbreviation | Description |
|---|---|
| IVA | Image Video Accelerator |
| JM | Joint Menu |
| JVT | Joint Video Team |
| MB | Macro Block |
| MBAFF | Macro Block Adaptive Field Frame |
| MMCO | Memory Management Control Operation |
| MPEG | Moving Pictures Experts Group |
| MV | Motion Vector |
| NAL | Network Adaptation Layer |
| NTSC | National Television Standards Committee |
| PicAFF | Picture Adaptive Field Frame |
| RMAN | Resource Manager |
| RTOS | Real Time Operating System |
| UUID | Unregistered Unique Identifier |
| VCL | Video Coding Layer |
| VGA | Video Graphics Array (640 x 480 resolution) |
| VOP | Video Object Plane |
| XDAIS | eXpressDSP Algorithm Interface Standard |
| XDM | eXpressDSP Digital Media |
| YUV | Color space in luminance and chrominance form |

## *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, quote the product name (H.264 High Profile Decoder on HDVICP2 ) 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 H.264 High Profile Decoder on the HDVICP2 and Media Controller based platform and its supported features.

**Topic** **Page**

## 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

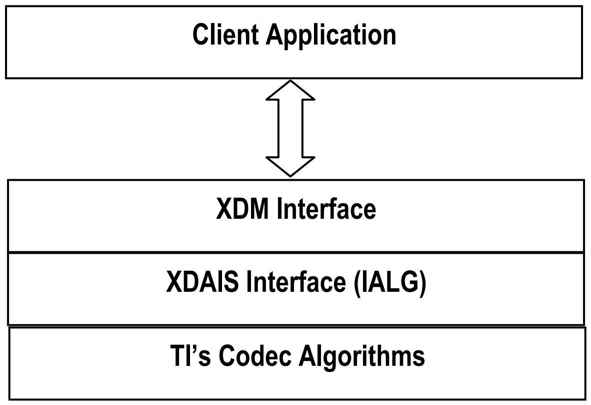
In the multimedia application space, you have the choice of integrating any codec into your multimedia system. For example, if you are building a video decoder system, you can use any of the available video decoders (such as MPEG4, H.263, or H.264) in your system. To enable easy integration with the 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).

### 1.1.3 IRES Overview

IRES is a generic, resource-agnostic, extendible resource query, initialization and activation interface. The application framework defines, implements, and supports concrete resource interfaces in the form of IRES extensions. Each algorithm implements the generic IRES interface, to request one or more concrete IRES resources. IRES defines standard interface functions that the framework uses to query, initialize, activate/deactivate and reallocate concrete IRES resources. To create an algorithm instance within an application framework, the algorithm and the application framework agrees on the concrete IRES resource types that are requested. The framework calls the IRES interface functions, in addition to the IALG functions, to perform IRES resource initialization, activation, and deactivation.

The IRES interface introduces support for a new standard protocol for cooperative preemption, in addition to the IALG-style non-cooperative sharing of scratch resources. Co-operative preemption allows activated algorithms to yield to higher priority tasks sharing common scratch resources. Framework components include the following modules and interfaces to support algorithms requesting IRES-based resources:

- **IRES** - Standard interface allowing the client application to query and provide the algorithm with its requested IRES resources.
- **RMAN -** Generic IRES-based resource manager, which manages and grants concrete IRES resources to algorithms and applications. RMAN uses a new standard interface, the IRESMAN, to support run-time registration of concrete IRES resource managers.

Client applications call the algorithm's IRES interface functions to query its concrete IRES resource requirements. If the requested IRES resource type matches a concrete IRES resource interface supported by the application framework, and if the resource is available, the client grants the algorithm logical IRES resource handles representing the allotted resources. Each handle provides the algorithm with access to the resource as defined by the concrete IRES resource interface.

IRES interface definition and function calling sequence is depicted in the following figure. For more details, see *Using IRES and RMAN Framework Components for C64x+* (literature number SPRAAI5).

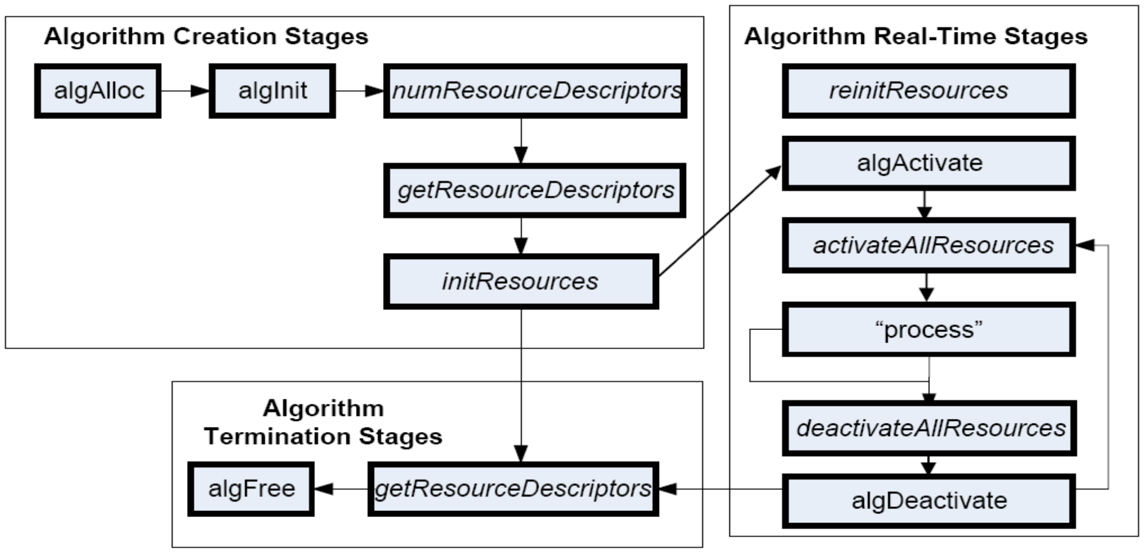


*Figure 1-1. IRES Interface Definition and Function Calling Sequence.*

For more details, see *Using IRES and RMAN Framework Components for C64x+* (literature number SPRAAI5).

## 1.2 Overview of H.264 High Profile Decoder

H.264 (from ITU-T, also called as H.264/AVC) is a popular video coding algorithm enabling high quality multimedia services on a limited bandwidth network. H.264 standard defines several profiles and levels that specify restrictions on the bit-stream and hence limits the capabilities needed to decode the bit-streams. Each profile specifies a sub-set of algorithmic features that limits all decoders conforming to that profile may support. Each level specifies a set of limits on the values that may be taken by the syntax elements in that profile.

Some important H.264 profiles and their special features are:

- Baseline Profile:
  - Only I and P type slices are present
  - Only frame mode (progressive) picture types are present
  - Only CAVLC is supported
- Main Profile:
  - Only I, P, and B type slices are present
  - Frame and field picture modes (in progressive and interlaced modes) picture types are present
  - Both CAVLC and CABAC are supported

- High Profile:
  - Only I, P, and B type slices are present
  - Frame and field picture modes (in progressive and interlaced modes) picture types are present
  - Both CAVLC and CABAC are supported
  - 8x8 transform supported
  - Scaling matrices supported

The input to the decoder is a H.264 encoded bit-stream in the byte-stream syntax. The byte-stream consists of a sequence of byte-stream NAL unit syntax structures. Each byte-stream NAL unit syntax structure contains one start code prefix of size four bytes and value 0x00000001, followed by one NAL unit syntax structure. The encoded frame data is a group of slices, each of which is encapsulated in NAL units. The slice consists of the following:

- Intra coded data: Spatial prediction mode and prediction error data that is subjected to DCT and later quantized.
- Inter coded data: Motion information and residual error data (differential data between two frames) that is subjected to DCT and later quantized.

The first frame received by the decoder is IDR (Instantaneous Decode Refresh) picture frame. The decoder reconstructs the frame by spatial intra-prediction specified by the mode and by adding the prediction error. The subsequent frames may be intra or inter coded.

In case of inter coding, the decoder reconstructs the bit-stream by adding the residual error data to the previously decoded image, at the location specified by the motion information. This process is repeated until the entire bit-stream is decoded. The output of the decoder is a YUV sequence, which is of 420 semi-planar format (Y is a single plane and the Chroma data – cb and cr are interleaved to form the other plane).

Figure 1-2 depicts the working of the decoder.

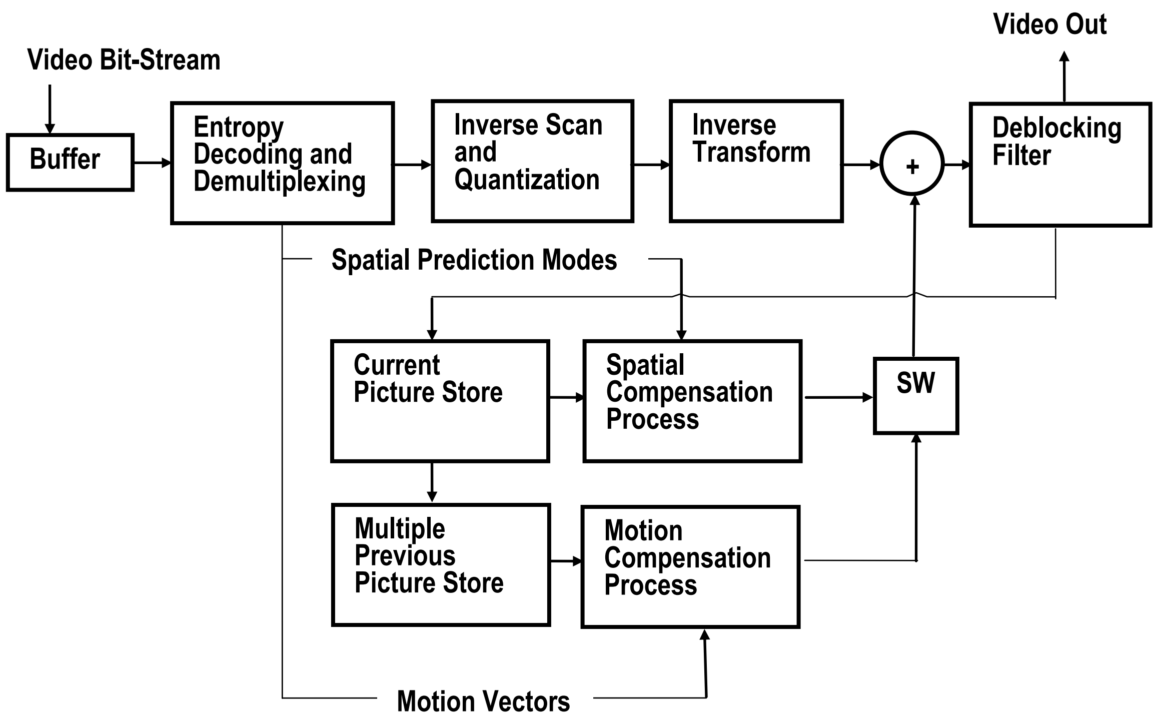

Video Bit-Stream
Video Out
Buffer
Entropy Decoding and Demultiplexing
Inverse Scan and Quantization
Inverse Transform
+
Deblocking Filter
Spatial Prediction Modes
Current Picture Store
Spatial Compensation Process
SW
Multiple Previous Picture Store
Motion Compensation Process
Motion Vectors

*Figure 1-2. Flow diagram of the H.264 Decoder*

From this point onwards, all references to H.264 Decoder means H.264 High Profile Decoder only.

## 1.3 Supported Services and Features

This user guide accompanies TI’s implementation of H.264 Decoder on the HDVICP2 based platform.

This version of the codec has the following supported features:

- eXpressDSP Digital Media (XDM IVIDDEC3) compliant
- Supports all features of the High Profile (HP)
- Supports resolution up to 4096 x 4096
- Supports progressive, interlaced, Picture Adaptive Frame Field (PicAFF) and Macro-block Adaptive Frame Field (MBAFF) type picture decoding.
- Supports multiple slices and multiple reference frames
- Supports CAVLC and CABAC decoding
- Supports all intra-prediction and inter-prediction modes
- Supports up to 16 MV per MB
- Supports frame based decoding
- Supports picture width and height (resolutions) greater than 64 pixels including all standard resolutions.
- Tested for compliance with JM version 10.1 reference decoder
- Supports reference picture list reordering
- Supports PCM macro block decoding
- Supports graceful exit and error reporting under error conditions
- Supports error concealment
- Supports parse header functionality
- Supports access to Parsed Supplemental Enhancement Information (SEI) and Video Usability information (VUI) data
- Supports YUV420 semi-planar chroma format
- Supports memory management and control operations (MMCO)
- Supports gaps in frame number
- Independent of any Operating System
- Ability to plug in any multimedia frameworks (For example, Codec engine, OpenMax, GStreamer etc.)
- Multiple instances of the decoder can be run simultaneously
- Supports decoding of one frame each of multiple channels in a single process call

- Supports skip functionality
- Supports dynamic change in resolution
- Supports configurable display delay for low delay applications
- Supports low DDR footprint, in closed loop scenarios
- Supports Data Sync at input and output
- Supports limited decoding for Scalable Video Coding (SVC)
- Supports parsing of stereo SEI and frame packing SEI
- Supports configurable Loop Filtering option to save some cycles
- Supports trace functionality to log information about last N frames
- Supports dual (YUV) output
- Supports decryption of watermarking key

This version of the decoder does not support the following features:

- ASO/FMO functionality

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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 (simulator release package) has been built and tested with limited test cases on the HDVICP2 and Media Controller Based Platform.

### *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 (Code Composer Studio v4) version. 4.2.0.09000 Code Composer Studio v4 caN be downloaded from the following location.

  http://software-dl.ti.com/dsps/dsps_registered_sw/sdo_ccstudio/CCSv4/Prereleases/setup_CCS_4.2.0.09000.zip

- **Code Generation Tools:** This project is compiled, assembled, archived, and linked using the code generation tools version 4.5.1. Although CG tools version 4.5.1 is a part of Code Composer Studio v4, It is recommended that you download and install the CG tools from the following location

  https://www-a.ti.com/downloads/sds_support/CodeGenerationTools.htm

  The project are built using g-make (GNU Make version 3.78.1)

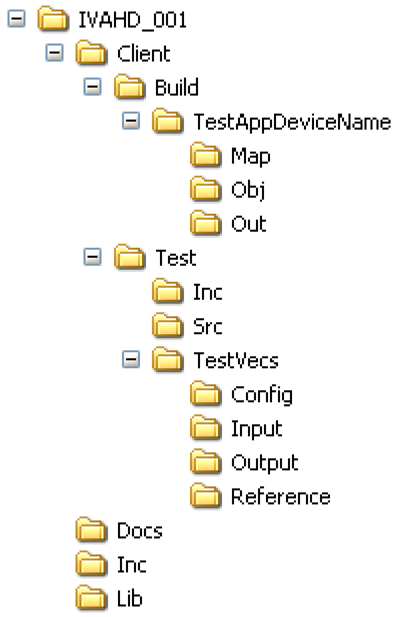
- **Platform Simulator:** This project is developed using DM81Xx/OMAP4 Simulator with CSP version 0.7.1. This release can be obtained by software updates on Code Composer Studio v4. Make sure that following site is listed as part of  Update sites to visit.

  http://software-dl.ti.com/dsps/dsps_public_sw/sdo_ccstudio/CCSv4/Updates/NETRA/site.xml

## 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 500.V.H264AVC.D.HP.IVAHD.02.00, under which another directory named IVAHD_001 is created.

Figure 2-1 shows the sub-directories created in the IVAHD_001 folder.



```
IVAHD_001
    Client
        Build
            TestAppDeviceName
                Map
                Obj
                Out
        Test
            Inc
            Src
            TestVecs
                Config
                Input
                Output
                Reference
    Docs
    Inc
    Lib
```

*Figure 2-1. Component Directory Structure*

Table 2-1 provides a description of the sub-directories created in the IVAHD_001 directory.

*Table 2-1. Component Directories*

| **Sub-Directory** | **Description** |
|---|---|
| \Client\Build\TestAppDevice Name | Contains the Code Composer Studio v4 project files. The name of this directory will not be same as mentioned here. Instead of device name string, and actual name of device will be present. |
| \Client\Build\TestAppDevice Name \Map | Contains the memory map generated on compilation of the code |
| \Client\Build\TestAppDevice Name \Obj | Contains the intermediate .asm and/or .obj file generated on compilation of the code |
| \Client\Build\TestAppDevice Name \Out | Contains the final application executable (.out) file generated by the sample test application |
| \Client\Test\Inc | Contains header files needed for the application code |
| \Client\Test\Src | Contains application C files |

| Sub-Directory | Description |
|---|---|
| \Client\Test\TestVecs\Config | Contains sample configuration file for H264 decoder |
| \Client\Test\TestVecs\Input | Contains input test vectors |
| \Client\Test\TestVecs\Output | Contains output generated by the codec. It is empty directory as part of release. |
| \Client\Test\TestVecs\Reference | Contains read-only reference files which is used for verifying against codec output |
| \docs | Contains user guide and datasheet |
| \Inc | Contains H.264 decoder related header files which allow interface to the codec library |
| \Lib | Contains the codec library file |

## 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 TI Framework Components (FC) and HDVICP2 library.

This version of the codec has been validated on Framework Component (FC) version 3.20.00.22.

This version of the codec has been validated HDVICP2 library version 01.00.00.19.

### *2.3.1 Installing Framework Component (FC)*

You can download FC from following website:

http://software-dl.ti.com/dsps/dsps_public_sw/sdo_sb/targetcontent/fc/3_20_00_22/index_FDS.html

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

<install directory>\CCStudio4.0

Set a system environment variable named FC_INSTALL_DIR pointing to <install directory>\CCStudio4.0\<fc_directory>

The test application uses the following IRES and XDM files:

- HDVICP related ires header files, these are available in the <install directory>\CCStudio4.0\<fc_directory>\packages \ti\sdo\fc\ires\hdvicp directory.

- ❑ Tiled memory related header file, these are available in the <install directory>\CStudio4.0\<fc_directory>\fctools\packages \ti\sdo\fc\ires\tiledmemory directory.
- ❑ XDM related header files, these are available in the <install directory>\CCStudio4.0\<fc_directory>\fctools\packages \ti\xdais directory.
- ❑ Memutils file for memory address translation, these are available in the <install directory>\CStudio4.0\<fc_directory>\ packages\ti\sdo\fc\memutils directory

### *2.3.2 Installing HDVICP2 library*

The HDVICP2 library should be available in the same place as the codec package.

Set a system environment variable named HDVICP2_INSTALL_DIR pointing to <hdvicp2_directory>\hdvicp20

The test application uses the HDVICP20 library file (ivahd_ti_api_vM3.lib) from <hdvicp2_directory>\hdvicp20\lib 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 installed TI's Code Composer Studio version 4.2.0.09000 and code generation tools version 4.5.1.

2) Start Code Composer Studio and set up the target configuration for platform specific simulator or emulator.

3) Verify that the following codec object libraries exist in \Lib sub-directory:
   - o h264vdec_ti.lib: H.264 decoder library for Media Controller

4) Open Code Composer Studio debug window with the appropriate platform configuration chosen.

5) Build the sample test application project using gmake. The makefile is present in Client\Build\TestAppDeviceName\make folder.

6) The above step creates an executable file, TestAppDecoder.out in the \Client\Build\TestAppDeviceName\Out sub-directory.

7) Select Target > Load Program, browse to the \Client\Build\ TestAppDeviceName\Out sub-directory, select the codec executable created in step 6, and load it onto Media Controller in Code Composer Studio in preparation for execution. You need not load executables for iCont1 and iCont2.

8) If you are using sub-system simulator then ensure that iCONT1 and iCONT2 are in running state, even without loading any program. If you are using platform simulator or EVM then this step is not needed.

9) Select Target > Run on Video Media Controller to execute the sample test application.

10) 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.

**Note:**

Order of triggering the processor to run is important and it should be as mentioned in above steps.

On successful completion, if you had set the configuration to conformance mode checking (see section 2.5), then the application displays the following messages for every display frame:

- "--- Frame # <frame number> Passed ----"
- If output file mode is selected, then the output is written to the file specified (this can then be manually compared against the reference).

On failure, the application exits after decoding the frame in which codec failed to generate correct result (for conformance check mode).

## 2.5 Configuration Files

This codec is shipped along with:

- Test Vecs file (Testvecs.cfg) – specifies list of test vectors to get executed. Each test vector refers to configuration used to decode one stream
- Decoder configuration files (Ex: fruits_p352x288_4.cfg) – specifies the configuration parameters used by the test application to configure the Decoder and run a stream.

### 2.5.1 Test Vecs File

The sample test application shipped along with the codec uses Testvecs.cfg which specifies list of test vectors to get executed.

A sample Testvecs.cfg file is as shown:

```
..\..\..\Test\TestVecs\Config\airshow_p176x144_1.cfg
..\..\..\Test\TestVecs\Config\airshow_p352x288_2.cfg
..\..\..\Test\TestVecs\Config\fruits_p176x144_3.cfg
..\..\..\Test\TestVecs\Config\fruits_p352x288_4.cfg
```

### 2.5.2 Decoder Configuration file

The decoder configuration file,.specifies the configuration parameters used by the test application to configure the Decoder and run a stream

A sample decoder configuration file is as shown:

```
##################################################################
##
# Input and Output
##################################################################
##
inputBitStream       =
"..\..\..\Test\TestVecs\Input\fruits_p352x288.264"
outputYUV            =
"..\..\..\Test\TestVecs\Output\fruits_p352x288.yuv"
outputDualYUV        =
"..\..\..\Test\TestVecs\Output\fruits_p352x288_Dual.yuv"
WaterMarkFile        =
"..\..\..\Test\TestVecs\Output\fruits_p352x288_Watermark.bin"
referenceYUV         =
"..\..\..\Test\TestVecs\Reference\fruits_p352x288.yuv"
frameSizeFile        =
"..\..\..\Test\TestVecs\Input\fruits_p352x288.txt"
TestCompliance       = 0         # 0->Dump Mode ,1->[Compare Mode
Not supported]
##################################################################
##
# Create Time Parameters
##################################################################
##
maxHeight            = 1088      # Max Image height in Pels
maxWidth             = 1920      # Max Image width in Pels
maxFrameRate         = 30        # 30 -> Frame rate in fps
```

```
maxBitRate           = 10485760  # Maximum Bit rate in Bytes
dataEndianness       = 1         # 1 -> 8-bit Big Endian stream.
forceChromaFormat    = 9         # 9 -> XDM_YUV_420SP
operatingMode        = 0         # 0 -> Decode Mode, 2->Transcode
displayDelay         = 16        # 0 -> No delay (Decode order)
inputDataMode        = 3         # 3->Frame Mode, 0,1 -> Sub-
Frame (DataSync) Mode
outputDataMode       = 3         # 3->Frame Mode, 2 -> Sub-Frame
(DataSync) Mode
numInputDataUnits    = 0         # 0 -> Non-DS mode. Non-Zero
positive for DS mode
numOutputDataUnits   = 0         # 0 -> Non-DS mode. Non-Zero
positive for DS mode
errorInfoMode        = 0         # 0 -> Error Info off
displayBufsMode      = 2         # 1 -> Embedded, 2 - Pointer to
struct
dpbSizeInFrames      = -1        # -1 -> Default, otherwise any
non-Negative 0-16
bitStreamFormat      = 0         # 0 -> Non-NAL mode, 1-> NAL
mode
errConcealmentMode   = 1         # 0 -> Disable EC, 1-> enable EC
temporalDirModePred  = 1         # 0 -> Detect temporal direct
mode & report
metadataType_0       = -1        # -1->No Metadata, 0-SEI, 1-VUI,
2-MB Info
metadataType_1       = -1        # -1->No Metadata, 0-SEI, 1-VUI,
2-MB Info
metadataType_2       = -1        # -1->No Metadata, 0-SEI, 1-VUI,
2-MB Info
svcExtensionFlag     = 0         # 0 -> Disable, 1-> Enable
svcTargetLayerDID    = -1        # -1 -> Default, 0-7  supported
svcTargetLayerTID    = -1        # -1 -> Default, 0-7  supported
svcTargetLayerQID    = -1        # -1 -> Default, 0-15 supported
presetLevelIdc       = 12        # 12 -> Default, 0-15 supported
presetProfileIdc     = 2         # 2 -> High Profile
detectCabacAlignErr  = 0         # 0 -> disable, 1->enable
detectIPCMAlignErr   = 0         # 0 -> disable, 1->enable
debugTraceLevel      = 0         # 0 - 4 supported
LastNFramesToLog     = 0         # Number of Frames to log the
Debug Trace
enableDualOutput     = 1         # 1 -> Enable Dual YUV dump, 0 -
> Disable Dual YUV dump
processCallLevel     = 0         # 0 -> field level process call,
1 -> frame level process call
enableWatermark      = 0         # 1 -> Enable Watermark, 0 ->
Disable Watermark
decodeFrameType = 0      # 2 - > Enable decoding of only I/IDR
frames, 1 -> Enable decoding only I/IDR and P frames , 0 ->
Enable decoding of all frame types (Default)
#################################################################
##
# Dynamic Parameters
#################################################################
##
decodeHeader         = 0         # 0 -> Disable decode Header
mode
displayWidth         = 0         # 0->Default, otherwise Positive
value
frameSkipMode        = 0         # 9 -> Skip non-reference, 0->
No skip
newFrameFlag         = 1         # 1 -> True, 0-> false
lateAcquireArg       = 0         # 0->Default
deblockFilterMode    = 3         # 3 -> Default, supports 0,1 and
```

```
2 as well
DynSvcTargetLayerDID = -1        # -1 -> Default, 0-7  Supported
DynSvcTargetLayerTID = -1        # -1 -> Default, 0-7  Supported
DynSvcTargetLayerQID = -1        # -1 -> Default, 0-15 Supported
DynSvcELayerDecode   = 0         # 0 ->  Disable, 1 -> Enable
DynRsvd0             = 0         # 0 -> Default, reserved one for
future use
DynRsvd1             = 0         # 0 -> Default, reserved one for
future use
DynRsvd2             = 0         # 0 -> Default, reserved one for
future use
#################################################################
##
# Application Control Parameters
#################################################################
##
SeiDataWriteMode     = 0         # 0->Parse 1->Encoded dump
VuiDataWriteMode     = 0         # 0->Parse 1->Encoded dump
MbInfoWriteMode      = 0         # 0->disable mbinfo dump 1-
>Enable mbinfo dump
TilerEnable          = 0         # 0 -> Disable, 1->Enable TILER
DualTilerEnable      = 0         # 0 -> Disable, 1->Enable TILER
(both op is treated as tiler.so this is Valid only when
TilerEnable is 1)
ChromaTilerMode      = 0         # 0 -> 16-Bit mode, 1->8-Bit
Mode
BitStreamMode        = 0         # 0 -> Buffer Mode, 1->Frame
size Mode
NumFramesToDecode    = 8000      # 8000 -> Default
parBoundCheck        = 0         # Parameter Boundary check: 0 ->
Disable, 1-> Enable
parExpectedStatus    = 0         # Expected Status during Param
Boundary check. 0->Pass, -1 -> Fail
exitLevel            = 0         # 1->Create Time, 2->XDM control
time
xdmReset             = 0         # 0->Disable XDM reset use, 1-
>Enable XDM reset use
DumpFrom             = 0         # 0 -> Default, frame number to
dump from
CRCEnable            = 0         # CRC check: 0 -> Disable, 1-
>Enable
ProfileEnable        = 0         # Frame level Profiling: 0 ->
Disable, 1->Enable
BaseClassOnly        = 0         # 0 -> Use Extended classes, 1-
>Use Base classes Only
DDRConstLocation     = 0         # 0->No specific location, 1-
>Specific address for constants
ivahdID              = 0         # 0-> Default. Supports 1 & 2
for Netra
AppRsvd0             = 0         # 0 -> Default, reserved one for
future use
```

**Note:**

All the settings mentioned in decoder config file are not supported in this version of release. See Section 1.3 Supported Services and Features for details on list of supported features in this version of H264 Decoder.

## 2.6 Uninstalling the Component

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

# Sample Usage

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

## 2.7 Overview of the Test Application

The test application exercises the `IVIDDEC3` base class of the H.264 Decoder library.

Figure 2-1 depicts the sequence of APIs exercised in the sample test application. Currently, the test application does not use RMAN resource manager. However, all the resource allocations happens through IRES interfaces.

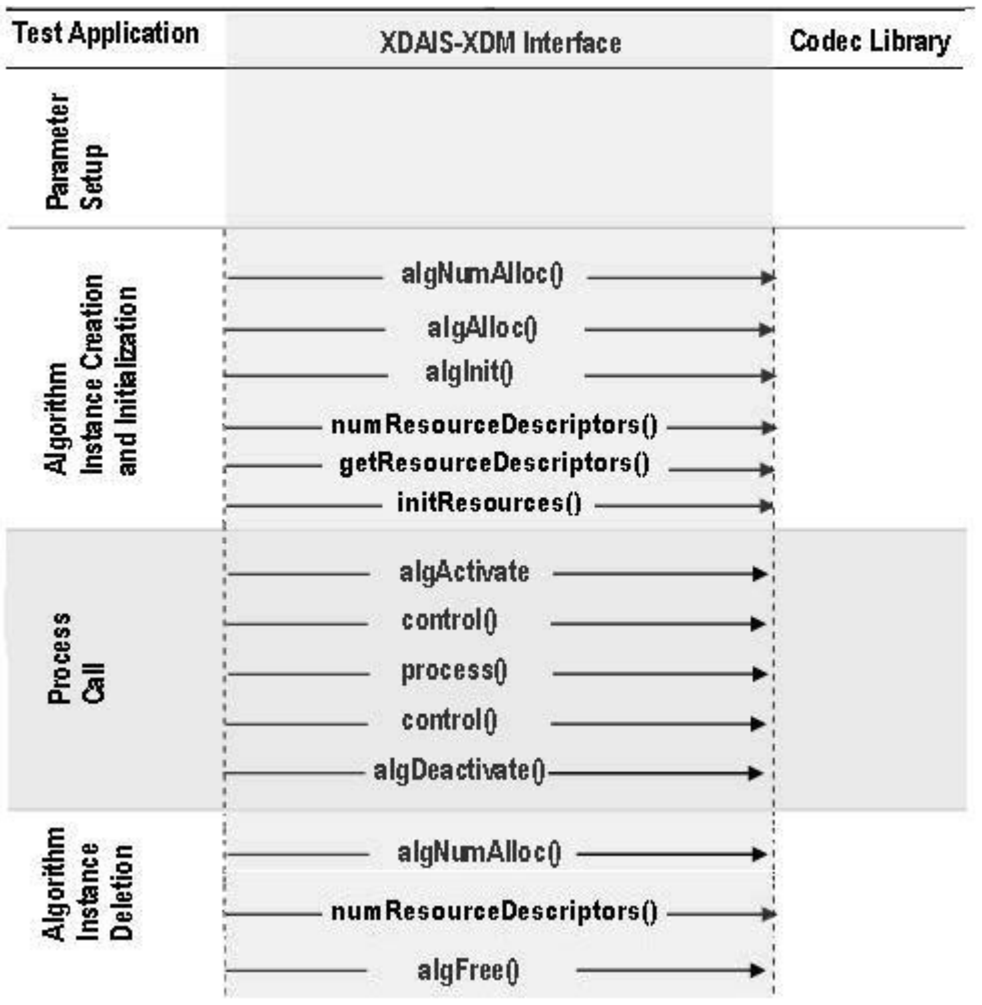


*Figure 2-1. Test Application Sample Implementation*

The test application is divided into four logical blocks:

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

### 2.7.1 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 Decoder configuration files.

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

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

Opens the Decoder 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.

Sets the `IVIDDEC3_Params` structure based on the values it reads from the Testparams.cfg file.

Reads the input bit-stream into the application input buffer.

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

### 2.7.2 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:

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

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

`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.

Note:

- Decoder requests only one memory buffer through `algNumAlloc`. This buffer is for the algorithm handle.
- Other memory buffer requirements are done through IRES interfaces.

After successful creation of the algorithm instance, the test application does HDVICP Resource and memory buffer allocation for the algorithm. Currently, RMAN resource manager is not used. However, all the resource allocations happen through IRES interfaces:

`numResourceDescriptors()` - To understand the number of resources (HDVICP and buffers) needed by algorithm.

`getResourceDescriptors()` – To get the attributes of the resources.

`initResources()` - After resources are created, application gives the resources to algorithm through this API**.**

### 2.7.3 Process Call

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

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

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.

Implements the process call based on the non-blocking mode of operation explained in step 4. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 3.2.1.9). The inputs to the `process()`functions are input and output buffer descriptors, pointer to the `IVIDDEC3_InArgs` and `IVIDDEC3_OutArgs` structures.

On the call to the `process()` function for encoding/decoding a single frame of data, the software triggers the start of encode/decode. After triggering the start of the encode/decode frame, the video task can be put to `SEM-pend` state using semaphores. On receipt of interrupt signal at the end of frame encode/decode, the application releases the semaphore and resume the video task, which does any book-keeping operations by the codec and updates the output parameter of `IVIDDEC3_OutArgs` structure.

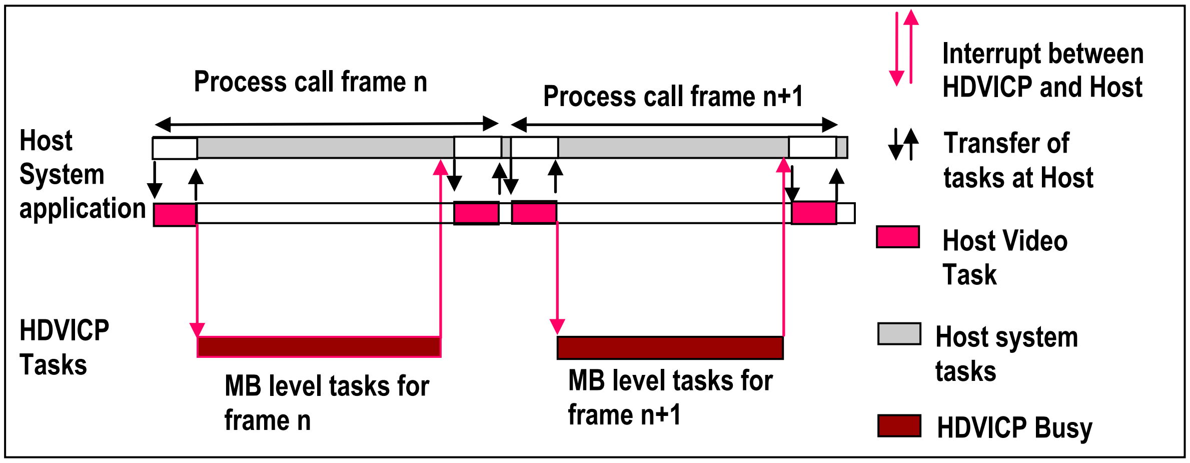


*Figure 2-2. Process call with Host release*

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 a sequence:

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

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

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

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

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

The do-while loop encapsulates picture 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. The test application does a cache invalidate for the valid input buffers before `process()` and a cache write back invalidate for output buffers after a `control()` call with `GET_STATUS` command.

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

### 2.7.4 Algorithm Instance Deletion

Once decoding/encoding is complete, the test application frees the memory resources and deletes the current algorithm instance. The following APIs are called in sequence:

`numResourceDescriptors()` - To get the number of resources and free them. If the application needs handles to the resources, it can call `getResourceDescriptors()`.

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

`algFree()` - To query the algorithm for memory, to free when removing an instance.

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.

## 2.8 Frame Buffer Management by Application

### 2.8.1 Frame Buffer Input and Output

With the new XDM, decoder does not ask for frame buffer at the time of `alg_create()`. It uses buffer from `XDM2_BufDesc  *outBufs`, which it reads during each decode process call. Hence, there is no distinction between DPB and display buffers. The framework needs to ensure that it does not overwrite the buffers that are locked by the codec.

```
H264VDEC_create();
H264VDEC_control(XDM_GETBUFINFO); /* Returns default 1080p
HD size */
do{
H264VDEC_decode(); //call the decode API
H264VDEC_control(XDM_GETBUFINFO); /* updates the memory
required as per the size parsed in stream header */
}
while(all frames)
```

**Note:**

- ❑ Application can take the information retured by the control function with the `XDM_GETBUFINFO` command and change the size of the buffer passed in the next process call.
- ❑ The output luma buffer size required is :
  `((width + (2*PADX))alligned to 128 byte bondary)*(height  + (4*PADY))`
  where `PADX =32` and `PADY = 24`. For chroma buffer, the height and PADY need to be halved. This assumes worst case padding requirement, That is, for inetrlaced coding. For the first `GETBUFINFO` call, `maxheight` and `maxwidth` are used for calculating buffer size. For subsequent `GETBUFINFO` calls (That is,

after the first process call, when the decoder gets to know the actual height and width from the headers) the actual height and with are used. Hence, this can be optionally used by the application to re allocate the buffer sizes, if required.

- Application can re-use the extra buffer space of the 1st frame, if the above control call returns a small size than that was provided.

The frame pointer given by the application and that returned by the algorithm may be different. `BufferID` (`InputID/outputID`) provides the unique ID to keep a record of the buffer given to the algorithm and released by the algorithm.

As explained above, buffer pointer cannot be used as a unique identifier to keep a record of frame buffers. Any buffer given to algorithm should be considered locked by algorithm, unless the buffer is returned to the application through `IVIDDEC3_OutArgs->freeBufID[]`.

**Note**:

`BufferID` returned in `IVIDDEC3_OutArgs ->outputID[]` is only for display purpose. Application should not consider it free unless it is a part of `IVIDDEC3_OutArgs->freeBufID[]`.

### 2.8.2 Frame Buffer Format

The frame buffer format to be used for both progressive and interlaced pictures is explained in the Appendix on Picture Format.

### 2.8.3 Address Translations

The buffers addresses (DDR addresses) as seen by Media Controller and IVA-HD (VDMA) will be different. Hence, address translations are needed to convert from one address view to another. The application implements a MEMUTILS function for this address translation ( which will be later implemented by the framework components). An example of the address translation function is as shown. The codec will make a call to this function from the host (Media Controller) library. Therefore, the function name and arguments will follow the example as shown in the following code snippet. For a given input address, the function returns the VDMA view of the buffer (that is, address as seen by HDVICP2).

```
void *MEMUTILS_getPhysicalAddr(Ptr Addr)
{
return ((void *)((unsigned int)Addr & VDMAVIEW_EXTMEM));
}
```

Sample settings for the macro `VDMAVIEW_EXTMEM` is as shown in the following code snippet.

```
#if defined(HOST_M3)
  #define VDMAVIEW_EXTMEM      (0xFFFFFFFF)
#else
  #define VDMAVIEW_EXTMEM      (0x07FFFFFF)
#endif
```

### 2.8.4 Frame Buffer Management by Application

The application framework can efficiently manage frame buffers by keeping a pool of free frames from which it gives the decoder empty frames on request.

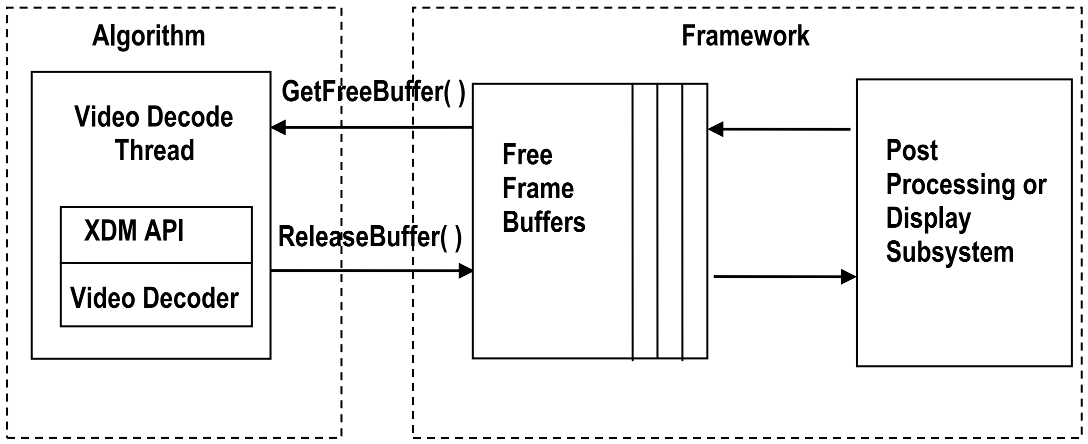


*Figure 2-3. Interaction of Frame Buffers Between Application and Framework*

The sample application also provides a prototype for managing frame buffers. It implements the following functions, which are defined in file TestApp_bufmanager.c provided along with test application.

- `BUFFMGR_Init()` - `BUFFMGR_Init` function is called by the test application to initialize the global buffer element array to default and to allocate the required number of memory data for reference and output buffers. The maximum required DPB size is defined by the supported profile and level.

- `BUFFMGR_ReInit()` - `BUFFMGR_ReInit` function allocates global luma and chroma buffers and allocates entire space to the first element. This element will be used in the first frame decode. After the picture height and width and its luma and chroma buffer requirements are obtained, the global luma and chroma buffers are re-initialized to other elements in the buffer array.

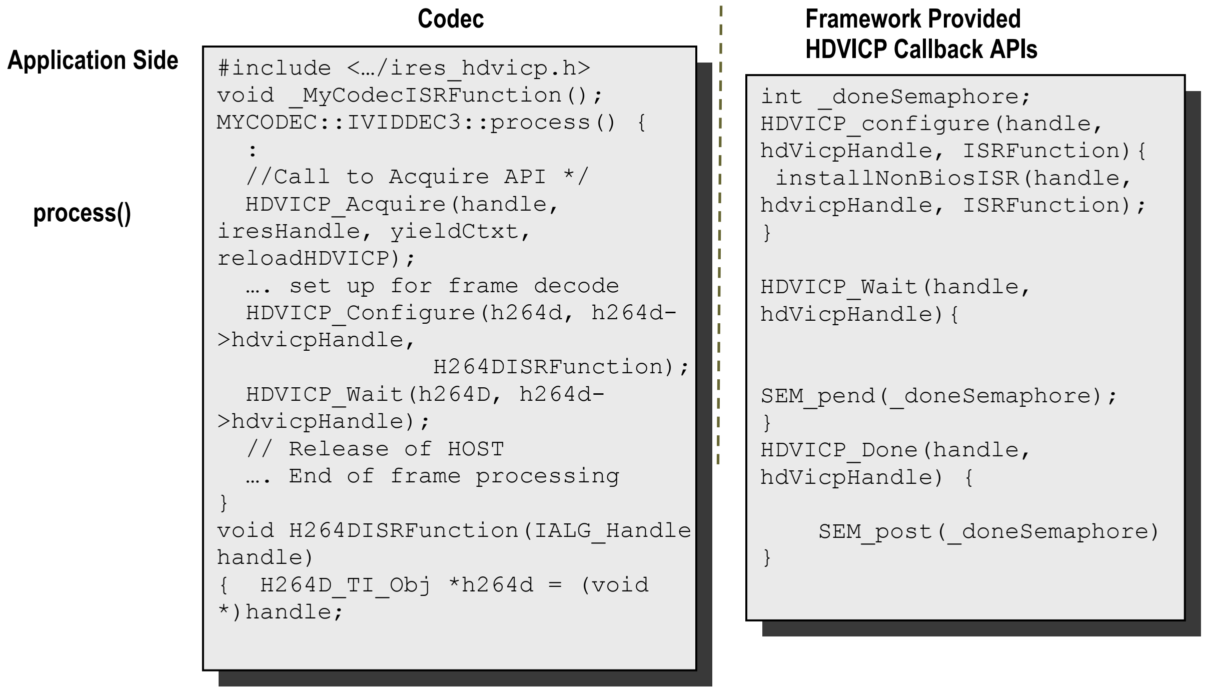
- `BUFFMGR_GetFreeBuffer()` - `BUFFMGR_GetFreeBuffer` function searches for a free buffer in the global buffer array and returns the address of that element. Incase none of the elements are free, then it returns `NULL`.

- `BUFFMGR_ReleaseBuffer()` - `BUFFMGR_ReleaseBuffer` function takes an array of buffer-IDs which are released by the test application. 0 is not a valid buffer ID, hence this function moves until it encounters a buffer ID as zero or it hits the `MAX_BUFF_ELEMENTS`.

- `BUFFMGR_DeInit()`- `BUFFMGR_DeInit` function releases all memory allocated by buffer manager.

## 2.9 Handshaking Between Application and Algorithm

Application provides the algorithm with its implementation of functions for the video task to move to `SEM-pend` state, when the execution happens in the co-processor. The algorithm calls these application functions to move the video task to `SEM-pend` state.



```
#include <…/ires_hdvicp.h>
void _MyCodecISRFunction();
MYCODEC::IVIDDEC3::process() {
  :
  //Call to Acquire API */
  HDVICP_Acquire(handle,
iresHandle, yieldCtxt,
reloadHDVICP);
  …. set up for frame decode
  HDVICP_Configure(h264d, h264d-
>hdvicpHandle,
               H264DISRFunction);
  HDVICP_Wait(h264D, h264d-
>hdvicpHandle);
  // Release of HOST
  …. End of frame processing
}
void H264DISRFunction(IALG_Handle
handle)
{  H264D_TI_Obj *h264d = (void
*)handle;
```

```
int _doneSemaphore;
HDVICP_configure(handle,
hdVicpHandle, ISRFunction){
 installNonBiosISR(handle,
hdvicpHandle, ISRFunction);
}

HDVICP_Wait(handle,
hdVicpHandle){


SEM_pend(_doneSemaphore);
}
HDVICP_Done(handle,
hdVicpHandle) {

    SEM_post(_doneSemaphore)
}
```

*Figure 2-4. Interaction Between Application and Codec*

**Note**:

- Process call architecture to share Host resource among multiple threads.
- ISR ownership is with the Host layer resource manager – outside the codec.
- The actual codec routine to be executed during ISR is provided by the codec.
- OS/System related calls (`SEM_pend, SEM_pos`t) also outside the codec.
- Codec implementation is OS independent.

The functions to be implemented by the application are:

- `void HDVICP_Acquire(IALG_Handle handle, IRES_HDVICP2_Handle iresHandle, IRES_YieldContext * yieldCtxt, Bool *reloadHDVICP)`

  This function is called by the algorithm to acquire the HDVICP2 resource.

- `HDVICP_Configure(IALG_Handle handle, IRES_HDVICP2_Handle iresHandle, void(*IRES_HDVICP2_CallbackFxn)(IALG_Handle handle, void *cbArgs), void *cbArgs)`

  This function is called by the algorithm to register its ISR function, which the application needs to call when it receives interrupts pertaining to the video task.

- `HDVICP_Wait (void *hdvicpHandle)`

  This function is called by the algorithm to move the video task to `SEM-pend` state.

- `HDVICP_Done (void *hdvicpHandle)`

  This function is called by the algorithm to release the video task from `SEM-pend` state. In the sample test application, these functions are implemented in hdvicp_framework.c file. The application can implement it in a way considering the underlying system.

- `Bool HDVICP_Reset(IALG_Handle handle, IRES_HDVICP2_Handle iresHandle).`

- This function is called by the algorithm to reset the HDVICP2 resource.

## 2.10 Sample Test Application

The test application exercises the `IVIDDEC3` base class of the H.264 Decoder.

*Table 2-1. Process() Implementation.*

```
/*Main Function acting as a client for Video Decode Call*/

  BUFFMGR_Init();


  TestApp_SetInitParams(&params.viddecParams);

  /*---------------- Decoder creation -----------------*/
  handle = (IALG_Handle) H264VDEC_create();

     /* Get Buffer information              */
  H264VDEC_control(handle, XDM_GETBUFINFO);


  /* Do-While Loop for Decode Call  for a given stream  */
    do
    {
/* Read the bitstream in the Application Input Buffer */
      validBytes = ReadByteStream(inFile);
```

```
       /* Get free buffer from buffer pool */
        buffEle = BUFFMGR_GetFreeBuffer();
/* Optional: Set Run-time parameters in the Algorithm via
control() */

     H264VDEC_control(handle, XDM_SETPARAMS);

/*-----------------------------------------------------*/
/* Start the process : To start decoding a frame      */
/*-----------------------------------------------------*/
      retVal = H264DEC_decodeFrame
            (
              handle,
              (XDM2_BufDesc *)&inputBufDesc,
              (XDM_BufDesc *)&outputBufDesc,
              (IVIDDEC3_InArgs *)&inArgs,
              (IVIDDEC3_OutArgs *)&outArgs
            );

     /* Get the statatus of the decoder using comtrol */
     H264VDEC_control(handle, IH264VDEC_GETSTATUS);

       /* Get Buffer information :      */
     H264VDEC_control(handle, XDM_GETBUFINFO);


      /* Optional: Reinit the buffer manager in case the
      /* frame size is different           */
     BUFFMGR_ReInit();

      /* Always release buffers - which are released from
      /* the algorithm side -back to the buffer manager
*/
       BUFFMGR_ReleaseBuffer((XDAS_UInt32
*)outArgs.freeBufID);


}  while(1);
/* end of Do-While loop - which decodes frames         */

ALG_delete (handle);

BUFFMGR_DeInit();
```

**Note**:

This sample test application does not depict the actual function parameter or control code. It shows the basic flow of the code.

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Chapter 3

# API Reference

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

## 3.1 Symbolic Constants and Enumerated Data Types

This section describes the XDM defined enumerated data types and H264 decoder specific enumerated data types.

*Table 3-1. 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 |
| | `IVIDEO_B_FRAME` | Bi-directional inter coded frame |
| | `IVIDEO_IDR_FRAME` | Intra coded frame that can be used for refreshing video content |
| | `IVIDEO_II_FRAME` | Interlaced Frame, both fields are I frames |
| | `IVIDEO_IP_FRAME` | Interlaced Frame, first field is an I frame, second field is a P frame |
| | `IVIDEO_IB_FRAME` | Interlaced Frame, first field is an I frame, second field is a B frame |
| | `IVIDEO_PI_FRAME` | Interlaced Frame, first field is a P frame, second field is a I frame |
| | `IVIDEO_PP_FRAME` | Interlaced Frame, both fields are P frames |
| | `IVIDEO_PB_FRAME` | Interlaced Frame, first field is a P frame, second field is a B frame |
| | `IVIDEO_BI_FRAME` | Interlaced Frame, first field is a B frame, second field is an I frame. |
| | `IVIDEO_BP_FRAME` | Interlaced Frame, first field is a B frame, second field is a P frame |
| | `IVIDEO_BB_FRAME` | Interlaced Frame, both fields are B frames |
| | `IVIDEO_MBAFF_I_FRAME` | Intra coded MBAFF frame |
| | `IVIDEO_MBAFF_P_FRAME` | Forward inter coded MBAFF frame |
| | `IVIDEO_MBAFF_B_FRAME` | Bi-directional inter coded MBAFF frame |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IVIDEO_MBAFF_IDR_FRAME` | Intra coded MBAFF frame that can be used for refreshing video content. |
| | `IVIDEO_FRAMETYPE_DEFAULT` | Default set to `IVIDEO_I_FRAME` |
| `IVIDEO_ContentType` | `IVIDEO_CONTENTTYPE_NA` | Content type is not applicable |
| | `IVIDEO_PROGRESSIVE` `IVIDEO_PROGRESSIVE_FRAME` | Progressive video content |
| | `IVIDEO_INTERLACED` `IVIDEO_INTERLACED_FRAME` | Interlaced video content |
| | `IVIDEO_INTERLACED_TOPFIELD` | Interlaced video content, Top field |
| | `IVIDEO_INTERLACED_BOTTOMFIELD` | Interlaced video content, Bottom field |
| | `IVIDEO_CONTENTTYPE_DEFAULT` | Default set to `IVIDEO_PROGRESSIVE` |
| `IVIDEO_FrameSkip` | `IVIDEO_NO_SKIP` | Do not skip the current frame. Default Value |
| | `IVIDEO_SKIP_P` | Skip forward inter coded frame. |
| | `IVIDEO_SKIP_B` | Skip bi-directional inter coded frame. |
| | `IVIDEO_SKIP_I` | Skip intra coded frame. |
| | `IVIDEO_SKIP_IP` | Skip I and P frame/field(s) |
| | `IVIDEO_SKIP_IB` | Skip I and B frame/field(s). |
| | `IVIDEO_SKIP_PB` | Skip P and B frame/field(s). |
| | `IVIDEO_SKIP_IPB` | Skip I/P/B/BI frames |
| | `IVIDEO_SKIP_IDR` | Skip IDR Frame |
| | `IVIDEO_SKIP_NONREFERENCE` | Skip non reference frame. |
| | `IVIDEO_SKIP_DEFAULT` | Default set to `IVIDEO_NO_SKIP` |
| `IVIDEO_VideoLayout` | `IVIDEO_FIELD_INTERLEAVED` | Buffer layout is interleaved. |
| | `IVIDEO_FIELD_SEPARATED` | Buffer layout is field separated. |
| | `IVIDEO_TOP_ONLY` | Buffer contains only top field. |

| **Group or Enumeration Class** | **Symbolic Constant Name** | **Description or Evaluation** |
|---|---|---|
| | `IVIDEO_BOTTOM_ONLY` | Buffer contains only bottom field |
| `IVIDEO_OperatingMode` | `IVIDEO_DECODE_ONLY` | Decoding Mode |
| | `IVIDEO_ENCODE_ONLY` | Encoding Mode |
| | `IVIDEO_TRANSCODE_FRAMELEVEL` | Transcode Mode of operation (encode/decode), which consumes /generates transcode information at the frame level. |
| | `IVIDEO_TRANSCODE_MBLEVEL` | Transcode Mode of operation (encode/decode), which consumes /generates transcode information at the MB level. |
| | `IVIDEO_TRANSRATE_FRAMELEVEL` | Transrate Mode of operation for encoder, which consumes transrate information at the frame level. |
| | `IVIDEO_TRANSRATE_MBLEVEL` | Transrate Mode of operation for encoder, which consumes transrate information at the MB level. |
| `IVIDEO_OutputFrameStatus` | `IVIDEO_FRAME_NOERROR` | Output buffer is available. |
| | `IVIDEO_FRAME_NOTAVAILABLE` | Codec does not have any output buffers. |
| | `IVIDEO_FRAME_ERROR` | Output buffer is available and corrupted. |
| | `IVIDEO_FRAME_OUTPUTSKIP` | The video frame was skipped (that is not decoded) |
| | `IVIDEO_OUTPUTFRAMESTATUS_DEFAULT` | Default set to `IVIDEO_FRAME_NOERROR` |
| `IVIDEO_PictureType` | `IVIDEO_NA_PICTURE` | Frame type not available |
| | `IVIDEO_I_PICTURE` | Intra coded picture |
| | `IVIDEO_P_PICTURE` | Forward inter coded picture |
| | `IVIDEO_B_PICTURE` | Bi-directional inter coded picture |
| `IVIDEO_DataMode` | `IVIDEO_FIXEDLENGTH` | Input to the decoder is in multiples of a fixed length (example, 4K) (input side for decoder) |
| | `IVIDEO_SLICEMODE` | Slice mode of operation (Input side for decoder). |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IVIDEO_NUMROWS` | Number of rows, each row is 16 lines of video (output side for decoder). |
| | `IVIDEO_ENTIREFRAME` | Processing of entire frame data |
| `IVIDEO_DecodeMode` | `IVIDEO_DECODE_ONLY` | Decoding mode. |
| | `IVIDEO_ENCODE_ONLY` | Encoding mode. |
| | `IVIDEO_TRANSCODE_FRAMELEVEL` | Transcode mode of operation encode/decode) which consumes/generates transcode information at the frame level. |
| | `IVIDEO_TRANSRATE_FRAMELEVEL` | Transcode mode of operation encode/decode) which consumes/generates transcode information at the MB level. |
| | `IVIDEO_TRANSRATE_MBLEVEL` | Transrate mode of operation encode/decode) which consumes/generates transcode information at the Frame level. |
| | `IVIDEO_TRANSCODE_MBLEVEL` | Transrate mode of operation encode/decode) which consumes/generates transcode information at the MB level. |
| `IVIDDEC3_displayDelay` | `IVIDDEC3_DISPLAY_DELAY_AUTO` | Decoder decides the display delay |
| | `IVIDDEC3_DECODE_ORDER` | Display frames are in decoded order without delay |
| | `IVIDDEC3_DISPLAY_DELAY_1` | Display the frames with 1 frame delay |
| | `IVIDDEC3_DISPLAY_DELAY_2` | Display the frames with 2 frame delay |
| | `IVIDDEC3_DISPLAY_DELAY_3` | Display the frames with 3 frame delay |
| | `IVIDDEC3_DISPLAY_DELAY_4` | Display the frames with 4 frame delay |
| | `IVIDDEC3_DISPLAY_DELAY_5` | Display the frames with 5 frame delay |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | IVIDDEC3_DISPLAY_DELAY_6 | Display the frames with 6 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_7 | Display the frames with 7 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_8 | Display the frames with 8 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_9 | Display the frames with 9 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_10 | Display the frames with 10 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_11 | Display the frames with 11 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_12 | Display the frames with 12 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_13 | Display the frames with 13 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_14 | Display the frames with 14 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_15 | Display the frames with 15 frame delay |
| | IVIDDEC3_DISPLAY_DELAY_16 | Display the frames with 16 frame delay |
| | IVIDDEC3_DISPLAYDELAY_DEFAULT | Same as IVIDDEC3_DISPLAY_DELAY_AUTO |
| XDM_DataFormat | XDM_BYTE | Big endian stream (default value) |
| | XDM_LE_16 | 16-bit little endian stream. |
| | XDM_LE_32 | 32-bit little endian stream. |
| | XDM_LE_64 | 64-bit little endian stream. |
| | XDM_BE_16 | 16-bit big endian stream. |
| | XDM_BE_32 | 32-bit big endian stream. |
| | XDM_BE_64 | 64-bit big endian stream. |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| `XDM_ChromaFormat` | `XDM_YUV_420P` | YUV 4:2:0 planar. |
| | `XDM_YUV_422P` | YUV 4:2:2 planar. |
| | `XDM_YUV_422IBE` | YUV 4:2:2 interleaved (big endian). |
| | `XDM_YUV_422ILE` | YUV 4:2:2 interleaved (little endian) (default value). |
| | `XDM_YUV_444P` | YUV 4:4:4 planar. |
| | `XDM_YUV_411P` | YUV 4:1:1 planar. |
| | `XDM_GRAY` | Gray format. |
| | `XDM_RGB` | RGB color format. |
| | `XDM_YUV_420SP` | YUV 4:2:0 chroma semi-planar |
| | `XDM_ARGB8888` | ARGB8888 color format. |
| | `XDM_RGB555` | RGB555 color format. |
| | `XDM_RGB565` | RGB565 color format. |
| | `XDM_YUV_444ILE` | YUV 4:4:4 interleaved (little endian) color format. |
| `XDM_MemoryType` | `XDM_MEMTYPE_ROW` | Raw Memory Type |
| | `XDM_MEMTYPE_TILED8` | 2D memory in 8-bit container of tiled memory space |
| | `XDM_MEMTYPE_TILED16` | 2D memory in 16-bit container of tiled memory space |
| | `XDM_MEMTYPE_TILED32` | 2D memory in 32-bit container of tiled memory space |
| | `XDM_MEMTYPE_TILEDPAGE` | 2D memory in page container of tiled memory space |
| `XDM_CmdId` | `XDM_GETSTATUS` | Query algorithm instance to fill `Status` structure |
| | `XDM_SETPARAMS` | Set run-time dynamic parameters via the `DynamicParams` structure |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `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 |
| | `XDM_GETVERSION` | Query the algorithm's version. The result will be returned in the data field of the Status structure. Application has to allocate memory for a buffer passed through data field. The minimum buffer size required is 50 bytes. |
| | `XDM_GETCONTEXTINFO` | Query a split codec part for its context needs. Not supported in this version of H264 Decoder. |
| | `XDM_GETDYNPARAMSDEFAULT` | Query algorithm instance regarding the dynamic parameters default values |
| `XDM_AccessMode` | `XDM_ACCESSMODE_READ` | The algorithm read from the buffer using the CPU. |
| | `XDM_ACCESSMODE_WRITE` | The algorithm wrote from the buffer using the CPU |
| `XDM_ErrorBit` | `XDM_APPLIEDCONCEALMENT` | Bit 9<br>❑ 1 - applied concealment<br>❑ 0 - Ignore |
| | `XDM_INSUFFICIENTDATA` | Bit 10<br>❑ 1 - Insufficient data<br>❑ 0 - Ignore |
| | `XDM_CORRUPTEDDATA` | Bit 11<br>❑ 1 - Data problem/corruption<br>❑ 0 - Ignore |
| | `XDM_CORRUPTEDHEADER` | Bit 12<br>❑ 1 - Header problem/corruption<br>❑ 0 - Ignore |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `XDM_UNSUPPORTEDINPUT` | Bit 13<br>❑ 1 - Unsupported feature/parameter in input<br>❑ 0 - Ignore |
| | `XDM_UNSUPPORTEDPARAM` | Bit 14<br>❑ 1 - Unsupported input parameter or configuration<br>❑ 0 - Ignore |
| | `XDM_FATALERROR` | Bit 15<br>❑ 1 - Fatal error<br>❑ 0 - Recoverable error |
| `IVIDEO_MetadataType` | `IVIDEO_METADATAPLANE_NONE` | Used to indicate that no metadata is requested or available |
| | `IVIDEO_METADATAPLANE_MBINFO` | Used to indicate that MB info metadata is requested or available |
| | `IVIDEO_METADATAPLANE_EINFO` | Used to indicate that the Error info metadata is requested or available |
| | `IVIDEO_METADATAPLANE_ALPHA` | Used to indicate that Alpha metadata is requested or available |
| `IVIDEO_BitRange` | `IVIDEO_YUVRANGE_FULL` | Pixel range for YUV is 0-255 |
| | `IVIDEO_YUVRANGE_ITU` | Pixel range for YUV is as per ITU-T |
| `IH264VDEC_dpbNumFrames` | `IH264VDEC_DPB_NUMFRAMES_AUTO` | Allow the decoder to choose the dpb size based on level at which decoder is created. |
| | `IH264VDEC_DPB_NUMFRAMES_0` | DPB size in frames is 0 |
| | `IH264VDEC_DPB_NUMFRAMES_1` | DPB size in frames is 1 |
| | `IH264VDEC_DPB_NUMFRAMES_2` | DPB size in frames is 2 |
| | `IH264VDEC_DPB_NUMFRAMES_3` | DPB size in frames is 3 |
| | `IH264VDEC_DPB_NUMFRAMES_4` | DPB size in frames is 4 |
| | `IH264VDEC_DPB_NUMFRAMES_5` | DPB size in frames is 5 |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IH264VDEC_DPB_NUMFRAMES_6` | DPB size in frames is 6 |
| | `IH264VDEC_DPB_NUMFRAMES_7` | DPB size in frames is 7 |
| | `IH264VDEC_DPB_NUMFRAMES_8` | DPB size in frames is 8 |
| | `IH264VDEC_DPB_NUMFRAMES_9` | DPB size in frames is 9 |
| | `IH264VDEC_DPB_NUMFRAMES_10` | DPB size in frames is 10 |
| | `IH264VDEC_DPB_NUMFRAMES_11` | DPB size in frames is 11 |
| | `IH264VDEC_DPB_NUMFRAMES_12` | DPB size in frames is 12 |
| | `IH264VDEC_DPB_NUMFRAMES_13` | DPB size in frames is 13 |
| | `IH264VDEC_DPB_NUMFRAMES_14` | DPB size in frames is 14 |
| | `IH264VDEC_DPB_NUMFRAMES_15` | DPB size in frames is 15 |
| | `IH264VDEC_DPB_NUMFRAMES_16` | DPB size in frames is 16 |
| | `IH264VDEC_DPB_NUMFRAMES_DEFAULT` | `IH264VDEC_DPB_NUMFRAMES_AUTO` |
| `IH264VDEC_ErrorBit` | `IH264VDEC_ERR_NOSLICE` | Bit 0<br>❑ 1 - No error-free slice header detected in the frame<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_SPS` | Bit 1<br>❑ 1 - Error in SPS parsing<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_PPS` | Bit 2<br>❑ 1 - Error during in parsing<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_SLICEHDR` | Bit 3<br>❑ 1 - Error in slice header parsing<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_MBDATA` | Bit 4<br>❑ 1 - Error in MB data parsing<br>❑ 0 - Ignore |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IH264VDEC_ERR_UNAVAILABLESPS` | Bit 5<br>❑ 1 - SPS rferred in the header is not available.<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_UNAVAILABLEPPS` | Bit 6<br>❑ 1 - PPS rferred in the header is not available<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_INVALIDPARAM_IGNORE` | Bit 7<br>❑ 1 - Invalid Parameter<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_UNSUPPFEATURE` | Bit 16<br>❑ 1 - Unsupported feature<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_METADATA_BUFOVERFLOW` | Bit 17<br>❑ 1 - Metadata Buffer overflow detected<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_STREAM_END` | Bit 18<br>❑ 1 - End of stream reached<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_NO_FREEBUF` | Bit 19<br>❑ 1 - No free buffers available for reference storing reference frame<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_PICSIZECHANGE` | Bit 20<br>❑ 1 - Change in resolution detected<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_UNSUPPRESOLUTION` | Bit 21<br>❑ 1 - Unsupported resolution by the decoder<br>❑ 0 - ignore |
| | `IH264VDEC_ERR_NUMREF_FRAMES` | Bit 22<br>❑ 1 - `maxNumRefFrames` parameter is not compliant to stream properties (does not comply to stream requirements).<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_INVALID_MBOX_MESSAGE` | Bit 23<br>❑ 1 - Invalid (unexpected) mail box message recieved by HDVICP2<br>❑ 0 - Ignore |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IH264VDEC_ERR_DATA_SYNC` | Bit 24<br>❑ 1 - In datasync enable mode, the input supplied is wrong<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_MISSINGSLICE` | Bit 25<br>❑ 1 - Missing slice in a frame<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_INPUT_DATASYNC_PARAMS` | Bit 26<br>❑ 1 - Input datasync enable mode, the input parameter is wrong<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_HDVICP2_IMPROPER_STATE` | Bit 27<br>❑ 1 - HDVICP2 standby failed or couldn't turn-on/off the IP's clock or HDVICP reset failed<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_TEMPORAL_DIRECT_MODE` | Bit 28<br>❑ 1 - Temporal direct mode is present in the bits stream when disableTemporalDirect parameter is set<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_DISPLAYWIDTH` | Bit 29<br>❑ 1 - DisplayWidth is less than the Image width + Padded width<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_NOHEADER` | Bit 30<br>❑ 1 - No SPS/PPS header is decoded in the current process call when in PARSE_HEADER mode (or) No watermark SEI data when watermark parameter is enabled.<br>❑ 0 - Ignore |
| | `IH264VDEC_ERR_GAPSINFRAMENUM` | Bit 31<br>❑ 1 - Indicates that a gap is detected in frame_num<br>❑ 0 - Ignore |
| `IH264VDEC_MetadataType` | `IH264VDEC_PARSED_SEI_DATA` | Write out Parsed SEI data |
| | `IH264VDEC_ENCODED_SEI_DATA` | Write out Encoded (compressed) SEI data (Not supported) |

| Group or Enumeration Class | Symbolic Constant Name | Description or Evaluation |
|---|---|---|
| | `IH264VDEC_PARSED_VUI_DATA` | Write out Parsed VUI data |
| | `IH264VDEC_ENCODED_VUI_DATA` | Write out Encoded (compressed) VUI data (Not supported) |
| `IH264VDEC_deblockFilterMode` | `IH264VDEC_DEBLOCK_DISABLE_NONE` | Perform de-blocking across all edges |
| | `IH264VDEC_DEBLOCK_DISABLE_ALL` | Disable de-blocking across all edges |
| | `IH264VDEC_DEBLOCK_DISABLE_SLICE_EDGE` | Disable de-blocking only at slice edges. Internal to slice, edges are deblocked. |
| | `IH264VDEC_DEBLOCK_DEFAULT` | Perform de-blocking as controlled by disable_deblocking_filter_idc of the bit-stream |
| `IH264VDEC_temporalDirModePred` | `IH264VDEC_DISABLE_TEMPORALDIRECT` | Do not decode slice with temporal direct |
| | `IH264VDEC_ENABLE_TEMPORALDIRECT` | Decode slice with temporal direct |
| `IH264VDEC_bitStreamFormat` | `IH264VDEC_BYTE_STREAM_FORMAT` | Input data is in Byte stream format (stream with start code). |
| | `IH264VDEC_NAL_UNIT_FORMAT` | Input data is in NAL stream format (No start code) |
| `IH264VDEC_ mbErrStatus` | `IH264VDEC_MB_NOERROR` | MB was non-erroneous |
| | `IH264VDEC_MB_ERROR` | MB was erroneous |

| **Group or Enumeration Class** | **Symbolic Constant Name** | **Description or Evaluation** |
|---|---|---|
| `IH264VDEC_svcExtension` | `IH264VDEC_DISABLE_SVCEXTENSION` | Do not support SVC extension |
| | `IH264VDEC_ENABLE_SVCEXTENSION` | Support SVC extension |
| `IH264VDEC_enableDualOutput` | `IH264VDEC_DUALOUTPUT_DISABLE` | Disable dual YUV output |
| | `IH264VDEC_DUALOUTPUT_ENABLE` | Enable dual YUV output |
| `IH264VDEC_decodeFrameType` | `IH264VDEC_DECODE_ALL` | Enable decoding of all frame types |
| | `IH264VDEC_DECODE_IP_ONLY` | Enable decoding all only I/IDR and P frame types |
| | `IH264VDEC_DECODE_I_ONLY` | Enable decoding of only I/IDR frame types |

## 3.2 Data Structures

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

### 3.2.1 Common XDM Data Structures

This section includes the following common XDM data structures:

- `XDM2_SingleBufDesc`
- `XDM2_BufDesc`
- `XDM1_AlgBufInfo`
- `IVIDEO2_BufDesc`
- `IVIDDEC3_Fxns`
- `IVIDDEC3_Params`
- `IVIDDEC3_DynamicParams`
- `IVIDDEC3_InArgs`
- `IVIDDEC3_Status`
- `IVIDDEC3_OutArgs`

#### 3.2.1.1 XDM2_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 |
| `memType` | `XDAS_Int16` | Input | Type of memory. See `XDM_MemoryType` enumeration for more details. |
| `usageMode` | `XDAS_Int16` | Input | Memory usage descriptor: This field is set by the the buffer owner (typically the application), and read by users of the buffer (including the algorithm). See `XDM_MemoryUsageMode` enumeration for more details. |
| `bufSize` | `XDM2_BufSize` | Input | Size of the buffer(for tile memory/row memory) |
| `accessMask` | `XDAS_Int32` | Output | Mask filled by the algorithm, declaring how the buffer was accessed by the algorithm processor. |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| | | | If the buffer was not accessed by the algorithm processor (for example, it was filled through DMA or other hardware accelerator that does not write through the algorithm's CPU), then bits in this mask should not be set.<br>It is acceptable to set several bits in this mask, if the algorithm accessed the buffer in several ways.<br>This mask is used by the application and/or framework to manage cache on cache-based systems.<br>See `XDM_AccessMode` enumeration in Table 3-1 for more details. |

### *3.2.1.2 XDM2_BufSize*

**‖ Description**

This defines the union describing a buffer size.

**‖ Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `tileMem` | `tileMem` | input | Structure having the size parameters for TILER memory/ |
| `bytes` | `XDM2_BufSize` | Input | Size of the buffer in bytes |

### *3.2.1.3 tileMem*

**‖ Description**

This defines the TILER memory attributes.

**‖ Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `width` | `XDAS_Int32` | Input | Width of buffer in 8-bit bytes.<br>Required only for tile memory. |
| `height` | `XDAS_Int32` | Input | Height of buffer in 8-bit bytes.<br>Required only for tile memory. |

### 3.2.1.4 XDM2_BufDesc

**‖ Description**

This structure defines the buffer descriptor for output buffers.

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numBufs` | `XDAS_Int32` | Input | Number of buffers |
| `descs[XDM_MAX_IO_BUFFERS]` | `XDM2_SingleBufDesc` | Input | Array of buffer descriptors |

### 3.2.1.5 XDM1_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]` | `XDM2_BufSize` | Output | Size required for each input buffer |
| `minOutBufSize[XDM_MAX_IO_BUFFERS]` | `XDM2_BufSize` | Output | Size required for each output buffer |
| `inBufMemoryType[XDM_MAX_IO_BUFFERS]` | `XDAS_Int32` | Output | Memory type for each input buffer |
| `outBufMemoryType[XDM_MAX_IO_BUFFERS]` | `XDAS_Int32` | Output | Memory type for each output buffer |
| `minNumBufSets` | `XDAS_Int32` | Output | Minimum number of buffer sets for buffer management. Not supported in this version of decoder. |

**Note:**

- For H264 High Profile Decoder, the buffer details are:
- Number of input buffer required is 1.

- ❑ Number of output buffer required is 2. If no metadata is requested by the application (one for Y plane and 1 for cb and cr)
- ❑ If metadata is requested by the application, then See Appendix B for buffer details.
- ❑ For frame mode of operation, there is no restriction on input buffer size except that it should contain atleast one frame of encoded data. See picture format spec for more details on width and height needed for an image

#### *3.2.1.6 IVIDEO2_BufDesc*

**‖ Description**

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

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numPlanes` | `XDAS_Int32` | Input/Output | Number of buffers for video planes |
| `numMetaPlanes` | `XDAS_Int32` | Input/Output | Number of buffers for Metadata |
| `dataLayout` | `XDAS_Int32` | Input/ Output | Video buffer layout. See `IVIDEO_VideoLayout` enumeration for more details |
| `planeDesc [IVIDEO_MAX_NUM_PLANES]` | `XDM2_SingleBufDesc` | Input/ Output | Plane Descriptor for video planes |
| `metadataPlaneDesc [IVIDEO_MAX_NUM_METADATA_PLANES]` | `XDM2_SingleBufDesc` | Input/ Output | Plane Descriptor for metadata planes |
| `secondFieldOffsetWidth[IVIDEO_MAX_NUM_PLANES]` | `XDAS_Int32` | Input/ Output | Off set value for second field in `planeDesc` buffer (width in pixels) |
| `secondFieldOffsetHeight[IVIDEO_MAX_NUM_PLANES]` | `XDAS_Int32` | Input/ Output | Off set value for second field in `planeDesc` buffer (height in lines) |
| `imagePitch [IVIDEO_MAX_NUM_PLANES]` | `XDAS_Int32` | Input/ Output | Image pitch for each plane. |
| `imageRegion` | `XDM_Rect` | Input/ Output | Decoded image region including padding /encoder input image |
| `activeFrameRegion` | `XDM_Rect` | Input/ Output | Actual display region/capture region |
| `extendedError` | `XDAS_Int32` | Input/ Output | Provision for informing the error type if any |
| `frameType` | `XDAS_Int32` | Input/ Output | Video frame types. See enumeration `IVIDEO_FrameType`. |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| | | | |
| `topFieldFirstFlag` | `XDAS_Int32` | Input/ Output | Indicates when the application (should display)/(had captured) the top field first.<br>Not applicable for progressive content. |
| `repeatFirstFieldFlag` | `XDAS_Int32` | Input/ Output | Indicates when the first field should be repeated. |
| `frameStatus` | `XDAS_Int32` | Input/ Output | Video in/out buffer status. |
| `repeatFrame` | `XDAS_Int32` | Input/ Output | Number of times to repeat the displayed frame. |
| `contentType` | `XDAS_Int32` | Input/ Output | Video content type. See `IVIDEO_ContentType` |
| `chromaFormat` | `XDAS_Int32` | Input/ Output | Chroma format for encoder input data/decoded output buffer. See `XDM_ChromaFormat` enumeration for details. |
| `scalingWidth` | `XDAS_Int32` | Input/ Output | Scaled image width for post processing for decoder. |
| `scalingHeight` | `XDAS_Int32` | Input/ Output | Scaled image height for post processing for decoder. |
| `rangeMappingLuma` | `XDAS_Int32` | Input/ Output | Applicable for VC1, set to -1 as default for other codecs |
| `rangeMappingChroma` | `XDAS_Int32` | Input/ Output | Applicable for VC1, set to -1 as default for other codecs |
| `enableRangeReductionFlag` | `XDAS_Int32` | Input/ Output | ON/OFF, default is OFF.<br>Applicable only for VC1. |

**Note:**

`IVIDEO_MAX_NUM_PLANES:`

- Max YUV buffers - one for Y and one for UV
- The following parameters are not supported/updated in this version of the decoder
  - `repeatFirstFieldFlag`
  - `repeatFrame`
  - `scalingWidth`
  - `scalingHeight`

- `rangeMappingLuma`
- `rangeMappingChroma`
- `enableRangeReductionFlag`

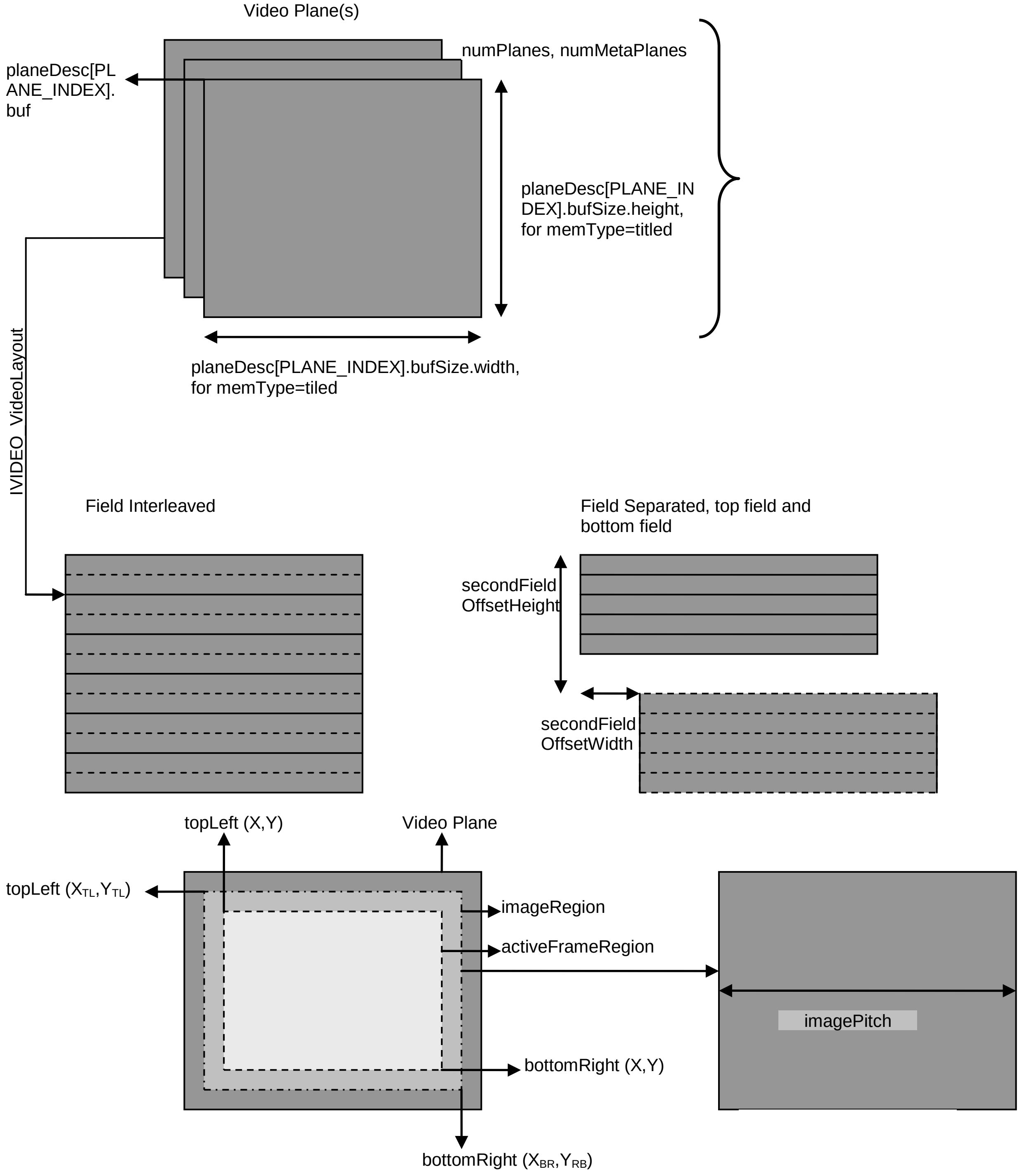
Video Plane(s)
numPlanes, numMetaPlanes
planeDesc[PLANE_INDEX].buf
planeDesc[PLANE_INDEX].bufSize.height, for memType=titled
planeDesc[PLANE_INDEX].bufSize.width, for memType=tiled
IVIDEO_VideoLayout
Field Interleaved
Field Separated, top field and bottom field
secondFieldOffsetHeight
secondFieldOffsetWidth
topLeft (X,Y)
Video Plane
topLeft ($X_{TL}$,$Y_{TL}$)
imageRegion
activeFrameRegion
imagePitch
bottomRight (X,Y)
bottomRight ($X_{BR}$,$Y_{RB}$)

*Figure 3-5. IVIDEO2_BufDesc With Associated Parameters*

### *3.2.1.7 IVIDDEC3_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.<br><br>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 |

### *3.2.1.8 IVIDDEC3_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. |
| `maxHeight` | `XDAS_Int32` | Input | Maximum video height to be supported in pixels |
| `maxWidth` | `XDAS_Int32` | Input | Maximum video width to be supported in pixels |
| `maxFrameRate` | `XDAS_Int32` | Input | Maximum frame rate in fps * 1000 to be supported. |
| `maxBitRate` | `XDAS_Int32` | Input | Maximum bit-rate to be supported in bits per second. For example, if bit-rate is 10 Mbps, set this field to 10485760. |
| `dataEndianness` | `XDAS_Int32` | Input | Endianness of input data. See `XDM_DataFormat` enumeration for details. |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `forceChromaFormat` | `XDAS_Int32` | Input | Sets the output to the specified format. Only 420 semi-planar format supported currently. For example, if the output should be in YUV 4:2:2 interleaved (little endian) format, set this field to `XDM_YUV_422ILE`.<br><br>See `XDM_ChromaFormat` and `eChromaFormat_t` enumerations for details. |
| `operatingMode` | `XDAS_Int32` | Input | Video coding mode of operation (encode/decode/transcode/transrate). |
| `displayDelay` | `XDAS_Int32` | Input | Display delay to start display. |
| `inputDataMode` | `XDAS_Int32` | Input | Input mode of operation.<br>For decoder, it is fixed length/slice mode/entire frame. |
| `outputDataMode` | `XDAS_Int32` | Input | Output mode of operation.<br>For decoder, it is row mode/entire frame.<br>. |
| `numInputDataUnits` | `XDAS_Int32` | Input | Number of input slices/rows.<br>. |
| `numOutputDataUnits` | `XDAS_Int32` | Input | Number of output slices/rows. |
| `errorInfoMode` | `XDAS_Int32` | Input | Enable/disable packet error information for input/output |
| `displayBufsMode` | `XDAS_Int32` | Input | Indicates the `displayBufs` mode. This field can be set either as `IVIDDEC3_DISPLAYBUFS_EMBEDDED` or `IVIDDEC3_DISPLAYBUFS_PTRS`. |
| `metadataType[IVIDEO_MAX_NUM_METADATA_PLANES]` | `XDAS_Int32` | Input | Type of each metadata plane. See `IVIDEO_MetadataType and IH264VDEC_MetadataType` enmumeration for details. |

### 3.2.1.9 IVIDDEC3_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. |
| `decodeHeader` | `XDAS_Int32` | Input | Number of access units to decode:<br>❑ 0 (`XDM_DECODE_AU`) - Decode entire frame including all the headers<br>❑ 1 (`XDM_PARSE_HEADER`) - Decode only one NAL unit |
| `displayWidth` | `XDAS_Int32` | Input | If the field is set to:<br>❑ 0 - Uses decoded image width as pitch<br>❑ If any other value greater than the decoded image width is given, then this value in pixels is used as pitch. |
| `frameSkipMode` | `XDAS_Int32` | Input | Frame skip mode. See `IVIDEO_FrameSkip` enumeration for details. |
| `newFrameFlag` | `XDAS_Int32` | Input | Flag to indicate that the algorithm should start a new frame.<br>Valid values are `XDAS_TRUE` and `XDAS_FALSE`.<br>This is useful for error recovery, for example, when the end of frame cannot be detected by the codec but is known to the application. |
| `*putDataFxn` | `XDM_DataSyncPutFxn` | Input | Function pointer to produce data at sub-frame level `(DataSync` call back function pointer for `putData)` |
| `putDataHandle` | `XDM_DataSyncHandle` | Input | Handle that identifies the data sync FIFO and is passed as argument to `putData` calls |
| `*getDataFxn` | `XDM_DataSyncGetFxn` | Input | Function pointer to receive data at sub-frame level (`DataSync` call back function pointer for `getData)` |
| `getDataHandle` | `XDM_DataSyncHandle` | Input | Handle that identifies the data sync FIFO and is passed as argument to `getData` calls |
| `putBufferFxn` | `XDM_DataSyncPutBufferFxn` | Input | Function pointer to receive buffer at sub-frame level (Not used by the this version of the decoder) |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| putBufferHandle | XDM_DataSyncHandle | Input | Handle that identifies the data sync FIFO and is passed as argument to getBufferFxn calls(Not used by the this version of the decoder) |
| lateAcquireArg | XDAS_Int32 | Input | Argument used during late acquire. If the codec supports late acquisition of resources,and the application has supplied a lateAcquireArg value (via #XDM_SETLATEACQUIREARG), then the codec must also provide this lateAcquireArg value when requesting resources (i.e. during their call to acquire() when requesting the resource). |

### 3.2.1.10 IVIDDEC3_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. |
| numBytes | XDAS_Int32 | Input | Size of input data (in bytes) provided to the algorithm for decoding |
| inputID | XDAS_Int32 | Input | Application passes this ID to algorithm and decoder will attach this ID to the corresponding output frames. This is useful in case of re-ordering (for example, B frames). If there is no re-ordering, outputID field in the IVIDDEC3_OutArgs data structure will be same as inputID field. |

**Note:**

H264 Decoder copies the inputID value to the outputID value of IVIDDEC3_OutArgs structure after factoring in the display delay.

### 3.2.1.11 IVIDDEC3_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 IH264VDEC_ErrorBit` enumerations for details. |
| `data` | `XDM1_SingleBufDesc` | Output | Buffer information structure for information passing buffer. This is not populated by this version of the decoder. |
| `maxNumDisplayBufs` | `XDAS_Int32` | Output | Maximum number of buffers required by the codec. |
| `maxOutArgsDisplayBufs` | `XDAS_Int32` | Output | The maximum number of display buffers that can be returned through `IVIDDEC3_OutArgs.displayBufs`. |
| `outputHeight` | `XDAS_Int32` | Output | Output height in pixels |
| `outputWidth` | `XDAS_Int32` | Output | Output width in pixels |
| `frameRate` | `XDAS_Int32` | Output | This value will be derived from VUI parameters as, `frameRate = (time_scale / (2 * num_units_in_ticks)) * 1000.` In case the VUI parameters are absent, the `frameRate` will be reported as 0, which should be inferred as 'not available'. |
| `bitRate` | `XDAS_Int32` | Output | Average bit-rate in bits per second |
| `contentType` | `XDAS_Int32` | Output | Video content. See `IVIDEO_ContentType` enumeration for details. |
| `sampleAspectRatioHeight` | `XDAS_Int32` | Output | Sample aspect ratio for height |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| sampleAspectRatioWidth | XDAS_Int32 | Output | Sample aspect ratio for width |
| bitRange | XDAS_Int32 | Output | Bit range. It is set to IVIDEO_YUVRANGE_FULL. |
| forceChromaFormat | XDAS_Int32 | Output | Output chroma format. See XDM_ChromaFormat and eChromaFormat_t enumeration for details. |
| operatingMode | XDAS_Int32 | Output | Mode of operation: Encoder/Decoder/Transcode/Transrate. It is set to IVIDEO_DECODE_ONLY. |
| frameOrder | XDAS_Int32 | Output | Indicates the output frame order. See IVIDDEC3_displayDelay enumeration for more details. |
| inputDataMode | XDAS_Int32 | Output | Input mode of operation.<br>For decoder, it is fixed length/slice mode/entire frame.<br>See IVIDEO_DataMode enumeration for more details.<br><br>This version of the decoder supports only the fixed length and entire frame mode. |
| outputDataMode | XDAS_Int32 | Output | Output mode of operation.<br>For decoder, it is the row mode/entire frame.<br>See IVIDEO_DataMode enumeration for more details.<br><br>This version of the decoder supports only the entire frame mode. |
| bufInfo | XDM1_AlgBufInfo | Output | Input and output buffer information. See XDM1_AlgBufInfo data structure for details. |
| numInputDataUnits | XDAS_Int32 | Output | Number of input slices/rows. Units depend on the inputDataMode, like number of slices/rows/blocks etc.<br>Ignore if inputDataMode is set to full frame mode. |
| numOutputDataUnits | XDAS_Int32 | Output | Number of output slices/rows. Units depend on the outputDataMode, like number of slices/rows/blocks etc. Ignore if outputDataMode is set to full frame mode. |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `configurationID` | `XDAS_Int32` | Output | Configuration ID of given codec is based on the input stream and can be used by the framework to optimize the save/restore overhead of any resources used. |
| `metadataType[IVIDEO_MAX_NUM_METADATA_PLANES]` | `XDAS_Int32` | Output | Type of each metadata plane. See the enum `IVIDEO_MetadataType`. |
| `decDynamicParams` | `IVIDDEC3_DynamicParams` | Output | Current values of the decoder's dynamic parameters. |

**Note:**

- Algorithm sets the `bitRate` field to a default value 10485760.
- H264 Decoder will not use the buffer descriptor meant for passing additional information between the application and the decoder.
- `sampleAspectRatioWidth` and `sampleAspectRatioHeight` are set to 0, if vui parameters are not present.
- `frameOrder` field in the status structure is set to the actual display delay value used by the decoder, which is minimum of `maxNumRefFrames`, and `displayDelay`.

#### 3.2.1.12 IVIDDEC3_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 | `extendedError` Field |
| `bytesConsumed` | `XDAS_Int32` | Output | Bytes consumed per decode call |
| `outputID[IVIDEO2_MAX_IO_BUFFERS]` | `XDAS_Int32` | Output | Output ID corresponding to `displayBufs` A value of zero (0) indicates an invalid ID. The first zero entry in array will indicate end of valid `outputID`s within the array. Hence, the application can stop reading the array when it encounters the |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| | | | first zero entry. |
| decodedBufs | IVIDEO2_BufDesc | Output | The decoder fills this structure with buffer pointers to the decoded frame. Related information fields for the decoded frame are also populated.<br>When frame decoding is not complete, as indicated by outBufsInUseFlag, the frame data in this structure will be incomplete. However, the algorithm will provide incomplete decoded frame data in case application may choose to use it for error recovery purposes. |
| freeBufID[IVIDEO2_MAX_IO_BUFFERS] | XDAS_Int32 | Output | This is an array of inputIDs corresponding to the frames that have been unlocked in the current process call. |
| outBufsInUseFlag | XDAS_Int32 | Output | Flag to indicate that the outBufs provided with the process() call are in use. No outBufs are required to be supplied with the next process() call. |
| displayBufsMode | XDAS_Int32 | Output | Indicates which mode the displayBufs are presented in. See the note below for details. |
| bufDesc [1] | IVIDEO2_BufDesc | Output | Array containing display frames corresponding to valid ID entries in the outputID array.<br>See IVIDEO2_BufDesc data structure for more details |
| *pBufDesc[IVIDEO2_MAX_IO_BUFFERS] | IVIDEO2_BufDesc * | Output | Array containing pointers to display frames corresponding to valid ID entries in the @c outputID[]. The parameters . bufDesc[1] and * pBufDesc[IVIDEO2_MAX_IO_BUFFERS] form a union and hence only one of them need to be used. |

**Note:**

IVIDEO2_MAX_IO_BUFFERS - Maximum number of I/O buffers set to 20.

The display buffer mode can be set as either IVIDDEC3_DISPLAYBUFS_EMBEDDED or IVIDDEC3_DISPLAYBUFS_PTRS.

The current implementation of the decoder will always return a maximum of one display buffer per process call. If the mode is IVIDDEC3_DISPLAYBUFS_EMBEDDED, then the instance of the display buffer structure will be present in OutArgs. If the mode is IVIDDEC3_DISPLAYBUFS_PTRS, then a pointer to the instance will be present in OutArgs,

### *3.2.1.13 XDM_Point*

**|| Description**

This structure specifies the two dimensional point.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| X | XDAS_Int32 | Input | X field of the frame |
| Y | XDAS_Int32 | Input | Y field of the frame |

### *3.2.1.14 XDM_Rect*

**|| Description**

This structure defines the region in the image that is decoded

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| topLeft | XDM_Point | Input | Top left corner of the frame.<br>See XDM_Point data structure for details. |
| bottomRight | XDM_Point | Input | Bottom right corner of the frame.<br>See XDM_Point data structure for details. |

### *3.2.1.15 XDM_DataSyncDesc*

**|| Description**

This structure provides the descriptor for the chunk of data being transferred in one call to putData or getData.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| size | XDAS_Int32 | Input/Output | Size of this structure |
| scatteredBlocksFlag | XDAS_Int32 | Input/Output | Flag indicating whether the individual data blocks may be scattered in memory. |
| *baseAddr | XDAS_Int32 | Input/Output | Base address of single data block or pointer to an array of data block addresses of size numBlocks.<br>If scatteredBlocksFlag is set to XDAS_FALSE, |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| | | | this field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If `scatteredBlocksFlag` is set to `XDAS_TRUE`, this field points to an array of pointers to data blocks. |
| `numBlocks` | `XDAS_Int32` | Input/Output | Number of blocks available |
| `varBlockSizesFlag` | `XDAS_Int32` | Input/Output | Flag indicating whether any of the data blocks vary in size.<br>Valid values are `XDAS_TRUE` and `XDAS_FALSE`. |
| `*blockSizes` | `XDAS_Int32` | Input/Output | Variable block sizes array.<br>If `varBlockSizesFlag` is `XDAS_TRUE`, this array contains the sizes of each block.<br>If `varBlockSizesFlag` is `XDAS_FALSE`, this contains the size of same-size blocks.<br>Memory for this array (of size `numBlocks`) has to be allocated by the caller of the `putData` API. |

### 3.2.2 H264 Decoder Data Structures

This section includes the following H264 Decoder specific data structures:

- ❑ `IH264VDEC_Params`
- ❑ `IH264VDEC_DynamicParams`
- ❑ `IH264VDEC_InArgs`
- ❑ `IH264VDEC_Status`
- ❑ `IH264VDEC_OutArgs`
- ❑ `IH264VDEC_ProcessParams`
- ❑ `IH264VDEC_ProcessParamsList`
- ❑ `IH264VDEC_Fxns`

#### 3.2.2.1 IH264VDEC _Params

**‖ Description**

This structure defines the creation parameters and any other implementation specific parameters for an H264 Decoder instance object. The creation parameters are defined in the XDM data structure, `IVIDDEC3_Params`.

**‖ Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `viddec3Params` | `IVIDDEC3_Params` | Input | See `IVIDDEC3_Params` data structure for details. |
| `maxNumRefFrames` | `XDAS_UInt32` | Input | The max number of frames required by the DPB (Decoded Picture Buffer) . This is the DPB size in number of frames. See the note following this section for more information.<br>Also, See enum `IH264VDEC_numRefFrames`.<br>See Appendix F for more information |
| `pConstantMemory` | `XDAS_Int32` | Input | This pointer points to the memory area where constants are located. Default value is NULL in which case, codec puts the constants in a default section. See the note following this section. |
| `bitStreamFormat` | `XDAS_Int32` | Input | Input bit stream format. See the enum `IH264VDEC_bitStreamFormat` for details. |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| errConcealmentMode | XDAS_UInt32 | Input | This Mode indicates whether to apply error concealment or not. See the enum IH264VDEC_errConcealmentMode for more details. |
| temporalDirModePred | XDAS_Int32 | Input | Parameter to enabled/disable temporal direct Prediction mode. See IH264VDEC_temporalDirModePred for more details |
| svcExtensionFlag | XDAS_UInt32 | Input | Flag to indicate support of SVC extension or not. See IH264VDEC_svcExtension for more details |
| svcTargetLayerDID | XDAS_Int32 | Input | SVC Spatial target layer ID |
| svcTargetLayerTID | XDAS_Int32 | Input | SVC Quality target layer ID |
| svcTargetLayerQID | XDAS_Int32 | Input | SVC Temporal target layer ID |
| presetLevelIdc | XDAS_Int32 | Input | Level at which decoder will be configured |
| presetProfileIdc | XDAS_Int32 | Input | Profile at which decoder will be configured.<br>Note: The current configuration of profile is not supported. The decoder always is configured for high profile, independent of value set in this field. |
| detectCabacAlignErr | XDAS_UInt32 | Input | This parameter configures the cabac alignment error detection |
| detectIPCMAlignErr | XDAS_UInt32 | Input | This parameter configures the IPCM alignment error detection |
| debugTraceLevel | XDAS_UInt32 | Input | This parameter configures the debug trace level for the codec |
| lastNFramesToLog | XDAS_UInt32 | Input | This parameter configures the codec to maintain a history of last N frames/pictures |
| enableDualOutput | XDAS_UInt32 | Input | Set it to IH264VDEC_DUALOUTPUT_ENABLE to enable dual YUV output. Set to IH264VDEC_DUALOUTPUT_DISABLE otherwise. Default value is IH264VDEC_DUALOUTPUT_DISABLE. See Appendix K for details on enabling and using dual output feature. |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| processCallLevel | XDAS_UInt32 | Input | Set it to IH264VDEC_FIELDLEVELPROCESSCALL to enable field level process call. Set to IH264VDEC_FRAMELEVELPROCESSCALL to enable frame level process call. Default value is IH264VDEC_FIELDLEVELPROCESSCALL. |
| enableWatermark | XDAS_UInt32 | Input | Set it to IH264VDEC_WATERMARK_ENABLE to enable watermarking. Set to IH264VDEC_WATERMARK_DISABLE otherwise. Default value is IH264VDEC_WATERMARK_DISABLE. See Appendix L for details on enabling and using watermark feature. |
| decodeFrameType | XDAS_UInt32 | Input | Set it to IH264VDEC_DECODE_ALL to enable decoding of all frame types. Set it to IH264VDEC_DECODE_IP_ONLY to decode only I/IDR and P frame types. Set it to IH264VDEC_DECODE_I_ONLY to decode only I/IDR frame types. Default value is IH264VDEC_DECODE_ALL. See Appendix-M for details on enabling and using this feature. |

#### 3.2.2.2 IH264VDEC_DynamicParams

**|| Description**

This structure defines the run-time parameters and any other implementation specific parameters for an H.264 instance object. The run-time parameters are defined in the XDM data structure, IVIDDEC3_DynamicParams.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| viddec3DynamicParams | IVIDDEC3_DynamicParams | Input | See IVIDDEC3_DynamicParams data structure for details. |

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `deblockFilterMode` | `XDAS_Int32` | Input | Parameter to indicate mode of deblocking filter. See enum `IH264VDEC_deblockFilterMode` for more details |
| `svcTargetLayerDID` | `XDAS_Int32` | Input | SVC Spatial target layer ID |
| `svcTargetLayerTID` | `XDAS_Int32` | Input | SVC Quality target layer ID |
| `svcTargetLayerQID` | `XDAS_Int32` | Input | SVC Temporal target layer ID |
| `svcELayerDecode` | `XDAS_Int32` | Input | Flag to enable or disable decoding of enhancement layer |
| `reserved[3]` | `XDAS_Int32` | Input | Reserved for future use |

### *3.2.2.3 IH264VDEC_InArgs*

**|| Description**

This structure defines the run-time input arguments for an H264 instance object.

**|| Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `viddec3InArgs` | `IVIDDEC3_InArgs` | Input | See `IVIDDEC3_InArgs` data structure for details. |

### *3.2.2.4 IH264VDEC_Status*

**|| Description**

This structure defines parameters that describe the status of the H264 Decoder and any other implementation specific parameters. The `status` parameters are defined in the XDM data structure, `IVIDDEC3_Status`.

**|| Fields**

| **Field** | **Data Type** | **Input/ Output** | **Description** |
|---|---|---|---|
| `viddec3Status` | `IVIDDEC3_Status` | Output | See `IVIDDEC3_Status` data structure for details |
| `svcTargetLayerDID` | `XDAS_Int32` | Output | SVC Spatial target layer ID |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| svcTargetLayerTID | XDAS_Int32 | Output | SVC Quality target layer ID |
| svcTargetLayerQID | XDAS_Int32 | Output | SVC Temporal target layer ID |
| debugTraceLevel | XDAS_UInt32 | Output | reports the debug trace level configured for the codec |
| lastNFramesToLog | XDAS_UInt32 | Output | This parameter reports the number of last N pictures for which history has been maintained |
| extMemoryDebugTraceAddr | XDAS_UInt32 | Output | reports the external memory address (as seen by Media Controller) where debug trace information is being dumped |
| extMemoryDebugTraceSize | XDAS_UInt32 | Output | reports the external memory buffer size(in bytes) where debug trace information is being dumped |
| gapInFrameNum | XDAS_UInt32 | Output | This parameter reports the gap in frame_num observed in the current frame |
| spsMaxRefFrames | XDAS_UInt32 | Output | This parameter reports max number of reference frames that gets used for decoding of a given stream, as present in SPS -> max_num_ref_frames. If SPS is not yet parsed, then this parameter holds value of DPB Size in frames based on create time level & resolution. |
| reserved[3] | XDAS_Int32 | Output | Reserved for future use |

### 3.2.2.5 IH264VDEC_OutArgs

**|| Description**

This structure defines the run-time output arguments for the H264 Decoder instance object.

**|| Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| viddec3OutArgs | IVIDDEC3_OutArgs | Output | See IVIDDEC3_OutArgs data structure for details. |
| decryptedKey | XDAS_UInt32 | Output | Watermark key decrypted by the decoder. |

### 3.2.2.6 IH264VDEC_ProcessParams

**‖ Description**

This structure defines the container for holding the channel information.

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `handle` | `IH264VDEC_Handle` | Input | Handle for the channel. |
| `inBufs` | `XDM2_BufDesc *` | Input | Input buffers for the channel. |
| `outBufs` | `XDM2_BufDesc *` | Input | Output buffers for the channel. |
| `inArgs` | `IVIDDEC3_InArgs *` | Input | Input arguments for the channel. |
| `outArgs` | `IVIDDEC3_OutArgs *` | Output | Output arguments for the channel. |

### 3.2.2.7 IH264VDEC_ProcessParamsList

**‖ Description**

This structure defines the container for holding the N channel information.

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `numEntries` | `XDAS_Int32` | Input | Number of channels in the given container. |
| `processParams[]` | `IH264VDEC_ProcessParams` | Input | Array holding the process parameters. The array has a maximum of `IH264VDEC_MAX_LENGTH_PROCESS_LIST` (24) elements. |

### 3.2.2.8 IH264VDEC_Fxns

**‖ Description**

This structure defines all the operations on H.264 decoder instance objects.

**‖ Fields**

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| `ividdec3` | `IVIDDEC3_Fxns` | Output | See `IVIDDEC3_Fxns` data structure for details. |
| `processMulti` | `XDAS_Int32` | Output | Function pointer to the multi-channel process call |

| Field | Data Type | Input/ Output | Description |
|---|---|---|---|
| | `*fnPtr(IH264VDEC_ProcessParamsList *processList)` | | definition. |

#### 3.2.2.8.1 *sSeiMessages_t*

**|| Description**

Structure contains Supplemental Enhancement Information messages.

**|| Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `full_frame_freeze` | `sFullFrameFreezeRepetition_t` | Output | Specifies the persistence of the full-frame freeze SEI message and may specify a picture order count interval within which another full-frame freeze SEI message or a full-frame freeze release SEI or the end of the coded video sequence shall be present in the bit-stream. |
| `full_frame_freeze_release` | `sFullFrameFreezeRelease_t` | Output | Cancels the effect of any full-frame freeze SEI message sent with pictures that precede the current picture in the output order. |
| `prog_refine_start` | `sProgRefineStart_t` | Output | Specifies the beginning of a set of consecutive coded pictures that is labeled as the current picture followed by a sequence of one or more pictures of refinement of the quality of the current picture, rather than as a representation of a continually moving scene. |
| `prog_refine_end` | `sProgRefineEnd_t` | Output | Specifies end of progressive refinement. |

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `user_data_registered` | `sUserDataRegisteredITUT_t` | Output | Message contains user data registered as specified by ITU-T Recommendation T.35 |
| `user_data_unregistered` | `sUserDataUnregistered` | Output | Message contains unregistered user data identified by a UUID |
| `buffering_period_info` | `sBufferingPeriod` | Output | Message specifies the buffering period |
| `pan_scan_rect` | `sPanScanRect_t` | Output | Message specifies the coordinates of a rectangle relative to the cropping rectangle of the sequence parameter set |
| `recovery_pt_info` | `sRecoveryPointInfo_t` | Output | The recovery point SEI message assists a decoder in determining when the decoding process will produce acceptable pictures for display after the decoder initiates random access or after the encoder indicates a broken link in the sequence. |
| `pic_timing` | `sPictureTiming` | Output | Specifies timing information regarding cpb delays, dpb output delay, and so on. |

### 3.2.2.8.2 sFullFrameFreezeRepetition_t

**‖ Description**

Structure contains information regarding frame freeze.

**‖ Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `full_frame_freeze_repetition_period` | `XDAS_UInt32` | Output | Specifies the persistence of the full-frame freeze SEI message |

#### *3.2.2.8.3 sFullFrameFreezeRelease_t*

**|| Description**

Structure contains information regarding frame freeze.

**|| Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `payloadSize` | `XDAS_UInt32` | Output | Size of the `frame_freeze_release` payload |

#### *3.2.2.8.4 sProgRefineStart_t*

**|| Description**

Structure contains information regarding progressive refinement.

**|| Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `progressive_refinement_id` | `XDAS_UInt32` | Output | Specifies an identification number for the progressive refinement operation. |
| `num_refinement_steps_minus1` | `XDAS_UInt32` | Output | Specifies the number of reference frames in the tagged set of consecutive coded pictures |

#### 3.2.2.8.5 sProgRefineEnd_t

**‖ Description**

Structure contains information regarding progressive refinement.

**‖ Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `progressive_ refinement_id` | `XDAS_UInt32` | Output | Specifies an identification number for the progressive refinement operation. |

#### 3.2.2.8.6 sRecoveryPointInfo_t

**‖ Description**

Structure contains information regarding recovery points.

**‖ Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `recovery_frame_cnt` | `XDAS_UInt32` | Output | Specifies the recovery point of output pictures in output order. |
| `exact_match_flag` | `XDAS_UInt32` | Output | Indicates whether decoded pictures at and subsequent to the specified recovery point in output order,<br>derived by starting the decoding process at the access unit associated with the recovery point SEI message, will be an<br>exact match to the pictures that would be produced by starting the decoding process at the location of a previous IDR access unit in the NAL unit stream. |
| `broken_link_flag` | `XDAS_UInt32` | Output | Indicates the presence or absence of a broken link in the NAL unit stream |
| `changing_slice_grou p_idc` | `XDAS_UInt32` | Output | Indicates whether decoded pictures are correct or approximately correct in content at and subsequent to the recovery point in output order when all macro-blocks of the primary coded pictures are decoded within the changing slice group period. |

### 3.2.2.8.7 sPictureTiming_t

**‖ Description**

Structure contains timing information such as DPB delay and CPD delay.

**‖ Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `NumClockTs` | `XDAS_UInt32` | Output | ❑ NumClockTS is determined by pic_struct as specified in Table D-1 of the h264 standard. There are up to NumClockTS sets of clock timestamp information for a picture, as specified by clock_timestamp_flag[ i ] for each set. |
| `cpb_removal_delay` | `XDAS_UInt32` | Output | Specifies how many clock ticks to wait after removal from the CPB of the access unit associated with the most recent buffering period SEI message before removing from the buffer the access unit data associated with the picture timing SEI message. |
| `dpb_output_delay` | `XDAS_UInt32` | Output | Used to compute the DPB output time of the picture. |
| `pic_struct` | `XDAS_UInt32` | Output | Indicates whether a picture  should be displayed as a frame or field |
| `clock_timestamp_flag[4]` | `XDAS_UInt32` | Output | ❑ 1 - Indicates number of clock timestamp syntax elements present and follow immediately<br>❑ 0 – Indicates associated clock timestamp syntax elements not present |
| `ct_type[4]` | `XDAS_UInt32` | Output | Indicates the scan type(interlaced or progressive) of the source material |
| `nuit_field_based_flag[4]` | `XDAS_UInt32` | Output | Used to calculate the `clockTimestamp` |
| `counting_type[4]` | `XDAS_UInt32` | Output | Specifies the method of dropping values of `n_frames` |
| `full_timestamp_flag[4]` | `XDAS_UInt32` | Output | ❑ 1 - Specifies that the `n_frames` syntax element is followed by `seconds_value`, `minutes_value`, and `hours_value`.<br>❑ 0 - Specifies that the `n_frames` |

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| | | | syntax element is followed by `seconds_flag` |
| `discontinuity_flag[4]` | `XDAS_UInt32` | Output | Indicates whether the difference between the current value of `clockTimestamp` and the value of `clockTimestamp` computed from the previous `clockTimestamp` in output order can be interpreted as the time difference between the times of origin or capture of the associated frames or fields. |
| `cnt_dropped_flag[4]` | `XDAS_UInt32` | Output | Specifies the skipping of one or more values of `n_frames` using the counting method |
| `n_frames[4]` | `XDAS_UInt32` | Output | Specifies the value of `nFrames` used to compute `clockTimestamp`. |
| `seconds_flag[4]` | `XDAS_UInt32` | Output | Equal to 1 specifies that seconds_value and `minutes_flag` are present when `full_timestamp_flag` is equal to 0. |
| `minutes_flag[4]` | `XDAS_UInt32` | Output | Equal to 1 specifies that `minutes_value` and `hours_flag` are present when `full_timestamp_flag` is equal to 0 and `seconds_flag` is equal to 1. |
| `hours_flag[4]` | `XDAS_UInt32` | Output | equal to 1 specifies that `hours_value` is present when `full_timestamp_flag` is equal to 0 and `seconds_flag` is equal to 1 and `minutes_flag` is equal to 1 |
| `seconds_value[4]` | `XDAS_UInt32` | Output | Specifies the value of `sS` used to compute `clockTimestamp`. |
| `minutes_value[4]` | `XDAS_UInt32` | Output | Specifies the value of `mM` used to compute `clockTimestamp`. |
| `hours_value[4]` | `XDAS_UInt32` | Output | Specifies the value of `hH` used to compute `clockTimestamp`. |
| `time_offset[4]` | `XDAS_UInt32` | Output | Specifies the value of `tOffset` used to compute `clockTimestamp` |

#### *3.2.2.8.8 sBufferingPeriod_t*

**|| Description**

Structure contains information regarding buffering period

**|| Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| parsed_flag | XDAS_UInt32 | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| seq_parameter_set_id | XDAS_UInt32 | Output | Specifies the sequence parameter set that contains the sequence HRD attributes |
| nal_cpb_removal_delay[MAXCPBCNT] | XDAS_UInt32 | Output | Specifies the delay for the indexed NAL CPB between the time of arrival in the CPB of the first bit of the coded data associated with the access unit associated with the buffering period SEI message and the time of removal from the CPB of the coded data associated with the same access unit, for the first buffering period after HRD initialization. |
| nal_cpb_removal_delay_offset[MAXCPBCNT] | XDAS_UInt32 | Output | Used for the indexed NAL CPB in combination with the `cpb_removal_delay` to specify the initial delivery time of coded access units to the CPB |
| vcl_cpb_removal_delay[MAXCPBCNT] | XDAS_UInt32 | Output | Specifies the delay for the indexed VCL CPB between the time of arrival in the CPB of the first bit of the coded data associated with the access unit associated with the buffering period SEI message and the time of removal from the CPB of the coded data associated with the same access unit, for the first buffering period after HRD initialization. |
| vcl_cpb_removal_delay_offset[MAXCPBCNT] | XDAS_UInt32 | Output | Used for the indexed VCL CPB in combination with the `cpb_removal_delay` to specify the initial delivery time of coded access units to the CPB |

#### *3.2.2.8.9 sUserDataRegisteredITUT_t*

**|| Description**

Structure contains information regarding the user data SEI message elements

**|| Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| parsed_flag | XDAS_UInt32 | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `num_payload_bytes` | `XDAS_UInt32` | Output | Specifies the size of the payload |
| `itu_t_t35_country_code` | `unsigned char` | Output | A byte having a value specified as a country code by ITU-T Recommendation T.35 Annex A |
| `itu_t_t35_country_code_extension_byte` | `unsigned char` | Output | A byte having a value specified as a country code by ITU-T Recommendation T.35 Annex B |
| `itu_t_t35_payload_byte[128]` | `unsigned char` | Output | A byte containing data registered as specified by ITU-T Recommendation T.35. This is restricted to a maximum size of 128 bytes. |

#### *3.2.2.8.10 sUserDataUnregistered*

**|| Description**

Structure contains information regarding the unregistered user data SEI message elements

**|| Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `num_payload_bytes` | `XDAS_UInt32` | Output | Specifies the size of the payload |
| `uuid_iso_iec_11578[16]` | `XDAS_UInt32` | Output | Value specified as a UUID according to the procedures of ISO/IEC 11578:1996 Annex A. |
| `user_data_payload_byte[128]` | `unsigned char` | Output | Byte containing data having syntax and semantics as specified by the UUID generator. This is restricted to a maximum size of 128 bytes. |

#### *3.2.2.8.11 sPanScanRect_t*

**|| Description**

Structure contains information regarding the pan-scan rectangle SEI message elements

**|| Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `pan_scan_rect_id` | `XDAS_UInt32` | Output | Specifies an identifying number that may be used to identify the purpose of the pan-scan rectangle |
| `pan_scan_rect_cancel_flag` | `XDAS_UInt32` | Output | Equal to 1 indicates that the SEI message cancels the persistence of any previous pan-scan rectangle SEI message in output order. `pan_scan_rect_cancel_flag` equal to 0 indicates that pan-scan rectangle information follows. |
| `pan_scan_cnt_minus1` | `XDAS_UInt32` | Output | Specifies the number of pan-scan rectangles that are present in the SEI message |
| `pan_scan_rect_left_offset[3]` | `int` | Output | Specifies as signed integer quantities in units of one-sixteenth sample spacing relative to the luma sampling grid, the location of the pan-scan rectangle |
| `pan_scan_rect_right_offset[3]` | `int` | Output | Specifies as signed integer quantities in units of one-sixteenth sample spacing relative to the luma sampling grid, the location of the pan-scan rectangle |
| `pan_scan_rect_top_offset[3]` | `int` | Output | Specifies as signed integer quantities in units of one-sixteenth sample spacing relative to the luma sampling grid, the location of the pan-scan rectangle |
| `pan_scan_rect_bottom_offset[3]` | `int` | Output | Specifies as signed integer quantities in units of one-sixteenth sample spacing relative to the luma sampling grid, the location of the pan-scan rectangle |
| `pan_scan_rect_repetition_period` | `XDAS_UInt32` | Output | Specifies the persistence of the pan-scan rectangle SEI message and may specify a picture order count interval within which another pan-scan rectangle SEI message with the same value of `pan_scan_rect_id` or the end of the coded video sequence shall be present in the bit-stream |

### *3.2.2.8.12 sSeiStereoVideoInfo*

**|| Description**

This structure defines parameters that describe the values of Stereo Sequence Parameter Set in the bit-stream.

**|| Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `field_views_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that all pictures in the current coded video sequence are fields<br>❑ 0 - indicates that all pictures in the current coded video sequence are frames. |
| `top_field_is_left_view_flag` | `XDAS_UInt32` | Output | ❑ 1 - top field is a left view.<br>❑ 0 – top field is right view. |
| `current_frame_is_left_view_flag` | `XDAS_UInt32` | Output | ❑ 1 - current frame is left view.<br>❑ 0 - current frame is right view. |
| `next_frame_is_second_view_flag` | `XDAS_UInt32` | Output | ❑ 1 - current picture and a next picture in output order form a stereo video pair.<br>❑ 0 - current picture and a previous picture in output order form a stereo video pair. |
| `left_view_self_contained_flag` | `XDAS_UInt32` | Output | ❑ 1 - it will not use right view as a reference picture for inter prediction<br>❑ 0 - it may use right view as a reference picture for inter prediction. |
| `right_view_self_contained_flag` | `XDAS_UInt32` | Output | ❑ 1 - it will not use left view as a reference picture for inter prediction<br>❑ 0 - it may use left view as a reference picture for inter prediction. |

#### *3.2.2.8.13sSeiFramePacking*

**‖ Description**

This structure defines parameters that describe the values of Frame Packing Sequence Parameter Set in the bit-stream.

**‖ Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `frame_packing_arrangement_id` | `XDAS_UInt32` | Output | Contains an identifying number that may be used to identify the usage of the frame packing arrangement SEI message. |
| `frame_packing_arrangement_repetition_period` | `XDAS_UInt32` | Output | Specifies the persistence of the frame packing arrangement.<br>SEI message and may specify a frame order count interval within which another frame packing arrangement SEI message with the same value of `frame_packing_arrangement_id` or the end of the coded video sequence shall be present in the bit-stream. |
| `frame_packing_arrangement_cancel_flag` | `XDAS_UInt8` | Output | ❑ 1 - Equal to 1 indicates that the frame packing arrangement. SEI message cancels the persistence of any previous frame packing arrangement SEI message in output order.<br>❑ 0 - Indicates that frame packing arrangement info follows |
| `frame_packing_arrangement_type` | `XDAS_UInt8` | Output | Indicates the type of packing arrangement of the frames |
| `quincunx_sampling_flag` | `XDAS_UInt8` | Output | ❑ 1 - Indicates that each color component plane of each constituent frame is quincunx sampled<br>❑ 0 - Indicates that each color component plane of each constituent frame is not quincunx sampled. |
| `content_interpretation_type` | `XDAS_UInt8` | Output | ❑ 1 - Frame 0 being associated with the left view and frame 1. This is associated with the right view<br>❑ 2 - Frame 0 being associated with the right view and frame 1.<br>This is associated with the left view |

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `spatial_flipping_flag` | `XDAS_UInt8` | Output | ❑ 1 - Spatial flipping is enabled for any one of the frame constituent, if `frame_packing_arrangement_type` is 3 or 4.<br>❑ 0 - Spatial flipping is disabled for any one of the frame constituent, if `frame_packing_arrangement_type` is 3 or 4. |
| `frame0_flipped_flag` | `XDAS_UInt8` | Output | ❑ 1 - Frame 0 is spatially flipped<br>❑ 0 - Frame 1 is spatially flipped |
| `field_views_flag` | `XDAS_UInt8` | Output | ❑ 1 - Indicates that all pictures in the current coded video sequence are coded as complementary field pairs.<br>❑ 0 - Indicates that all pictures in the current coded video sequence are coded as frame. |
| `current_frame_is_frame0_flag` | `XDAS_UInt8` | Output | ❑ 1 - Indicates that the current decoded frame is constituent frame 0 and the next decoded frame in output order is constituent frame 1.<br>❑ 0 - Indicates that the current decoded frame is constituent frame 1 and the next decoded frame in output order is constituent frame 0. |
| `frame0_self_contained_flag` | `XDAS_UInt8` | Output | ❑ 1 - Indicates that the constituent frame 0 is dependent on constituent frame 1 in decoding process<br>❑ 0 - Indicates that the constituent frame 0 may dependent on constituent frame 1 in decoding process |
| `frame1_self_contained_flag` | `XDAS_UInt8` | Output | ❑ 1 - Indicates that the constituent frame 1 is dependent on constituent frame 0 in decoding process<br>❑ 0 - Indicates that the constituent frame 1 may dependent on constituent frame 0 in decoding process |
| `frame0_grid_position_x` | `XDAS_UInt8` | Output | Specifies the horizontal location of the upper left sample of constituent frame 0 in the units of one sixteenth of the luma samples |
| `frame0_grid_position_y` | `XDAS_UInt8` | Output | Specifies the vertical location of the upper left sample of constituent frame 0 in the units of one sixteenth of the luma samples |
| `frame1_grid_position_x` | `XDAS_UInt8` | Output | Specifies the horizontal location of the upper left sample of constituent frame 1 in the units of one sixteenth of the luma samples |
| `frame1_grid_position_y` | `XDAS_UInt8` | Output | Specifies the vertical location of the upper left sample of constituent frame 1 in the units |

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| | | | of one sixteenth of the luma samples |
| `frame_packing_arrangement_reserved_byte` | `XDAS_UInt8` | Output | Reserved for the future use. |
| `frame_packing_arrangement_extension_flag;` | `XDAS_UInt8` | Output | ❑ 0 - Indicates that no additional data follows within the frame packing arrangement SEI message.<br>❑ 1 - Reserved for the future use. |

### *3.2.2.8.14 sVuiParams*

**‖ Description**

This structure defines parameters that describe the values of various video usability parameters that come as a part of Sequence Parameter Set in the bit-stream.

**‖ Fields**

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `parsed_flag` | `XDAS_UInt32` | Output | ❑ 1 - Indicates that in the current process call, contents of the structure is updated<br>❑ 0 - Indicates contents of the structure is not updated |
| `aspect_ratio_info_present_flag` | `XDAS_UInt32` | Output | Indicates whether aspect ratio `idc` is present or not. |
| `aspect_ratio_idc` | `XDAS_UInt32` | Output | Aspect ratio of Luma samples |
| `sar_width` | `XDAS_UInt32` | Output | Horizontal size of sample aspect ratio |
| `sar_height` | `XDAS_UInt32` | Output | Vertical size of sample aspect ratio |
| `overscan_info_present_flag` | `XDAS_UInt32` | Output | `Overscan_appropriate_flag` |
| `overscan_appropriate_flag` | `XDAS_UInt32` | Output | Cropped decoded pictures are suitable for display or not. |
| `video_signal_type_present_flag` | `XDAS_UInt32` | Output | Flag indicates whether `video_format`, `video_full_range_flag` and `colour_description_present_flag` are present or not |
| `video_format` | `XDAS_UInt32` | Output | Video format indexed by a table. For example, PAL/NTSC |

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| video_full_range_flag | XDAS_UInt32 | Output | Black level, luma and chroma ranges. It should be used for BT.601 compliance |
| colour_description_present_flag | XDAS_UInt32 | Output | Indicates whether colour_primaries, transfer_characteristics and matrix_coefficients are present. |
| colour_primaries | XDAS_UInt32 | Output | Chromaticity co-ordinates of source primaries |
| transfer_characteristics | XDAS_UInt32 | Output | Opto-electronic transfer characteristics of the source picture |
| matrix_coefficients | XDAS_UInt32 | Output | Matrix coefficients for deriving Luma and chroma data from RGB components. |
| chroma_location_info_present_flag | XDAS_UInt32 | Output | Flag indicates whether chroma_sample_loc_type_top field and chroma_sample_loctype bottom_field are present. |
| chroma_sample_loc_type_top_field | XDAS_UInt32 | Output | Location of chroma_sample top field |
| chroma_sample_loc_type_bottom_field | XDAS_UInt32 | Output | Location of chroma_sample bottom field |
| timing_info_present_flag | XDAS_UInt32 | Output | Indicates whether num_units_in_tick, time_scale, and fixed_frame_rate_flag are present. |
| num_units_in_tick | XDAS_UInt32 | Output | Number of units of a clock that corresponds to 1 increment of a clock tick counter |
| time_scale | XDAS_UInt32 | Output | Indicates actual increase in time for 1 increment of a clock tick counter |
| fixed_frame_rate_flag | XDAS_UInt32 | Output | Indicates how the temporal distance between HRD output times of any two output pictures is constrained |
| nal_hrd_parameters_present_flag | XDAS_UInt32 | Output | Indicates whether nal_hrd_parameters are present |
| nal_hrd_parameters | sHrdParams | Output | See sHrdParm_t datastructure for details. |
| vcl_hrd_parameters_present_flag | XDAS_UInt32 | Output | Indicates whether vcl_hrd_parameters are present |
| vcl_hrd_parameters | sHrdParams | Output | See sHrdParm_t datastructure for details. |

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| low_delay_hrd_flag | XDAS_UInt32 | Output | HRD operational mode as in Annex C of the standard |
| pic_struct_present_flag | XDAS_UInt32 | Output | Indicates whether picture timing SEI messages are present |
| bitstream_restriction_flag | XDAS_UInt32 | Output | Indicates if the bit-stream restriction parameters are present |
| motion_vectors_over_pic_boundaries_flag | XDAS_UInt32 | Output | Specifies whether motion vectors can point to regions outside the picture boundaries |
| max_bytes_per_pic_denom | XDAS_UInt32 | Output | Maximum number of bytes not exceeded by the sum of sizes of all VCL NAL units of a single coded picture |
| max_bits_per_mb_denom | XDAS_UInt32 | Output | Maximum number of bits taken by any coded MB |
| log2_max_mv_length_vertical | XDAS_UInt32 | Output | Maximum value of any motion vector's vertical component |
| log2_max_mv_length_horizontal | XDAS_UInt32 | Output | Maximum value of any motion vector's horizontal component |
| num_reorder_frames | XDAS_UInt32 | Output | Maximum number of frames that need to be re-ordered |
| max_dec_frame_buffering | XDAS_UInt32 | Output | Size of HRD decoded buffer (DPB) in terms of frame buffers |

### *3.2.2.8.15sHrdParm*

**|| Description**

This structure defines the HRD parameters that are in H264 bit-stream as a part of video usability Information.

**|| Fields**

| Field | Datatype | Input/ Output | Description |
|---|---|---|---|
| cpb_cnt_minus1 | XDAS_UInt32 | Output | Number of alternative CPB specifications in the bit-stream (minus 1). |
| bit_rate_scale | XDAS_UInt32 | Output | Together with `bit_rate_value[i]`, it specifies the maximum input bit-rate for the $i^{th}$ CPB. |

| **Field** | **Datatype** | **Input/ Output** | **Description** |
|---|---|---|---|
| `cpb_size_scale` | `XDAS_UInt32` | Output | Together with `cpb_size_value[i]`, specifies the maximum CPB size for the i$^{th}$ CPB. |
| `bit_rate_value_minus1[i]` | `XDAS_UInt32` | Output | Maximum `input bitrate` for the i$^{th}$ CPB |
| `bit_rate_value_minus1[i]` | `XDAS_UInt32` | Output | Maximum `CPB size for` the i$^{th}$ CPB |
| `bit_rate_value_minus1[i]` | `XDAS_UInt32` | Output | Specifies the i$^{th}$ CPB is operated in Constant Bit-rate mode or variable bit-rate mode |
| `initial_cpb_removal_delay_length_minus1` | `XDAS_UInt32` | Output | Length in bits of `initial_cpb_removal_length` syntax element |
| `cpb_removal_delay_length_minus1` | `XDAS_UInt32` | Output | Length in bits of `cpb_removal_delay_length` syntax element |
| `dpb_output_delay_length_minus1` | `XDAS_UInt32` | Output | Length in bits of `dpb_output_delay_length` syntax element |
| `time_offset_length` | `XDAS_UInt32` | Output | Length in bits of `time_offset` syntax element |

**Note:**

SEI / VUI parsing is handled by the decoder as follows (For more details on metadata access, please see Appendix B for more information).:

A flag, `parsed_flag`, is present as the first element of structure of every SEI message, VUI structure and the `SEI_VUI` structure. This flag when set to one by the decoder indicates that in the current process call, contents of this structure was updated.

Currently parsing of the following SEI messages are supported.

- Full-frame freeze SEI message
- Full-frame freeze release SEI message
- Progressive refinement segment start SEI message
- Progressive refinement segment end SEI message
- Recovery point SEI message
- Picture timing SEI message
- Buffering period SEI message
- User data registered by ITU-T T.35 SEI message

- User data unregistered SEI message
- Pan-scan Rectangle SEI message

Other types of SEI messages will be simply skipped by the decoder.

## 3.3 Default and Supported Parameters

This section describes default and supported values for parameters of the following structures:

- `IVIDDEC3_Params`
- `IVIDDEC3_DynamicParams`
- `IH264VDEC_Params`
- `IH264VDEC_DynamicParams`

### 3.3.1 Default and Supported values of IVIDDEC3_Params

| Field | Default Value | Supported Values |
|---|---|---|
| `Size` | `sizeof(IVIDDEC3_Params)` | sizeof(`IVIDDEC3_Params)`<br>sizeof(`IH264VDEC_Params)` |
| `maxHeight` | `1088` | `64 < = maxHeight < = 4096` |
| `maxWidth` | `1920` | `64 < =  maxWidth < = 4096` |
| `maxFrameRate` | Don't Care | Don't Care |
| `maxBitRate` | Don't Care | Don't Care |
| `dataEndianness` | `XDM_BYTE` | `XDM_BYTE` |
| `forceChromaFormat` | `XDM_YUV_420SP` | `XDM_YUV_420SP` |
| `operatingMode` | `IVIDEO_DECODE_ONLY` | `IVIDEO_DECODE_ONLY,`<br>`IVIDEO_TRANSCODE_FRAMELEVEL` |
| `displayDelay` | `IVIDDEC3_DISPLAY_DELAY_AUTO` | All possible values of Enumeration `IVIDDEC3_displayDelay` |
| `inputDataMode` | `IVIDEO_ENTIREFRAME` | `IVIDEO_ENTIREFRAME`<br>`IVIDEO_FIXEDLENGTH`<br>`IVIDEO_SLICEMODE`<br>`IH264VDEC_NALUNIT_MODE` |
| `outputDataMode` | `IVIDEO_ENTIREFRAME` | `IVIDEO_ENTIREFRAME`<br>`IVIDEO_NUMROWS` |
| `numInputDataUnits` | Don't care | 1 |
| `numOutputDataUnits` | Don't Care | Any positive number |
| `errorInfoMode` | `IVIDEO_ERRORINFO_OFF` | `IVIDEO_ERRORINFO_OFF` |
| `displayBufsMode` | `IVIDDEC3_DISPLAYBUFS_EMBEDDED` | `IVIDDEC3_DISPLAYBUFS_EMBEDDED`<br>`IVIDDEC3_DISPLAYBUFS_PTRS` |
| `metadataType [IVIDEO_MAX_NUM _METADATA_PLANES]` | `IVIDEO_METADATAPLANE_NONE` | `IVIDEO_METADATAPLANE_NONE`<br>`IVIDEO_METADATAPLANE_MBINFO`<br>`IH264VDEC_PARSED_SEI_DATA`<br>`IH264VDEC_PARSED_VUI_DATA` |

**Note:**

During codec creation, `maxHeight` and `maxWidth` as specified in above table are allowed. Note that `maxHeight` and `maxWidth` should be always greater than or equal to image width and image height.

Minimum width and height supported per frame is 64. So, minimum width and height supported per field is 32. However during decoder creation, if either of `maxHeight` or `maxWidth` is greater than 2048, then the minimum width supported per frame is 336 and the minimum width supported per field is 176.

Decoder will be able to decode streams for which image width or height are non-multiples of 16. However note that during decoder creation, `maxHeight` and `maxWidth` should be a multiple of 16.

### 3.3.2 Default and Supported values of IVIDDEC3_DynamicParams

| Field | Default Value | Supported Values |
|---|---|---|
| `Size` | `sizeof(IVIDDEC3_DynamicParams)` | `sizeof(IVIDDEC3_DynamicParams)`<br>`sizeof(IH264VDEC_DynamicParams)` |
| `decodeHeader` | `XDM_DECODE_AU` | ❑ `XDM_PARSE_HEADER`<br>❑ `XDM_DECODE_AU` |
| `displayWidth` | `0` | If YUV buffers are in RAW/TILED_PAGE region, Any value > = 0, which is a multiple of 128 bytes.<br>If YUV buffers are in TILED region, then this parameter value is ignored. |
| `frameSkipMode` | `IVIDEO_NO_SKIP` | ❑ `IVIDEO_NO_SKIP`<br>❑ `IVIDEO_SKIP_NONREFERENCE` |
| `newFrameFlag` | Don’t Care | Don’t Care |
| `putDataFxn` | Don’t Care | Valid (Non-NULL) Function pointer |
| `putDataHandle` | Don’t Care | Don’t Care |
| `getDataFxn` | Don’t Care | Valid (Non-NULL) Function pointer |

| Field | Default Value | Supported Values |
|---|---|---|
| getDataHandle | Don't Care | Don't Care |
| putBufferFxn | Don't Care | Valid (Non-NULL) Function pointer |
| putBufferHandle | Don't Care | Don't Care |
| lateAcquireArg | IRES_HDVICP2_UNKNOWNLATEACQUIREARG | Any Value |

### 3.3.3 Default and Supported values of IH264VDEC_Params

| Field | Default Value | Supported Value |
|---|---|---|
| IVIDDEC3_Params | See Section 3.3.1 | See Section 3.3.1 |
| dpbSizeInFrames | IH264VDEC_DPB_NUMFRAMES_DEFAULT | All possible values of enumeration IH264VDEC_dpbNumFrames |
| pConstantMemory | NULL | NULL, Any valid address pointing to constants in DDR |
| bitStreamFormat | IH264VDEC_BYTE_STREAM_FORMAT | ❑ IH264VDEC_BYTE_STREAM_FORMAT<br>❑ IH264VDEC_NAL_UNIT_FORMAT |
| errConcealmentMode | IH264VDEC_APPLY_CONCEALMENT | ❑ IH264VDEC_NO_CONCEALMENT<br>❑ IH264VDEC_APPLY_CONCEALMENT |
| temporalDirModePred | IH264VDEC_ENABLE_TEMPORALDIRECT | ❑ IH264VDEC_ENABLE_TEMPORALDIRECT<br>❑ IH264VDEC_DISABLE_TEMPORALDIRECT |
| svcExtensionFlag | IH264VDEC_DISABLE_SVCEXTENSTION | ❑ IH264VDEC_DISABLE_SVCEXTENSTION<br>❑ IH264VDEC_ENABLE_SVCEXTENSION |
| svcTargetLayerDID | IH264VDEC_TARGET_DID_DEFAULT | All possible values of enumeration type IH264VDEC_dependancyLayerIds |
| svcTargetLayerTID | IH264VDEC_TARGET_TID_DEFAULT | All possible values of enumeration type IH264VDEC_temporalLayerIds |

| **Field** | **Default Value** | **Supported Value** |
|---|---|---|
| svcTargetLayerQID | IH264VDEC_TARGET_QID_DEFAULT | All possible values of enumeration type IH264VDEC_qualityLayerIds |
| presetLevelIdc | IH264VDEC_LEVEL41 | ❑ IH264VDEC_LEVEL1<br>❑ IH264VDEC_LEVEL1B<br>❑ IH264VDEC_LEVEL11<br>❑ IH264VDEC_LEVEL12<br>❑ IH264VDEC_LEVEL13<br>❑ IH264VDEC_LEVEL2<br>❑ IH264VDEC_LEVEL21<br>❑ IH264VDEC_LEVEL22<br>❑ IH264VDEC_LEVEL3<br>❑ IH264VDEC_LEVEL31<br>❑ IH264VDEC_LEVEL32<br>❑ IH264VDEC_LEVEL4<br>❑ IH264VDEC_LEVEL41<br>❑ IH264VDEC_LEVEL42<br>❑ IH264VDEC_LEVEL5<br>❑ IH264VDEC_LEVEL51 |
| presetProfileIdc | IH264VDEC_PROFILE_HIGH | Don't care |
| detectCabacAlignErr | IH264VDEC_DISABLE_CABACALIGNERR_DETECTION | ❑ IH264VDEC_DISABLE_CABACALIGNERR_DETECTION<br>❑ IH264VDEC_ENABLE_CABACALIGNERR_DETECTION |
| detectIPCMAlignErr | IH264VDEC_DISABLE_IPCMALIGNERR_DETECTION | ❑ IH264VDEC_DISABLE_IPCMALIGNERR_DETECTION<br>❑ IH264VDEC_ENABLE_IPCMALIGNERR_DETECTION |
| debugTraceLevel | IH264VDEC_DEBUGTRACE_LEVEL0 | ❑ IH264VDEC_DEBUGTRACE_LEVEL0<br>❑ IH264VDEC_DEBUGTRACE_LEVEL1 |
| lastNFramesToLog | 0 | Any number >= 0 |
| enableDualOutput | IH264VDEC_DUALOUTPUT_DISABLE | ❑ IH264VDEC_DUALOUTPUT_DISABLE<br>❑ IH264VDEC_DUALOUTPUT_ENABLE |
| processCallLevel | IH264VDEC_FIELDLEVELPROCESSCALL | ❑ IH264VDEC_FIELDLEVELPROCESSCALL<br>❑ IH264VDEC_FRAMELEVELPROCESSCALL |

| Field | Default Value | Supported Value |
|---|---|---|
| enableWatermark | IH264VDEC_WATERMARK_DISABLE | ❑ IH264VDEC_WATERMARK_DISABLE<br>❑ IH264VDEC_WATERMARK_ENABLE |

### 3.3.4 Default and Supported values of IH264VDEC_DynamicParams

| Field | Default Value | Supported Values |
|---|---|---|
| viddec3DynamicParams | See Section 4.3.2 | See Section 4.3.2 |
| svcTargetLayerDID | IH264VDEC_TARGET_DID_DEFAULT | All possible values of enumeration type IH264VDEC_dependancyLayerIds |
| svcTargetLayerTID | IH264VDEC_TARGET_TID_DEFAULT | All possible values of enumeration type IH264VDEC_temporalLayerIds |
| svcTargetLayerQID | IH264VDEC_TARGET_QID_DEFAULT | All possible values of enumeration type IH264VDEC_qualityLayerIds |
| deblockFilterMode | IH264VDEC_DEBLOCK_DEFAULT | ❑ IH264VDEC_DEBLOCK_DISABLE_NONE<br>❑ IH264VDEC_DEBLOCK_DISABLE_ALL<br>❑ IH264VDEC_DEBLOCK_DISABLE_SLICE_EDGE<br>❑ IH264VDEC_DEBLOCK_DEFAULT |
| svcELayerDecode | IH264VDEC_DISABLE_ELAYERDECODE | ❑ IH264VDEC_DISABLE_ELAYERDECODE<br>❑ IH264VDEC_ENABLE_ELAYERDECODE |
| reserved[3] | 0 | 0 |

## 3.4 Interface Functions

This section describes the application programming interfaces used in the H264 Decoder. The H264 Decoder 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.

### 3.4.1 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.

**|| 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. Since the client 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.

## ‖ See Also

`algNumAlloc(), algFree()`

### 3.4.2 Initialization API

Initialization API is used to initialize an instance of the H264 Decoder. The initialization parameters are defined in the `IVIDDEC3_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; /* handle to the algorithm instance*/

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. All fields in the `params` structure must be set as described in `IALG_Params` structure (see Data Structures section for details).

For more details, see TMS320 DSP Algorithm Standard API Reference.

**‖ See Also**

`algAlloc(), algMoved()`

### 3.4.3 Control API

Control API is used for controlling the functioning of H264 Decoder during run-time. This is done by changing the status of the controllable parameters of the decoder during run-time. These controllable parameters are defined in the `IVIDDEC3_DynamicParams` data structure (see Data Structures section for details).

**|| Name**

`control()` – change run-time parameters of the H264 Decoder and query the decoder status

**|| Synopsis**

```
XDAS_Int32 (*control)(IVIDDEC3_Handle handle, IVIDDEC3_Cmd
id,IVIDDEC3_DynamicParams *params, IVIDDEC3_Status
*status);
```

**|| Arguments**

```
IVIDDEC3_Handle handle; /* handle to the H264 decoder
instance */

IVIDDEC3_Cmd id; /* H264 decoder specific control
commands*/

IVIDDEC3_DynamicParams *params /* H264 decoder run-time
parameters */

IVIDDEC3_Status *status /* H264 decoder instance status
parameters */
```

**|| Return Value**

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

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

**|| Description**

This function changes the run-time parameters of H264 Decoder and queries the status of decoder. `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 the H264 Decoder instance object.

The second argument is a command ID. See `IVIDDEC3_Cmd` in enumeration table for details.

The third and fourth arguments are pointers to the `IVIDDEC3_DynamicParams` and `IVIDDEC3_Status` data structures respectively.

**|| See Also**

`algInit()`

### 3.4.4 Data Processing API

Data processing API is used for processing the input data using the H264 Decoder.

**‖ 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 video decoding call

## || Synopsis

```
XDAS_Int32 (*process)(IVIDDEC3_Handle handle, XDM2_BufDesc
*inBufs, XDM2_BufDesc *outBufs, IVIDDEC3_InArgs *inargs,
IVIDDEC3_OutArgs *outargs);
```

## || Arguments

```
IVIDDEC3_Handle handle; /* handle to the H264 decoder
instance */
```

```
XDM2_BufDesc *inBufs; /* pointer to input buffer descriptor
data structure */
```

```
XDM2_BufDesc *outBufs; /* pointer to output buffer
descriptor data structure */
```

```
IVIDDEC3_InArgs *inargs /* pointer to the H264 decoder
runtime input arguments data structure */
```

```
IVIDDEC3_OutArgs *outargs /* pointer to the H264 decoder
runtime output arguments data structure */
```

## || Return Value

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

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

## || Description

This function does the basic H264 video decoding. The first argument to `process()` is a handle to the H264 Decoder instance object.

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `XDM2_BufDesc and XDM_BufDesc` data structure for details).

The fourth argument is a pointer to the `IVIDDEC3_InArgs` data structure that defines the run-time input arguments for the H264 Decoder instance object.

**Note:**

Prior to each decode call, ensure that all fields are set as described in `XDM2_BufDesc` and `IVIDDEC3_InArgs` structures.

The last argument is a pointer to the `IVIDDEC3_OutArgs` data structure that defines the run-time output arguments for the H264 Decoder instance object.

The algorithm may also modify the output buffer pointers. The return value is `IALG_EOK` for success or `IALG_EFAIL` in case of failure. The `extendedError` field of the `IVIDDEC3_OutArgs and IVIDDEC3_Status` structure contains error conditions flagged by the algorithm. The status structure can be populated by a calling Control API using `XDM_GETSTATUS` command.

## || See Also

`control()`

**|| Name**

`processMulti()` – N channel video decoding call

**|| Synopsis**

```
XDAS_Int32 (*processMulti) (IH264VDEC_ProcessParamsList
*processList);
```

**|| Arguments**

```
IH264VDEC_ProcessParamsList *processList; /* Container for
N channels. Each channel contains handle, *inBufs,
*outBufs, *inArgs, *outArgs */
```

**|| Return Value**

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

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

**|| Description**

This function does the basic H264 video decoding for N channels. The argument to `processMulti()` is a container for N channels. The structure `IH264VDEC_ProcessParamsList` contains five parameters. The first parameter is a handle to H264 Decoder instance object.

The second and third parameters are pointers to the input and output buffer descriptor data structures respectively (see `XDM2_BufDesc` data structure for details).

The fourth parameter is a pointer to the `IVIDDEC3_InArgs` data structure that defines the run-time input arguments for the H264 Decoder instance object.

**Note:**

Prior to each decode call, ensure that all fields are set as described in `XDM2_BufDesc` and `IVIDDEC3_InArgs` structures.

The fifth parameter is a pointer to the `IVIDDEC3_OutArgs` data structure that defines the run-time output arguments for the H264 Decoder instance object.

The algorithm may also modify the output buffer pointers. The return value is `IALG_EOK` for success or `IALG_EFAIL` in case of failure. The `extendedError` field of the `IVIDDEC3_OutArgs and IVIDDEC3_Status` structure contains error conditions flagged by the algorithm. The status structure can be populated by a calling Control API using `XDM_GETSTATUS` command.

**|| See Also**

`control()`

**‖ 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.

**‖ See Also**

`algActivate()`

### 3.4.5 Termination API

Termination API is used to terminate the H264 Decoder 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()`

Chapter 4

# Frequenty Asked Questions

This chapter provides answers to few frequently asked questions related to using this HDVICP2 H264 Decoder.

## 4.1 Release Package

| Question | Answer |
|---|---|
| Can this codec release be used on any Media Controller and HDVICP2 based platform? | Yes, you can use it on any Media Controller and IAHD based platform. But the Test application shipped along with this release is meant for a particular platform. Before using it to different platform, you need to ensure that the addresses provided in linker command file are taken care. In addition, the HDVICP2 related addresses through HDVICP IRES interface should be provided correctly. |

## 4.2 Issues with Tools/FC Version

| Question | Answer |
|---|---|
| What tools are required to run the standalone codec? | To run the codec on standalone setup, you need Framework components, Code Composer Studio, ARM compiler tools (CG tools). If you are running on the simulator, then the correct version of the Platform specific CSP is needed. |
| Which simulator version should I use for this release of H.264 decoder on IVA-HD? | Code Composer Studio (CCSv4) version 4.2.0.09000 has to be installed. DM81xx simulator CSP version 0.7.1 (or newer) has to be installed after installing Code Composer Studio,<br>This release can be obtained by software updates on CCSV4. Please make sure that following site is listed as part of “Update sites to visit” http://software-dl.ti.com/dsps/dsps_public_sw/sdo_ccstudio/CCSv4/Updates/NETRA/site.xml |
| What CG tools version is used for this release? | CG tools version 4.5.1 is used for this release. |
| What if the application is using different CG tools version? | The memory layout of the interface data structures  does not change with different version of compilers(if bit-fields are not used). In addition, it does not change the mechanism of generating signature for functions. This version can be used even if the application is with different CG tools because no bit-fields are used in interface. |
| Is this decoder integrated with codec engine, if yes with which version? | Yes, this decoder is integrated with Codec Engine version 3.20.00.16 |

## 4.3 Supported Features and Performance Related

| **Question** | **Answer** |
|---|---|
| What XDM interface does codec support? | Codec supports XDM IVIDDEC3 interface |
| What are the profiles supported in this version of decoder? | This version of decoder supports baseline, main and high profiles. ASO/FMO feature is not supported for baseline profile. |
| What is the maximum level supported by this decoder? | The decoder supports levels up to 5.1 for functionality.<br>However note that the bit rate and frame rate supported by decoder in real time, depends on the frequency of HDVICP2. For ex: At 266 MHz, 1080P 30fps, upto 25 Mbps CABAC is supported. |
| What is the maximum bit rate supported? | For CAVLC coded streams, bit rate supported in real time decoding is around 100 Mbps at 266Mhz<br><br>For CABAC coded streams, bit rate supported in real time decoding is around 25 Mbps at 266Mhz<br><br>Slightly more bit rates than above, can be supported in following cases:<br>- Buffering of some frames are done at display side to average out the load<br>- Bits are more evenly / uniformly distributed among frames.<br><br>Note that, from functionality perspective, all bit rates are supported. |
| What stream formats are supported in this version of decoder? | This version supports byte-stream and NALU format |
| What are the output frame formats supported? | This version supports only YUV420 semi-planar output buffer format. |
| What are the resolutions supported? | The decoder supports all resolutions until up to 4096x4096. The minimum resolution supported is 64x64. However during decoder creation, if either of `maxHeight` or `maxWidth` is greater than 2048 then the minimum width supported is 336.<br><br>Streams with resolutions, which are non-multiples of 16, are also supported. However, create time resolution has to be multiple of 16. |
| Does the decoder support meta data output? | Yes. Refer Appendix for more information. |
| Does this version of H264 Decoder expose MB Info for a frame to the application? | Yes. Refer Appendix for more information. |
| Does this version of decoder support interlaced coding? | Yes. Both PicAFF and MBAFF. |
| Does this version of decoder support decoding multiple slices in a frame? | Yes. |

| **Question** | **Answer** |
|---|---|
| Is there a limit on number of slices supported per frame by decoder? | Functionality wise, there is no limit. Decoder can support one slice per MB also.<br>Note, however, that number of slices per frame supported in Real Time depends on frequency of HDVICP2 and complexity of the slice header.<br>Ex: For average complexity slice headers, one slice per row can be supported at 266 Mhz, 1080p resolution, 30 fps. |
| Does decoder handle change in resolution? | Yes. Refer Appendix on details regarding handling of change in resolution. |
| Does the decoder support multi-channel operation? | Yes. |
| Can the decoder support higher resolutions at lower FPS? | Yes, But maximum resolution supported is 4096x4096. Not beyond that. |
| What is the maximum FPS at which the decoder can perform 1080p real time? | It depends on the frequency of HDVICP2 sub-system AND ability of DDR and data path of the device to provide necessary data throughput to HDVICP2.<br>Typical cases:<br>30 fps, 1080p at 266Mhz of HDVICP2.<br>60 fps, 1080p at 533Mhz of HDVICP2. |
| Is the performance quoted in datasheet the worst case performance? | No, they are average numbers. |
| What is the DDR bandwidth? | Actual number depends considerably on the complexity of the stream, in terms of number of motion vectors per MB and how different the values of motion vectors are.<br><br>As an average number, it is around 800 Mbytes per sec for 1080P @ 30fps. (Assuming B frames in GOP, burst size of 4x4 and DDR memory efficiency of 100%) |
| Will the decoder sustain the performance even for error streams? | No.<br>In case of errors in the bit stream, cycles consumed by decoder will be slightly different. Exact amount of difference in cycles will depend on how many Macro Blocks are in error.<br>Cycles consumed by decoder will be considerably more if concealment is enabled. |
| Is there any unsupported feature? | ASO/FMO is not supported |
| What is the decoder behavior for the unsupported features? | Only unsupported feature currently is ASO/FMO. Bit positions IH264VDEC_ERR_UNSUPPFEATURE and XDM_UNSUPPORTEDINPUT will be set in extended error field. |
| Is there a plan to support ASO/FMO in future releases? | Not in current plans. |

| Question | Answer |
|---|---|
| In data sheet, input buffer size is mentioned as 1000Kbytes. Does it mean bit stream buffer (input buffer) has to be of that size? | No. Not necessarily. This is just a suggestive number for size of input buffer. Actual size will depend on the application use case.<br>Note that, when bit stream in provided to decoder at frame level (instead of sub-frame level), then the buffer should be big enough to accommodate bit stream of at least one frame. Now max size of one frame of bit stream depends on the bit rate and encoded YUV content. |
| In data sheet, Output buffer size is mentioned as 3441Kbytes. What is the meaning of this number? | This is just size of one YUV frame of resolution 1920x1088 and additional space for padding. |
| In data sheet Table 3, why is the TILED8 and TILED16 DDR memory requirement mentioned as 0? | Table 3 does not depict input and output buffer sizes. It mentions memory required during decoder creation. All the memory requested during create time is of nature TILEDPAGE or RAW.<br>Table 3 does not include YUV buffers needed for decoder, since YUV buffers are provided to decoder during process calls as output buffers. Hence TILED8 and TILED16 are mentioned as zero. |
| How many YUV buffers are needed to run the decoder? And how will application be able to get this number? | Application needs to perform Control call with XDM_GETSTATUS command. Decoder reports number of YUV buffers needed in the parameter maxNumDisplayBufs.<br><br>**Notes:**<br><br>1. The number reported in maxNumDisplayBufs is 2N + 1, where N is a number dependent on Creation time level and resolution of the image.<br>For Ex:<br>In case of Level 4.1 and 1920x1080 resolution N = 4.<br>In case of Level 4.1 and 352x288 resolution N = 16.<br><br>2. The number 2N + 1 is a worst case requirement. For typical streams N+3 or N+4 number of buffers should be enough.<br><br>Refer Appendix for more information regarding method to reduce DDR Footprint. |
| Does decoder support skipping of frames? | Yes. Refer Appendix for more information. |
| Does decoder support decoding of long term reference frames? If yes, are there any changes needed from application perspective? | Yes. Since this is a universal decoder, there is support for decoding of long term reference frames. No additional changes are needed from application perspective. No extra memory, compared to regular decoding, is needed for long term reference frames. |

## 4.4 Interlaced Related

| Question | Answer |
|---|---|
| In case of interlaced, can two fields of a frame be present in aribitrary locations? | No. The two fields need to be one below the other, at a certain offset. Refer Appendix for more details on Picture Format. |
| In case of interlaced, will single decode call (Process call), decode both the fields? | No.<br>In one process call, decoder decodes only one field. So two process calls are needed to decode both fields of a frame. |
| How should YUV buffers be passed to decoder in case of interlaced? | In first process call, App needs to give a buffer big enough to accommodate both fields. In second process call, Application needs to pass same buffer pointer again. |
| In case of PicAFF (Sequence with a mix of frames and fields), how will the Application understand whether to send same buffer again or a new buffer? | After a process call, Application should check value reported in parameter outArgs.viddec3OutArgs.outBufsInUseFlag.<br>If the value is 1, it means decoder has only populated one field. So in this case Application should send same buffer again.<br>If the value is 0, it means decoder has populated both fields. So in this case Application should pass a new buffer. |
| In case of interlaced, can Bottom field come first in bit stream? | Yes. A sequence can look like this: BF, TF, BF, TF, BF, TF… |
| In case of interlaced, can order of Bottom and Top fields get shuffled? | Yes. A sequence can look like this: TF, BF, BF, TF, TF, BF, TF, BF….. |
| In case of interlaced, if bottom field comes first, will the placement of Top and bottom fields in the buffer change? | No. Irrespective of which field comes first, Top Field will always be kept above and bottom field will be kept below. |
| In case of interlaced, how will application understand which field was decoded first? | Application needs to look at value populated in displayBufs->topFieldFirstFlag.<br>If this value is XDAS_TRUE, it means decoder decoded Top Field first.<br>If this value is XDAS_FALSE, it means decoder decoded bottom field first. |
| If a field is missing, what is the behavior of the decoder? | In the first process call decoder will decode first field. In second process call, decoder will understand that a field is missing. In this case, decoder will conceal the missing field, if concealment is enabled. And also decoder shall not consume bytes belonging to next frame. |

## 4.5 Others

| Question | Answer |
|---|---|
| What is granularity of the process call? | The decoder supports only frame level decoding API. However, it supports data sync APIs for sub frame level data exchange between Application and Decoder, both at input and output side. Refer Appendix for more information. |
| Can the decoder be run on any OS? | Yes.<br>Decoder implementation is independent of Operating System.<br>Only necessity is that the component interacting with decoder has to be VIDDEC3 interface compliant. |
| Decoder asks few buffers in TILED memory, can I override the decoder's request and provided buffers in different space? | Yes, you can over ride the decoder's request but with below constraints<br>1. TILED PAGE can be overridden by RAW<br>2. TILED8, TILED16 can be overridden by TILED PAGE, RAW<br>3. TILED16 can be overridden by TILED8, RAW, TILED PAGE<br><br>However note that in cases, 2 and 3, there will be certain performance impacts. |
| Can Application allocate few Luma buffers in TILED8 and few in other areas (like RAW region)? | No. All Luma Buffers for the given instance of the decoder need to be in same type of area. |
| Can Application allocate few Chroma buffers in TILED16 and few in other areas (like RAW region)? | No. All Chroma Buffers for the given instance of the decoder need to be in same type of area. |
| Can Application allocate all Luma buffers in one type of area and all chroma buffers in a different type of area? | Yes. For example all Luma buffers can be in TILED8, while all chroma buffers are in RAW region. |
| Does a Luma buffer and corresponding Chroma buffer needs to be contiguous in memory? | No |
| What is the behavior of Codec on cache properties of input and output buffer | All input and output buffer of decoder are read/written by DMA. So codec assumes that all input data is valid in DDR memory before feeding in to decoder. Also output of decoder is gauranteed to be in DDR.<br><br>However for the trace and debug related buffers produced by decoder it is not true. There are some buffers for which data can be in cache memory and cache write back from application side will be needed from Media Controller side, Refer Appendix for more details |
| Decoder starts displaying only after 5 frames of HD or 17 frames of CIF. Can I display early? | Yes. Displaying of frames can be forced to begin early in scenarios where the Application is aware of the GOP structure. Refer Appendix for more details. |
| Can DDR footprint of decoder be reduced? Can the number of YUV buffers be reduced? | Yes. In scenarios where the Application is aware of the number of reference frames and GOP structure. Refer Appendix for more details |

| **Question** | **Answer** |
|---|---|
| Can DDR footprint of decoder be reduced, if we need to decode only TI Encoder generated streams? Can the number of YUV buffers be reduced? | Yes, significant reduction is possible. Refer Appendix for more details |
| In use cases, where only D1 resolution OR smaller resolutions need to be decoded, can the DDR footprint be reduced? | Yes. If only D1 needs to be decoded, then decoder can be created at Level 3.0 and Max Resolution of D1. This will take significantly lesser DDR footprint than creating decoder at Level 4.1 |
| Is size of DDR memory requested during create time dependent on level of the decoder created? | Yes. Lower the level, lower will be the memory requested. |
| Can the decoder return NULL output buffer pointer? | No |
| Which are the supported/unsupported GOP types? | It’s a universal decoder and ALL GOP types are supported. |
| Does the decoder support a stream with no IDR frames? | Yes |
| What could be the reason for frames getting displayed out of order? | During decoder creation, if parameters dpbSizeInFrames and displayDelay are set to DEFAULT, then display can never look out of order.<br>If they are not set to default, then the values set might not be enough for the particular stream. There may be a need to increase the values. |
| Can the decoder start decoding from a non – I frame? | Yes |
| If decoder starts decoding from a non-I frame, what will be used as reference? | Grey Pixels (128 value) will be used as reference. |
| Does the bytes consumed in a process call include any trailing bytes? | No |
| If a frame ends in the middle of a byte, do the bytes consumed include that byte? | Yes. However note that H264 standard does not allow for syntax compliant stream to be ending at the middle of a byte. |
| Is the filler data NAL unit, AUD NAL unit etc. following a frame included in the bytes consumed for that frame? | No |
| Is it possible to configure the stream format (Byte stream vs NAL stream format) at frame level run-time? | No |

| Question | Answer |
|---|---|
| In case of skipping of non-ref frames, does decoder perform concealment of skipped frames? | No |
| Does the decoder behavior assume anything from the syntax parameter “gaps_in_frame_num_value_allowed” for skipping frames, if configured in SKIP MODE? | No |
| svcElayerDecode flag is not part of create time, but only dynamic parameter structure, unlike other SVC related parameters. Why? What if the application does not make SETPARAMS control call? | This flag is used to enable enhancement layer decoding for SVC. By default, this will be OFF. If the user wants to decode enhancement layer, he has to make a control call and set this flag. |

## 4.6 Trouble Shooting

| Problem | Possible Reasons |
|---|---|
| I am getting a Build error: “code memory section is not sufficient” | Ensure that project settings are not changed from the release package settings. Such as, making project setting as File -03 and no debug information, this throws an error that code memory section is not sufficient. |
| After running some frames, my application runs out of buffers | The application should allocate required number of YUV buffers depending on the resolution of the image and the level at which the decoder is created. To get this information as to how many buffers are required, application needs to perform a Control call with XDM_GETSTATUS command. Decoder reports number of YUV buffers needed in the parameter maxNumDisplayBufs.<br>And the freebufID array in outArgs indicates the buffer IDs that can be freed after each process call. The buffer manager on the application side should take care that freed buffers are re-allocated for subsequent process calls. |
| The decoder gives error during creation | Create time failure is due to unsupported values for parameter. Refer section on supported values for parameters for more information. |
| The XDM control call fails | These are few of reasons for the error:<br>❑ Control call parameter values are un-supported.<br>❑ Structure passed might be NULL. |
| The process call returns error | The following are few of reasons for the error:<br>❑ The input or output pointers are null<br>❑ The input or output buffer sizes are not sufficient or incorrect<br>❑ Run time error occurred during decoding of the frame<br>Refer Appendix for more infomration on error handling. |

| **Problem** | **Possible Reasons** |
|---|---|
| In the first process call, I am getting the error as `IH264VDEC_ERR_HDVICP2_IMPROPER_STATE` | Before HDVICP2 is given to codec, HDVICP2 has to be in standby mode. Other wise this error will show up. So check the IVAHD_Reset functionality used on the Application side. For sample flow and implementation, refer Test Application in the decoder release package. Note that in some configurations of simulator, reset might not be needed. |
| Frames are getting displayed out of order | During decoder creation, if parameters dpbSizeInFrames and displayDelay are set to DEFAULT, then display can never look out of order.<br>If they are not set to default, then the values set might not be enough for the particular stream. There may be a need to increase the values. |
| I am not able to run the sample test application on simulator | Check that the macro SIMULATOR_RUN is enabled in the header file TestApp_Constants.h. For detailed steps, refer section 2.4 |
| Some error streams are failing on simulator | Error streams are fully tested only on Hardware and not on simulator. There could be potential issues while running complex streams on simulator due to hardware modeling deficiencies.<br>Hence, it is recommended to use hardware for testing error streams and complicated non-error streams. |

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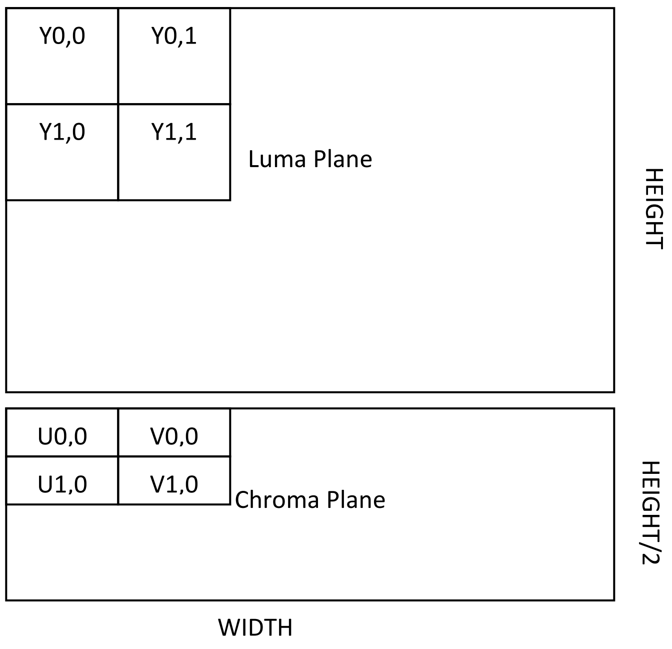
# Picture Format

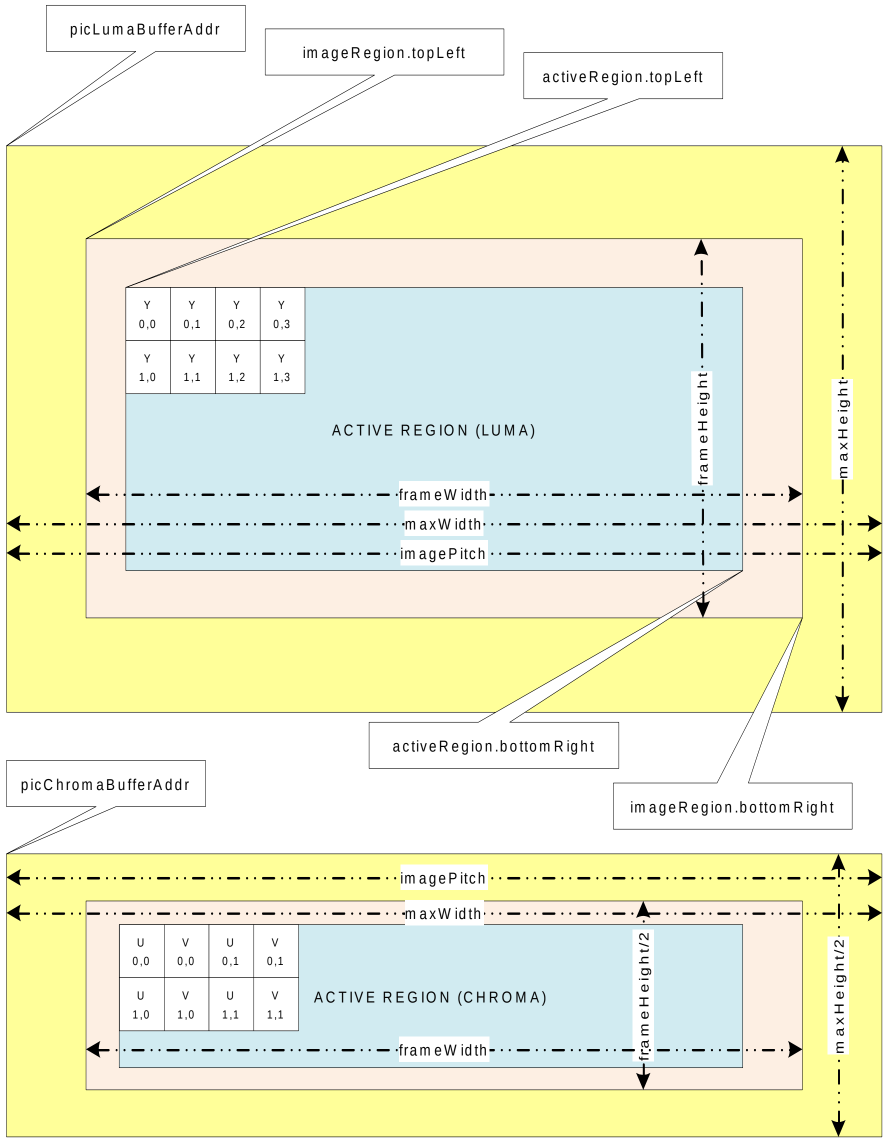
This Appendix explains picture format details for decoder. Decoder outputs YUV frames in NV 12 format.

## A.1 NV12 Chroma Format

NV12 is YUV 420 semi-planar with two separate planes, one for Y, one for U and V interleaved.



## A.2 Progressive Picture Format

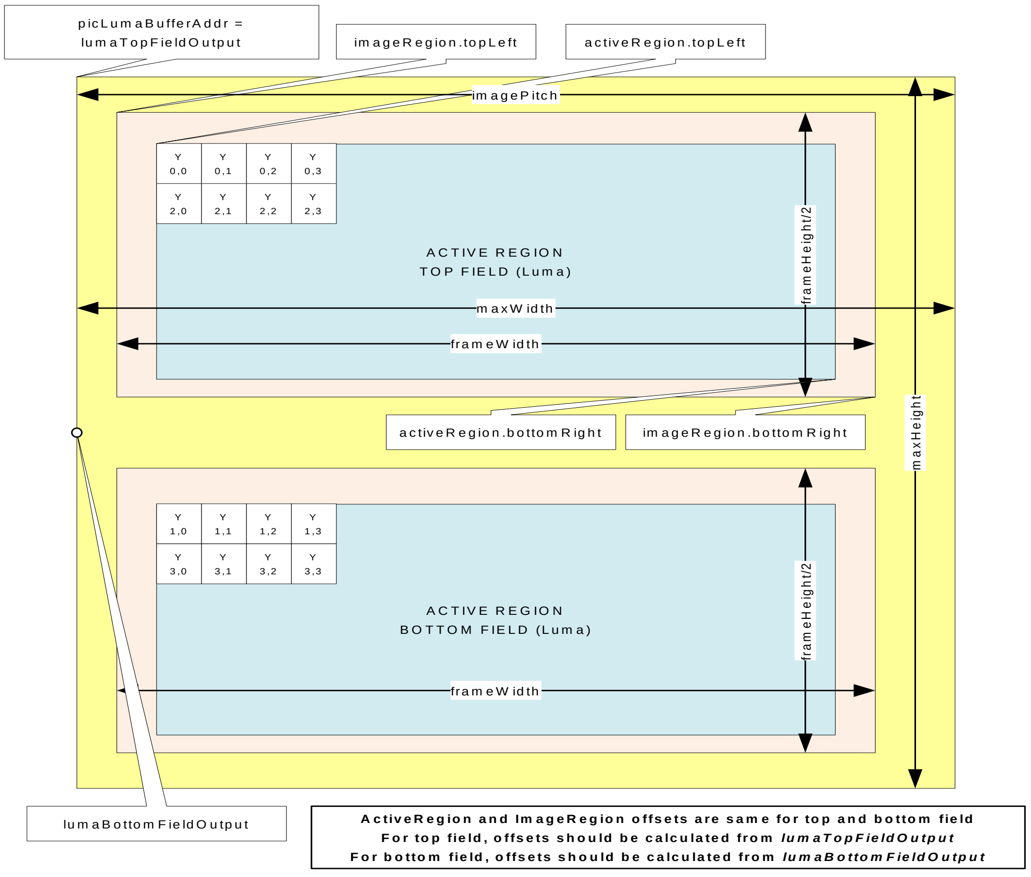


ActiveRegion and ImageRegion offsets for chroma are derived from luma offset
ChromaXoffset = lumaX_offset & 0xfffffffe;
ChromaYoffset = (lumaY_offset>>1) & 0xfffffffe;

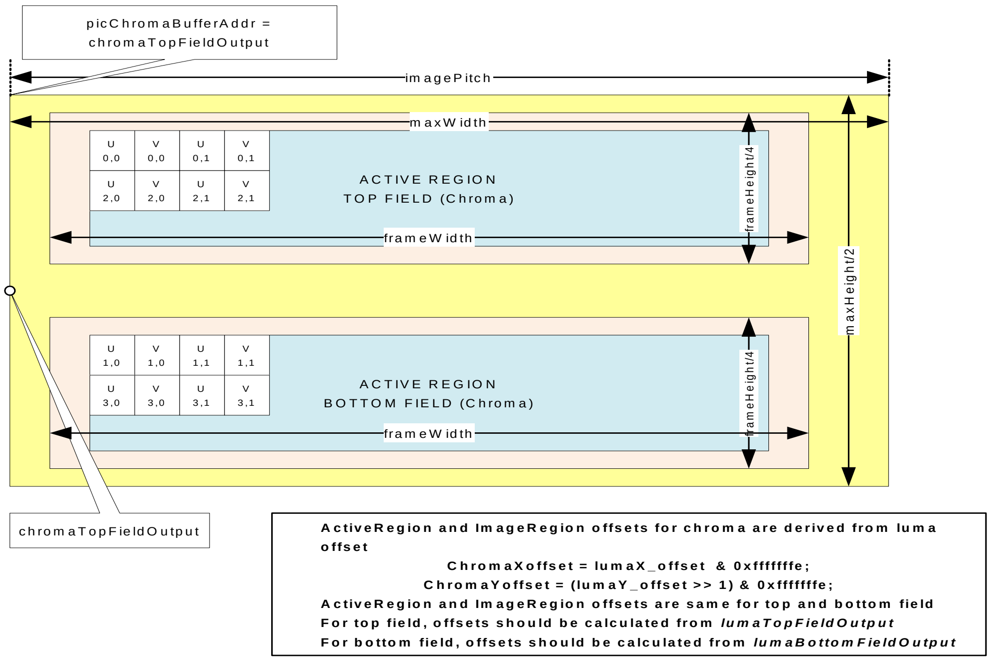
Note that for decoder in case of progressive sequence:

- Luma and chroma buffer addresses can be allocated independently
- Application shall provide this through separate buffer addresses
- The outermost yellow coloured region is the minimum buffer that application should allocate for a given *maxWidth* and *maxHeight*
- *activeRegion*
  - The displayable region after cropping done by application.
  - The cropping information is derived from VUI information in the bitstream
- *imageRegion*
  - Image data decoded by the decoder whose dimensions are always multiple of 16.
  - Contains the activeRegion as a proper subset.
- *Picture Buffer (pic(Luma/Chroma)BufferAddr)*
  - Contains padded regions and extra region due to alignment constraints.
  - Contains the imageRegion as a proper subset.
- *imagePitch*
  - The difference in addresses of two vertically adjacent pixels
  - Typically equal to width of the picture Buffer.
- *Padding Amounts*
  - In vertical direction  (top and bottom), padding amount is 24 pixels for Luma buffer and 12 pixels for chroma buffer.
  - In horizontal direction (left and right), padding  amount is 32 pixels for both Luma buffer chroma buffer.

## A.3 Interlaced Picture Format



**ActiveRegion and ImageRegion offsets are same for top and bottom field**
**For top field, offsets should be calculated from *lumaTopFieldOutput***
**For bottom field, offsets should be calculated from *lumaBottomFieldOutput***



**ActiveRegion and ImageRegion offsets for chroma are derived from luma offset**
**ChromaXoffset = lumaX_offset & 0xfffffffe;**
**ChromaYoffset = (lumaY_offset >> 1) & 0xfffffffe;**
**ActiveRegion and ImageRegion offsets are same for top and bottom field**
**For top field, offsets should be calculated from *lumaTopFieldOutput***
**For bottom field, offsets should be calculated from *lumaBottomFieldOutput***

Note that for decoder in case of interlaced/MBAFF/PicAFF sequence:

- Luma and chroma buffers can be allocated independently
- Field buffer allocation cannot be independent
- For every pair of top and bottom field, decoder shall expect a single buffer address from the application
- The outermost yellow coloured region is the minimum buffer that application should allocate for a given *maxWidth* and *maxHeight*
- *activeRegion*
  - The displayable region after cropping done by application.
  - The cropping information is derived from VUI information in the bitstream
- *imageRegion*
  - Image data decoded by the decoder.
  - Contains the activeRegion as a proper subset.
- *Picture Buffer (pic(Luma/Chroma)BufferAddr)*
  - Contains padded regions and extra region due to alignment constraints.
  - Contains the imageRegion as a proper subset.
- *imagePitch*
  - The difference in addresses of two vertically adjacent pixels
  - Typically equal to width of the picture Buffer.
- *Padding Amounts*
  - In vertical direction  (top and bottom), for each field, padding amount is 24 pixels for Luma buffer and 12 pixels for chroma buffer.
  - In horizontal direction (left and right), padding  amount is 32 pixels for both Luma buffer chroma buffer.

## A.4 Constraints on Buffer Allocation for Decoder

- *maxWidth* and *maxHeight* are inputs given by the decoder to the applications
  - Application may not know the output format of the decoder.
  - Therefore, application should allocate Image Buffer based on *maxWidth* and *maxHeight*
    - The extra region beyond the (maxWidth x maxHeight) requirements may be allocated by application due to alignment, pitch or some other constraints
- Application needs to ensure following conditions regarding *imagePitch*
  - *imagePitch* shall be greater or equal to the maxWidth.
  - *imagePitch* shall be multiple of 128 bytes (if the buffer is not in TILED region).
  - *imagePitch* shall actually be the tiler space width (i.e. depends on how many bit per pixel, for 8bpp 16bpp and 32bpp respectively 16Kbyte, 32Kbyte and 32Kbyte). (if the buffer is in TILED region).
  - Application may set *imagePitch* greater than *maxWidth* as per display constraints. However this value must be a multiple of 128 bytes (if the buffer is not in TILED region).
- picLumaBufferAddr and picChromaBufferAddr shall be 16-byte aligned address. (if the buffer is not in TILED region).
- ActiveRegion.topLeft and ActiveRegion.bottomRight are decoder outputs
  - Application should calculate actual display width and display height based on these parameters
  - *ActiveRegion.topLeft* and *ActiveRegion.bottomRight* shall be identical for both fields in case of interlaced format
- Maximum and Minimum Resolution is defined as below
  - Progressive
    - Minimum frameWidth = 64
    - Minimum frameHeight = 64
    - Maximum frameWidth = 4096
    - Maximum frameHeight = 4096
  - Interlaced
    - Minimum frameWidth = 64
    - Minimum (frameHeight / 2) = 32
    - Maximum frameWidth = 4096
    - Maximum (frameHeight / 2) = 2048
- Typically picture buffer allocation requirements for decoder, after buffer addresses meet alignment constraints (depends on decoder's padding requirements), for both progressive and interlaced are as given below.

- Luma buffer size = maxWidth x maxHeight  and Chroma buffer size = maxWidth x maxHeight/2 where
    - maxWidth = frameWidth + 64 (progressive/interlaced)
    - maxHeight = frameHeight + 48 (progressive)
    - maxHeight = frameHeight + 96 (interlaced)

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Appendix B

# Meta Data Support

This version of the decoder supports writing out the parsed SEI, VUI data and MB Info data into application provided buffers. If SEI and VUI is present in the stream for this frame, the parsed data is given back to the application. For the details on SEI and VUI data structures, See section 4.2.2.

This feature can be enabled/disabled through create time parameters `IVIDDEC3_Params::metadataType[IVIDEO_MAX_NUM_METADATA_PLANES]`. There can be maximum 3 (`IVIDEO_MAX_NUM_METADATA_PLANES`) meta data planes possible to be supported with one instance of the decoder.

Each element of `metadataType[]` array can take following enumerated values.

| **Enumeration** | **Value** |
|---|---|
| `IVIDEO_METADATAPLANE_NONE` | -1 |
| `IVIDEO_METADATAPLANE_MBINFO` | 0 |
| `IVIDEO_METADATAPLANE_EINFO` | 1 |
| `IVIDEO_METADATAPLANE_ALPHA` | 2 |
| `IH264VDEC_PARSED_SEI_DATA` | 256 |
| `IH264VDEC_ENCODED_SEI_DATA` | 257 |
| `IH264VDEC_PARSED_VUI_DATA` | 258 |
| `IH264VDEC_ENCODED_VUI_DATA` | 259 |

This version of the decoder supports only following enumerated values:

**`IVIDEO_METADATAPLANE_NONE`**

**`IH264VDEC_PARSED_SEI_DATA`**

**`IH264VDEC_PARSED_VUI_DATA`**

**`IVIDEO_METADATAPLANE_MBINFO`**

If user wants to get the SEI data, then `IVIDDEC3_Params::metadataType[0]` should be set to `IH264VDEC_PARSED_SEI_DATA`. Similarly, if both SEI and VUI data are needed, then set `IVIDDEC3_Params::metadataType[0]` should be set to `IH264VDEC_PARSED_SEI_DATA` and `IVIDDEC3_Params::metadataType[1]` to `IH264VDEC_PARSED_VUI_DATA`

If user does not want to use any meta data plane then all the entries of `IVIDDEC3_Params::metadataType[]` should be set to `IVIDEO_METADATAPLANE_NONE`. Note that the `metadataType[]` array need to be filled contiguosly (there cannot be `IVIDEO_METADATAPLANE_NONE` between 2 metadata types.

The buffer requirements for metadata can be obtained using Control call with XDM_GETBUFINFO:

- If any of the SEI or VUI metadata is requested during create time, then the size of the buffer needed for populating SEI and VUI data are indicated by the decoder in the Status structure during control call of `XDM_GETBUFINFO`.
- If both SEI and VUI data is requested during create, then the number of output buffers needed is 4. `status->bufInfo.minNumOutBufs = 4` (2 for Y and UV data, one each for SEI and VUI).
- If only one of SEI or VUI data is requested, then the number of output buffers needed is 3. `status->bufInfo.minNumOutBufs = 3`.
- The order of the metadata buffer info supplied using status structure is same as the order set by the user in the `metadataType[]` array during create time. For example if the user has `IVIDDEC3_Params::metadataType[0] = IH264VDEC_PARSED_SEI_DATA` and `IVIDDEC3_Params::metadataType[1]= IH264VDEC_PARSED_VUI_DATA` then `status->bufInfo.minOutBufSize[2]` will have the SEI buffer requirement and `status->bufInfo.minOutBufSize[3]`.bytes will have VUI buffer size information.

The buffer pointers for the metadata need to be supplied as below during process Call:

- When the application makes the `process()` call, the pointers to the buffers where SEI/VUI data should be stored needs to be provided to the codec in the output buffer descriptor `[outputBufDesc.descs]`.
- `OutBufs->numBufs = numBuffers` forYUVPlanes + number of meta data enabled (This is =4 if both SEI and VUI are enabled)
  - `outBufs->descs[0]` -> Y plane
  - `outBufs->descs[1]` -> Cb/Cr plane outBufs.
  - `outBufs->descs[2]` -> Buffer allocated for SEI
  - `outBufs->descs[3]` -> Buffer allocated for VUI

- The order of the metadata buffers need to be supplied for the process call is same as the order set by the user in the `metadataType[]` array during create time. For example if the user has `IVIDDEC3_Params::metadataType[0] = IH264VDEC_PARSED_SEI_DATA` and `IVIDDEC3_Params::metadataType[1]= IH264VDEC_PARSED_VUI_DATA` then `outBufs->descs[2]` will be assumed as SEI buffer and `outBufs->descs[3] will be assumed as VUI buffer.`

- Codec internally writes the meta data in appropriate buffer. When the decoder writes the SEI/VUI message, the number of metadata planes is indicated by `outArgs->decodedBufs.numMetaPlanes` (this is 2 if both SEI and VUI are enabled by the app)

- Also, the respective buffer pointer is copied back in the first meta-plane pointer: `outArgs->decodedBufs.metadataPl aneDesc[0].buf` , again the ordering of the metadata is as per the order supplied by `IVIDDEC3_Params::metadataType[] inpput parameter.`

Decoder parses metadata in the current process call and returns in the same process call. This means, effectively meta data will be given out in decode order [Not in Display Order]. If application is interested in display order, it should have a logic to track based on input and output ID. In case of interlaced pictures, meta data buffers provided for each field (each process call) is assumed to be independent.

**REMAINDER OF THIS APPENDIX GIVES MORE INFORMATION ABOUT `IVIDEO_METADATAPLANE_MBINFO`**

Decoder shares two types of information at MB Level:

MB Error Map: It's an array of bytes - One byte per MB (Refer Enum IH264VDEC_ mbErrStatus). The byte indicates whether the MB is in error or not.

MB Info structure: It is a structure which defines properties of a MB. Refer structure IH264VDEC_TI_MbInfo in ih264vdec.h file. Size per MB = 208 bytes.

Decoder also shares a structure, which has information useful for concealment purposes. Refer structure sErrConcealLayerStr in ih264vdec.h file.

**Case1:** If the Application sets viddec3Params.metadataType[x] = IVIDEO_METADATAPLANE_MBINFO and IVIDDEC3_Params.operatingMode = IVIDEO_DECODE_ONLY, then decoder will dump out MB Error Map and error concealment structure at buffer location given for MB Info meta data.

**Case2:** If the Application sets viddec3Params.metadataType[x] = IVIDEO_METADATAPLANE_MBINFO and IVIDDEC3_Params.operatingMode = IVIDEO_TRANSCODE_FRAMELEVEL, then decoder will dump out MB Error Map at buffer location given for MB Info meta data. Error Map will be followed by MB Info structure for all MBs. This will be followed by error concealment structure.

Note that if the Application does not set viddec3Params.metadataType[x] = IVIDEO_METADATAPLANE_MBINFO, then no information will be dumped, irrespective of the value of IVIDDEC3_Params.operatingMode. Also, as a minor Interface limitation, there is no provision to dump MB Info structure alone w/o error map and error concealment structure.

**Format details for Case 1 (Dumping of Error map and Error concealment structure):**

**Case 1a, Progressive Frame:**

| |
|---|
| Error Map, Size in Bytes = Number of MBs in Frame |
| Error Concealment Structure, Size in Bytes = sizeof(sErrConcealLayerStr) |

**Case 1b, Interlaced Frame:**

| |
|---|
| Error Map for Top Field, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Map for Bottom Field, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Concealment Structure for Top Field, Size in Bytes = sizeof(sErrConcealLayerStr) |
| Error Concealment Structure for Bottom Field, Size in Bytes = sizeof(sErrConcealLayerStr) |

**Case 1c, MBAFF Frame:**

| |
|---|
| Error Map for all Top MBs of the MB pair, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Map for all Bottom MBs of the MB pair, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Concealment Structure for entire frame, Size in Bytes = sizeof(sErrConcealLayerStr) |

**Format details for Case 2 (Dumping of Error map, MB Info and Error concealment structure):**

**Case 2a, Progressive Frame:**

| |
|---|
| Error Map, Size in Bytes = Number of MBs in Frame |
| MB Info structure for all MBs, Size in Bytes = 208 * Number of MBs in Frame |
| Error Concealment Structure, Size in Bytes = sizeof(sErrConcealLayerStr) |

**Case 2b, Interlaced Frame:**

| |
|---|
| Error Map for Top Field, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Map for Bottom Field, Size in Bytes = (Number of MBs in Frame / 2) |
| MB Info structure for all MBs of Top Field, Size in Bytes = 208 * (Number of MBs in Frame / 2) |
| MB Info structure for all MBs of Bottom Field, Size in Bytes = 208 * (Number of MBs in Frame / 2) |
| Error Concealment Structure for Top Field, Size in Bytes = sizeof(sErrConcealLayerStr) |
| Error Concealment Structure for Bottom Field, Size in Bytes = sizeof(sErrConcealLayerStr) |

**Case 2c, MBAFF Frame:**

| |
|---|
| Error Map for Top MBs of all MB Pairs, Size in Bytes = (Number of MBs in Frame / 2) |
| Error Map for Bottom MBs of all MB Pairs, Size in Bytes = (Number of MBs in Frame / 2) |
| MB Info structure for Top MBs of all MB Pairs, Size in Bytes = 208 * (Number of MBs in Frame / 2) |
| MB Info structure for Bottom MBs of all MB Pairs, Size in Bytes = 208 * (Number of MBs in Frame / 2) |
| Error Concealment Structure for Entire Frame, Size in Bytes = sizeof(sErrConcealLayerStr) |

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# Error Handling

This version of the decoder supports handling of erroneous situations while decoding. If decoder encounters errors in bit stream or any other erroneous situations, decoder shall exit grace fully without any hang or crash. Also decoder process call shall return `IVIDDEC3_EFAIL` and relevant error code will be populated in `extendedError` field of `outArgs`. Different error codes and their meanings are described below.

Definitions of bits numbered 8-15 are as per common XDM definition. Definition of remaining bits are H264 Decoder specific and as given in below tabular column. Bit numbering in the 32 bit word `extendedError` is from Least Significant Bit to Most Significant Bit.

Some of the erroneous situations will get reported as `XDM_FATALERROR` by the decoder. In these cases, Application should perform XDM_RESET of the decoder. After an `XDM_RESET` is performed, the decoder will treat the bit stream provided freshly and it shall use no information from previously parsed data.

In certain fatal erroneous situations, the Application, might flush out the locked buffers, if need be. See below table for more details on error situations when flush can be performed.

In case of non-fatal errors, application need not perform `XDM_RESET`. It can proceed with more decode calls, if bit stream is still not exhausted.

Meanings of various error codes and the recommended application behavior are provided in the following table:

*Table 4-2. Error Codes Information*

| Bit | Error code | Explanation | XDM Error Code Mapping | Recommended App Behavior |
|---|---|---|---|---|
| 0 | IH264VDEC_ERR _NOSLICE | Not even a single error-free slice header found in this process call, did not start MB loop | XDM_CORRUPTEDHE ADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 1 | IH264VDEC_ERR _SPS | Any syntax error while parsing an SPS in this process call | XDM_CORRUPTEDHE ADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |

| Bit | Error code | Explanation | XDM Error Code Mapping | Recommended App Behavior |
|---|---|---|---|---|
| 2 | IH264VDEC_ERR_PPS | Any syntax error while parsing a PPS in this process call | XDM_CORRUPTEDHEADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 3 | IH264VDEC_ERR_SLICEHDR | Any syntax error while parsing a slice header in this process call. Can be first slice or intermediate slice. | XDM_CORRUPTEDHEADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 4 | IH264VDEC_ERR_MBDATA | ECD3 reported error while parsing MB data OR decoded more MBs wrongly in a slice OR did SC overrun at end of frame without finding any error | XDM_CORRUPTEDDATA | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 5 | IH264VDEC_ERR_UNAVAILABLESPS | The SPS that a PPS/slice header referred to in this process call has not been received yet OR it was erroneous and thus invalid. | XDM_CORRUPTEDHEADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 6 | IH264VDEC_ERR_UNAVAILABLEPPS | The PPS that a slice header referred to in this process call has not been received yet OR it was erroneous and thus invalid. | XDM_CORRUPTEDHEADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 7 | IH264VDEC_ERR_INVALIDPARAM_IGNORE | Some error was detected while slice header decoding, which the codec corrected and continued. Application should ignore this error. | XDM_CORRUPTEDHEADER | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 8 | XDM_PARAMSCHANGE | Sequence Parameters Change | XDM_PARAMSCHANGE | Refer codec specific error which causes this |

| Bit | Error code | Explanation | XDM Error Code Mapping | Recommended App Behavior |
|---|---|---|---|---|
| 9 | XDM_APPLIEDCONCEALMENT | Applied concealment | XDM_APPLIEDCONCEALMENT | Refer codec specific error which causes this |
| 10 | XDM_INSUFFICIENTDATA | Insufficient input data | XDM_INSUFFICIENTDATA | Refer codec specific error which causes this |
| 11 | XDM_CORRUPTEDDATA | Data problem/corruption | XDM_CORRUPTEDDATA | Refer codec specific error which causes this |
| 12 | XDM_CORRUPTEDHEADER | Header problem/corruption | XDM_CORRUPTEDHEADER | Refer codec specific error which causes this |
| 13 | XDM_UNSUPPORTEDINPUT | Unsupported feature/parameter | XDM_UNSUPPORTEDINPUT | Refer codec specific error which causes this |
| 14 | XDM_UNSUPPORTEDPARAM | Unsupported input parameter | XDM_UNSUPPORTEDPARAM | Refer codec specific error which causes this |
| 15 | XDM_FATALERROR | Fatal error | XDM_FATALERROR | Refer codec specific error which causes this |
| 16 | IH264VDEC_ERR_UNSUPPFEATURE | Unsupported feature (FMO) is present in the bit stream, indicated while decoding a slice header | XDM_UNSUPPORTEDINPUT | Can either continue with the stream giving a fresh pointer OR do XDM Reset and give a fresh stream |
| 17 | IH264VDEC_ERR_METADATA_BUFOVERFLOW | The size of the metadata buffer given by the application is not sufficient | XDM_UNSUPPORTEDINPUT | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |

| Bit | Error code | Explanation | XDM Error Code Mapping | Recommended App Behavior |
|---|---|---|---|---|
| 18 | IH264VDEC_ERR_STREAM_END | End of Stream NAL was found in this process call OR codec is in flush mode | No XDM mapping | Normal Mode of Decoder - Do XDM_FLUSH, Else - XDM_RESET and Next Stream |
| 19 | IH264VDEC_ERR_NO_FREEBUF | Not used as of now - Future use | XDM_FATALERROR | |
| 20 | IH264VDEC_ERR_PICSIZECHANGE | A resolution change is detected while decoding a slice header in this process call | XDM_PARAMSCHANGE | Perform FLUSH. No need to perform XDM_RESET. Do buffer re-allocation based on new GETSTATUS call. Pass the pointer again. |
| 21 | IH264VDEC_ERR_UNSUPPRESOLUTION | Width or height is less than the minimum supported or more than the maximum supported | XDM_FATALERROR | Can do a FLUSH, then XDM Reset and pass a fresh stream |
| 22 | IH264VDEC_ERR_NUMREF_FRAMES | The num_ref_frames in active SPS is more than the supported max_num_ref_frames | XDM_FATALERROR | Can do a FLUSH, then XDM Reset and pass a fresh stream |
| 23 | IH264VDEC_ERR_INVALID_MBOX_MESSAGE | Invalid message received on MB, which causes interrupt on Media Controller or HDVICP2, depending on the FIFO - Stray writes into FIFO by some one other than codec | XDM_FATALERROR | Should not do XDM_FLUSH. Do HDVICP_Reset, XDM Reset and pass stream |
| 24 | IH264VDEC_ERR_DATA_SYNC | Output datasync enabled, and buffer pointer in display bufs is different from decode bufs | XDM_FATALERROR | Can do a FLUSH, then XDM Reset and pass a fresh stream |
| 25 | IH264VDEC_ERR_MISSINGSLICE | One or more slices are completely missing in this picture | XDM_CORRUPTEDDATA | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 26 | IH264VDEC_ERR_INPUT_DATASYNC_PARAMS | Error in input datasync parameters | XDM_UNSUPPORTEDPARAM | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |

| Bit | Error code | Explanation | XDM Error Code Mapping | Recommended App Behavior |
|---|---|---|---|---|
| 27 | IH264VDEC_ERR_HDVICP2_IMPROPER_STATE | Turn on clocks failed for HWAs, OR HDVICP standby failed OR HDVICP Reset failed | XDM_FATALERROR | Should not do XDM_FLUSH. Do HDVICP_Reset, XDM Reset and pass stream |
| 28 | IH264VDEC_ERR_TEMPORAL_DIRECT_MODE | Temporal direct mode is disabled by app, and the stream contains temporal direct mode. | XDM_UNSUPPORTED INPUT | If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation. |
| 29 | IH264VDEC_ERR_DISPLAYWIDTH | DisplayWidth is less than the Image width + Padded width | XDM_FATALERROR | Should not do XDM_FLUSH. Perform XDM_Reset. Do a control call and set suitable value of displayWidth. Perform FLUSH. No need to perform XDM Reset. Pass the pointer again. |
| 30 | IH264VDEC_ERR_NOHEADER | Indicates that no SPS/PPS header is decoded in the current process call, when operating in PARSE_HEADER mode (or) No watermark SEI data when watermark parameter is enabled. | XDM_UNSUPPORTED INPUT | Perform control call and set decoder in DECODE_AU mode and do next process call. |
| 31 | IH264VDEC_ERR_GAPSINFRAMENUM | Indicates that a gap is detected in frame_num. | Nothing | Application can infer actual gap in frame number by performing GET STATUS control call and can take any action which it wishes. However, decoding can be continued for the remainder of the stream normally. |

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Appendix D

# Parse Header Support

This version of the decoder provides support to parse just header of the H264 bit stream. For decoder to operate in this mode Application needs to perform a `XDM_SETPARAMS` control call with `dynamicParams->decodeHeader = XDM_PARSE_HEADER`

Typical usage of this feature by the application is to understand the resolution of picture in bit stream and allocate frame buffer of size as needed by that bit stream. Sequence of operations on the application side typically is as follows:

1. Decoder_Create
2. Control call (XDM_SETPARAMS) to configure decoder in parse header mode
3. Process call to decoder which shall decode SPS+PPS
4. Control call (XDM_GETBUFINFO) to understand buffer requirements
5. Allocate buffers of size exactly needed to decode this particular bit stream
6. Control call (XDM_SETPARAMS) to configure decoder in normal mode (dynamicParams->decodeHeader = XDM_DECODE_AU)
7. Process calls to decode frames

**Note:**

Following aspects of decoder behavior when configured in `XDM_PARSE_HEADER` mode:.

- ❑ Decoder shall neglect slice data, if encountered, before obtaining at least one SPS+PPS in a bit stream. Decoder shall parse multiple SPS and PPS NALs, if present, in the same process call until a slice header is encountered.
- ❑ After encountering at least one SPS+PPS in the bit stream, if decoder encounters slice data in the same process call, then decoder shall parse initial portion of slice header to understand SPS ID and hence the resolution of the image. However bytes consumed value returned by decoder will not include bytes of slice header.
- ❑ After at least one SPS+PPS is parsed, if application still performs process calls with decoder in `XDM_PARSE_HEADER` mode, then decoder behavior is as follows:
- ❑ If decoder encounters SPS/PPS, it shall parse them until slice data is encountered. After encountering slice data, it shall infer SPS Id and return from process call

- ❑ If decoder encounters slice data, w/o encountering SPS+PPS in the current process call, then decoder shall return `H264D_ERR_NOHEADER` error, thereby indicating application to re-configure decoder in `XDM_DECODE_AU` mode.
- ❑ If application creates decoder to parse SEI and VUI, then decoder will parse SEI / VUI if they are present in bit stream. Hence the application is expected to pass the buffers for SEI and VUI appropriately.
- ❑ Output buffers for YUV data is don’t care for decoder, while in parse header mode

Appendix E

# Skip Support

This version of the decoder provides support for skipping of decoding non-reference frames. Typical usages of this feature by the application are as follows:

1. In scenarios where video decoding takes more time and needs to catch up with real time. So Application would wish decoder to skip decoding of non-reference frames and hence save some time

2. In certain trick-play scenarios, where application is not interested in decoding / displaying non-reference frames

To configure decoder in skip mode, Application needs to be perform `XDM_SETPARAMS` control call, with `dynamicParams-> frameSkipMode = IVIDEO_SKIP_NONREFERENCE`.

When configured in skip mode, if decoder encounters non-reference pictures, it shall skip the decoding, regardless of slice type. Bit stream is just parsed to understand end of picture and decoder shall report back the bytes consumed as equal to bytes of that picture. Decoder shall indicate to the application that it has skipped decoding by setting `decodedBufs->frameStatus = IVIDEO_FRAME_OUTPUTSKIP`.

Even, when the decoder skips decoding, buffer given by the application shall be consumed by the decoder and the normal buffer-sharing interface will be adhered to.

When buffer of the skipped picture is given out for display, decoder indicates this to the application by setting `displayBufs->frameStatus = IVIDEO_FRAME_OUTPUTSKIP`. Also note that decoder does not perform concealment of skipped frames. Contents of the provided YUV buffer will not be altered.

To re-configure decoder back into non-skip mode, application needs to perform `XDM_SETPARAMS` control call, with `dynamicParams-> frameSkipMode = IVIDEO_NO_SKIP`

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Appendix F

# Support for Display Delay and Low DDR Memory Footprint

This version of decoder supports configurability to achieve desired display delay and low DDR memory footprint.

It is recommended to utilize this feature only when the application is well aware of the nature of the bit stream in terms of the GOP structure and the number of reference frames used.

Desired display delay can be achieved by the application by setting IVIDDEC3_Params::displayDelay. Decoder shall start displaying of frames not later than displayDelay number of frames are decoded.

In certain application use cases, number of reference frames (and hence DPB size needed) might be less than the standard allowed level limits. In these cases decoder can be configured to operate with lower DDR footprint – with respect to the amount of memory requested during create time and in terms of number of frame buffers locked inside the decoder for referencing. Application can utilize this feature by configuring IH264VDEC_Params::dpbSizeInFrames.

For simple GOP structures, typically, it is enough if dpbSizeInFrames is configured as M+1. And display delay is set as M, where M = SPS -> max_num_ref_frames. In this case, decoder will not lock more than 2M+2 buffers. Above said values need to be exercised under caution, in closed loop scenarios only, where the application is well aware of the GOP structure. Refer Note below for more information.

**Note:**

- ❑ If the GOP structure of the stream demands a display delay more than as set by the application, decoder shall not be able to detect this situation. Hence frames given out for display will be out of order.
- ❑ In certain scenarios, decoder can infer that the stream requires more reference frames than the dpbSizeInFrames set by the application. In these cases, decoder shall have a process call failure with error code of H264D_ERR_NUMREF_FRAMES. However, in certain GOP structures, decoder might not be able to detect this situation and hence in these cases decoder may lock up more frames than expected.
- ❑ If the application use case is not well aware of the display delay and number of reference frames needed by the bit streams, it is strongly recommended, that the application sets both displayDelay and dpbSizeInFrames as DEFAULT.

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Appendix G

# Support for Dynamic Change in Resolution

This version of decoder supports handling of change in resolution in a stream. Procedure to be followed is as follows:

When the decoder detects that a change in resolution has occurred:

- Decoder shall send out an error code of H264VDEC_ERR_PICSIZECHANGE.
- bytesConsumed value returned by decoder shall not be inclusive of the slice belonging to new resolution.

When the application observes the error code of H264VDEC_ERR_PICSIZECHANGE, it should take the following steps:

- Flush out all frames locked inside decoder [These frames will be of the older resolution]
- Perform control call with GET STATUS command to understand the new resolution
- Re-allocate YUV buffers based on the new resolution
- Start performing process call again.

Note:

- There is no need to perform XDM_Reset in the above flow
- Above flow is same irrespective of whether the resolution increases or decreases

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Appendix H

# Support for Debug Trace

This appendix explains the details of Debug Trace generated by decoder.

## H.1 Debug Trace DDR Memory Format in H264 Decoder

| |
|---|
| Debug trace header |
| Debug Trace Parameters for Process Call 1 |
| Debug Trace Parameters for Process Call 2 |
| Debug Trace Parameters for Process Call 3 |
| Debug Trace Parameters for Process Call 4 |
| : |
| : |
| : |
| Debug Trace Parameters for Process Call N |
| Debug Trace Parameters for Process Call N+1. |

Decoder collects and dumps the Debug Trace Information in DDR in above format. At the start of the buffer, is a header. Following the header, Debug Trace parameters for each process call is stored. There are N+1 buffers, since logs of last N process calls need to be stored and one extra buffer for current process call logs.

Buffers for N+1 process calls are used in a circular manner by decoder - once data for N+1 process calls are collected, decoder wraps back in the buffer and starts storing from first buffer location.

## H.2 Method to Configure decoder to collect debug trace:

During decoder creation, application needs to set IH264VDEC_Params::debugTraceLevel = IH264VDEC_DEBUGTRACE_LEVEL1. And set IH264VDEC_Params::lastNFramesToLog = N, where N refers to number of process calls for which trace needs to be collected. Note that the buffer for debug trace collection will be requested by decoder, in DDR, during create time and size of it will be linearly proportional to N.

## H.3 Method for Application to collect debug trace:

Application can understand the address of the buffer by performing control call with `XDM_GETSTATUS` command. Base address of the buffer will be reported in IH264VDEC_Status::extMemoryDebugTraceAddr. Total size of the buffer will be reported in IH264VDEC_Status::extMemoryDebugTraceSize.

NOTE: Before collecting the contents from DDR, Application needs to perform cache write back of the header portion of the buffer from Media Controller side. Media Controller_Cache_WriteBack needs to be performed at address IH264VDEC_Status::extMemoryDebugTraceAddr and for a size equal to that of header (In this release, size of header is 96 Bytes)

Appendix I

# Low Latency / Sub Frame Level Synchronization

## I.1 Brief Description

Sub frame level data synchronization between decoder and application is supported in this release at both input and output level.

At decoder input level (Bit Stream), there are two modes of operation:

1. **Fixed mode:** where in multiples of 1K of bit stream can be given
2. **Slice mode:** where in individual NALs can be given.

At decoder output level, decoder can give out reconstructed rows of MB, instead of waiting until the entire frame is reconstructed.

## I.2 Details of using Sub Frame Level data sync at output side:

This section explains the IVIDDEC3 interface details which help to achieve the sub frame level communications at the output side.

Below tables explain the creation, control and handshake parameters related to sub frame level data communication for output data of video decoder respectively.

Details column is a generic column and “valid values” column is specific to video decoder output.

**Creation time parameter related to sub frame level data communication for output data of video decoder:**

| Parameter Name | Details | Valid values | |
|---|---|---|---|
| IVIDDEC3_Params::outputDataMode | Defines the mode of producing the output frame. | *IVIDEO_ENTIREFRAME* | entire frame data is produced by decoder for display |
| | | *IVIDEO_NUMROWS* | Frame data is given in unit of Number of mb rows, each mb row is 16 lines of video |

| | | |
|---|---|---|
| IVIDENC2_Params::numOutputDataUnits | Unit of output data | Don't care if IVIDDEC3_Params::outputDataMode == IVIDEO_ENTIREFRAME<br>If IVIDDEC3_Params::outputDataMode == IVIDEO_NUMROWS then it defines the frequency at which decoder should inform to application about data availability. For example numOutputDataUnits = 2 means that after every 2 MB row (2*16 lines) availability in display buffer, decoder should inform to application |

**Dynamic parameters related to sub frame level data communication for output data of video decoder:**

| **Parameter Name** | **Details** | **Valid values** |
|---|---|---|
| IVIDDEC3_DynamicParams::putDataFxn | This function pointer is provided by the app/framework to the video decoder. The decoder calls this function when sub-frame data has been put into an output buffer and is available. | *Any non-NULL value if outputDataMode != IVIDEO_ENTIREFRAME* |
| IVIDDEC3_DynamicParams::putDataHandle | It defines the handle to be used while informing data availability to application. This is a handle which the codec must provide when calling the app-registered IVIDDEC3_DynamicParams.putDataFxn().Apps/frameworks that don't support datasync should set this to NULL. For an algorithm, this handle is read-only; it must not be modified when calling the app-registered IVIDDEC3_DynamicParams.putDataFxn().<br>The app/framework can use this handle to differentiate callbacks from different algorithms. | *Any Value* |

**Handshake parameters related to sub frame level data communication for output data of video decoder:**

| **Parameter Name** | **Details** | **Valid values** |
|---|---|---|
| XDM_DataSyncDesc::size | Size of the XDM_DataSyncDesc structure | *Sizeof(XDM_DataSyncDesc)* |
| XDM_DataSyncDesc:: scatteredBlocksFlag | Flag indicating whether the individual data blocks may be scattered in memory.<br>Note that each individual block must be physically contiguous.<br>Valid values are XDAS_TRUE and XDAS_FALSE.<br>If set to XDAS_FALSE, the baseAddr field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If set to XDAS_TRUE, the baseAddr array must contain the base address of each individual block. | **Don't care, always assumed to be 0** |
| XDM_DataSyncDesc::baseAddr | Base address of single data block or pointer to an array of data block addresses of size numBlocks.<br>If scatteredBlocksFlag is set to XDAS_FALSE, this field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If scatteredBlocksFlag is set to XDAS_TRUE, this field points to an array of pointers to the data blocks. | **Don't care** |
| XDM_DataSyncDesc::numBlocks | Number of data blocks | Number of rows given out by decoder in this call of putDataFxn. Value can be k*numOutputDataUnits. K = 1, 2 etc. Also towards the end of frame it will take value = [(no of rows in picture) mod (numOutputDataUnits)] |
| XDM_DataSyncDesc::varBlockSizeFlag | Flag indicating whether any of the data blocks vary in size. | **Don't care**, as unit of size is one row |
| XDM_DataSyncDesc::blockSizes | Variable block sizes array. | **Don't care** Since unit is assumed to be multiple of number of rows which is indicated by numBlocks. |

If application, wants to use video decoder to operate with sub frame on output side

- It should create the video decoder with IVIDDEC3_Params::outputDataMode = IVIDEO_NUMROWS*.*

- It should also make a control call with IVIDDEC3_DynamicParams::putDataFxn = non-NULL; to use sub frame level data communication, control call is mandatory.
- Address of the Luma and chroma output buffer will be present in decoded/display buffs. It will not be communicated via DataSyncDesc structure.
- If Video decode Media Controller thread doesn't get scheduled before the next data availability, then in that situation codec give numBlocks as k*numOutputDataUnits.
- Constraint: display order not being same as decode order with IVIDDEC3_Params::outputDataMode = IVIDEO_NUMROWS, is an erroneous situation.
- IVIDDEC3_DynamicParams::putDataFxn == NULL && IVIDDEC3_Params::outputDataMode == IVIDEO_NUMROWS is an erroneous situation and codec returns error during process call

## I.3 Details of using Sub Frame Level data sync at input side:

This section explains the IVIDDEC3 interface details, which help to achieve the sub frame level communications for input.

Below tables explain the creation and control parameters related to sub frame level data communication for input data of video decoder respectively.

Details column is a generic column and "valid values" column is specific to video decoder.

**Creation time parameter related to sub frame level data communication for input data of video decoder:**

| **Parameter Name** | **Details** | **Valid values** | |
|---|---|---|---|
| IVIDDEC3_Params::inputDataMode | Defines the mode of accepting the input data. | *IVIDEO_ENTIRE FRAME* | Entire frame bit-stream is provided to the decoder |
| | | *IVIDEO_FIXEDLENGTH* | bit-stream is provided to decoder after a fixed length of bytes. The length has to be multiple of 1K |
| | | *IVIDEO_SLICE MODE* | bit-stream is provided to decoder after having a single(or more) number of slice NAL Units |
| IVIDDEC3_Params::numInputData | Unit of input data | ***Don't care*** | |

| | | |
|---|---|---|
| Units | | |

**Dynamic parameters related to sub frame level data communication for input data of video decoder:**

| **Parameter Name** | **Details** | **Valid values** |
|---|---|---|
| IVIDDEC3_DynamicParams::getDataFxn | This function is provided by the app/framework to the video decoder. The decoder calls this function to get partial compressed bit-stream data from the app/framework. Apps/frameworks that don't support datasync should set this to NULL. | *Any non-NULL value if outputDataMode != IVIDEO_ENTIREFRAME* |
| IVIDDEC3_DynamicParams::getDataHandle | It defines the handle to be used while requesting data to application. This is a handle which the codec must provide when calling getDataFxn. Apps/frameworks that don't support datasync should set this to NULL. For an algorithm, this handle is read-only; it must not be modified when calling the app-registered IVIDDEC3_DynamicParams. getDataFxn(). The app/framework can use this handle to differentiate callbacks from different algorithms. | *Any Value* |

Incase of inputDataMode = IVIDEO_SLICEMODE, following points should be noticed

- No data is assumed to be available during process call, hence IVIDDEC3_InArgs::numBytes is don't care. All the data has to be provided via data synch calls
- Application can provide maximum 32 non-contiguous buffers of varying size, but total size of data in one transaction has to be >= 1024 bytes
- If the data provided during any data synch transaction is less than 1024 bytes then decoder assumes it as end of frame

- At the end of process call IVIDDEC3_OutArgs::bytesConsumed indicates the sum of total bytes consumed by decoder

**Handshake parameters related to sub frame level data communication for input data of video decoder (inputDataMode = IVIDEO_SLICEMODE):**

| **Parameter Name** | **Details** | **Valid values** |
|---|---|---|
| XDM_DataSyncDesc::size | Size of the XDM_DataSyncDesc structure | *sizeof(XDM_DataSyncDesc)* |
| XDM_DataSyncDesc:: scatteredBlocksFlag | Flag indicating whether the individual data blocks may be scattered in memory.<br>Note that each individual block must be physically contiguous.<br>Valid values are XDAS_TRUE and XDAS_FALSE.<br>If set to XDAS_FALSE, the baseAddr field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If set to XDAS_TRUE, the baseAddr array must contain the base address of each individual block. | Flag indicating whether the individual data slices may be scattered in memory.<br>XDAS_TRUE or XDAS_FALSE |
| XDM_DataSyncDesc::baseAddr | Base address of single data block or pointer to an array of data block addresses of size numBlocks.<br>If scatteredBlocksFlag is set to XDAS_FALSE, this field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If scatteredBlocksFlag is set to XDAS_TRUE, this field points to an array of pointers to the data blocks. | If scatteredBlocksFlag is set to XDAS_FALSE, this field points directly to the start of the first block, and is not treated as a pointer to an array.<br>If scatteredBlocksFlag is set to XDAS_TRUE, this field points to an array of pointers to the data blocks. |
| XDM_DataSyncDesc::numBlocks | Number of data blocks | ***Constraint** App can provide maximum 32 blocks in one transaction*<br>*1 <= numBlocks <= 32* |
| XDM_DataSyncDesc::varBlockSizeFlag | Flag indicating whether any of the data blocks vary in size. | XDAS_TRUE or XDAS_FALSE(slice sizes are not constant most of the time) |
| XDM_DataSyncDesc::blockSizes | Variable block sizes array. | If varBlockSizesFlag is XDAS_TRUE, this array contains the sizes of each slice. So Total_size = sum of (blockSizes[0] to blockSizes[numBlocks -1].<br>If varBlockSizesFlag is XDAS_FALSE, this |

| | | |
|---|---|---|
| | | contains the size of same-size slices. So Total_size = (numBlocks * blocSizes[0]) ***Constraint*** *Total_size >= 1024 otherwise decoder assumes end of frame* |

Incase of inputDataMode = IVIDEO_FIXEDLENGTH, following points should be noticed

- No data is assumed to be available during process call, hence IVIDDEC3_InArgs::numBytes is don't care. All the data has to be provided via data synch calls
- Application can provide maximum 1 buffers of size as multiple of 1K during any data synch transaction
    - During first data synch transaction, the data provided need not to be multiple of 1024 bytes
    - If the data provided during any data synch transaction is less than 1024 bytes then decoder assume it as end of frame
- At the end of process call IVIDDEC3_OutArgs::bytesConsumed indicates the sum of total bytes consumed by decoder

**Handshake parameters related to sub frame level data communication for input data of video decoder (inputDataMode = IVIDEO_FIXEDLENGTH):**

| **Parameter Name** | **Details** | **Valid values** |
|---|---|---|
| XDM_DataSyncDesc::size | Size of the XDM_DataSyncDesc structure | *sizeof(XDM_DataSyncDesc)* |
| XDM_DataSyncDesc:: scatteredBlocksFlag | Flag indicating whether the individual data blocks may be scattered in memory. Note that each individual block must be physically contiguous. Valid values are XDAS_TRUE and XDAS_FALSE. If set to XDAS_FALSE, the baseAddr field points directly to the start of the first block, and is not treated as a pointer to an array. If set to XDAS_TRUE, the baseAddr array must contain the base address of each individual block. | Don't care assumed to be XDAS_FALSE |
| XDM_DataSyncDesc::baseAddr | Base address of single data block or pointer to an array of data block addresses of size numBlocks. If scatteredBlocksFlag is set to XDAS_FALSE, this field points directly to | This field points directly to the start of the data |

| | | |
|---|---|---|
| | the start of the first block, and is not treated as a pointer to an array.<br>If scatteredBlocksFlag is set to XDAS_TRUE, this field points to an array of pointers to the data blocks. | |
| XDM_DataSyncDesc::numBlocks | Number of data blocks | ***Constraint*** *App can provide maximum 1 block in one transaction*<br>*1 <= numBlocks <= 1* |
| XDM_DataSyncDesc::varBlockSizeFlag | Flag indicating whether any of the data blocks vary in size. | Don't care assumed to be XDAS_FALSE |
| XDM_DataSyncDesc::blockSizes | Variable block sizes array. | Total_size = blockSizes[0];<br>***Constraint*** *Except for first transaction, in rest all the transactions Total_size should be multiple of 1K bytes. If not decoder assumes it end of frame* |

If application want to use video decoder to operate with sub frame on input side

- It should create the video decoder with IVIDDEC3_Params::inputDataMode = IVIDEO_SLICEMODE or IVIDEO_FIXEDLENGTH.
- It should also make a control call with IVIDDEC3_DynamicParams::getDataFxn = non-NULL; to use sub frame level data communication, control call is mandatory.
- It should not provide the base address and available data of the input buffer during process call

IVIDDEC3_DynamicParams::putDataFxn == NULL && IVIDDEC3_Params::inputDataMode != IVIDEO_ENTIREFRAME is an erroneous situation and codec returns error during process call.

**Video Decoder input buffer release mechanism:**

To facilitate the release of the input buffer, which has been consumed by video decoder; IVIDDEC3 provides a mechanism.

Once the decoder consumes buffers given by Application during data sync call, decoder shall notify the application through VIDDEC3_DynamicParams::putBufferFxn API. Buffers received by decoder during nth data sync call will be returned by decoder just before (n+2)th data sync call.

Note: Considering the above mechanism for buffer release, Application needs to maintain three sets of buffers and rotate among them, so that buffers are provided to decoder without delay.

Appendix J

# Support for Scalable Video Decoding

## J.1 Brief Description

This version of decoder has partial support for Scalable Video Decoding. To use this support, user needs a wrapper component (500.V.SVC.D.IVAHD), which in turn calls this decoder as a sub component. Please refer to user guide for 500.V.SVC.D.IVAHD for all the details.

## J.2 Flow for SVC support

To obtain support for SVC, Application needs to interact with the wrapper component 500.V.SVC.D.IVAHD. This wrapper component will internally instantiate components of the decoder 500.V.H264AVC.D.IVAHD. Wrapper component shall perform certain parsing operations and provide data in a suitable form for the decoder component. Creating and managing the decoder component is completely taken care by the wrapper component and the application needs to interact only with the wrapper component.

## J.3 SVC feature support

Wrapper component 500.V.SVC.D.IVAHD along with decoder component of 500.V.H264AVC.D.IVAHD, provides support for following features of SVC:

- Support for H.264/AVC Annex-G/Scalable Video Coding without inter layer prediction
- SVC Baseline Support
- Support for spatial, Temporal, SNR scalabilities without interlayer prediction

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Appendix K

# Support for Dual YUV Output

## K.1 Brief Description

This decoder supports YUV dump in two buffers. This would be an optional feature that can be enabled by the application at create time.

When this feature is enabled, the application needs to provide two output buffers. Both buffers will provide output in display order as usual.

## K.2 Enabling and using Dual Output

An additional create time flag has been added to request for secondary output.

The following parameter has been added to IH264VDEC_Params.

| | |
|---|---|
| `enableDualOutput` | Set it to 1 to enable dual YUV output. Set to 0 otherwise. Default value is 0. |

If the application enables dual YUV output, it has to provide separate buffers to hold two frames through `XDM2_BufDesc *outBufs` while calling `process`().

`XDM2_BufDesc` is defined as follows.

```
typedef struct XDM2_BufDesc {
      XDAS_Int32   numBufs;
      XDM2_SingleBufDesc descs[XDM_MAX_IO_BUFFERS];
} XDM2_BufDesc;
```

`numBufs` should be set to 4 (two frames of YUV420, separate buffers for Y and CbCr) if metadata is not enabled. If metadata is enabled, then `numBufs` should be set to (4 + number of metadata planes). `descs[0]` and `descs[1]` shall hold descriptors to luma and chroma buffers, respectively, of output frame buffer 0. `descs[2]` and `descs[3]` shall hold descriptors to luma and chroma buffers, respectively, of output frame buffer 1. Indices 4 and above of `descs[]` array shall be used for metadata buffers, if applicable.

The following table explains the description of buffers.

| Buffer Descriptor | Description |
|---|---|
| `descs[0]` | Luma buffer of output frame buffer 0 |
| `descs[1]` | Chroma buffer of output frame buffer 0 |
| `descs[2]` | Luma buffer of output frame buffer 1 |
| `descs[3]` | Chroma buffer of output frame buffer 1 |

The application is expected to provide tiled buffers in `descs[0]` and `descs[1]`. This (output frame buffer 0) would be used as reference buffer by the decoder.

The decoder shall return the current decoded frame through `IVIDEO2_BufDesc decodedBufs` in *IH264VDEC_OutArgs,* in buffers pointed by outBufs.descs[0].buf and outBufs.descs[1].buf*.*

The decoder shall return the frame to be displayed through `IVIDEO2_BufDesc displayBufs` in *IH264VDEC_OutArgs,* in buffers pointed by outBufs.descs[2].buf and outBufs.descs[3].buf*.*

The Luma and Chroma output buffers to be displayed is pointed by `displayBufs.pBufDesc[0].planeDesc[0].buf` and `displayBufs.pBufDesc[0]. planeDesc[1].buf`. The Luma and Chroma reference buffers is pointed by `displayBufs.pBufDesc[1]. planeDesc[0].buf` and `displayBufs.pBufDesc[1]. planeDesc[1].buf`.

Both the output buffers are freed simultaneously through `freeBufID[]` field in `outArgs` when no longer needed as both the buffers share the same `inputID`.

If one of the buffers in dual output mode is TILED and another is non-TILED, it is recommended that application should provide the TILED buffer as output frame 0 i.e., it should provide the TILED buffer through descs[0] and descs[1]. Giving the non-TILED buffer as output frame buffer 0 may cause degradation in performance.

**Note:**

The buffer requirement for output buffers is *doubled* when dual output is enabled.

Appendix L

# Support for Watermarking

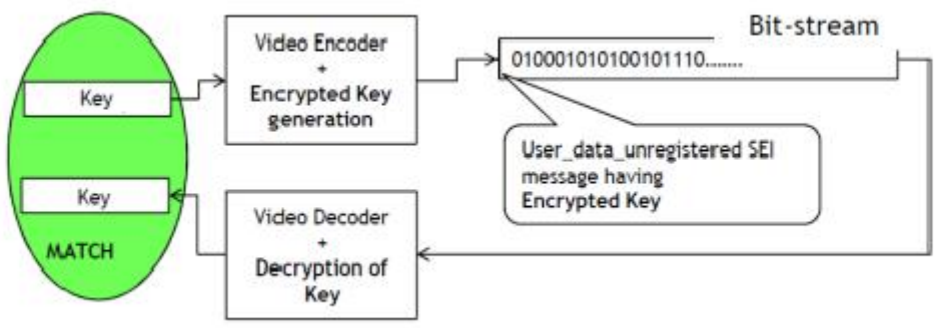
## L.1 Brief Description

With the rapid development of Internet technology, media data are used more and more widely. This makes media data not only easy to be transmitted, but also easy to be copied and spread out. Thus, the legal issue arises that some media data should be protected from unauthorized users or operations.

Watermarking is a mechanism to add identity to a bitstream to help decoder to identify the media content. For video security applications, it has become a de-facto requirement to prevent tampering with video.

IVAHD H.264 codecs support a watermarking scheme at no loss in performance.

The proposed watermarking mechanism in IVAHD H.264 codec is shown in the following figure.


Key
Key
MATCH
Video Encoder + Encrypted Key generation
Video Decoder + Decryption of Key
Bit-stream
010001010100101110.......
User_data_unregistered SEI message having Encrypted Key

**H.264 Encoder**

- Encoder accepts a 32-bit key
- Encoder encrypts the key using the properties of bit-stream which can be obtained on decoder side as well

  Encrypted Key = fn(input_key, bit-stream parameters)
- Encoder inserts the encrypted key in form of user data unregistered SEI message in the encoded stream

**H.264 Decoder**

- Decodes the encrypted key in form of user data unregistered SEI message
- Decrypts the key using the properties of bit-stream
- Provides the decrypted 32-bit key

**System**

- Feeds the key on encoder, gets the key from decoder and compares them to identify content tampering

**Note**

There would be a delay of 1 frame in the watermarking system. The key given to the encoder for the *n*th frame would be output by the decoder at the end of decoding (*n + 1*)th frame.

## L.2 Usage of watermarking feature

### *Enabling Watermark Support*

An additional create time flag has been added to enable watermarking feature.

The following parameter has been added to IH264VDEC_Params.

| | |
|---|---|
| `enableWatermark` | Set it to `IH264VDEC_WATERMARK_ENABLE` to enable watermarking. Set to `IH264VDEC_WATERMARK_DISABLE` otherwise. Default value is `IH264VDEC_WATERMARK_DISABLE`. |

### *Getting the decrypted key from the Decoder*

The decoder outputs the decrypted key through the following parameter in IH264VDEC_outArgs.

| | |
|---|---|
| `decryptedKey` | Key decrypted by the decoder |

The decrypted watermark keys would be given out in display order. At the decoder side, the display delay can be zero or non-zero. If the display delay is non-zero, the application receives decrypted keys in display order without any delay.

When the display delay is zero, the picture will be displayed immediately after decoding. Since the watermarking system has one frame delay, it is not possible to output decrypted keys without delay. So, we maintain one frame delay in giving out the decrypted key to the application i.e., the decrypted key given at nth frame will be the key for (n-1)th frame.

When the display delay is one and if the stream has one B-frame, then watermark decrypted keys will be given out in decode order instead of display order. In this scenario B-frames were displayed without any delay and since the watermarking system has one frame delay, the corresponding B-frame watermark key will be available in the next process call only. So, along with the B frame we give out previous decoded frame's watermark key. Only for this particular case we give watermark keys in decode/stream order.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Decode order | I1 | P1 | B1 | I2 | P2 | B2 | I3 | P3 | B3 |
| Display order | | I1 | B1 | P1 | I2 | B2 | P2 | I3 | B3 |
| Watermark | | I1 | P1 | B1 | I2 | P2 | B2 | I3 | P3 |
| Freebuf | | | I1 | B1 | P1 | I2 | B2 | P2 | I3 |

After completing the last frame decoding, decoder is invoked once again to parse watermark SEI data for the last frame and only the decrypted key will be output to the application. At this point, the decoder returns `IVIDDEC3_EFAIL` with `XDM_INSUFFICIENTDATA` error bit set.

When watermark parameter is enabled, decoder expects watermark SEI data for every frame except the first frame. If watermark SEI data is unavailable in any frame, then it returns `IVIDDEC3_EFAIL` with `IH264VDEC_ERR_NOHEADER` error bit set.

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Appendix M

# Support for N Channel Process Call

## M.1 Brief Description

Decoder can support N channel processing in single process call. In this method user has to provide all the necessary input parameter (like handle, InArgs, outArgs, InBufs, outBuf) for each channel through newly defined XDM API for multi-channel process call. This method is useful in reducing the thread overhead at Media Controller. This support can be utilized to decode one frame each from N channels.

## M.2 Max value of numChannels (N)

Max value of number of channels that can be processed in single process call depends on the maximum create time resolution of the decoder out of the N channels. Below Table gives the maximum number of channels supported in N channel process call.

| **Max create Resolution** | **Max number of channels** |
|---|---|
| 1920 x 1080 | 1 |
| 1280 x 720 | 24 |
| 720 x 480 | 24 |
| 640 x 480 | 24 |
| 352 x 288 | 24 |
| 176 x 144 | 24 |

## M.3 Limitations when using N channel processing

Followings are the limitations of N channel process call support

- No DataSync / Low latency feature
- Multiple frames from same channel in the same N channel group is not supported

Multichannel process calls with some channels in FLUSH mode and others in non-FLUSH mode are not supported. If one channel ends early, application has to make single channel process calls for completely flushing out that channel and then continue multichannel process calls with the other channels.

In this method HDVICP acquire is done when first channel processing starts and release is done after all the channel processing is finished. All the acquire and release is done with the last channel handle.

## M.4 XDM interface for Multi Channel process call

```
#define IH264VDEC_MAX_LENGTH_PROCESS_LIST (24)

typedef struct
{
  IH264VDEC_Handle handle;
  XDM2_BufDesc *inBufs;
  XDM2_BufDesc *outBufs;
  IVIDDEC3_InArgs *inArgs;
  IVIDDEC3_OutArgs *outArgs;
} IH264VDEC_ProcessParams;

typedef struct
{
  XDAS_Int32 numEntries ;
  IH264VDEC_ProcessParams
processParams[IH264VDEC_MAX_LENGTH_PROCESS_LIST];
} IH264VDEC_ProcessParamsList ;

typedef struct IH264VDEC_Fxns
{
    IVIDDEC3_Fxns ividdec3;
    XDAS_Int32 (*processMulti)
(IH264VDEC_ProcessParamsList *processList);
} IH264VDEC_Fxns;
```

New processMulti API has been defined for this purpose.

## M.5 Steps to achieve N channel processing in single process call

- Populate all the input parameters (handle, inBufs, outBufs, inArgs, outArgs) for every channel of input data.
- Prepare the instance of the data type IH264VDEC_ProcessParamsList.
- Call the newly defined API processMulti with address of IH264VDEC_ProcessParamsList as a single argument.
- After return from the multi process call, utilize the information updated by codec for each channel in corresponding outArgs and outBufs.

## M.6 Backward Compatibility

Backward compatibility is maintained after supporting N channel process call. Older process call API can still be used for single channel processing in a process call.

Appendix N

# Support for decoding only specific frame types using less memory

## N.1 Brief Description

Decoder supports this feature to decode only I and IDR, IP or all frame types. If user chooses to decode only I/IDR or IP frame types then memory requested by decoder at create time will be comparatively less than in case if user chooses to decode all frame types. User is advised to use this feature if he is aware of frame types in the bitstream. However if a stream having frame types, which are not requested by user to decode, is given to decoder then it decodes only frame types requested by user to decode and skips unsupported frame types. Setting of IVIDDEC3_DynamicParams::frameSkipMode = IVIDEO_SKIP_PB could have been used for this purpose but it is defined at dynamic level, whereas the intention of this feature is to have create time indication to codec for lesser memory foot print request. Please refer datasheet for memory numbers when this feature is enabled.

## N.2 Steps to enable this feature

Set the create time parameter – decodeFrameType to

- IH264VDEC_DECODE_I_ONLY - To decode only I/IDR frames from the bitstream
- IH264VDEC_DECODE_IP_ONLY - To decode I/IDR & P frame types
- IH264VDEC_DECODE_ALL - To decode all frame types – I/IDR, P & B

## N.3 Important points regarding this feature

- The output buffer given for the decoder for a particular process call is displayed and freed for that process call only if IH264VDEC_DECODE_I_ONLY is requested. The display delay and DPB size given by user will be overridden to 0.
- If IH264VDEC_DECODE_I_ONLY or IH264VDEC_DECODE_IP_ONLY is requested then decoder requests only one frame size collocated MB Info buffer in high resolution case (> 2048) and in case of low resolution (< 2048), decoder doesn’t request any MB Info buffer and number of resources requested by decoder in this case will be one less than in case of IH264VDEC_DECODE_ALL.
- If XDM_FLUSH is called when IH264VDEC_DECODE_I_ONLY feature is enabled, no display buffers are given out, as no frames are stored in DPB to flush out.
- Error concealment will be applied to only those frame types which user requests to decode and for unsupported frame types, no concealment is applied as we don’t give out any display buffer in that case.

- In case of interlaced, if either of top or bottom fields is slice type which user doesn't want decoder to decode then entire frame is not displayed. Suppose if first field decoded is has slice type which user wants decoder to decode and second field has slice type which user doesn't want decoder to decode then, first field is decoded without any error but when second field is seen as unsupported and entire frame is not displayed.
- Decoder returns IH264VDEC_ERR_UNSUPPFEATURE extended error code whenever it encounters frame types which user doesn't want it to decode.