MPEG2 Main Profile Decoder on DM365

User's Guide

Literature Number: SPRUGS7A
September 2010

Preface

Read This First

About This Manual

This document describes how to install and work with Texas Instruments' (TI) MPEG-2 Main Profile Decoder implementation on the DM365 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) and IRES standards. XDM and IRES are extensions of 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 DM365 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, Framework Components (FC), and software architecture. 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.
- **Appendix A** – **Revision History,** highlights the changes made to SPRUGS7 codec specific user guide to make it SPRUGS7A.

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 Interoperability Standard (also known as XDAIS) specification.
- *Using IRES and RMAN Framework Components for C64x+* (literature number SPRAAI5) provides an overview of the IRES interface, with some concrete resource types and resource managers that illustrate the definition, management and use of new types of resources.

Related Documentation

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

- *ISO/IEC 13818-2:2000(E), 'Information Technology – Coding Of Audio-Visual Objects – Part 2: Visual'*

Abbreviations

The following abbreviations are used in this document.

Table 1-1. List of Abbreviations

Abbreviation	Description
BIOS	TI's simple RTOS for DSPs
CMEM	Generic memory manager in Linux
CSL	Chip Support library
D1	720x480 or 720x576 resolutions in progressive scan
DCT	Discrete Cosine Transform
DMA	Direct Memory Access
EDMA	Enhanced Direct Memory Access
Full HD	1920x1088 or 1920x1080 resolution
HDTV	High Definition Television
HDVICP	High Definition Video and Imaging Coprocessor sub-system

Abbreviation	Description
ITU-T	International Telecommunication Union
IMX	Imaging Multimedia Extension
MB	Macro Block
MBAFF	Macro Block Adaptive Field Frame
MPEG	Motion Pictures Expert Group
MV	Motion Vector
NAL	Network Abstraction Layer
NTSC	National Television Standards Committee
PDM	Parallel Debug Manager
PMP	Portable Media Player
RMAN	Resource Manager
RTOS	Real Time Operating System
SW	Switch
UUID	Universal Unique Identifier
VGA	Video Graphics Array
VUI	Video Usability Information
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 (MPEG2 Main Profile Decoder on DM365) 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, XDM, and DM365 software architecture. It also provides an overview of TI's implementation of the MPEG-2 Main profile Decoder on the DM365 platform and its supported features.

Topic **Page**

1.1 Software Architecture

DM365 codec provides XDM compliant API to the application for easy integration and management. The details of the interface are provided in the subsequent sections.

DM365 is a digital multi-media system on-chip primarily used for video security, video conferencing, PMP and other related application.

DM365 codec are OS agonistic and interacts with kernel through the Framework Component (FC) APIs. FC acts as a software interface between OS and the codec. FC manages resources and memory by interacting with kernel through predefined APIs.

Following diagram shows the software architecture.

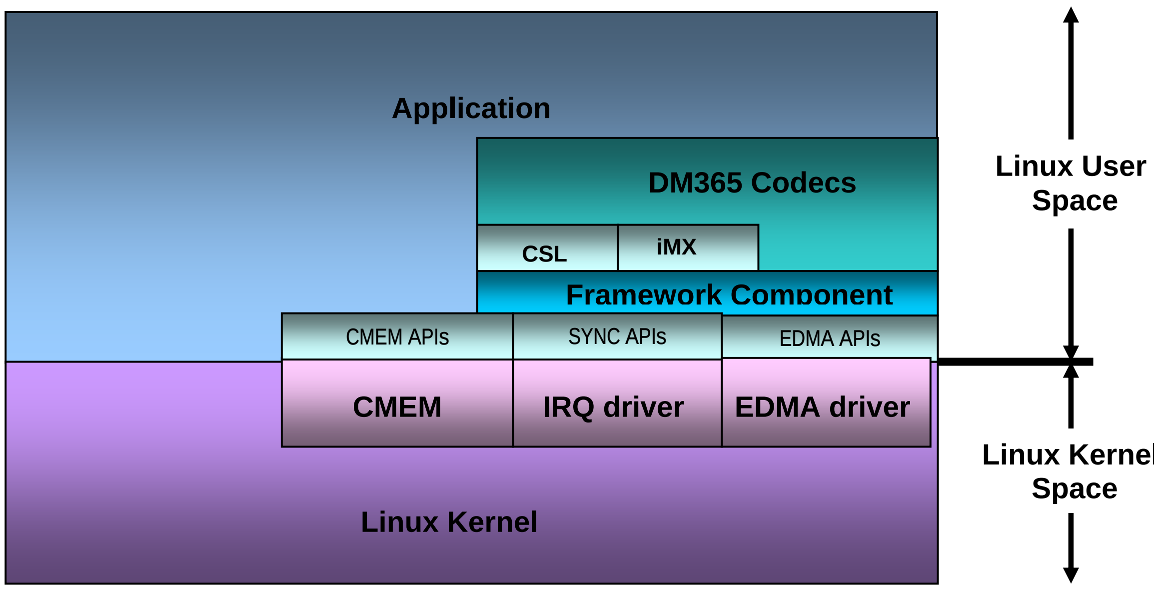


Figure 1-1. Software Architecture.

1.2 Overview of XDAIS, XDM, and Framework Component Tools

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). IRES is a TMS320 DSP Algorithm Standard (xDAIS) interface for management and utilization of special resource types such as hardware accelerators, certain types of memory and DMA. RMAN is a generic Resource Manager that manages software component's logical resources based on their IRES interface configuration. Both IRES and RMAN are Framework Component modules.

1.2.1 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. 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 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).

1.2.2 XDM Overview

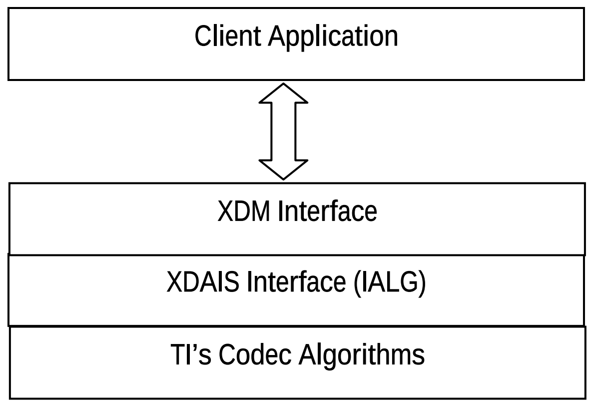
In the multimedia application space, you have the choice of integrating any codec into your multimedia system. For example, if you are building a video decoder system, you can use any of the available video decoders (such as MPEG4, H.263, or MPEG2) in your system. To enable easy integration with the 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. This API represents a blocking call for the encoder and the decoder, that is, with the usage of this API, the control is returned to the calling application only after encode or decode of one unit (frame) is completed. Since in case of DM365, the main encode or decode is carried out by the hardware accelerators, the host processor from which the `process()` call is made can be used by the application in parallel with the encode or the decode operation. To enable this, the framework provides flexibility to the application to pend the decoder task when the frame level computation is happening on coprocessor.

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

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



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

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

1.2.3 Framework Component

As discussed earlier, Framework Component acts like a middle layer between the codec and OS and also serves as a resource manager. The following block diagram shows the FC components and their interfacing structure.

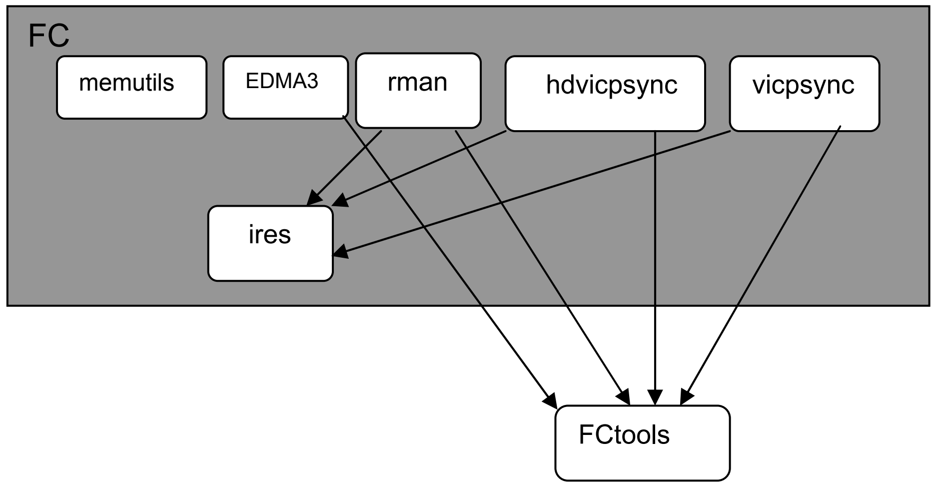


Figure 1-2. Framework Component Interfacing Structure.

Each component is explained in detail in the following sections.

1.2.3.1 IRES and RMAN 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 must agree on the concrete IRES resource types that are being 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 includes the following modules and interfaces to support algorithms requesting IRES-based resources:

- **IRES** - This is the standard interface allowing the client application to query and provide the algorithm with its requested IRES resources.

- **RMAN** - This is the generic IRES-based resource manager. It 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).

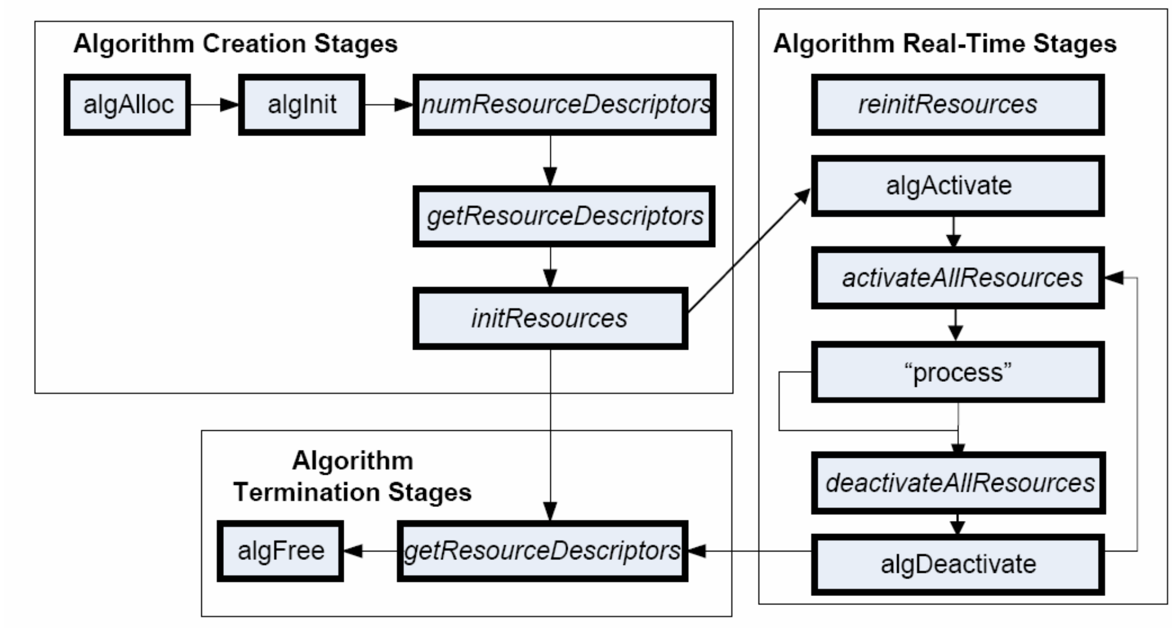


Figure 1-3. IRES Interface Definition and Function-calling Sequence.

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

1.2.3.2 HDVICP

The IRES HDVICP Resource Interface, IRES_HDVICP, allows algorithms to request and receive handles representing Hardware Accelerator resource, HDVICP, on supported hardware platforms. Algorithms can request and acquire one of the co-processors using a single IRES request descriptor. IRES_HDVICP is an example of a very simple resource type definition, which operates at the granularity of the entire processor and does not publish any details about the resource that is being acquired other than the ID of the processor. The algorithm manages internals of the resource based on the ID.

1.2.3.3 EDMA3

The IRES EDMA3 Resource Interface, IRES_EDMA3CHAN, allows algorithms to request and receive handles representing EDMA3 resources associated with a single EDMA3 channel. This is a very low-level resource definition.

> **Note:**
>
> The existing XDAIS IDMA3 and IDMA2 interfaces can be used to request logical DMA channels, but the IRES EDMA3CHAN interface provides the ability to request resources with finer precision than with IDMA2 or IDMA3.

1.2.3.4 VICP

The Imaging Coprocessor provides an integrated platform for the imaging hardware accelerators required to achieve the performance goals for the targeted device.

1.2.3.5 HDVICP Sync

Synchronization is necessary in a coprocessor system. HDVICP sync provides framework support for synchronization between codec and HDVICP coprocessor usage. This module is used by frameworks or applications, which have XDIAS algorithms that use HDVICP hardware accelerators.

1.2.3.6 Memutils

This for generic APIs to perform cache and memory related operations:

- `cacheInv` – Invalidates a range of cache
- `cacheWb` – Writes back a range of cache
- `cacheWbInv` – Writes back and invalidates cache
- `getPhysicalAddr` – Obtains physical (hardware specific) address

1.3 Overview of MPEG-2 Main Profile Decoder

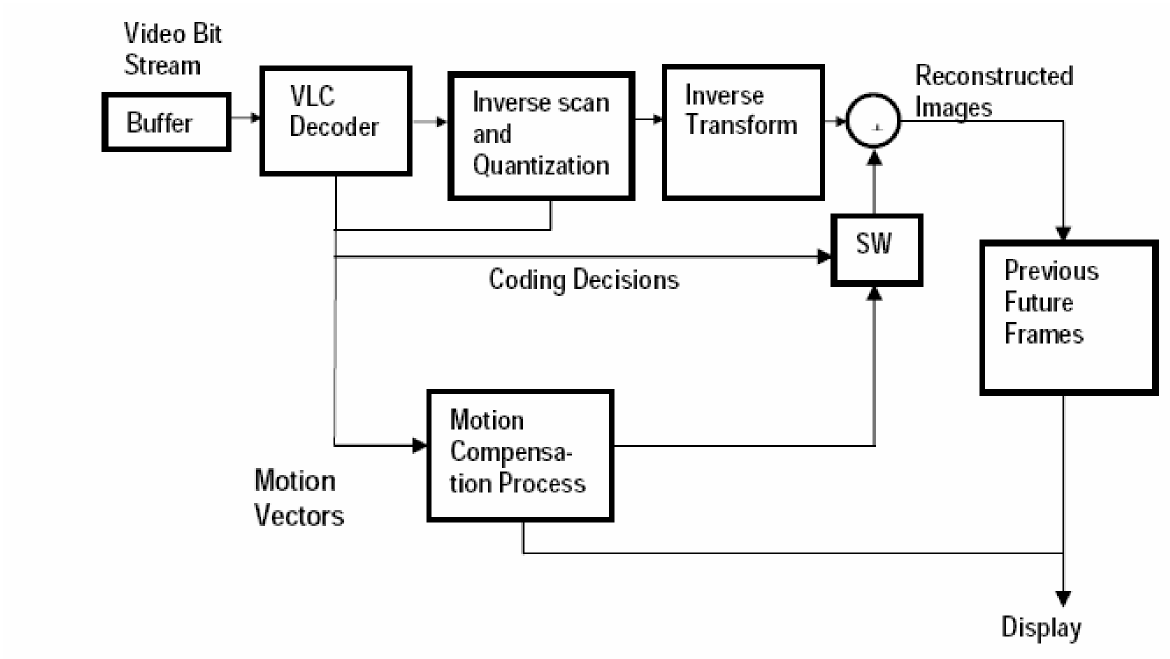
The MPEG2 video standard specifies the decompression and coded representation for entertainment-quality digital video. It is widely used in different digital video systems, including DTV (Digital Television), DVB (Digital Video Broadcast), DSS (Direct Satellite System), and DVD (Digital Versatile Disc). The MPEG2 video decoder plays an important role in consumer electronics like DVD players, set-top boxes, and DSS units.

Figure 1-1 depicts the flow diagram of the MPEG2 Decoder

- Simple Profile: Allows the use of I−frames (Intra-coded) and P−frames (predicted).

- Main Profile: Allows the use of I−frames (Intra-coded), P−frames (predicted) and B−frames (bidirectional predicted).

From this point onwards, all references to MPEG2 Decoder means MPEG2 Main Profile Decoder only.



1.4 Supported Services and Features

This user guide accompanies TI's implementation of MPEG-2 decoder on the DM365 platform.

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

- eXpressDSP Digital Media (XDM1.0 IVIDDEC2) compliant
- Supports all I, P, and B frame decoding
- Supports both progressive and interlaced
- Outputs are available in YUV 420 interleaved formats (Y in one plane and U and V data interleaved to form the other plane)
- Supports frame based decoding with frame size being multiples of 16
- Supports Simple Profile MPEG2 decoding
- Supports Main Profile MPEG2 decoding
- Supports DMA based framework
- Supports interrupt based communication between processors

  This version of the decoder does not support the Dynamic change in resolution.

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.

2.1 System Requirements for Linux

This section describes the hardware and software requirements for the normal functioning of the codec component in Linux. For details about the version of the tools and software, see Release Note.

2.1.1 Hardware

- DM365 EVM (Set all the bits of SW4 and SW5 to low(0) position RS232 cable and network cable.

2.1.2 Software

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

- **Build Environment:** This project is built using Linux with MVL ARM.
- **ARM Tool Chain**: This project is compiled and linked using MVL ARM tool chain.

2.2 Installing the Component for Linux

The codec component is released as a compressed archive. To install the codec, extract the contents of the tar file onto your local hard disk. The tar file extraction creates a directory called dm365_mpeg2vdec_xx_xx_xx_xx_production. Figure 2-1 shows the sub-directories created in this directory.

Note:

xx_xx_xx_xx in the directory name is the version of the codec. For example, If the version of the codec is 02.00.01.00, then the directory created on extraction of tar file is dm365_mpeg2vdec _02_00_01_00_production.

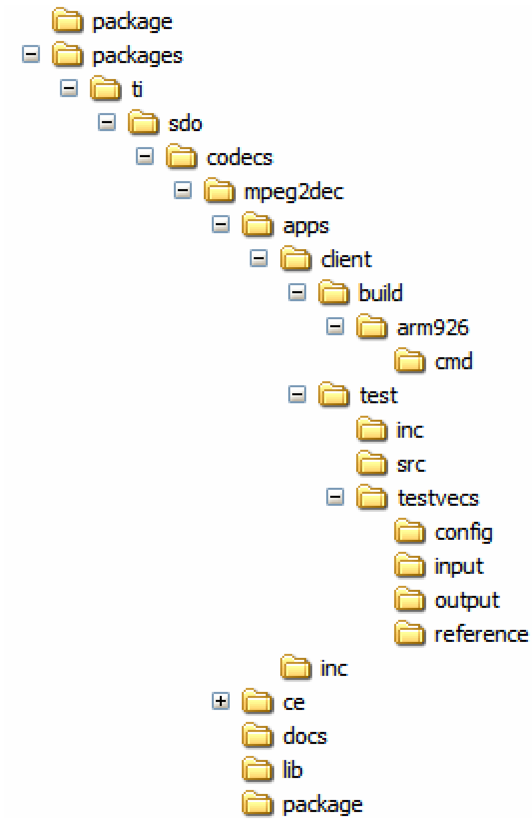


Figure 2-1. Component Directory Structure for Linux.

Table 2-2 provides a description of the sub-directories created in the dm365_mpeg2vdec_xx_xx_xx_xx_production directory.

Table 2-2. Component Directories for Linux.

Sub-Directory	Description
\package	Contains files related while building the package
\packages\ti\sdo\codecs\mpeg2dec\lib	Contains the codec library files on host
\packages\ti\sdo\codecs\mpeg2dec\docs	Contains user guide and release notes
\packages\ti\sdo\codecs\mpeg2dec\apps\client\build\arm926	Contains the make file to built sample test application
\packages\ti\sdo\codecs\mpeg2dec\apps\client\build\arm926\cmd	Contains a template (.xdt) file to used to generate linker command file
\packages\ti\sdo\codecs\mpeg2dec\apps\client\build\arm926\map	Contains the memory map generated on compilation of the code
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\src	Contains application C files

Sub-Directory	Description
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\inc	Contains header files needed for the application code
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\testvecs\input	Contains input test vectors
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\testvecs\output	Contains output generated by the codec
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\testvecs\reference	Contains read-only reference output to be used for verifying against codec output
\packages\ti\sdo\codecs\mpeg2dec\apps\client\test\testvecs\config	Contains configuration parameter files

2.3 Building and Running the Sample Test Application on LINUX

To build the sample test application in Linux environment, follow these steps:

1) Verify that dma library, dma_ti_dm365.a, exists in the packages\ti\sdo\codecs\mpeg2dec\lib.

2) Verify that codec object library, mpeg2vdec_ti_arm926.a, exists in the \packages\ti\sdo\codecs\mpeg2dec\lib.

3) Ensure that you have installed the LSP, MontaVista Arm tool chain, XDC, Framework components releases with version numbers as mentioned in the release notes.

4) For installing framework component, unzip the content at some location and set the path of the base folder in FC_INSTALL_DIR environment variable.

5) Verify that the release package top-level folder is mapped to the target file system and is accessible from EVM.

6) In the folder \packages\ti\sdo\codecs\mpeg2dec\client\build\arm926, change the paths in the file rules.make according to your setup.

7) Open the command prompt at the sub-directory \packages\ti\sdo\codecs\mpeg2dec\client\build\arm926 and type the command **make**. This generates an executable file mpeg2vdec-r in the same directory.

8) To run the executable generated from the above steps, branch to the directory where the executable is present and type ./mpeg2vdec-r in the command window.

2.4 Configuration Files

This codec is shipped along with:

- Generic configuration file (testvecs_linux.cfg) – specifies input and reference files for the sample test application.
- Decoder configuration file (Testparams.cfg) – specifies the configuration parameters used by the test application to configure the Decoder.

2.4.1 Generic Configuration File

The sample test application shipped along with the codec uses the configuration file, testvecs_linux.cfg, for determining the input and reference files for running the codec and checking for compliance. The testvecs_linux.cfg files are available in the \client\test\testvecs\config sub-directory.

The format of the testvecs_linux.cfg file is:

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

where:

- `X` may be set as:
  - 1 - Compliance checking, no output file is created
  - 0 - Writing the output to the output file
- `Config` is the Decoder configuration file. For details, see Section 2.4.2.
- `Input` is the input file name (use complete path).
- `Output/Reference` is the output file name (if `X` is 0) or reference file name (if `X` is 1).

A sample testvecs_linux.cfg file is as shown.

```
0
../../test/testvecs/config/Testparams.cfg
../../test/testvecs/input/colorful_toys_cif_5frms_420P.m2v
../../test/testvecs/output/colorful_toys_cif_5frms_420P.yuv
```

2.4.2 Decoder Configuration File

The decoder configuration file, Testparams.cfg contains the configuration parameters required for the decoder. The Testparams.cfg file is available in the \client\test\testvecs\config sub-directory.

A sample Testparams.cfg file for 1080p stream is as shown.

```
# New Input File Format is as follows
# <ParameterName> = <ParameterValue> # Comment
##########################################################
# Parameters
##########################################################
ImageWidth             = 1920    # Image width in Pels,
                                 # must be multiple of16
ImageHeight            = 1088    # Image height in Pels,
                                 # must be multiple of 16
                                #  0 -> rset only at alg
                                #   init;
display_delay          = 1      # 0 -> No delay(Decode
                                #    order),
                                # 1->(Default value)
                                # Display order for
                                #  streams with  B frames
ChromaFormat            = 9     # 9 => XDM_YUV_420SP
FramesToDecode         = -1   # Number of frames to be
                                # coded
DumpFrom               = 0      # Start dumping from this
                                # frame.
CRCEnable              = 0      # 1 -> CRC calculation;
                                # 0 -> YUV Dump
```

To check the functionality of the codec for the other inputs (other than the input provided with the release), change the configuration file accordingly with the corresponding input test vector.

2.5 Uninstalling the Component

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

Chapter 3

Sample Usage

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

3.1 Overview of the Test Application

The test application exercises the extended class (extended over `IVIDDEC2`) structure `IMPEG2VDEC_Obj` of the MPEG2 Decoder library. The main test application files are mpeg2vdec_ti_arm926testapp.c and mpeg2vdec_ti_arm926testapp.h . These files are available in the \client\test\src and \client\test\inc sub-directories respectively.

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

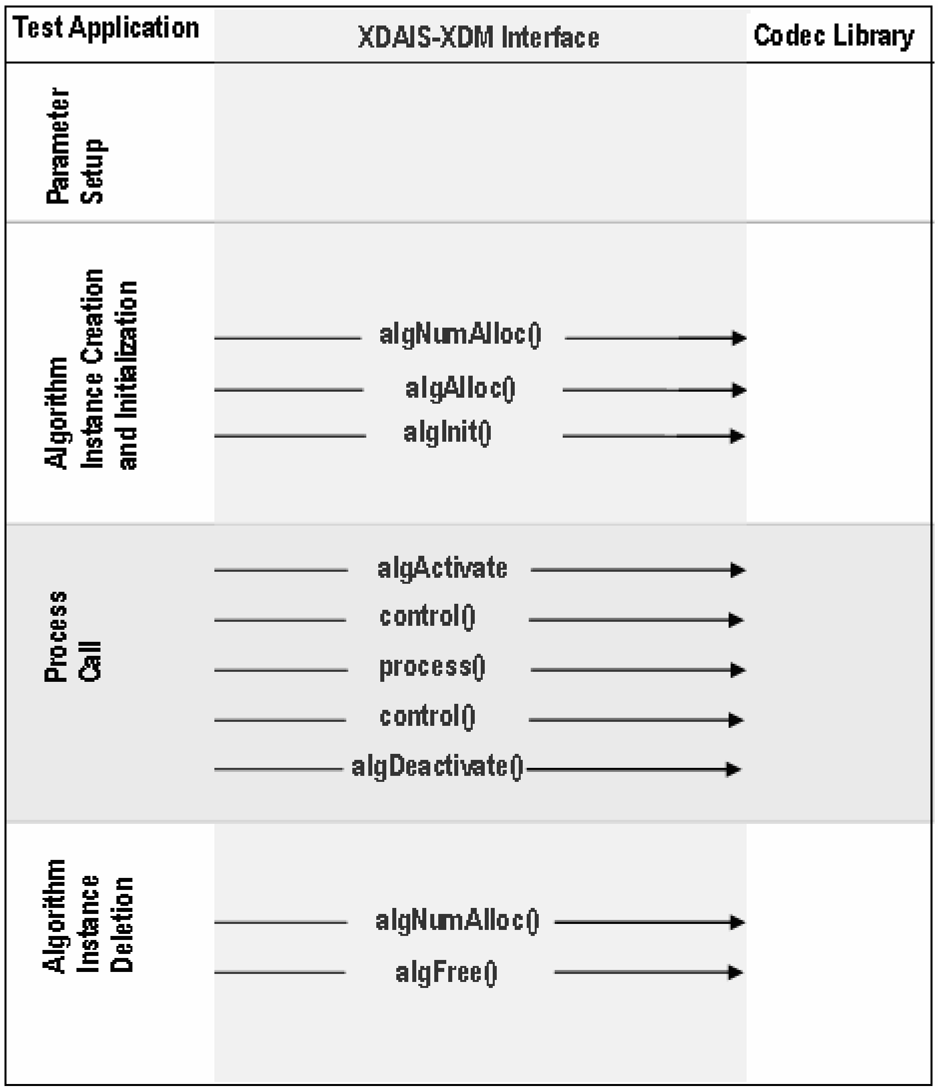


Figure 3-1. Test Application Sample Implementation

The test application is divided into four logical blocks:

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

3.1.1 Parameter Setup

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

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

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

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

3) Sets the `IVIDDEC2_Params` structure based on the values it reads from the Testparams.cfg file.

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

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

3.1.2 Algorithm Instance Creation and Initialization

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

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

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

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

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

After successful creation of the algorithm instance, the test application does DMA resource allocation for the algorithm.

Note:

DMAN3 function and IDMA3 interface is not implemented in DM365 codecs. Instead, it uses a DMA resource header file that gives the framework the flexibility to change DMA resource to codec.

3.1.3 Process Call

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

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

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

3) Implements the process call based on the mode of operation – blocking or non-blocking. These different modes of operation are explained below. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 4.2.1.9). The input to the `process()` functions are input and output buffer descriptors, pointer to the `IVIDDEC2_InArgs` and `IVIDDEC2_OutArgs` structures.

4) Call the `process()` function to encode/decode a single frame of data. After triggering the start of the encode/decode frame start, the video task can be moved to SEM-pend state using semaphores. On receipt of interrupt signal for the end of frame encode/decode, the application should release the semaphore and resume the video task that does any book-keeping operations by the codec and updates the output parameters of the `IVIDDEC2_OutArgs` structure.

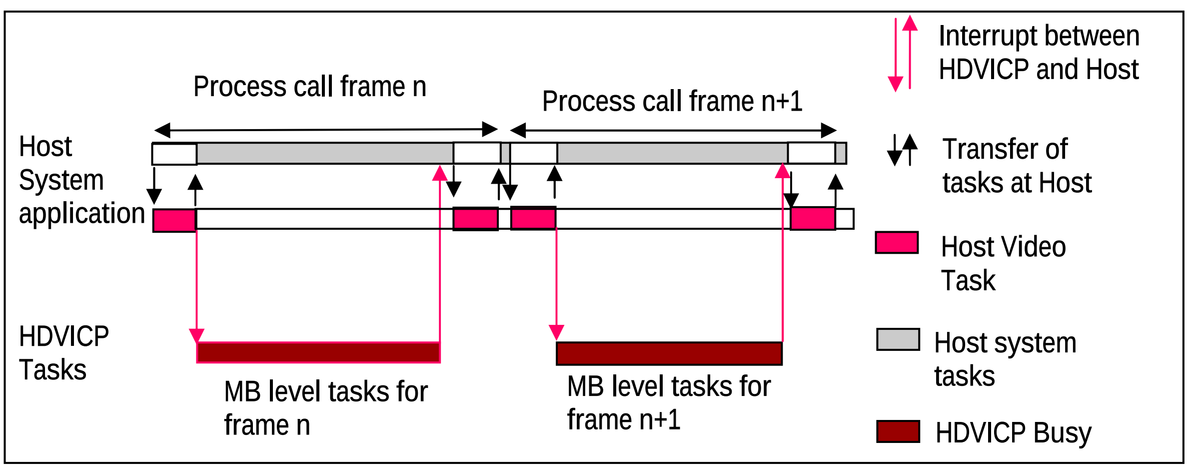


Figure 3-2. Process Call with Host Release

Note:

- The process call returns the control to the application after the initial setup related tasks are completed.
- Application can schedule a different task to use free Host resource.
- All service requests from HDVICP are handled through interrupts.
- Application resumes the suspended process call after last service request for HDVICP has been handled.
- Application can now complete concluding portions of the process call.

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:

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

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

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

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

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

The do-while loop encapsulates frame level `process()` call and updates the input buffer pointer before the next call. The do-while loop breaks off either when an error condition occurs or when the input buffer exhausts.

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

3.1.4 Algorithm Instance Deletion

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

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

2) `algFree()` - To query the algorithm to get the memory record information, which can be used by the application for freeing them up.

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.

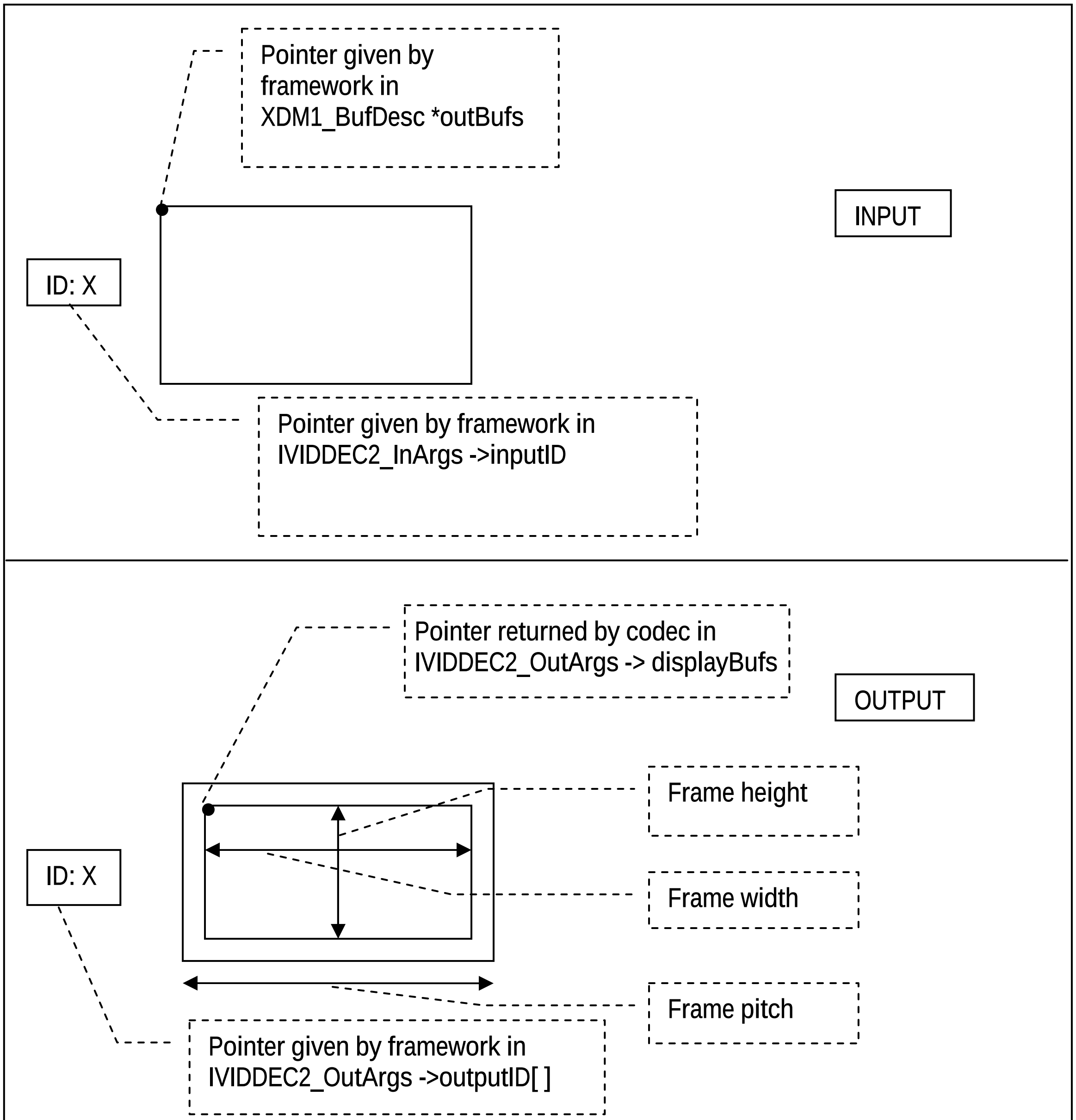
3.2 Frame Buffer Management by Application

3.2.1 Frame Buffer Input and Output

With the new XDM 1.0, decoder does not ask for frame buffer at the time of `alg_create()`. It uses buffer from `XDM1_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.

```
MPEG2VDEC_create();
MPEG2VDEC_control(XDM_GETBUFINFO); /* Returns maximum number
of
                                    buffers with size based on
                                    resolution configured */
do
{
     MPEG2VDEC_decode();           /* Call the decode API */
}
while(all_frames)
```

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



Note:

- Frame pointer returned by the codec in `display_bufs` points to the actual start location of the picture.
- Frame height and width is the actual height and width (after removing cropping and padded width).
- Frame pitch indicates the jump to traverse to the same pixel location in the next line.

Figure 3-3. Frame Buffer Pointer Implementation

As explained , the buffer pointer cannot be used as a unique identifier to keep a record of the frame buffers. Any buffer given to the algorithm should be considered locked by the algorithm, unless the buffer is returned to the application through `IVIDDEC2_OutArgs->freeBufID[]`.

> **Note**:
>
> `BufferID` returned in `IVIDDEC2_OutArgs ->outputID[]` is for display purpose. Application should not consider it free, unless it comes as part of `IVIDDEC2_OutArgs->freeBufID[]`.

3.2.2 Frame Buffer Memory Optimizations

The `control()` API function (with `XDM_GETBUFINFO` command) requests the buffers of the size, based on the configured resolution. However, the actual memory required may be less compared to the one requested through `XDM_GETBUFINFO` for a given stream to be decoded. This is because stream properties are unknown to the decoder at that moment. After first successful frame decode, `XDM_GETBUFINFO` can return the correct memory requirements. Hence, to save on memory requirements, two `XDM_GETBUFINFO` `control()` API calls can be made. After first call, application may choose to allocate only one buffer of the requested resolution. Rest of the buffers can be allocated for exact resolution after second call.

```
MPEG2VDEC_create();
MPEG2VDEC_control(XDM_GETBUFINFO); /* Returns maximum number
of
                                    buffers with size based on
                                    resolution configured */
/* Allocate memory for 1 frame buffer */
frame_num = 0;

do
{
    MPEG2VDEC_decode();           /* Call the decode API */

    if no header related error
    {
        frame_num++;
    }

    if(frame_num == 1)
    {
        MPEG2VDEC_control(XDM_GETBUFINFO); /* Returns exact
                                             size buffers */

        /* Allocate memory for rest of frame buffers */
    }
}
while(all_frames)
```

The first frame decode is said to be successful, if there is no header related error. If the first frame decode is unsuccessful, the frame buffer is freed by the decoder and can be reused by the application to continue decoding for next frame. The following are the header related errors:

1) Specified by extended error `XDM_UNSUPPORTEDINPUT` bit

2) Specified by extended error `XDM_CORRUPTEDHEADER` bit

3) Specified by extended error code `IMPEG2VDEC_ERR_JUNK_DATA` or `IMPEG2VDEC_ERR_SEQ_HEADER`

> **Note**:
>
> Application can choose to re-use the extra buffer space of the 1st frame, if the second control call returns a smaller size.

The number of buffers requested may be same in both the control calls. If the application has the prior knowledge of the level of the streams to be decoded, it can configure an appropriate value for `levelLimit` during `MPEG2VDEC_create()`as described in 4.2.2.1. The decoder in that case requests the maximum number of buffers required for the decoded resolution and level configured.

3.2.3 Frame Buffer Management by Application

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

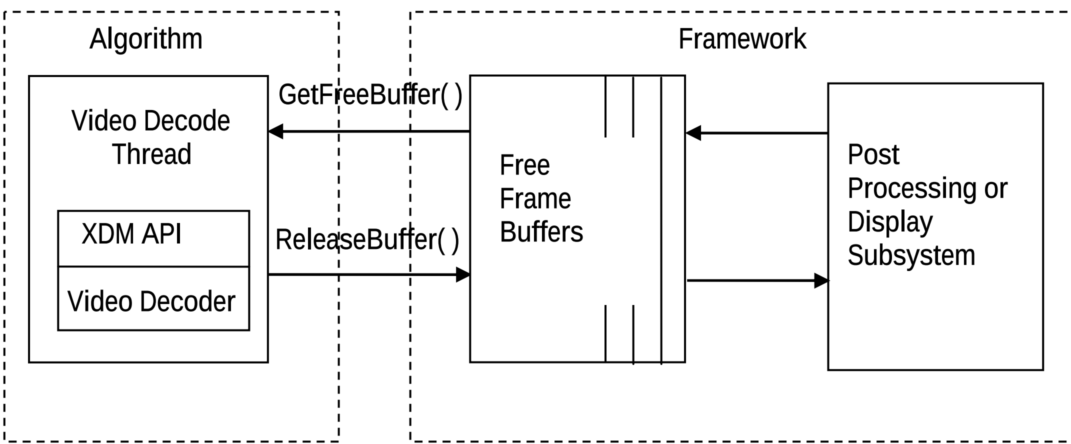


Figure 3-4. Interaction of Frame Buffers between Application and Framework

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

1) `BUFFMGR_Init()`

   The `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.

2) `BUFFMGR_ReInit()`

The `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.

3) `BUFFMGR_GetFreeBuffer()`

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

4) `BUFFMGR_ReleaseBuffer()`

The `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 keeps moving until it encounters a buffer ID as zero or it hits the `MAX_BUFF_ELEMENTS`.

5) `BUFFMGR_DeInit()`

The `BUFFMGR_DeInit` function releases all memory allocated by buffer manager.

3.3 Handshaking Between Application and Algorithm

3.3.1 Resource Level Interaction

Following diagram explains about the resource level interaction of the application with framework component and codecs. Application uses XDM for interacting with codecs. Similarly, it uses RMAN to grant resources to the codec.

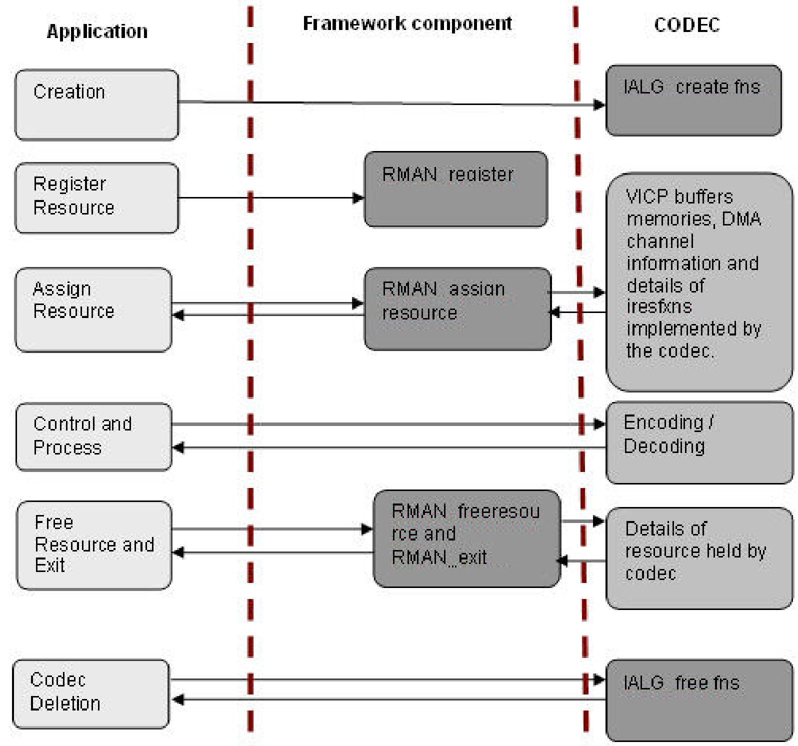


Figure 3-5. Process Call with Host Release.

3.3.2 Handshaking Between Application and Algorithms

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.

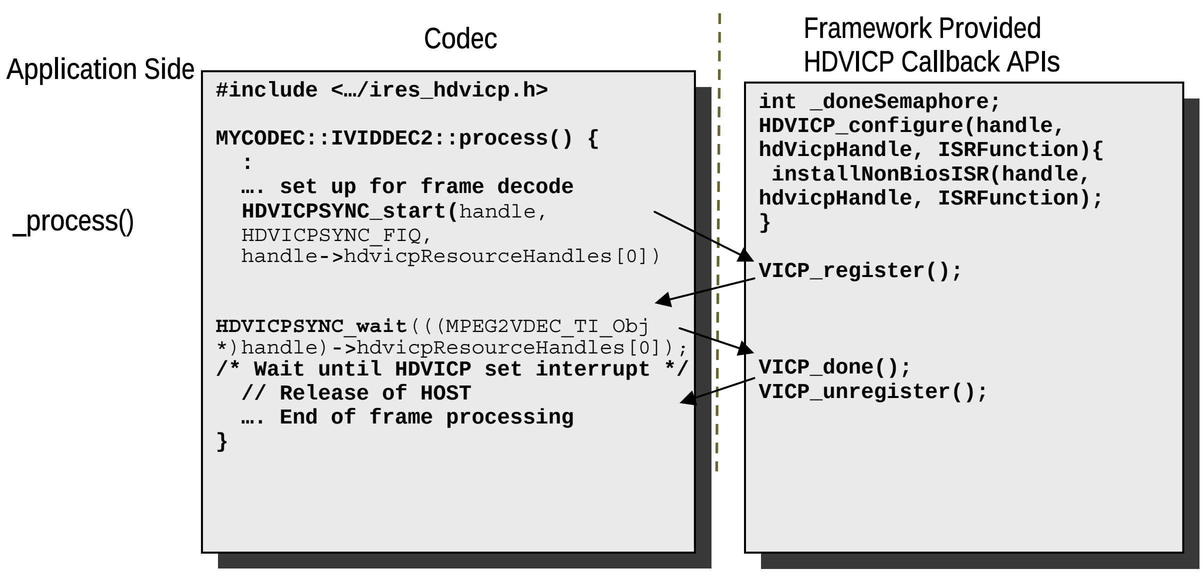


Figure 3-6. Interaction Between Application and Codec.

Note:

- Process call architecture shares Host resource among multiple threads.
- ISR ownership is with the FC manager – outside the codec.
- Codec implementation is OS independent.

The functions to be implemented by the application are:

1) `HDVICPSYNC_start(IALG_Handle handle, HDVICPSYNC_InterruptType intType, IRES_HDVICP_Handle hdvicpHandle)`

   This function is called by the algorithm to register the interrupt with the OS. This function also configures the Framework Component interrupt synchronization routine.

2) `HDVICPSYNC_wait (IRES_HDVICP_Handle hdvicpHandle)`

   This function is a FC call back function use to pend on a semaphore. Whenever the codec has completed the work on Host processor (after transfer of frame level encode/decode to HDVICP) and needs to relive the CPU for other tasks, it calls this function.

   This function of FC implements a semaphore, which goes into pend state and then the OS switches the task to another non-codec task.

   Interrupts from HDVICP to Host ARM926 is used to inform when the frame processing is done. HDVICP sends interrupt which maps to `INT No 10` of ARM926 INTC. After receiving this interrupt, the semaphore on which the codec task was waiting gets released and the execution resumes after the `HDVICPSYNC_wait()` function.

   The following figure explains the interrupt interaction between application and codec.

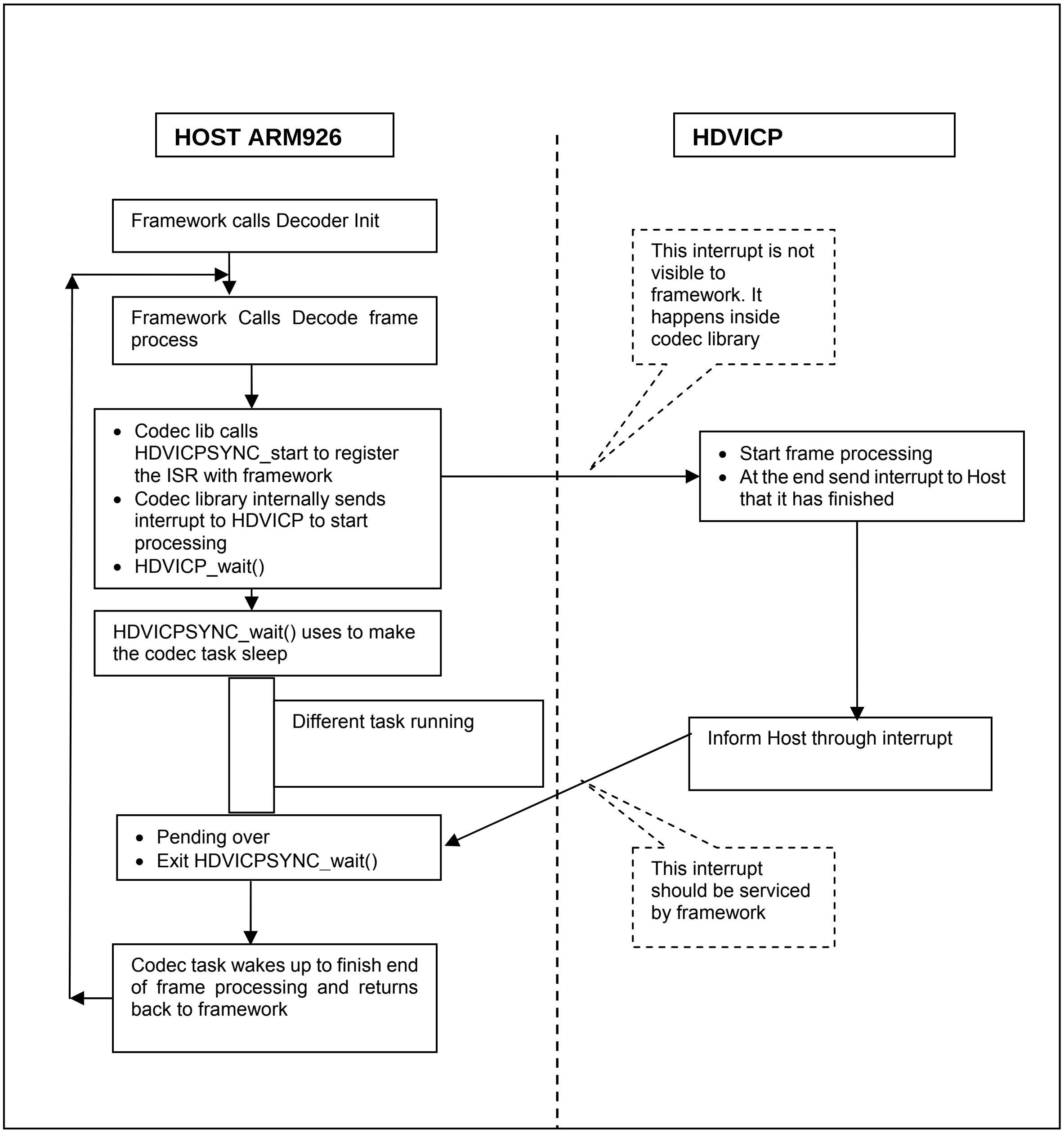


Figure 3-7. Interrupt Between Codec and Application.

3.4 Cache Management by Application

3.4.1 Cache Usage by Codec Algorithm

The codec source code and data, which runs on Host ARM926, can be placed in DDR (Double Data Rate). The host of DM365 has MMU and cache that the application can enable for better performance. Since the codec also uses DMA, there can be inherent cache coherency problems when application turns on the cache.

3.4.2 Cache and Memory Related Call Back Functions for Linux

To resolve the cache coherency and virtual to physical address issues, FC provides memory until library. These following functions can be used by codecs to resolve the cache coherency issues in Linux:

- `cacheInvalidate`
- `cacheWb`
- `cacheWbInv`
- `getPhysicalAddr`

3.4.2.1 cacheInvalidate

Cache invalidation deletes the entries of cache. This API Invalidate a range of cache.

```
Void MEMUTILS_cacheInv (Ptr  addr, Int  sizeInBytes)
```

3.4.2.2 cacheWb

This API writes back cache to the cache source when it is necessary.

```
Void MEMUTILS_cacheWb (Ptr  addr, Int  sizeInBytes)
```

3.4.2.3 cacheWbInv

This API writes back cache to the cache source when it is necessary and deletes cache contents.

```
Void MEMUTILS_cacheWbInv (Ptr  addr, Int  sizeInBytes)
```

3.4.2.4 getPhysicalAddr

This API obtains the physical address.

```
Void* MEMUTILS_getPhysicalAddr (Ptr  addr))
```

3.5 Sample Test Application

The test application exercises the `IVIDDEC2` base class of the MPEG2 Decoder.

Table 3-1. Process() Implementation

```
/* Main Function acting as a client for Video decode Call*/
/* Acquiring and intializing the resources needed to run
the decoder */
iresStatus = (IRES_Status) RMAN_init();
iresStatus = (IRES_Status)
RMAN_register(&IRESMAN_EDMA3CHAN,
(IRESMAN_Params *)&configParams);
```

```
iresStatus = (IRES_Status) RMAN_register(&IRESMAN_HDVICP,
(IRESMAN_Params *)&configParams);
iresStatus = (IRES_Status)RMAN_register(&IRESMAN_ADDRSPACE,
(IRESMAN_Params *)&configParams);


/*---------------- Decoder creation -----------------*/
handle = MPEG2VDEC_create(&fxns, &params)

/*Getting instance of algorithms that implements IALG and
IRES functions*/
iErrorFlag = RMAN_assignResources((IALG_Handle)handle,
                            &MPEG2VDEC_TI_IRES, /*
IRES_Fxns* */
                              1 /* scratchId */);
/* Get Buffer information  */
iErrorFlag = MPEG2VDEC_control(
            handle, // Instance Handle
            XDM_GETBUFINFO, // Command
            NULL, // Pointer to Dynamicparam structure
            &status// Pointer to the status structure
        );
/* Allocate memory for input and output frame buffers */

do {

/* Read bit-stream in the Application Input Buffer */
TestApp_ReadByteStream(inFile);
     /* Get a free frame buffer for decoder */
    BUFFMGR_GetFreeBuffer();

   iErrorFlag = MPEG2VDEC_decode (
                handle,   // Instance Handle    - Input
                &inobj,   // Input Buffers      - Input
                &outobj,  // Output Buffers     - Output
                &inargs,  // Input Parameters   - Input
                &outargs  // Output Parameters  - Output
            );
/* Get the status of the Decoder using control */
   MPEG2VDEC_control(
               handle,         // Instance Handle
               XDM_GETSTATUS,  // Command - GET STATUS
               NULL, // Input
               &status         // Output
                );

    /* Display decoder output frame buffer, if any */

    /* Free, if frame buffer is released by decoder */
    BUFFMGR_ReleaseBuffer((XDAS_UInt32*)
                         outArgs.viddecOutArgs.freeBufID);
}* end of Do-While loop - which Decodes frames  */

/* Free assigned resources */
RMAN_freeResources((IALG_Handle)(handle),
                    &MPEG2VDEC_TI_IRES, /* IRES_Fxns* */
                   );
/* Delete the decoder Object handle*/
MPEG2VDEC_delete(handle);

/* Free input and output frame buffers memory */
/* Unregister protocal*/
RMAN_unregister(&IRESMAN_EDMA3CHAN);
```

```
RMAN_unregister(&IRESMAN_HDVICP);
RMAN_unregister(&IRESMAN_ADDRSPACE);

RMAN_exit();
```

Note:

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

3.6 Error Reporting and Inconsistencies Within Error Codes

While decoding the encoded bit-stream, any error that occurs is reported by the decoder algorithm in multiple ways. The definition and the interpretation of error codes by the decoder is provided as possible enumeration values for `XDM_ErrorBit` and codec specific error codes.

The user/application can access these process returned error codes in three methods:

- Error code as returned in `extendedError` element of `IVIDDEC2_Status` structure in `control()` API function with `XDM_GETSTATUS` command.
- Error code returned in `decodedBufs` element of `IVIDDEC2_OutArgs` structure in `process()` API function.
- Error code as returned in `displayBufs` element of `IVIDDEC2_OutArgs` structure in `process()` API function.

Since `extendedError` element of `IVIDDEC2_Status` structure and `decodedBufs` element of `IVIDDEC2_OutArgs` structure are obtained after frame decode, these two error codes are always in sync. However, the error code in `displayBufs` element of `IVIDDEC2_OutArgs` structure is obtained when the given frame is flushed or displayed..The `display_delay` parameter of `IVIDDEC2_Params` structure controls when a frame is displayed. If the `display_delay` parameter is set to a lower value (less than 1), then it is possible that a picture is displayed before its actual turn.

This timing difference between the error codes can result in `ERR_ORDER` bit of the error code to be set in `displayBufs` element, while it is not set in `decodedBufs` and `extendedError` elements. In case of multiple errors encountered in `process()` API function, only one codec specific error code is reported as there is no provision to update multiple codec specific error codes.

Table 3-2 List of Codec Specific Error Codes.

Error Code	Error Name	Error Description
0x2	IMPEG2VDEC_ERR_INCORRECT_HANDLE	Receiving function call with incorrect handle
0x3	IMPEG2VDEC_ERR_INCORRECT_CODEC_ID	Receiving decode call with incorrect Codec ID,
0x4	IMPEG2VDEC_ERR_RESOURCE_INIT_UNSUCCESSFUL	INIT call unsuccessful
0x5	IMPEG2VDEC_ERR_INPUT_ARGUMENT_NULL	`InArgs` to the Function call NULL
0x6	IMPEG2VDEC_ERR_INPUT_ARGUMENT_SIZE_INCORRECT	Incorrect `Inargs` size

Error Code	Error Name	Error Description
0x7	IMPEG2VDEC_ERR_IVIDENC1_INBUFS_BUFDESC	Erroneous `Bufdesc` in `InBufs` argument passed to the function
0x8	IMPEG2VDEC_ERR_IVIDENC1_OUTBUFS_BUFDESC	Erroneous `Bufdesc` in `OutBufs` argument passed to the function
0x9	IMPEG2VDEC_ERR_IVIDDEC2_INARGS_SIZE	Erroneous `InArgs` Size
0xA	IMPEG2VDEC_ERR_SEQ_HEADER	Erroneous/ Missing Seq Header in the bit-stream
0xB	IMPEG2VDEC_ERR_INV_ARG_HANDLE_IN_CONTROL	Invalid HANDLE passed to control call
0xC	IMPEG2VDEC_ERR_ALGO_NOT_ACTIVATED	Codec not activated and decode process called
0xD	IMPEG2VDEC_ERR_RESOURCES_NOT_INITIATED	Resources requested by the codec are not initialised
0xE	IMPEG2VDEC_ERR_REQ_RESOURCES_NOTALL_ACTIVATED	Not all resources requested by the codec initialized
0xF	IMPEG2VDEC_ERR_INVALID_INPUT_ID	Invalid Input ID
0x10	IMPEG2VDEC_ERR_INVALID_NUM_BYTES	Process call made with invalid number of bytes as input
0x11	IMPEG2VDEC_ERR_FORBIDDEN_FRAME_RATE_CODE	Frame rate code value forbidden .
0x12	IMPEG2VDEC_ERR_FORBIDDEN_BIT_RATE	Forbidden bit-rate in the bit-stream.
0x13	IMPEG2VDEC_ERR_DISPLAY_HOR_SIZE_ZERO	Display horizontal size erroneous in the bit stream.
0x14	IMPEG2VDEC_ERR_DISPLAY_VERTICAL_SIZE_ZERO	Display vertical size zero in the bit-stream.
0x15	IMPEG2VDEC_ERR_SLICE_VERIFICATION_CHECK_FAILED	Slice verification error. Slice missing or slice start code erroneous.
0x16	IMPEG2VDEC_ERR_JUNK_DATA	Junk data passed by application
0x17	IMPEG2VDEC_ERR_INVALID_DISPLAY_WIDTH	Invalid display width requested by the bit stream.
0x18	IMPEG2VDEC_ERR_DISPLAY_WIDTH_DYNAMIC_CHANGE_INVALID	Dynamic change of display width not allowed
0x19	IMPEG2VDEC_ERR_SET_DEFAULT_VALUE_ZERO	Params passed had forbidden value. Set the params to default value.

Error Code	Error Name	Error Description
0x1A	IMPEG2VDEC_ERR_VALUE_OUT_OF_RANGE	Params passed out of allowed range .
0x1B	IMPEG2VDEC_ERR_HEIGTH_OR_WIDTH_EXCEEDING_MAX	Height or width in the bit-stream exceeding maximum value decodable by the decoder.
0x1C	IMPEG2VDEC_ERR_HEIGTH_OR_WIDTH_LESSTHAN_MIN	Height or width less than minimum value 96 .
0x1D	IMPEG2VDEC_ERR_HEIGTH_OR_WIDTH_ODD_VAL	Height or width having odd value not supported.
0x1E	IMPEG2VDEC_ERR_INCORRECT_ASPECT_RATIO	Aspect ratio in the bit-stream incorrect. See the standard for allowed range.
0x1F	IMPEG2VDEC_ERR_MARKER_BIT_NOT_FOUND	Marker bit in the bit-stream incorrect.
0x20	IMPEG2VDEC_ERR_INCORRECT_QUANT_MATRIX	Incorrect quant matrix in the bit stream.
0x21	IMPEG2VDEC_ERR_INVALID_PIC_CODING_TYPE	Picture coding type invalid in the bit-stream.
0x22	IMPEG2VDEC_ERR_FIELD_PIC_PAIR_NOT_FOUND	Field picture pair not found in the bit-stream.
0x23	IMPEG2VDEC_ERR_OUTPUT_FORMAT_NOT_SUPPORTED	Output format in the bit-stream is not supported by the decoder.
0x24	IMPEG2VDEC_ERR_MP_LEVEL_HT_WD_LIMITS_EXCEEDED	Main profile level’s height and width exceeding allowed value.
0x25	IMPEG2VDEC_ERR_HP_LEVEL8_HT_WD_LIMITS_EXCEEDED	High profile level 8 height and width exceeding limit.
0x26	IMPEG2VDEC_ERR_SCALABILITY_NOT_SUPPORTED	Scalability unsupported by the decoder.
0x27	IMPEG2VDEC_ERR_INVALID_F_CODE	Application F_code in valid in the bit-stream.
0x28	IMPEG2VDEC_ERR_INVALID_DISPLAY_WIDTH	Illegal interlaced Content in the bit-stream.
0x29	IMPEG2VDEC_ERR_INVALID_FRAME_PRED_FRAME_DCT	Invalid Frame pred frame dct flag in the bit-stream.
0x2A	IMPEG2VDEC_ERR_INVALID_REPEAT_1ST_FIELD	Invalid repeat first field flag in the bit-stream.
0x2B	IMPEG2VDEC_ERR_422FORMAT_UNSUPPORTED	422 Format input not supported .

Error Code	Error Name	Error Description
0x2C	IMPEG2VDEC_ERR_PROFILE_AND_LEVEL_UNSUPPORTED	Profile or Level of the bit-stream not supported by the decoder.
0x2D	IMPEG2VDEC_ERR_INCORRECT_INPUTID_FOR_SECOND_FLD	Input ID changed by the application for the second field
0x2E	IMPEG2VDEC_ERR_FRAME_ORDER_NON_CONF_AFTER_FIRST_FRAME	`frameOrder` configurable only for the first frame. It cannot be configured dynamically.

Chapter 4

API Reference

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

4.1 Symbolic Constants and Enumerated Data Types

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

4.1.1 Common XDM Constants and Enumerated Data Types

This section summarizes all the common XDM constants and enumerated data types.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	`IVIDDEC2_MAX_IO_BUFFERS`	20 – used to assign maximum number of buffers used in `IVIDDEC2_OutArgs` and `IVIDDEC2_Status` structures.
`IVIDEO_FrameType`	`IVIDEO_I_FRAME`	Intra coded progressive frame. This also represents the frame type, when returning after decode of intra coded first field of an interlaced frame
	`IVIDEO_P_FRAME`	Forward inter coded frame. This also represents the frame type, when returning after decode of forward inter coded first field of an interlaced frame
	`IVIDEO_B_FRAME`	Bi-directional inter coded frame. This also represents the frame type, when returning after decode of bi-directional inter coded first field of an interlaced frame
	`IVIDEO_IDR_FRAME`	Intra coded frame that can be used for refreshing video content. This also represents the frame type, when returning after decode of IDR coded first field of an interlaced frame
	`IVIDEO_II_FRAME`	Interlaced frame, top field is an I or IDR, bottom field is again I or IDR frame
	`IVIDEO_IP_FRAME`	Interlaced frame, top field is an I or IDR frame, bottom field is a P frame.
	`IVIDEO_IB_FRAME`	Interlaced frame, top field is an I or IDR frame, bottom field is a B frame.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_PI_FRAME	Interlaced frame, top field is a P frame, bottom field is an I or IDR frame.
	IVIDEO_PP_FRAME	Interlaced frame, both fields are P frames.
	IVIDEO_PB_FRAME	Interlaced frame, top field is a P frame, bottom field is a B frame.
	IVIDEO_BI_FRAME	Interlaced frame, top field is a B frame, bottom field is an I or IDR frame.
	IVIDEO_BP_FRAME	Interlaced frame, top field is a B frame, bottom 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.
	IVIDEO_MBAFF_IDR_FRAME	Intra coded MBAFF frame that can be used for refreshing video content.
	IVIDEO_FRAMETYPE_DEFAULT	By default, it is set to IVIDEO_I_FRAME.
IVIDEO_OutputFrameStatus	IVIDEO_FRAME_NOERROR	The output buffer is available.
	IVIDEO_FRAME_NOTAVAILABLE	The codec does not have any output buffers.
	IVIDEO_FRAME_ERROR	The output buffer is available and corrupted.
	IVIDEO_OUTPUTFRAMESTATUS_DEFAULT	By default, it is set to IVIDEO_FRAME_NOERROR.
IVIDEO_ContentType	IVIDEO_CONTENTTYPE_NA	Content type is not applicable
	IVIDEO_PROGRESSIVE	Progressive video content

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_INTERLACED	Interlaced video content.
IVIDEO_FrameSkip	IVIDEO_NO_SKIP	Do not skip the current frame. This is the default value.
	IVIDEO_SKIP_P	Skip forward inter coded frame. Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_B	Skip bi-directional inter coded frame. Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_I	Skip intra coded frame. Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_IP	Skip I and P frame/field(s). Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_IB	Skip I and B frame/field(s). Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_PB	Skip P and B frame/field(s). Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_IPB	Skip I/P/B/BI frames. Not supported in this version of MPEG2 Decoder.
	IVIDEO_SKIP_IDR	Skip IDR Frame. Not supported in this version of MPEG2 Decoder.
XDM_DataFormat	XDM_BYTE	Big endian stream
	XDM_LE_16	16-bit little endian stream. Not supported in this version of MPEG2 Decoder.
	XDM_LE_32	32-bit little endian stream. Not supported in this version of MPEG2 Decoder.
XDM_ChromaFormat	XDM_YUV_420P	YUV 4:2:0 planar. Not supported in this version of MPEG2 Decoder.
	XDM_YUV_422P	YUV 4:2:2 planar. Not supported in this version of MPEG2 Decoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_YUV_422IBE	YUV 4:2:2 interleaved (big endian). Not supported in this version of MPEG2 Decoder.
	XDM_YUV_422ILE	YUV 4:2:2 interleaved (little endian). Not supported in this version of MPEG2 Decoder.
	XDM_YUV_444P	YUV 4:4:4 planar. Not supported in this version of MPEG2 Decoder.
	XDM_YUV_411P	YUV 4:1:1 planar. Not supported in this version of MPEG2 Decoder.
	XDM_GRAY	Gray format. Not supported in this version of MPEG2 Decoder.
	XDM_RGB	RGB color format. Not supported in this version of MPEG2 Decoder.
	XDM_YUV_420SP	YUV 420 semiplaner (Luma 1st plane, * CbCr interleaved 2nd plane)
	XDM_ARGB8888	Alpha plane Not supported in this version of MPEG2 Decoder
	XDM_RGB555	RGB 555 color format Not supported in this version of MPEG2 Decoder
	XDM_RGB565	RGB 556 color format Not supported in this version of MPEG2 Decoder
	XDM_YUV_444ILE	YUV 4:4:4 interleaved (little endian) Not supported in this version of MPEG2 Decoder
XDM_CmdId	XDM_GETSTATUS	Query algorithm instance to fill Status structure.
	XDM_SETPARAMS	Set dynamic parameters via the DynamicParams structure. Most of the parameters in the structure are allowed to change only before the first process call in this version of MPEG2 Decoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_RESET	Reset the algorithm. All fields in the internal data structures are reset and all internal buffers are flushed.
	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.
XDM_AccessMode	XDM_ACCESSMODE_READ	The algorithm reads from the buffer using the CPU.
	XDM_ACCESSMODE_WRITE	The algorithm writes from the buffer using the CPU.
XDM_ErrorBit	XDM_APPLIEDCONCEALMENT	Bit 9 ❑ 1 - Applied concealment ❑ 0 - Ignore
	XDM_INSUFFICIENTDATA	Bit 10 ❑ 1 - Insufficient data ❑ 0 - Ignore
	XDM_CORRUPTEDDATA	Bit 11 ❑ 1 - Data problem/corruption ❑ 0 - Ignore
	XDM_CORRUPTEDHEADER	Bit 12 ❑ 1 - Header problem/corruption ❑ 0 - Ignore
	XDM_UNSUPPORTEDINPUT	Bit 13 ❑ 1 - Unsupported feature/parameter in input ❑ 0 - Ignore
	XDM_UNSUPPORTEDPARAM	Bit 14 ❑ 1 - Unsupported input parameter or configuration ❑ 0 - Ignore
	XDM_FATALERROR	Bit 15 ❑ 1 - Fatal error (stop decoding) ❑ 0 - Recoverable error

Table 4-1. List of Enumerated Data Types

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

- Bit 16-32:Reserved
- Bit 8: Reserved
- Bit 0-7:Codec and implementation specific error as described in section 3.6

4.2 Data Structures

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

4.2.1 Common XDM Data Structures

This section includes the following common XDM data structures:

- XDM_BufDesc
- XDM1_BufDesc
- XDM_SingleBufDesc
- XDM1_SingleBufDesc
- XDM_AlgBufInfo
- IVIDEO1_BufDesc
- IVIDDEC2_Fxns
- IVIDDEC2_Params
- IVIDDEC2_DynamicParams
- IVIDDEC2_InArgs
- IVIDDEC2_Status
- IVIDDEC2_OutArgs

4.2.1.1 XDM_BufDesc

|| Description

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

|| Fields

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

4.2.1.2 XDM1_BufDesc

|| Description

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

|| Fields

Field	Data type	Input/ Output	Description
numBufs	XDAS_Int32	Input	Number of buffers
descs[XDM_MAX _IO_BUFFERS]	XDM1_SingleBufDesc	Input	Array of buffer descriptors.

4.2.1.3 XDM_SingleBufDesc

|| Description

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

|| Fields

Field	Data type	Input/ Output	Description
*bufs	XDAS_Int8	Input	Pointer to the buffer
bufSize	XDAS_Int32	Input	Size of the buffer in bytes

4.2.1.4 XDM1_SingleBufDesc

|| Description

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

|| Fields

Field	Data type	Input/ Output	Description
*bufs	XDAS_Int8	Input	Pointer to the buffer
bufSize	XDAS_Int32	Input	Size of the buffer in bytes
accessMask	XDAS_Int32	Output	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 CPU), then no bits in this mask should be set.

4.2.1.5 XDM_AlgBufInfo

|| Description

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

|| Fields

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

Note:

For MPEG2 Main Profile Decoder, the buffer details are:

- Number of input buffer required is 1.
- Number of output buffer required is 2 for YUV420 interleaved.
- There is no restriction on input buffer size except that it should contain atleast one frame of encoded data.
- The output buffer sizes (in bytes) for worst case 1080p format are:

  For YUV 420 interleaved:

  Y buffer = 1920 * 1088

  UV buffer = 1920 * 544

These are the maximum buffer sizes, but you can reconfigure depending on the format of the bit stream.

4.2.1.6 IVIDEO1_BufDesc

|| Description

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

|| Fields

Field	Data type	Input/ Output	Description
`numBufs`	`XDAS_Int32`	Output	Number of buffers

Field	Data type	Input/ Output	Description
frameWidth	XDAS_Int32	Output	Width of the video frame
frameHeight	XDAS_Int32	Output	Height of the video frame
framePitch	XDAS_Int32	Output	Frame pitch used to store the frame
bufDesc[IVIDEO_MAX_YUV_BUFFERS]	XDM1_SingleBufDesc	Output	Pointer to the vector containing buffer addresses
extendedError	XDAS_Int32	Output	Extended error information
frameType	XDAS_Int32	Output	Type of the video frame. This takes one of the values from enumerated datatype IVIDEO_FrameType as described in Table 4-1.
topFieldFirstFlag	XDAS_Int32	Output	Flag to indicate when the application should display the top field first Note : This feature is not supported in this version of MPEG2 Decoder on DM365
repeatFirstFieldFlag	XDAS_Int32	Output	Flag to indicate when the first field should be repeated Note : This feature is not supported in this version of MPEG2 Decoder on DM365
frameStatus	XDAS_Int32	Output	Flag to indicate the status of the output frame. This takes one of the values from enumerated datatype IVIDEO_OutputFrameStatus as described in Table 4-1.
repeatFrame	XDAS_Int32	Output	Number of times the display process needs to repeat the displayed progressive frame Note : This feature is not supported in this version of MPEG2 Decoder on DM365
contentType	XDAS_Int32	Output	Content type of the buffer IVIDEO_ContentType
chromaFormat	XDAS_Int32	Output	Only supported value is XDM_YUV_420SP

4.2.1.7 IVIDDEC2_Fxns

|| Description

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

|| Fields

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

4.2.1.8 IVIDDEC2_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. Default values will be used if the data structure points to `NULL`.

|| Fields

Field	Data type	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes. Default value = 196
maxHeight	XDAS_Int32	Input	Maximum video height to be supported in pixels Default value = 1088 The minimum height supported by this implementation is 96 pixels (for luma).
maxWidth	XDAS_Int32	Input	Maximum video width to be supported in pixels Default value = 1920 The minimum width of the picture supported in this implementation is 96 pixels (for luma).
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

Field	Data type	Input/ Output	Description
			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. Default value = XDM_BYTE
forceChromaFormat	XDAS_Int32	Input	Only supported value is XDM_YUV_420SP

Note:

- MPEG2 Decoder does not use the maxFrameRate and maxBitRate fields for creating the algorithm instance.
- Maximum video height and width supported are 1920 pixels and 1088 pixels respectively.
- dataEndianness field should be set to XDM_BYTE. If this value is set to some other value other than XDM_BYTE, decoder will assume it as XDM_BYTE and continue decoding.

4.2.1.9 IVIDDEC2_DynamicParams

|| Description

This structure defines the run-time parameters for an algorithm instance object..The decoder does not use a few of the parameters. Few others are honored only before the first frame decode and hence run-time change for those parameters is not allowed. This structure must be initialized, while calling control() API with SETPARAMS command.

|| 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: ❑ 0 (XDM_DECODE_AU) - Decode entire frame including all the headers ❑ 1 (XDM_PARSE_HEADER) - Decode only one sequence header unit

Field	Data type	Input/ Output	Description
displayWidth	XDAS_Int32	Input	Display buffer pitch: ❑ 0 – Default Display buffer pitch. Configuring with the default value before first frame decode means, the decoder should derive the minimum possible display buffer pitch based on the decoded image width. ❑ Any non-zero value width be considered as display buffer pitch. However, after decoding the frame, if the configured displayWidth is found to be insufficient for the given stream, the process call is returned with fatal error. This can be used to configure only before the first frame decode. Run time change in displayWidth is not allowed.When calling control() API with SETPARAMS command after first frame decode, it must have the same value as the one used before first frame decode or must be set to default 0 value. This needs to be an integral multiple of 32 pixels.
displayHeight	XDAS_Int32	Input	This field is reserved. No use case assigned to it.
frameSkipMode	XDAS_Int32	Input	Frame skip mode. See IVIDEO_FrameSkip enumeration for details. Note: This feature is not supported in this version of MPEG2 Decoder on DM365. The value should be set to default value 0.
frameOrder	XDAS_Int32	Input	Frame display order. ❑ 0 (IVIDDEC2_DISPLAY_ORDER) – Decoder provides decoded output in actual order of display. When IVIDDEC2_DISPLAY_ORDER is configured, the display delay set through displayDelay as explained in section 4.2.2.1. IMPEG2VDEC_Params is honoured. Hence, in case displayDelay is set to 1, the decoder honours frame order and dumps the ouput in display order itself . ❑ 1 (IVIDDEC2_DECODE_ORDER) – Decoder provides decoded output in order of decoding. This sets the display delay to 0, that is, the frame buffer is given back for display as soon as it is decoded. The display delay set through display delay as explained in section 4.2.2.1 IMPEG2VDEC_Params gets overwriten internally. This can be used to configure only before the first frame decode. Run time change in frame order is not allowed. When calling control() API with SETPARAMS command after first frame decode, it must have the same value as the one used before first frame decode.

Field	Data type	Input/ Output	Description
newFrameFlag	XDAS_Int32	Input	Flag to indicate that, the algorithm should start a new frame. Valid values are XDAS_TRUE and XDAS_FALSE. 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. This logic is not implemented in the current version of decoder and it thus expects newFrameFlag to be set to XDAS_FALSE. Note: This feature is not supported in this version of MPEG2 Decoder on DM365 and hence this falg has to be always set to default value 0.
mbDataFlag	XDAS_Int32	Input	Flag to indicate that the algorithm should generate MB Data in addition to decoding the data. Valid values are XDAS_TRUE and XDAS_FALSE. Note: This feature is not supported in this version of MPEG2 Decoder on DM365 and hence this flag has to be always set to default value 0.

4.2.1.10 IVIDDEC2_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 the 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 IVIDDEC2_OutArgs data structure will be same as inputID field.

Note:

- MPEG2 Decoder returns a failure if `inputID` is 0, otherwise it copies the `inputID` value to the `outputID` value of `IVIDDEC2_OutArgs` structure.
- MPEG2 decoder always expects `numBytes` to be equal to 1 frame of data.if `numBytes` is less than 4, a failure is returned.

4.2.1.11 IVIDDEC2_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 section 3.6 for details.
data	XDM_SingleBufDesc	Input/Output	Buffer information structure for information passing buffer.
maxNumDisplayBufs	XDAS_Int32	Output	The maximum number of buffers that is required by the codec. The maximum number of buffers can be IVIDDEC2_MAX_IO_BUFFERS. In this decoder implementation it is always set to 17, if `levelLimit` field of `IVIDDEC2_Params` is not set. However, in case `levelLimit` is set to an appropriate valid value, `maxNumDisplayBufs` is derived based on `levelLimit, maxWidth and maxHeight` fields of `IVIDDEC2_Params`.
outputHeight	XDAS_Int32	Output	Output height in pixels
outputWidth	XDAS_Int32	Output	Output width in pixels
frameRate	XDAS_Int32	Output	Average frame rate in fps * 1000. The average frame rate for all video decoders is 30 fps.
bitRate	XDAS_Int32	Output	Average bit-rate in bits per second
contentType	XDAS_Int32	Output	Video content. See `IVIDEO_ContentType` enumeration for details.

Field	Data type	Input/ Output	Description
outputChromaFormat	XDAS_Int32	Output	Only supported value is XDM_YUV_420SP.
bufInfo	XDM_AlgBufInfo	Output	Input and output buffer information. See XDM_AlgBufInfo data structure for details.

Note:

- Algorithm sets the frameRate and bitRate fields to zero
- MPEG2 Decoder does not use the buffer descriptor meant for passing additional information between the application and the decoder.

4.2.1.12 IVIDDEC2_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.
bytesConsumed	XDAS_Int32	Output	Bytes consumed per decode call
outputID[IVIDDEC2_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 indicates end of valid outputIDs within the array. Hence the application stops reading the array when it encounters the first zero entry
decodedBufs	IVIDEO1_BufDesc	Output	The decoder fills this structure with buffer pointers to the decoded frame. Related information fields for the decoded frame are also populated When frame decoding is not complete, as indicated by outBufsInUseFlag, the frame data in this structure is incomplete. However, the algorithm provides incomplete decoded frame data in case the application chooses to use it for error recovery
displayBufs[IVIDDEC2_MAX_IO_BUFFERS]	IVIDEO1_BufDesc	Output	Array containing display frames corresponding to valid ID entries in the outputID[] array.
outputMbDataID	XDAS_Int32	Output	Output ID corresponding with the MB Data Note : This feature is not supported in this version of

Field	Data type	Input/ Output	Description
			MPEG2 Decoder on DM365
mbDataBuf	XDM1_SingleBufDesc	Output	The decoder populates the last buffer among the buffers supplied within outBufs->bufs[] with the decoded MB data generated by the decoder module Note :This feature is not supported in this version of MPEG2 Decoder on DM365
freeBufID[IVIDDEC2_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. outBufs are not required for the next process() call

Note:

- MPEG2 Decoder copies the inputID value to the outputID value of IVIDDEC2_OutArgs structure.
- OutputMbDataID and mbDataBuf is not given as output in this version of the decoder. These fields may return an uninitialized value when read.
- After decoding first field of an interlaced frame, outBufsInUseFlag is set to 1.

4.2.2 MPEG2 Decoder Data Structures

This section includes the following MPEG2 decoder specific data structures:

- Imp2VDEC_Params
- Imp2VDEC_DynamicParams
- Imp2VDEC_InArgs
- Imp2VDEC_Status
- Imp2VDEC_OutArgs

4.2.2.1 Imp2VDEC_Params

|| Description

This structure defines the creation parameters and any other implementation specific parameters for the MPEG2 Decoder instance object. The creation parameters are defined in the XDM data structure, IVIDDEC2_Params.

|| Fields

Field	Data type	Input/ Output	Description
viddecParams	IVIDDEC2_Params	Input	See IVIDDEC2_Params data structure for details.
display_delay	XDAS_Int32	Input	Display delay before which the decoder starts to output frames for display. ❑ Default value: 0(when base class is used). ❑ Valid range: [0, 1] Delay in the display can also be controlled by frameOrder. See section 4.2.1.9 IVIDDEC2_DynamicParams

4.2.2.2 Imp2VDEC_DynamicParams

|| Description

This structure defines the run-time parameters and any other implementation specific parameters for the MPEG2 Decoder instance object. The run-time parameters are defined in the XDM data structure, IVIDDEC2_DynamicParams.

|| Fields

Field	Data type	Input/ Output	Description

Field	Data type	Input/ Output	Description
viddecDynamicParams	IVIDDEC2_DynamicParams	Input	See IVIDDEC2_DynamicParams data structure for details.
bottom_fld_DDR_Opt	XDAS_Int8	Input	Flag to turn on/off the DMA transfer for bottom fields of B frame picture or to bypass decoding a B bottom Field picture. This is an option to save on DDR bandwidth. Note : This feature is not supported in this version of MPEG2 Decoder on DM365 and the value of this variable has to be set to default 0.
mb_error_reporting	XDAS_Int8	Input	Setting this flag gives the no of error mbs in the frame through the status extended structure Note : This feature is not supported in the current version and the variable has to be set to default value 0 .
errorConceal	XDAS_Int32	Input	Concealment flag to invoke the concealment for the current frame. This variable is dynamically configurable.
reset_HDVICP_every_frame	XDAS_Int8	Input	Flag to reset HDVICP at the start of every frame being decoded. This is useful for multi-channel and multi-format encoding/decoding. ❑ Default value: 1 – ON (when base class is used). ❑ 0 – OFF Default value - 1 If this flag is set, then MPEG2 decoder assumes that the memory of HDVICP was overwritten by some other codec or by other instance of same codec with different picture type. For example, Application will set this flag to 1 if running another instance of different codec like MPEG2 encoder or if running another MPEG2 decoder instance with different picture type. However, the application can set this flag to 0 for better performance if it runs multiple instances of MPEG2 decoder with same picture type.

4.2.2.3 Imp2VDEC_InArgs

|| Description

This structure defines the run-time input arguments for the MPEG2 Decoder instance object.

|| Fields

Field	Data type	Input/ Output	Description
viddecInArgs	IVIDDEC2_InArgs	Input	See IVIDDEC2_InArgs data structure for details.

4.2.2.4 Imp2VDEC_Status

|| Description

This structure defines parameters that describe the status of the MPEG2 Decoder and any other implementation specific parameters. The status parameters are defined in the XDM data structure, IVIDDEC2_Status.

|| Fields

Field	Data type	Input/ Output	Description
viddecStatus	IVIDDEC2_Status	Output	See IVIDDEC2_Status data structure for details.

4.2.2.5 Imp2VDEC_OutArgs

|| Description

This structure defines the run-time output arguments for the MPEG2 Decoder instance object.

|| Fields

Field	Data type	Input/ Output	Description
viddecOutArgs	IVIDDEC2_OutArgs	Output	See IVIDDEC2_OutArgs data structure for details.

4.3 Interface Functions

This section describes the Application Programming Interfaces (APIs) used in the MPEG2 Decoder. The APIs are logically grouped into the following categories:

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

You must call these APIs in the following sequence:

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

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

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

4.3.1 Creation APIs

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

|| Name

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

|| Synopsis

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

|| Arguments

```
Void
```

|| Return Value

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

|| Description

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

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

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

|| See Also

`algAlloc()`

‖ Name

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

‖ Synopsis

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

‖ Arguments

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

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

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

‖ Return Value

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

IALG_EFAIL /* Status indicating failure */
```

‖ 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. If the size of this argument is not equal to the size of `IVIDDEC2_Params` or the size of `Imp2VDEC_Params` then the default values of `Imp2VDEC_Params` structure are used.

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

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

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

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

‖ See Also

`algNumAlloc()`, `algFree()`

4.3.2 Initialization API

Initialization API is used to initialize an instance of the algorithm. The initialization parameters are defined in the `Params` structure (see section 4.2 for details).

|| Name

`algInit()` – initialize an algorithm instance

|| Synopsis

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

|| Arguments

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

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

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

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

|| Return Value

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

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

|| Description

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

The first argument to `algInit()` is a handle to an algorithm instance. This value is initialized to the base field of `memTab[0]` . This version of the decoder returns failure if this is `NULL`.

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()` . This version of the decoder returns failure if this is `NULL`.

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. If any of the input fields in this parameter structure are invalid as defined by the table in section 4.2.2.1, this function uses default values wherever possible and raises a warning flag - `XDM_UNSUPPORTEDPARAM` through `extended_error` field of status structure during immediate `control()` API `(XDM_GETSTATUS)` call.

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

|| See Also

`algAlloc(), algMoved()`

4.3.3 Control API

Control API is used to control the functioning and querying of the status of the algorithm instance during run-time. `XDM_FLUSH` and `XDM_RESET` control commands are supported in this implementation. `XDM_GETBUFINFO`, `XDM_GETSTATUS`, `XDM_SETPARAMS`, `XDM_SETDEFAULT and XDM_GETVERSION` are few other commands that are implemented.

‖ Name

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

‖ Synopsis

```
XDAS_Int32 (*control) (IVIDDEC2_Handle handle,
IVIDDEC2_Cmd id, IVIDDEC2_DynamicParams *params,
IVIDDEC2_Status *status);
```

‖ Arguments

```
IVIDDEC2_Handle handle; /* algorithm instance handle */

IVIDDEC2_Cmd id; /* algorithm specific control commands*/

IVIDDEC2_DynamicParams *params /* algorithm run-time
parameters */

IVIDDEC2_Status *status /* algorithm instance status
parameters */
```

‖ Return Value

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

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

‖ Description

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

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

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

The third and fourth arguments are pointers to the `IVIDDEC2_DynamicParams` and `IVIDDEC2_Status` data structures respectively. `DynamicParams` structure is used in the `control()` API only for `XDM_SETPARAMS` command, hence no validation check is performed on the contents of this structure and this structure pointer can be `NULL` as well for supported commands like `XDM_GETBUFINFO` , `XDM_FLUSH, XDM_RESET, XDM_GETSTATUS, XDM_SETDEFAULT and GETVERSION`.

> **Note:**
>
> If extended data structures are used, then the fourth argument must be a pointer to the extended `Status` data structure. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters. However, in this implementation the `status` structure does not have any extended structure members.

‖ Preconditions

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

- `control()` can be called only after successful return from `algInit()` and `algActivate()`.
- `handle` must be a valid handle for the algorithm instance object.

‖ Postconditions

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

- If the control operation is successful, the return value from this operation is equal to `IALG_EOK`.
- If the control command is not supported or recognized, the return value from this operation is equal to `IVIDDEC2_EUNSUPPORTED`
- If the control operation is not successful for a supported command, the return value from this operation is equal to `IALG_EFAIL`.

> **Note:**
>
> If the operation is not successful for `IH264VDEC_SETPARAMS` control command due to invalid dynamic parameter settings that are not supported by the decoder, it returns `IALG_EFAIL with XDM_UNSUPPORTEDPARAM` bit set in `extendedError` element of `IVIDDEC2_Status` structure.

‖ Example

See test application file, mpeg2vdec_ti_arm926testapp.c available in the \client\test\src sub-directory.

‖ See Also

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

4.3.4 Data Processing API

Data processing API is used for processing the input data.

|| Name

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

|| Synopsis

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

|| Arguments

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

|| Return Value

```
Void
```

|| Description

`algActivate()` initializes any of the instance scratch buffers using the persistent memory that is part of the algorithm 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 processing methods.

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

|| See Also

`algDeactivate()`

|| Name

`process()` – basic encoding/decoding blocking call

|| Synopsis

```
XDAS_Int32 (*process)(IVIDDEC2_Handle handle, XDM1_BufDesc
*inBufs, XDM_BufDesc *outBufs, IVIDDEC2_InArgs *inargs,
IVIDDEC2_OutArgs *outargs);
```

|| Arguments

```
IVIDDEC2_Handle handle; /* algorithm instance handle */

XDM1_BufDesc *inBufs; /* algorithm input buffer descriptor
*/

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

IVIDDEC2_InArgs *inargs /* algorithm runtime input
arguments */

IVIDDEC2_OutArgs *outargs /* algorithm runtime output
arguments */
```

|| Return Value

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

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

|| Description

This function is a blocking call implementation for encoding/decoding process for the current frame. In case of field pictures, process call has to be invoked for each field.

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

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `XDM_BufDesc` data structure for details). When the flush mode is 0, the number of input buffers supported is 1. If it is not equal to the above-mentioned value, this version of the decoder returns failure.In the flush mode (flush mode is 1) these fields are ignored.

The fourth argument is a pointer to the `IVIDDEC2_InArgs` data structure that defines the run-time input arguments for an algorithm instance object.

The last argument is a pointer to the `IVIDDEC2_OutArgs` data structure that defines the run - time output arguments for an algorithm instance object.

> **Note:**
>
> The `process()` API can be called with base or extended `InArgs` and `OutArgs` data structures. If you are using extended data structures, the fourth and fifth arguments must be pointers to the extended `InArgs` and `OutArgs` data structures respectively. Also, ensure that the `size` field is set to the size of the extended data structure. Depending on the value set for the `size` field, the algorithm uses either basic or extended parameters.

|| Preconditions

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

- `process()` can only be called after a successful return from `algInit()` and `algActivate()`.
- `handle` must be a valid handle for the algorithm instance object.
- Buffer descriptor for input and output buffers must be valid when not in flush mode.
- Input buffers must have valid input data when not in flush mode.

|| Postconditions

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

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

|| Example

See test application file, mpeg2vdec_ti_arm926testapp.c available in the \client\test\src sub-directory.

|| See Also

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

> **Note:**
>
> A video encoder or decoder cannot be pre-empted by any other video encoder or decoder instance. That is, you cannot perform task switching while encode/decode of a particular frame is in progress.

|| 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 instance object.

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

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

‖ See Also

`algActivate()`

4.3.5 Termination API

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

|| Name

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

|| Synopsis

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

|| Arguments

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

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

|| Return Value

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

|| Description

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

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

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

> **Note:**
>
> In the current implementation `algFree()` API additionally resets HDVICP hardware co-processor and also releases DMA resources held by it. Thus, its important that this function is used only to release the resource at the end and not in between `process()`/`control()` API functions.

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

|| See Also

`algAlloc()`

Appendix A

Revision History

This user guide revision history highlights the changes made to SPRUGS7 codec specific user guide to make it SPRUGS7A.

Table A-1. Revision History for MPEG2 MP Decoder on DM365

Section	Addition/Deletion/Modifications
Global changes	❑ Table 3-2 - Updated List of Codec Specific Error Codes.