VC1 Advanced Profile Decoder on IVAHD and M3 Based Platform

User's Guide

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Read This First

About This Manual

This document describes how to install and work with Texas Instruments' (TI) VC1 Advanced profile Decoder implementation on the IVAHD and M3 Based Platform platform. It also provides a detailed Application Programming Interface (API) reference and information on the sample application that accompanies this component.

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

Intended Audience

This document is intended for system engineers who want to integrate TI's codecs with other software to build a multimedia system based on the IVAHD and M3 Based Platform 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**, introduces the XDAIS and XDM standards. It also provides an overview of the codec and lists its supported features.
- **Chapter 2 - Installation Overview**, describes how to install, build, and run the codec.
- **Chapter 3 - Sample Usage**, describes the sample usage of the codec.
- **Chapter 4 - API Reference**, describes the data structures and interface functions used in the codec.
- **Chapter 5 - Frequently Asked Questions,** provides answers frequently asked questions related to using VC1 Advanced Profile Decoder
- **Chapter 6 – Debug trace usage,** describes how to collect debug trace information dumped by the decoder.

- **Chapter 7 - Picture Format,** describes the format of the output pictures of the VC1 Decoder on IVAHD.
- **Chapter 8 - Error handling,** describes the error reporting mechanism of the decoder, also recommends the application behaviour for all error scenarios.
- **Chapter 9 – Bit-Stream format,** describes the bit-stream formats and codec expectation and behaviour for different formats.
- **Chapter 10 – Meta Data Support,** provides information on writing out MB info data into application provided buffers**.**

Related Documentation From Texas Instruments

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

- *TMS320 DSP Algorithm Standard Rules and Guidelines* (literature number SPRU352) defines a set of requirements for DSP algorithms that, if followed, allow system integrators to quickly assemble production-quality systems from one or more such algorithms.
- *TMS320 DSP Algorithm Standard API Reference* (literature number SPRU360) describes all the APIs that are defined by the TMS320 DSP Algorithm Inteface Standard (also known as XDAIS) specification.
- *Technical Overview of eXpressDSP - Compliant Algorithms for DSP Software Producers* (literature number SPRA579) describes how to make algorithms compliant with the TMS320 DSP Algorithm Standard which is part of TI's eXpressDSP technology initiative.
- *Using the TMS320 DSP Algorithm Standard in a Static DSP System* (literature number SPRA577) describes how an eXpressDSP-compliant algorithm may be used effectively in a static system with limited memory.
- eXpressDSP Digital Media (XDM) Standard API Reference (literature number SPRUEC8)
- *Using IRES and RMAN Framework Components for C64x+* (literature number SPRAAI5), describes the IRES interface definition and function calling sequence

Related Documentation

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

- SMPTE 421M: - *Proposed SMPTE Standard for Television: VC-1 Compressed Video Bitstream Format and Decoding Process*

Abbreviations

The following abbreviations are used in this document.

Table 1-1 *List of Abbreviations*

Abbreviation	Description

Abbreviation	Description
WMV	Windows Media Video
SMPTE	Society Of Motion Picture and Television Engineers
BIOS	TI's simple RTOS for DSPs
AC/DC PRED	Prediction of the first DCT co-efficient in each row and each column of a block from adjacent blocks
ASF	Advanced Systems Format
CPB	Coded Picture Buffer
CSL	Chip Support Library
D1	720x480 or 720x576 resolutions in progressive scan
DCT	Discrete Cosine Transform
DMA	Direct Memory Access
DMAN	DMA Manager
DPB	Decoded Picture Buffer
EVM	Evaluation Module
IDR	Instantaneous Decoding Refresh
HDTV	High Definition Television
VC-1	SMPTE 421M approved standard for Television.
VLC	Variable Length Coding
IRES	Interface standard to request and receive handles to resources
ITU-T	International Telecommunication Union
IVA	Image Video Accelerator
SMPTE	Society of Motion Picture and Television Engineers
MB	Macro Block
MV	Motion Vector
NTSC	National Television Standards Committee
RMAN	Resource Manager

Abbreviation	Description
RTOS	Real Time Operating System
VGA	Video Graphics Array (640 x 480 resolution)
VOP	Video Object Plane
XDAIS	eXpressDSP Algorithm Interface Standard
XDM	eXpressDSP Digital Media
YUV	Color space in luminance and chrominance form

Text Conventions

The following conventions are used in this document:

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

Product Support

When contacting TI for support on this codec, quote the product name (VC1 Advanced Profile Decoder on IVAHD and M3 Based Platform) and version number. The version number of the codec is included in the title of the Release Notes that accompanies this codec.

Trademarks

Contents

Figures

Tables

Chapter 1

Introduction

This chapter provides a brief introduction to XDAIS and XDM. It also provides an overview of TI's implementation of the VC1 Advanced Profile Decoder on the IVAHD and M3 Based Platform and its supported features.

Topic **Page**

1.1 Overview of XDAIS, XDM, and IRES

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 the interface for management and utilization of special resource types such as hardware accelerators, certain types of memory and DMA. This interface allows the client application to query and provide the algorithm its requested resources.

1.1.1 XDAIS Overview

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

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

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

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

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

1.1.2 XDM Overview

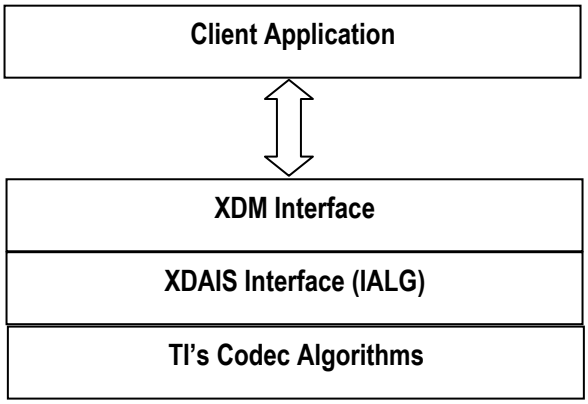
In the multimedia application space, you have the choice of integrating any codec into your multimedia system. For example, if you are building a video decoder system, you can use any of the available video decoders (such as VC1,MPEG4, H.263, or H.264) in your system. To enable easy integration with the client application, it is important that all codecs with similar functionality use similar APIs. XDM was primarily defined as an extension to XDAIS to ensure uniformity across different classes of codecs (for example audio, video, image, and speech). The XDM standard defines the following two APIs:

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

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

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

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



As depicted in the figure, XDM is an extension to XDAIS and forms an interface between the client application and the codec component. XDM insulates the client application from component-level changes. Since TI's multimedia algorithms are XDM compliant, it provides you with the flexibility to use any TI algorithm without changing the client application code. For example, if you have developed a client application using an XDM-compliant VC1 video decoder, then you can easily replace VC1 with another XDM-compliant video decoder, say H.263, with minimal changes to the client application.

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

1.1.3 IRES Overview

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

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

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

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

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

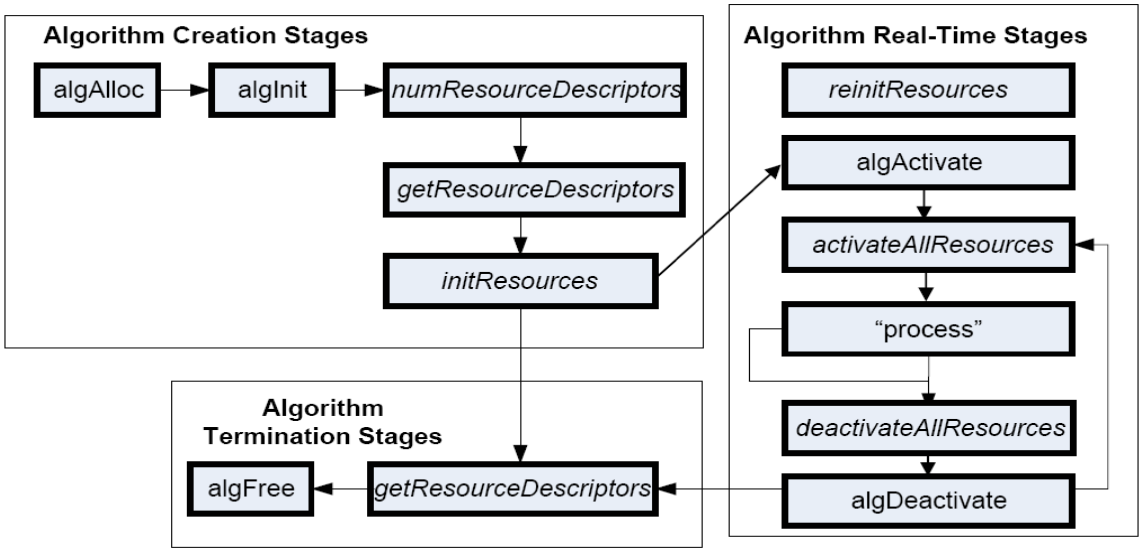


Figure 1-1. IRES Interface Definition and Function Calling Sequence.

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

1.2 Overview of VC1 Advanced Profile Decoder

- VC1 is the Society of Motion Picture and Television Engineers (SMPTE) standardized video decoder. VC1 consists of three profiles namely, simple, main, and advanced. Simple and main profiles were developed for use in lower-bit-rate networked computing environments. VC1 standard defines several profiles and levels that specify restrictions on the bit stream, and hence limits the capabilities needed to decode the bit-streams. Each profile specifies a subset of algorithmic features and limits all decoders conforming to that profile may support. Each level specifies a set of limits on the values that may be taken by the syntax elements in the profile.

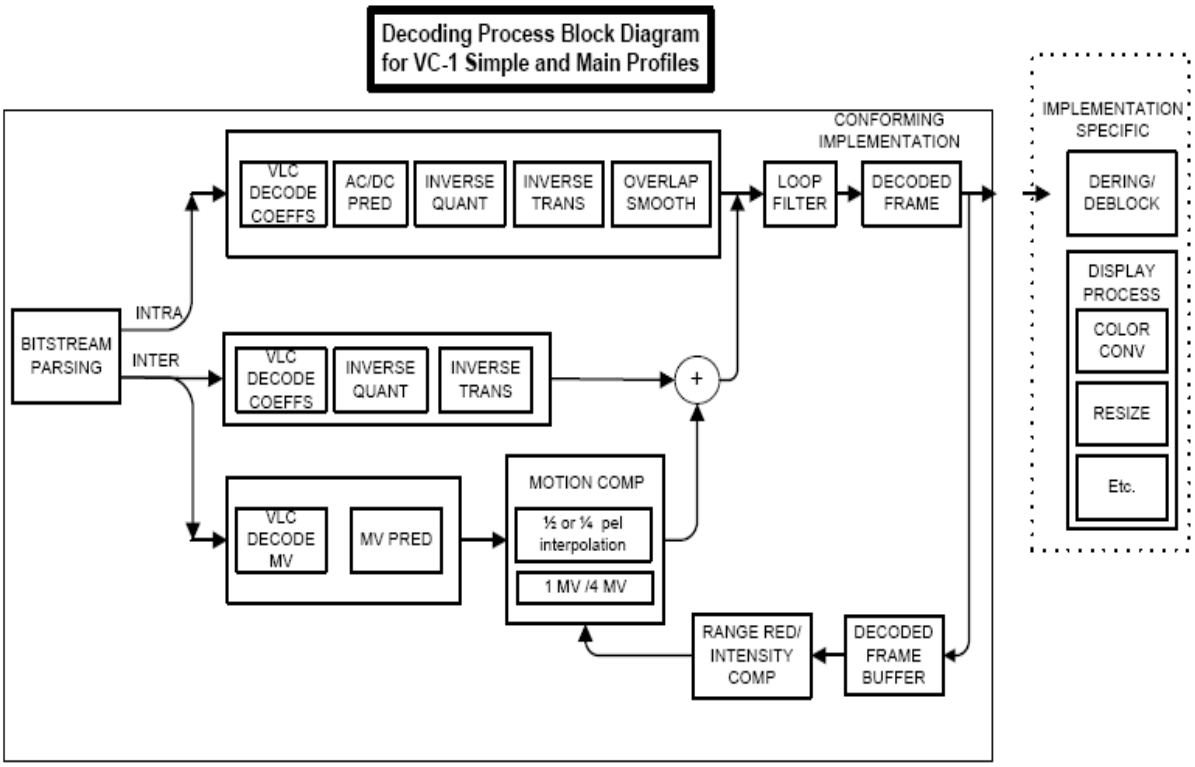


Figure 1-2. Block Diagram of VC1 Decoder

From this point onwards, all references to VC1 decoder mean VC1 Advanced Profile (AP) decoder only.

Figure 1-3 depicts the working of the VC1 Decoder algorithm.

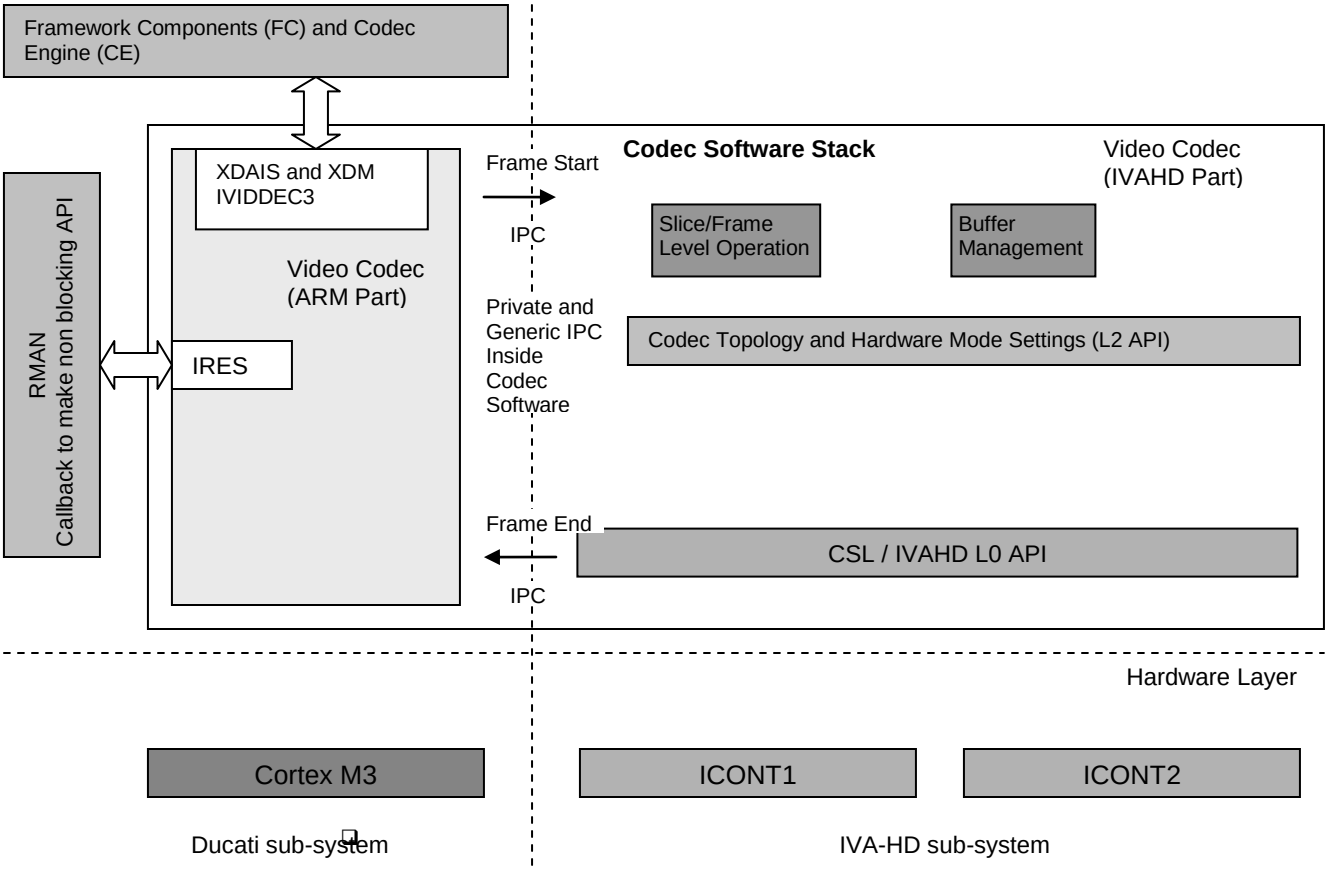


Figure 1-3. Working of VC1 Decoder

VC1 Advanced Profile Decoder implementation on OMAP4 has two parts:

- Core part of the decoding, which includes all frame and slice level operation and core decoding algorithm. This part is implemented on IVA-HD sub-system
- Interface part of the decoder, which interacts with application and system software. This part is implemented on M3. All the interfaces to query algorithm resource needs belongs to this part. This part of the video codec is exposed to system software and core part is hidden.

Interface part of the video codec communicates with core part of video codec with private IPC defined in codec software through mailbox.

1.3 Supported Services and Features

This user guide accompanies TI's implementation of VC1 Decoder on the IVAHD video accelerators.

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

- eXpressDSP Digital Media (XDM IVIDDEC3) compliant
- Uses hardware accelerators of IVAHD
- VC1 Advanced Profile up to Level 3 compliant
- All features of Simple Profile, Main Profile and Advanced Profile are supported
- Supports Multiple slices
- Minimum resolution supported is 64 x 64
- Non-multiples of 16 resolutions are also supported
- Progressive, Interlaced frame and Interlaced field type picture decoding supported
- Supports all block type partitions and modes
- Outputs are available in YUV420 interleaved little Endian format
- Tested for compliance with SMPTE reference decoder release 7
- Cache aware decoder library
- Independent of any OS (DSP/BIOS, Linux, Window CE, Symbian and so on
- Ability to plug in any multimedia frameworks (e.g. Codec engine, OpenMax, GStreamer, …)
- Supports multi-channel functionality.
- Supports resolutions from all standard resolutions from QCIF to 1080p/1080i.
- All features of Simple Profile, Main Profile and Advanced Profile are supported
- Both RCV(RCV V1, RCV V2) and Elementary stream formats are supported
- Support for error resiliency and error concealment

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.

Topic **Page**

2.1 System Requirements

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

2.1.1 Hardware

This codec (OMAP4 release package) has been built and tested on OMAP4ES1.

2.1.2 Software

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

- **Development Environment:** This project is developed using CodeComposer Studio (Code Composer Studio v4) version. 4.2.0.09000. Code Composer Studio v4 can be downloaded from the following location.

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

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

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

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

- **IVAHD Simulator:** This codec has been tested using IVAHD simulator version 5.0.16 (IVAHD simulation CSP 1.1.5). This release can be obtained by software updates on Code Composer Studio v4. Make sure that following site is listed as part of Update sites to visit.

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

2.2 Installing the Component

The codec component is released as a compressed archive. To install the codec, extract the contents of the zip file onto your local hard disk. The zip file extraction creates a top-level directory called 500.V.VC1.D.IVAHD.01.00, under which is directory named IVAHD_001.

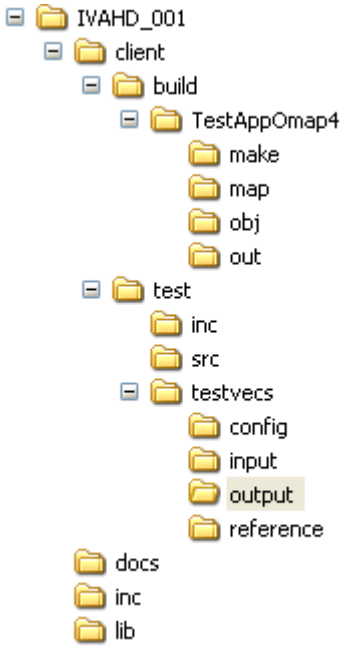


Figure 2-1. Component Directory Structure

Sub-Directory	Description
\inc	Contains XDM related header files which allow interface to the codec library
\lib	Contains the codec library file
\docs	Contains user guide and datasheet
\client\build\TestAppOmap4	Contains the M3 cmd file.
\client\build\TestAppOmap4\make	Contains the make file for the test application project.
\client\build\TestAppOmap4\map	Contains the memory map generated on compilation of the code
\client\build\TestAppOmap4\obj	Contains the intermediate .asm and/or .obj file generated on compilation of the code
\client\build\TestAppOmap4\out	Contains the final application executable (.out) file generated by the sample test application
\client\test\src	Contains application C files
\client\ test\inc	Contains header files needed for the application code
\client\testvecs\config	Contains configuration parameter files
\client\test\testvecs\input	Contains input test vectors
\client\test\testvecs\output	Contains output generated by the codec
\client\test\testvecs\reference	Contains read-only reference output to be used for cross-checking against codec output

Table 2-1. Component Directories

2.3 Before Building the Sample Test Application

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

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

To run the Simulator version of the codec, the IVAHD simulator has to be installed. The version of the simulator is 5.0.16. This can be done using the “Help->Software Updates->Find and Install” option in CCSv4. Detailed instructions to set up the configuration can be found in ivahd_sim_user_guide.pdf present in <CCSv4 Installation Dir>\simulation_csp_omap4\docs\pdf\ directory.

This codec has also been validated on Netra Video Processing Simulator that simulates all the three IVAHDs in DM816x. The simulator required for this is Netra CSP (Simulation) version 0.7.1. This simulator can also be installed using the “Help->Software Updates->Find and Install” option in CCSv4. Detailed instructions to set up the configuration can be found in netra_sim_user_guide.pdf present in <CCSv4 Installation Dir>\ simulation_netra\docs\user_guide directory.

Install CG Tools version 4.5.1 for ARM (TMS470) at the following location in your system: <CCSv4_InstallFolder>\ccsv4\tools\compiler\tms470. CGTools 4.5.1 can be downloaded from

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

Please note that CG Tools 4.5.1 is installed at the location mentioned above along with the CCS v4 installation by default. But, as some problems have been reported about this, we recommend that you install CG Tools 4.5.1 again with the installer obtained from the above link

Set environment variable CG_TOOL_DIR to <cgtools_install_dir>.

<CG_TOOL_DIR>/bin should contain all required code generation tools executables.

Set environment variables HDVICP2_INSTALL_DIR and CSP_INSTALL_DIR to the locations where the HDVICP20 API library and IVAHD CSL are present. The HDVICP20 API library and the IVAHD CSL can be downloaded from the same place as the codec package. The HDVICP20 API .lib files should be present at HDVICP2_INSTALL_DIR/lib and HDVICP20 API interface header files at HDVICP2_INSTALL_DIR/inc. The folders csl_ivahd and csl_soc of IVAHD CSL should be present at CSP_INSTALL_DIR/.

This version of the codec has been validated with HDVICP2.0 API library version 01.00.00.22 and HDVICP2.0 CSL Version 00.05.02.

Set the system environment variable TI_DIR to the CCSv4 installation path. Example: TI_DIR = <CCSv4 Installation Dir>\ccsv4.

Add gmake (GNU Make version 3.78.1) utility folder path (for example, “C:\CCStudioV4.0\ccsv4\utils\gmake”) at the beginning of the PATH environment variable.

The version of the XDC tools required is 3.20.04.68 GA.

2.3.1 Installing Framework Component (FC)

You can download FC from the TI website:

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

Extract the FC zip file to the some location and set the system environment variable FC_INSTALL_DIR to this path. For example: if the zip file was extracted to C:\CCSv4\, set FC_INSTALL_DIR as C:\CCSv4\ framework_components_3_20_00_22.

The test application uses the following IRES and XDM files:

- HDVICP related IRES header files, these are available in the FC_INSTALL_DIR\packages\ti\sdo\fc\ires\hdvicp directory.
- Tiled memory related Header file, these are available in the FC_INSTALL_DIR\fctools\packages\ti\sdo\fc\ires\tiledmemory directory.
- XDM related header files, these are available in the FC_INSTALL_DIR\fctools\packages\ti\xdais directory

2.4 Building and Running the Sample Test Application

2.4.1 Building the Sample Test Application

This library release of VC1 Decoder on HDVICP2.0 and M3-based platform contains the following project.

Project	Make file Path	Output Files
Test Application	\client\build\TestAppOmap4\make\	\client\build\TestAppOmap4\out \vc1vdec_ti_host_testapp.out

Verify that the following codec object libraries exist in \lib sub-directory:
vc1vdec_ti_host_M3.lib: VC1 decoder library for Ducati

make file in the project can be built using the following commands.

- gmake –k –s deps
- gmake –k –s all

Use the following command to clean previous builds.

- gmake –k –s clean

2.4.2 Running the Sample Test Application on OMAP4 ES1.0

The sample test application that accompanies this codec component will run in TI's Code Composer Studio development environment. To run the sample test application on OMAP4 ES1.0, follow these steps:

- Start Code Composer Studio v4 and set up the target configuration for OMAP4 ES1.0 Emulator.
- Select the Debug perspective in the workbench. Launch OMAP4 ES1.0 Emulator in CCSv4.

- Select CortexA9_0 device, right click and choose “Connect Target” and wait for emulator to connect to CortexA9 and execute the GEL file (omap4430 startup sequence).
- Select Cortex_M3_0 device, right click and choose “Connect Target” and wait for emulator to connect to CortexM3.
- Select Cortex_M3_0 device and **Target > Load Program**, browse to the \client\build\TestAppOmap4\out\ sub-directory, select the codec executable “vc1vdec_ti_host_testapp.out” and load it in preparation for execution.
- Select **Target > Run** to execute the application for Cortex_M3_0 device.
- Test application will take input streams from \client\test\testvecs\input\ directory and generates outputs in \client\test\testvecs\output\ directory. Configuration Files

> **Note:**
>
> Order of connecting to the devices is important and it should be as mentioned in above steps.

2.4.3 Running the Sample Test Application on OMAP4 IVAHD Simulator

The sample test application that accompanies this codec component will run in TI’s Code Composer Studio development environment. To run the sample test application on IVAHD Simulator, follow these steps:

- Ensure that you have installed IVAHD Simulator version 5.0.16.
- Start Code Composer Studio v4 and set up the target configuration for OMAP4 IVAHD Simulator.
- Select the Debug perspective in the workbench. Launch OMAP4 IVAHD Simulator in CCSv4.
- Select CORTEX_M3_APP device and Target > Load Program, browse to the \client\build\TestApp Omap4\out\ sub-directory, select the codec executable “vc1vdec_ti_host_testapp.out” and load it into Code Composer Studio in preparation for execution.
- Select ICONT1 device and Target > **Run** to give iCont1 device a free run.
- Select ICONT2 device and Target > **Run** to give iCont2 device a free run.
- Select CORTEX_M3_APP device and select **Target > Run** to execute the application.
- Test application will take input streams from \client\test\testvecs\input\ directory and generates outputs in \client\test\testvecs\output\ directory.

2.5 Configuration Files

This codec is shipped along with:

- Generic configuration file (testvecs.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.

2.5.1 Generic Configuration File

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

The format of the testvecs.cfg file is:

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

where:

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

```
1
..\..\..\test\testvecs\config\testparams.cfg
..\..\..\test\testvecs\input\foreman_176x144.rcv
..\..\..\test\testvecs\reference\foreman_176x144.txt
0
..\..\..\test\testvecs\config\testparams.cfg
..\..\..\test\testvecs\input\foreman_176x144.rcv
..\..\..\test\testvecs\output\foreman_176x144.yuv
```

In compliance mode of operation, the decoder compared the reference and the generated output and declares Passes/Failed message. If output dump mode is selected(X set to 0), then the decoder dumps the output to the specified file.

Note:

Compliance test will not work for Interlaced test cases

2.5.2 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 is as shown:

```
# New Input File Format is as follows
# <ParameterName> = <ParameterValue> # Comment
#

###############################################################
##############################
# Parameters
###############################################################
##############################
ImageWidth                  = 1920    # Image width in Pels,
must be multiple of 16
ImageHeight                 = 1088    # Image height in Pels,
must be multiple of 16
FramesToDecode               = 500    # Number of frames to be
decoded
DumpFrom                     = 0       # Start dumping from
this frame.
isTiler                      = 0     # 1-> ENable Tiler Memory
Usage for Output Buffers, 0-> Use RAW memory.

debugTraceLevel         = 0       # 0,1,2,3,4 are the Valid
Trace Levels.
lastNFramesToLog        = 0       # 0 to 10 are the Valid
Values.
metaDataEnable          = 1       # 0 -> (Default) 1->
Parsed MetaData
metaDataType            = 0       # -1 -> (Default) 0->
Parse MB Info
```

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

Note:

ChromaFormat supported in this codec is 420 semi-planar, that is, the chroma planes (Cb and Cr) are interleaved.

2.6 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.

Topic	Page

3.1 Overview of the Test Application

The test application exercises the `IVIDDEC3` base class of the VC1 Decoder library. The main test application files are vc1vdec_ti_host_testapp.c and vc1vdec_ti_ires_app.c. These files are available in the \client\test\src directory.

Figure 3-1 depicts the sequence of APIs exercised in the sample test application. Currently, the test application does not use RMAN resource manager. However, all the resource allocations happens through IRES interfaces.

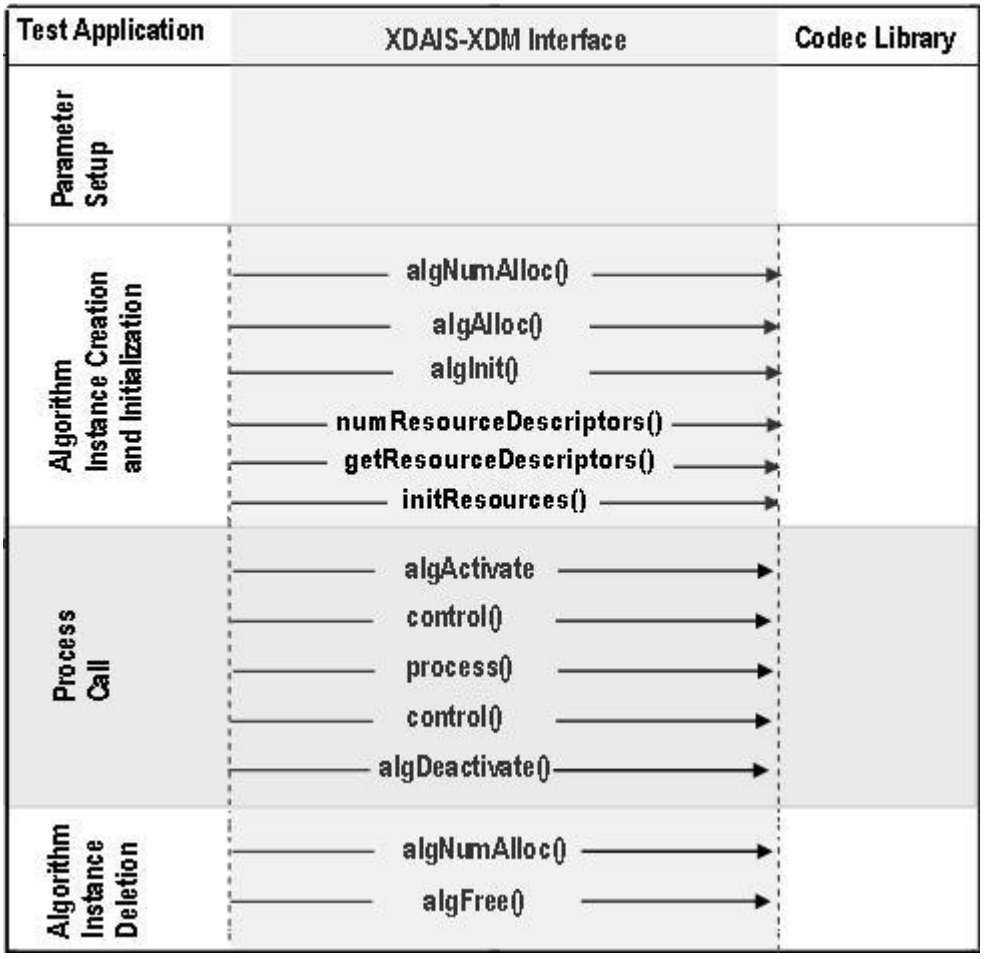


Figure 3-1. Test Application Sample Implementation

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:

- Opens the generic configuration file, Testvecs.cfg and reads the compliance checking parameter, Decoder configuration file name (Testparams.cfg), input file name, and output/reference file name.
- Opens the Decoer configuration file, (Testparams.cfg) and reads the various configuration parameters required for the algorithm. For more details on the configuration files, see Section 2.5.
- Sets the `IVIDDEC3_Params` structure based on the values it reads from the Testparams.cfg file.
- Reads the input bit-stream into the application input buffer.

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

3.1.2 Algorithm Instance Creation and Initialization

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

- `algNumAlloc()` - To query the algorithm about the number of memory records it requires.
- `algAlloc()` - To query the algorithm about the memory requirement to be filled in the memory records.
- `algInit()` - To initialize the algorithm with the memory structures provided by the application.

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

Note:

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

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

- `numResourceDescriptors()` - To understand the number of resources (HDVICP and buffers) needed by algorithm.
- `getResourceDescriptors()` – To get the attributes of the resources.
- `initResources()` - After resources are created, application gives the resources to algorithm through this API.

3.1.3 Process Call

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

- Sets the dynamic parameters (if they change during run-time) by calling the `control()` function with the `XDM_SETPARAMS` command.
- Sets the input and output buffer descriptors required for the `process()` function call. The input and output buffer descriptors are obtained by calling the `control()` function with the `XDM_GETBUFINFO` command.
- Implements the process call based on the non-blocking mode of operation explained in step 4. The behavior of the algorithm can be controlled using various dynamic parameters (see Section 4.2.1.8). The inputs to the `process()` functions are input and output buffer descriptors, pointer to the `IVIDDEC3_InArgs` and `IVIDDEC3_OutArgs` structures.
- On the call to the `process()` function for encoding/decoding a single frame of data, the software triggers the start of encode/decode. After triggering the start of the encode/decode frame, the video task can be put to `SEM-pend` state using semaphores. On receipt of interrupt signal at the end of frame encode/decode, the application releases the semaphore and resume the video task, which does any book-keeping operations by the codec and updates the output parameter of `IVIDDEC3_OutArgs` structure.

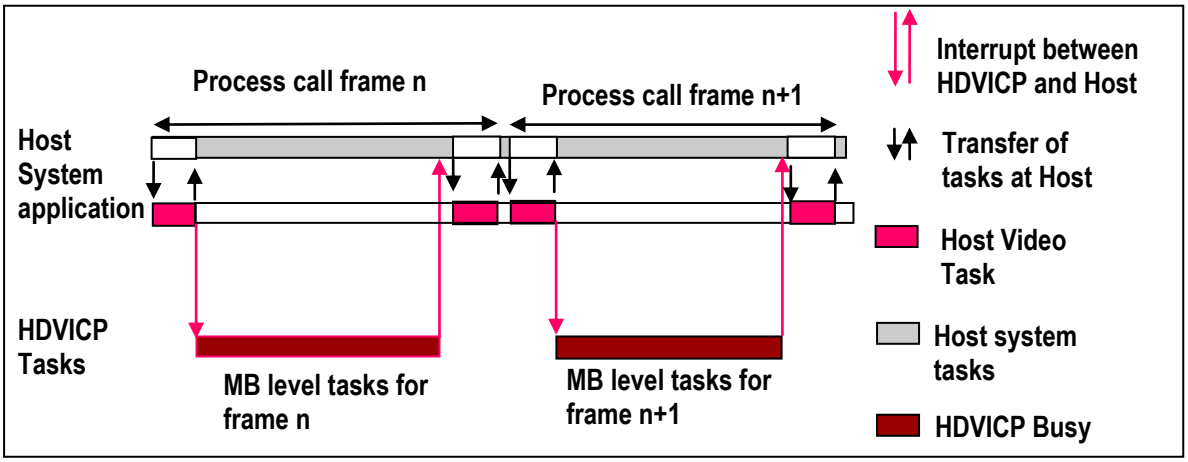


Figure 3-2. Process call with Host release

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

- `algActivate()` - To activate the algorithm instance.
- `control()` (optional) - To query the algorithm on status or setting of dynamic parameters and so on, using the six available control commands.
- `process()` - To call the Decoder with appropriate input/output buffer and arguments information.
- `control()` (optional) - To query the algorithm on status or setting of dynamic parameters and so on, using the six available control commands.
- `algDeactivate()` - To deactivate the algorithm instance.

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

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

3.1.4 Algorithm Instance Deletion

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

- `numResourceDescriptors()` - To get the number of resources and free them. If the application needs handles to the resources, it can call `getResourceDescriptors()`.
- `algNumAlloc()` - To query the algorithm about the number of memory records it used.
- `algFree()` - To query the algorithm for memory, to free when removing an instance.

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

3.2 Frame Buffer Management by Application

3.2.1 Frame Buffer Input and Output

With the new XDM IVIDDEC3 class, 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.

```
                    VC1VDEC_create();

                    VC1VDEC_control(XDM_GETBUFINFO); /*
                    Returns default PAL D1 size */

                    do{

                    VC1VDEC_decode(); //call the decode
                    API

                    VC1VDEC_control(XDM_GETBUFINFO); /*
                    updates the memory required as per
                    the size parsed in stream header */

                    }
while(all frames)
```

Note:

- Application can take the information retured by the control function with the `XDM_GETBUFINFO` command and change the size of the buffer passed in the next process call.
- Application can re-use the extra buffer space of the 1st frame, if

the above control call returns a small size than that was provided.

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

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

Note:

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

3.2.2 Frame Buffer Format

The frame buffer format to be used for both progressive and interlaced pictures is as explained in the following document available in the release package.

\IVAHD_001\docs\IVAHD_Picture_Format.pdf

3.2.3 Frame Buffer Management by Application

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

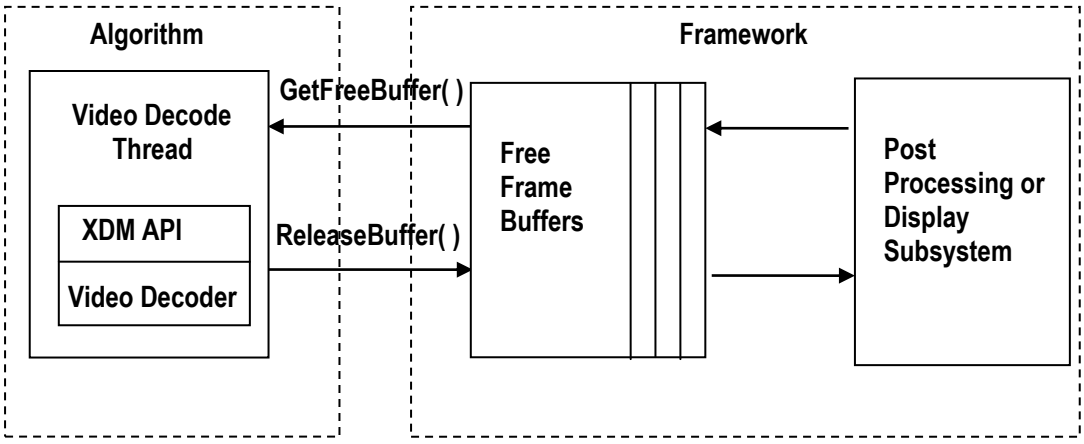


Figure 3-3. Interaction of Frame Buffers Between Application and Framework

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

- BUFFMGR_Init() – BUFFMGR_Init function is called by the test application to initialize the global buffer element array to default and to allocate the required number of memory data for reference and output buffers. The maximum required DPB size is defined by the supported profile and level.
- BUFFMGR_ReInit() - BUFFMGR_ReInit function allocates global luma and chroma buffers and allocates entire space to the first element. This element will be used in the first frame decode. After the picture height and width and its luma and chroma buffer requirements are obtained, the global luma and chroma buffers are re-initialized to other elements in the buffer array.
- BUFFMGR_GetFreeBuffer() - BUFFMGR_GetFreeBuffer function searches for a free buffer in the global buffer array and returns the address of that element. Incase none of the elements are free, then it returns NULL.
- BUFFMGR_ReleaseBuffer() - BUFFMGR_ReleaseBuffer function takes an array of buffer-IDs which are released by the test application. 0 is not a valid buffer ID, hence this function moves until it encounters a buffer ID as zero or it hits the MAX_BUFF_ELEMENTS.
- BUFFMGR_DeInit()- BUFFMGR_DeInit function releases all memory allocated by buffer manager.

3.3 Handshaking Between Application and Algorithm

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

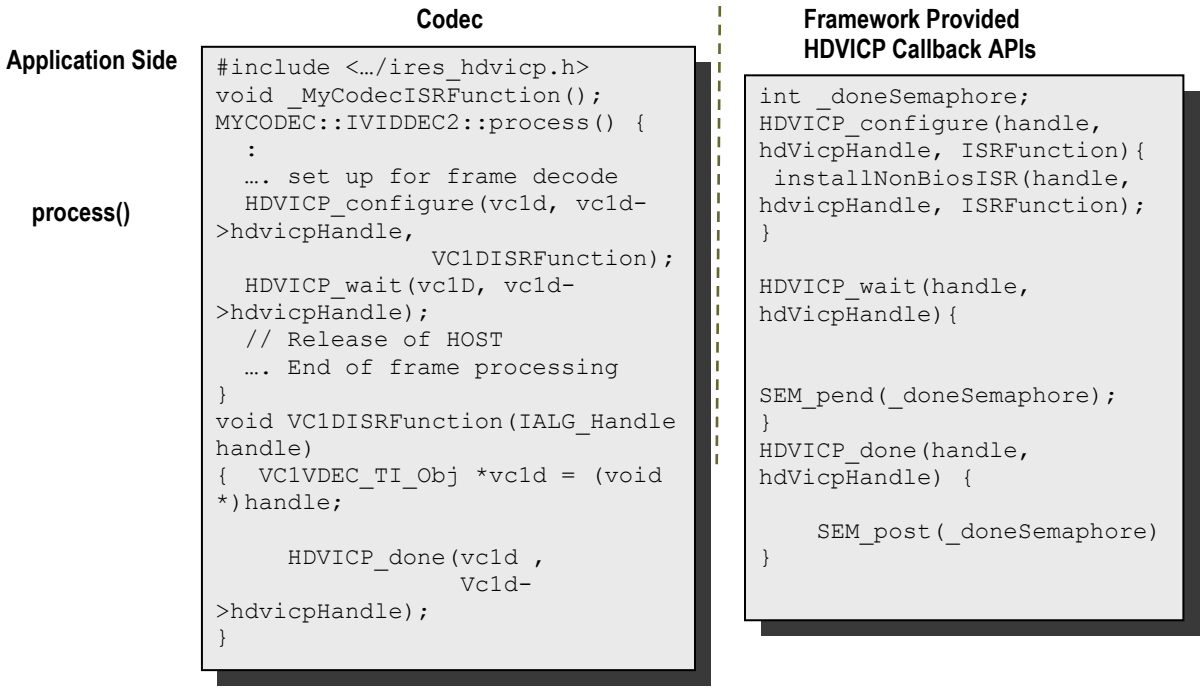


Figure 3-4. Interaction Between Application and Codec

Note:

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

The functions to be implemented by the application are:

- `HDVICP_configure(IALG_Handle handle, void *hdvicpHandle, void (*ISRfunctionptr)(IALG_Handle handle))`

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

- `HDVICP_wait (void *hdvicpHandle)`

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

- `HDVICP_done (void *hdvicpHandle)`

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

3.4 Address Translations

The buffers addresses(DDR addresses) as seen by Ducati(Cortex-M3) and IVA-HD(VDMA) will be different. Hence, address translations are needed to convert from one address view to another. The application needs to implement a MEMUTILS function for this address translation (which will be later implemented by the framework components). An example of the address translation function is as shown. The codec will make a call to this function from the host (cortex-M3) library. Therefore, the function name and arguments should follow the example provided below. For a given input address, this function returns the VDMA view of the buffer (that is, address as seen by IVAHD).

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

Sample settings for the macro `VDMAVIEW_EXTMEM` is as shown.

```
 #if defined(HOSTARM968_FPGA)
    #define VDMAVIEW_EXTMEM (0x07FFFFFF)
 #elif defined(HOSTCORTEXM3_OMAP4)
    #define VDMAVIEW_EXTMEM (0xFFFFFFFF)
 #elif defined(HOSTCORTEXM3_GAIA)
    #define VDMAVIEW_EXTMEM (0x1FFFFFFF)
 #else
    #define VDMAVIEW_EXTMEM (0x07FFFFFF)
 #endif
```

3.5 Sample Test Application

The test application exercises the `IVC1VDEC` extended class of the VC1 Decoder.

Table 3-1. Process ( ) Implementation

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

        BUFFMGR_Init();

        TestApp_SetInitParams(&params.viddecParams);

        RMAN_AssignResources(&hdvicpObj);

/*---------------- Decoder creation -----------------*/

       handle = (IALG_Handle) VC1VDEC_create();

/* Get Buffer information */

       VC1VDEC_control(handle, XDM_GETBUFINFO);

/* Do-While Loop for Decode Call  for a given stream */

    do{

/* Read the bitstream in the Application Input Buffer*/

        validBytes = ReadByteStream(inFile);

/* Get free buffer from buffer pool */

        buffEle = BUFFMGR_GetFreeBuffer();

/* Optional: Set Run-time parameters in the Algorithm
via control() */

        VC1VDEC_control(handle, XDM_SETPARAMS);

/* Start the process : To start decoding a frame*/

/* This will always follow a VC1VDEC_decode_end call */

        retVal = VC1VDEC_decode(handle,(XDM1_BufDesc
*)&inputBufDesc,(XDM_BufDesc *)&outputBufDesc,
(IVIDDEC1_InArgs *)&inArgs,(IVIDDEC1_OutArgs *)&outArgs
         );

/* Get the statatus of the decoder using comtrol */

        VC1VDEC_control(handle, IVC1VDEC_GETSTATUS);

/* Get Buffer information: */

        VC1VDEC_control(handle, XDM_GETBUFINFO);

/* Optional: Reinit the buffer manager in case the

/* frame size is different*/

        BUFFMGR_ReInit();

/* Always release buffers - which are released from

/* the algorithm side -back to the buffer manager*/
```

```
        BUFFMGR_ReleaseBuffer((XDAS_UInt32
*)outArgs.freeBufID);

}while(1);

/* end of Do-While loop - which decodes frames */

/* Reset the decode process. Bring the decoder to */

/* the state where decode process can start afresh */

        VC1VDEC_control(handle, XDM_RESET);

        ALG_delete (handle);

        BUFFMGR_DeInit();
```

Note:

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

Chapter 4

API Reference

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

Topic **Page**

4.1 Symbolic Constants and Enumerated Data Types

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.

Table 4-1. List of Enumerated Data Types

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IVIDEO_FrameType	IVIDEO_NA_FRAME	Frame type not available
	IVIDEO_I_FRAME	Intra coded frame
	IVIDEO_P_FRAME	Forward inter coded frame
	IVIDEO_B_FRAME	Bi-directional inter coded frame
	IVIDEO_IDR_FRAME	Intra coded frame that can be used for refreshing video content
	IVIDEO_II_FRAME	Interlaced Frame, both fields are I frames
	IVIDEO_IP_FRAME	Interlaced Frame, first field is an I frame, second field is a P frame
	IVIDEO_IB_FRAME	Interlaced Frame, first field is an I frame, second field is a B frame
	IVIDEO_PI_FRAME	Interlaced Frame, first field is a P frame, second field is a I frame
	IVIDEO_PP_FRAME	Interlaced Frame, both fields are P frames
	IVIDEO_PB_FRAME	Interlaced Frame, first field is a P frame, second field is a B frame
	IVIDEO_BI_FRAME	Interlaced Frame, first field is a B frame, second field is an I frame.
	IVIDEO_BP_FRAME	Interlaced Frame, first field is a B frame, second field is a P frame
	IVIDEO_BB_FRAME	Interlaced Frame, both fields are B frames
	IVIDEO_MBAFF_I_FRAME	Intra coded MBAFF frame
	IVIDEO_MBAFF_P_FRAME	Forward inter coded MBAFF frame
	IVIDEO_MBAFF_B_FRAME	Bi-directional inter coded MBAFF frame

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_MBAFF_IDR_FRAME	Intra coded MBAFF frame that can be used for refreshing video content.
	IVIDEO_FRAMETYPE_DEFAULT	Default set to IVIDEO_I_FRAME
IVIDEO_ContentType	IVIDEO_CONTENTTYPE_NA	Content type is not applicable
	IVIDEO_PROGRESSIVE IVIDEO_PROGRESSIVE_FRAME	Progressive video content
	IVIDEO_INTERLACED IVIDEO_INTERLACED_FRAME	Interlaced video content
	IVIDEO_INTERLACED_TOPFIELD	Interlaced video content, Top field
	IVIDEO_INTERLACED_TOPFIELD	Interlaced video content, Bottom field
	IVIDEO_CONTENTTYPE_DEFAULT	Default set to IVIDEO_PROGRESSIVE
IVIDEO_FrameSkip	IVIDEO_NO_SKIP	Do not skip the current frame. Default Value Not supported in this version of VC1 Decoder
	IVIDEO_SKIP_P	Skip forward inter coded frame. Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_B	Skip bi-directional inter coded frame. Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_I	Skip intra coded frame. Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_IP	Skip I and P frame/field(s) Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_IB	Skip I and B frame/field(s). Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_PB	Skip P and B frame/field(s). Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_IPB	Skip I/P/B/BI frames Not supported in this version of VC1 Decoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDEO_SKIP_IDR	Skip IDR Frame Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_NONREFERENCE	Skip non reference frame Not supported in this version of VC1 Decoder.
	IVIDEO_SKIP_DEFAULT	Default set to IVIDEO_NO_SKIP
IVIDEO_VideoLayout	IVIDEO_FIELD_INTERLEAVED	Buffer layout is interleaved.
	IVIDEO_FIELD_SEPARATED	Buffer layout is field separated.
	IVIDEO_TOP_ONLY	Buffer contains only top field.
	IVIDEO_BOTTOM_ONLY	Buffer contains only bottom field
IVIDEO_OperatingMode	IVIDEO_DECODE_ONLY	Decoding Mode
	IVIDEO_ENCODE_ONLY	Encoding Mode
	IVIDEO_TRANSCODE_FRAMELEVEL	Transcode Mode of operation (encode/decode), which consumes /generates transcode information at the frame level.
	IVIDEO_TRANSCODE_MBLEVEL	Transcode Mode of operation (encode/decode), which consumes /generates transcode information at the MB level. Not supported in this version of VC1 Decoder
	IVIDEO_TRANSRATE_FRAMELEVEL	Transrate Mode of operation for encoder, which consumes transrate information at the frame level. Not supported in this version of VC1 Decoder
	IVIDEO_TRANSRATE_MBLEVEL	Transrate Mode of operation for encoder, which consumes transrate information at the MB level. Not supported in this version of VC1 Decoder
IVIDEO_OutputFrameStatus	IVIDEO_FRAME_NOERROR	Output buffer is available.
	IVIDEO_FRAME_NOTAVAILABLE	Codec does not have any output buffers.
	IVIDEO_FRAME_ERROR	Output buffer is available and corrupted.
	IVIDEO_OUTPUTFRAMESTATUS_DEFAULT	Default set to IVIDEO_FRAME_NOERROR

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IVIDEO_PictureType	IVIDEO_NA_PICTURE	Frame type not available
	IVIDEO_I_PICTURE	Intra coded picture
	IVIDEO_P_PICTURE	Forward inter coded picture
	IVIDEO_B_PICTURE	Bi-directional inter coded picture
IVIDEO_DataMode	IVIDEO_FIXEDLENGTH	Input to the decoder is in multiples of a fixed length (example, 4K) (input side for decoder)
	IVIDEO_SLICEMODE	Slice mode of operation (Input side for decoder). Not supported in this version of VC1 Decoder.
	IVIDEO_NUMROWS	Number of rows, each row is 16 lines of video (output side for decoder). Not supported in this version of VC1 Decoder.
	IVIDEO_ENTIREFRAME	Processing of entire frame data
IVIDEO_DataMode	IVIDEO_DECODE_ONLY	Decoding mode.
	IVIDEO_ENCODE_ONLY	Encoding mode.
	IVIDEO_TRANSCODE_FRAMELEVEL	Transcode mode of operation encode/decode) which consumes/generates transcode information at the frame level. Not supported in this version of VC1 Decoder.
	IVIDEO_TRANSRATE_FRAMELEVEL	Transcode mode of operation encode/decode) which consumes/generates transcode information at the MB level. Not supported in this version of VC1 Decoder.
	IVIDEO_TRANSRATE_MBLEVEL	Transrate mode of operation encode/decode) which consumes/generates transcode information at the Frame level. Not supported in this version of VC1 Decoder.
	IVIDEO_TRANSCODE_MBLEVEL	Transrate mode of operation encode/decode) which consumes/generates transcode information at the MB level. Not supported in this version of VC1 Decoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
IVIDDEC3_displayDelay	IVIDDEC3_DISPLAY_DELAY_AUTO	Decoder decides the display delay
	IVIDDEC3_DECODE_ORDER	Display frames are in decoded order without delay Other than IVIDDEC3_DECODE_ORDER and IVIDDEC3_DISPLAY_DELAY_AUTO are not supported in this version of VC1 decoder.
	IVIDDEC3_DISPLAY_DELAY_1	Display the frames with 1 frame delay
	IVIDDEC3_DISPLAY_DELAY_2	Display the frames with 2 frame delay
	IVIDDEC3_DISPLAY_DELAY_3	Display the frames with 3 frame delay
	IVIDDEC3_DISPLAY_DELAY_4	Display the frames with 4 frame delay
	IVIDDEC3_DISPLAY_DELAY_5	Display the frames with 5 frame delay
	IVIDDEC3_DISPLAY_DELAY_6	Display the frames with 6 frame delay
	IVIDDEC3_DISPLAY_DELAY_7	Display the frames with 7 frame delay
	IVIDDEC3_DISPLAY_DELAY_8	Display the frames with 8 frame delay
	IVIDDEC3_DISPLAY_DELAY_9	Display the frames with 9 frame delay
	IVIDDEC3_DISPLAY_DELAY_10	Display the frames with 10 frame delay
	IVIDDEC3_DISPLAY_DELAY_11	Display the frames with 11 frame delay
	IVIDDEC3_DISPLAY_DELAY_12	Display the frames with 12 frame delay
	IVIDDEC3_DISPLAY_DELAY_13	Display the frames with 13 frame delay
	IVIDDEC3_DISPLAY_DELAY_14	Display the frames with 14 frame delay
	IVIDDEC3_DISPLAY_DELAY_15	Display the frames with 15 frame delay

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	IVIDDEC3_DISPLAY_DELAY_16	Display the frames with 16 frame delay
	IVIDDEC3_DISPLAYDELAY_DEFAULT	Same as IVIDDEC3_DISPLAY_DELAY_AUTO
XDM_DataFormat	XDM_BYTE	Big endian stream (default value)
	XDM_LE_16	16-bit little endian stream. Not supported in this version of VC1 Decoder.
	XDM_LE_32	32-bit little endian stream. Not supported in this version of VC1 Decoder.
	XDM_LE_64	64-bit little endian stream. Not supported in this version of VC1 Decoder.
	XDM_BE_16	16-bit big endian stream. Not supported in this version of VC1 Decoder.
	XDM_BE_32	32-bit big endian stream. Not supported in this version of VC1 Decoder.
	XDM_BE_64	64-bit big endian stream. Not supported in this version of VC1 Decoder.
XDM_ChromaFormat	XDM_YUV_420P	YUV 4:2:0 planar. Not supported in this version of VC1 Decoder.
	XDM_YUV_422P	YUV 4:2:2 planar. Not supported in this version of VC1 Decoder.
	XDM_YUV_422IBE	YUV 4:2:2 interleaved (big endian). Not supported in this version of VC1 Decoder.
	XDM_YUV_422ILE	YUV 4:2:2 interleaved (little endian) (default value). Not supported in this version of VC1 Decoder.
	XDM_YUV_444P	YUV 4:4:4 planar. Not supported in this version of VC1 Decoder.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_YUV_411P	YUV 4:1:1 planar. Not supported in this version of VC1 Decoder.
	XDM_GRAY	Gray format. Not supported in this version of VC1 Decoder.
	XDM_RGB	RGB color format. Not supported in this version of VC1 Decoder.
	XDM_YUV_420SP	YUV 4:2:0 chroma semi-planar
	XDM_ARGB8888	ARGB8888 color format. Not supported in this version of VC1 Decoder.
	XDM_RGB555	RGB555 color format. Not supported in this version of VC1 Decoder.
	XDM_RGB565	RGB565 color format. Not supported in this version of VC1 Decoder.
	XDM_YUV_444ILE	YUV 4:4:4 interleaved (little endian) color format. Not supported in this version of VC1 Decoder.
XDM_MemoryType	XDM_MEMTYPE_ROW	Raw Memory Type
	XDM_MEMTYPE_TILED8	2D memory in 8-bit container of tiled memory space
	XDM_MEMTYPE_TILED16	2D memory in 16-bit container of tiled memory space
	XDM_MEMTYPE_TILED32	2D memory in 32-bit container of tiled memory space
	XDM_MEMTYPE_TILEDPAGE	2D memory in page container of tiled memory space
XDM_CmdId	XDM_GETSTATUS	Query algorithm instance to fill `Status` structure
	XDM_SETPARAMS	Set run-time dynamic parameters via the `DynamicParams` structure
	XDM_RESET	Reset the algorithm.

Group or Enumeration Class	Symbolic Constant Name	Description or Evaluation
	XDM_SETDEFAULT	Initialize all fields in Params structure to default values specified in the library.
	XDM_FLUSH	Handle end of stream conditions. This command forces algorithm instance to output data without additional input.
	XDM_GETBUFINFO	Query algorithm instance regarding the properties of input and output buffers
	XDM_GETVERSION	Query the algorithm's version. The result will be returned in the @ data field of the Status structure The application should provide a buffer of minimum size of 200 bytes to hold the version information. The buffer will be provided to codec through data field as mentioned above.
	XDM_GETDYNPARAMSDEFAULT	Query algorithm instance regarding the dynamic parameters default values
XDM_AccessMode	XDM_ACCESSMODE_READ	The algorithm read from the buffer using the CPU.
	XDM_ACCESSMODE_WRITE	The algorithm wrote from the buffer using the CPU
IVC1VDEC_mbErrStatus	IVC1VDEC_MB_NOERROR	This indicates that the current MB is not erroneous.
	IVC1VDEC_MB_ERROR	This indicates that the current MB is erroneous.

4.2 Data Structures

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

4.2.1 Common XDM Data Structures

This section includes the following common XDM data structures:

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

4.2.1.1 XDM2_SingleBufDesc

Description

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

Fields

Field	Data Type	Input/ Output	Description
*buf	XDAS_Int8	Input	Pointer to the buffer
memType	XDAS_Int32	Input	Type of memory. See XDM_MemoryType enumeration for more details.
bufSize	XDM2_BufSize	Input	Size of the buffer(for tile memory/row memory)
accessMask	XDAS_Int32	Output	If the buffer was not accessed by the algorithm processor (for example, it was filled by DMA or other hardware accelerator that does not write through the algorithm CPU), then bits in this mask should not be set.

4.2.1.2 XDM2_BufSize

‖ Description

This defines the union describing a buffer size.

‖ Fields

Field	Data Type	Input/ Output	Description
width	XDAS_Int32	Input	Width of buffer in 8-bit bytes. Required only for tile memory.
height	XDAS_Int32	Input	Height of buffer in 8-bit bytes. Required only for tile memory.
bytes	XDM2_BufSize	Input	Size of the buffer in bytes

4.2.1.3 XDM2_BufDesc

‖ Description

This structure defines the buffer descriptor for output buffers.

‖ Fields

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

4.2.1.4 XDM1_AlgBufInfo

‖ Description

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

‖ Fields

Field	Data Type	Input/ Output	Description
minNumInBufs	XDAS_Int32	Output	Number of input buffers
minNumOutBufs	XDAS_Int32	Output	Number of output buffers
minInBufSize[XDM_MAX_IO_BUFFERS]	XDM2_BufSize	Output	Size required for each input buffer

Field	Data Type	Input/ Output	Description
minOutBufSize[XDM_MAX_IO_BUFFERS]	XDM2_BufSize	Output	Size required for each output buffer
inBufMemoryType[XDM_MAX_IO_BUFFERS]	XDAS_Int32	Output	Memory type for each input buffer
outBufMemoryType[XDM_MAX_IO_BUFFERS]	XDAS_Int32	Output	Memory type for each output buffer
minNumBufSets	XDAS_Int32	Output	Minimum number of buffer sets for buffer management

Note:

For VC1 Advanced Profile Decoder, the buffer details are:

- Number of input buffer required is 1.
- Number of output buffer required is 2 for YUV420 SP.
- For frame mode of operation, 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 SP:
Y buffer = (((1920+ 2*PAD_LUMA_X +127)>>7)<<7) * (1088 + 2*PAD_LUMA_Y)
UV buffer = (((1920+ 2*PAD_CHROMA_X +127)>>7)<<7) * (544 + 4*PAD_CHROMA_Y)

Where,

PAD_LUMA_X = 32

PAD_LUMA_Y = 40

PAD_CHROMA_X = 32

PAD_CHROMA_Y = 20

These are the maximum buffer sizes but they can be reconfigured depending on the format of the bit-stream.

4.2.1.5 IVIDEO2_BufDesc

‖ Description

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

‖ Fields

Field	Data Type	Input/ Output	Description
numPlanes	XDAS_Int32	Input/Output	Number of buffers for video planes
numMetaPlanes	XDAS_Int32	Input/Output	Number of buffers for Metadata
dataLayout	XDAS_Int32	Input/O	Video buffer layout. See

Field	Data Type	Input/ Output	Description
		utput	IVIDEO_VideoLayout enumeration for more details
planeDesc [IVIDEO_MAX_NUM_PLANES]	XDM1_SingleBufDesc	Input/Output	Description for video planes
metadataPlaneDesc [IVIDEO_MAX_NUM_METADATA_PLANES]	XDM1_SingleBufDesc	Input/Output	Description for metadata planes
secondFieldOffsetWidth[IVIDEO_MAX_NUM_PLANES]	XDAS_Int32	Input/Output	Offset value for second field in planeDesc buffer (width in pixels)
secondFieldOffsetHeight[IVIDEO_MAX_NUM_PLANES]	XDAS_Int32	Input/Output	Offset value for second field in planeDesc buffer (height in lines)
imagePitch	XDAS_Int32	Input/Output	Image pitch, common for all planes
imageRegion	XDM_Rect	Input/Output	Decoded image region including padding /encoder input image
activeFrameRegion	XDM_Rect	Input/Output	Actual display region/capture region
extendedError	XDAS_Int32	Input/Output	Provision for informing the error type if any
frameType	XDAS_Int32	Input/Output	Video frame types. See enumeration IVIDEO_FrameType. Not applicable for encoders
topFieldFirstFlag	XDAS_Int32	Input/Output	Indicates when the application (should display)/(had captured) the top field first. Not applicable for progressive content.
repeatFirstFieldFlag	XDAS_Int32	Input/Output	Indicates when the first field should be repeated. Not applicable for encoders.
frameStatus	XDAS_Int32	Input/Output	Video in/out buffer status. Not applicable for encoders.
repeatFrame	XDAS_Int32	Input/Output	Number of times to repeat the displayed frame. Not applicable for encoders.
contentType	XDAS_Int32	Input/Output	Video content type. See IVIDEO_ContentType
chromaFormat	XDAS_Int32	Input/Output	Chroma format for encoder input data/decoded output buffer. See

Field	Data Type	Input/ Output	Description
			XDM_ChromaFormat enumeration for details.
scalingWidth	XDAS_Int32	Input/Output	Scaled image width for post processing for decoder. This field is updated when scaling parameters are present in the bit-stream
scalingHeight	XDAS_Int32	Input/Output	Scaled image height for post processing for decoder. This field is updated when scaling parameters are present in the bit-stream.
rangeMappingLuma	XDAS_Int32	Input/Output	The process of rescaling decoded pixels is called range mapping. The Luma scale factor for range mapping is indicated by this field. This field takes the value from 0 to 7.
rangeMappingChroma	XDAS_Int32	Input/Output	The process of rescaling decoded pixels is called range mapping. The chroma scale factor for range mapping is indicated by this field. This field takes the value from 0 to 7.
enableRangeReductionFlag	XDAS_Int32	Input/Output	This flag indicates that the decoded pixel values are scaled by a scaling factor indicated by rangeMappingLuma & rangeMappingChroma. This information can be used by the application for post processing. This flag is updated only for advanced profile streams.

Note:

IVIDEO_MAX_NUM_PLANES:

- Max YUV buffers - one each for Y, U, and V.
- Metaplane data is not given out in this version of the codec.
- The following parameters are not supported/updated in this version of the decoder
  - repeatFrame
- The Range mapping for luma and chroma should be done by the application, using the below formulae.

```
Y[n] = CLIP ((((Y[n] – 128) * (rangeMappingLuma + 9) + 4) >> 3) + 128);

Cb[n] = CLIP ((((Cb[n] – 128) * (rangeMappingChroma + 9) + 4) >> 3) + 128);

Cr[n] = CLIP ((((Cr[n] – 128) * (rangeMappingChroma + 9) + 4) >> 3) + 128);
```

  Where, Y[n] corresponds to every Luma pixel, Cb[n] and Cr[n] correpond to every choma pair.

4.2.1.6 IVIDDEC3_Fxns

Description

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

Fields

Field	Data Type	Input/ Output	Description
Ialg	IALG_Fxns	Input	Structure containing pointers to all the XDAIS interface functions. 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

4.2.1.7 IVIDDEC3_Params

Description

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

Fields

Field	Data Type	Input/ Output	Description
Size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
maxHeight	XDAS_Int32	Input	Maximum video height to be supported in pixels
maxWidth	XDAS_Int32	Input	Maximum video width to be supported in pixels
maxFrameRate	XDAS_Int32	Input	Maximum frame rate in fps * 1000 to be supported.
maxBitRate	XDAS_Int32	Input	Maximum bit-rate to be supported in bits per second. For example, if bit-rate is 10 Mbps, set this field to 10485760.
dataEndianness	XDAS_Int32	Input	Endianness of input data. See

Field	Data Type	Input/ Output	Description
			XDM_DataFormat enumeration for details.
forceChromaFormat	XDAS_Int32	Input	Sets the output to the specified format. Only 420 semi-planar format supported currently. See XDM_ChromaFormat and eChromaFormat_t enumerations for details.
operatingMode	XDAS_Int32	Input	Video coding mode of operation (encode/decode/transcode/transrate). Only decode mode is supported in this version.
displayDelay	XDAS_Int32	Input	Display delay to start display.
inputDataMode	XDAS_Int32	Input	Input mode of operation. For decoder, it is fixed length/slice mode/entire frame.
outputDataMode	XDAS_Int32	Input	Output mode of operation. For decoder, it is row mode/entire frame.
numInputDataUnits	XDAS_Int32	Input	Number of input slices/rows. For decoder, it is the number of slices or number of fixed length units.
numOutputDataUnits	XDAS_Int32	Input	Number of output slices/rows. For decoder, it is the number of rows of output.
errorInfoMode	XDAS_Int32	Input	Enable/disable packet error information for input/output
displayBufsMode	XDAS_Int32	Input	Indicates the displayBufs mode. This field can be set either as IVIDDEC3_DISPLAYBUFS_EMBEDDED or IVIDDEC3_DISPLAYBUFS_PTRS.

4.2.1.8 IVIDDEC3_DynamicParams

‖ Description

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

‖ Fields

Field	Data Type	Input/ Output	Description
`Size`	`XDAS_Int32`	Input	Size of the basic or extended (if being used) data structure in bytes.
`decodeHeader`	`XDAS_Int32`	Input	Number of access units to decode: ❑ 0 (`XDM_DECODE_AU`) - Decode entire frame including all the headers ❑ 1 (`XDM_PARSE_HEADER`) - Decode only one NAL unit (Not Supported)
`displayWidth`	`XDAS_Int32`	Input	If the field is set to: ❑ 0 - Uses decoded image width as pitch ❑ If any other value greater than the decoded image width is given, then this value in pixels is used as pitch.
`frameSkipMode`	`XDAS_Int32`	Input	Frame skip mode. See `IVIDEO_FrameSkip` enumeration for details.
`newFrameFlag`	`XDAS_Int32`	Input	Flag to indicate that the algorithm should start a new frame. 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.
`*putDataFxn`	`XDM_DataSyncPutFxn`	Input	`DataSync` call back function pointer for `putData`
`putDataHandle`	`XDM_DataSyncHandle`	Input	`DataSync` handle for `putData`
`*getDataFxn`	`XDM_DataSyncGetFxn`	Input	`DataSync` call back function pointer for `getData`
`getDataHandle`	`XDM_DataSyncHandle`	Input	`DataSync` handle for `getData`
`putBufferFxn`	`XDM_DataSyncPutBufferFxn`	Input	Function pointer provided to make a sub-frame level callback to request buffers.

Field	Data Type	Input/ Output	Description
putBufferHandle	XDM_DataSyncHandle	Input	This is a handle which the codec must provide when calling the app-registered IVIDDEC3_DynamicParam.putBufferFxn().
lateAcquireArg	XDAS_Int32	Input	Argument used during late acquire mode of IVAHD. If the codec supports late acquisition of resources,and the application has supplied a lateAcquireArg value (via #XDM_SETLATEACQUIREARG), then the codec must also provide this lateAcquireArg value when requesting resources (i.e. during their call to acquire() when requesting the resource).

4.2.1.9 IVIDDEC3_InArgs

‖ Description

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

‖ Fields

Field	Data Type	Input/ Output	Description
Size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
numBytes	XDAS_Int32	Input	Size of input data (in bytes) provided to the algorithm for decoding
inputID	XDAS_Int32	Input	Application passes this ID to algorithm and decoder will attach this ID to the corresponding output frames. This is useful in case of re-ordering (for example, B frames). If there is no re-ordering, outputID field in the IVIDDEC3_OutArgs data structure will be same as inputID field.

Note:

VC1 Decoder copies the inputID value to the outputID value of IVIDDEC3_OutArgs structure after factoring in the display delay.

4.2.1.10 IVIDDEC3_Status

‖ Description

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

‖ Fields

Field	Data Type	Input/ Output	Description
Size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
extendedError	XDAS_Int32	Output	Extended error code. See XDM_ErrorBit enumeration for details.
data	XDM1_SingleBufDesc	Output	Buffer information structure for information passing buffer.
maxNumDisplayBufs	XDAS_Int32	Output	Maximum number of buffers required by the codec.
maxOutArgsDisplayBufs	XDAS_Int32	Output	The maximum number of display buffers that can be returned through IVIDDEC3_OutArgs.displayBufs.
outputHeight	XDAS_Int32	Output	Output height in pixels
outputWidth	XDAS_Int32	Output	Output width in pixels
frameRate	XDAS_Int32	Output	Average frame rate in fps * 1000
bitRate	XDAS_Int32	Output	Average bit-rate in bits per second
contentType	XDAS_Int32	Output	Video content. See IVIDEO_ContentType enumeration for details.
sampleAspectRatioHeight	XDAS_Int32	Output	Sample aspect ratio for height
sampleAspectRatioWidth	XDAS_Int32	Output	Sample aspect ratio for width
bitRange	XDAS_Int32	Output	Bit range. It is set to IVIDEO_YUVRANGE_FULL.
forceChromaFormat	XDAS_Int32	Output	Output chroma format. See XDM_ChromaFormat and eChromaFormat_t enumeration for details.

Field	Data Type	Input/ Output	Description
operatingMode	XDAS_Int32	Output	Mode of operation: Encoder/Decoder/Transcode/Transrate. It is set to IVIDEO_DECODE_ONLY.
frameOrder	XDAS_Int32	Output	Indicates the output frame order. See IVIDDEC3_displayDelay enumeration for more details.
inputDataMode	XDAS_Int32	Output	Input mode of operation. For decoder, it is fixed length/slice mode/entire frame. This version of the decoder supports only the and entire frame mode.
outputDataMode	XDAS_Int32	Output	Output mode of operation. For decoder, it is the row mode/entire frame. This version of the decoder supports only the entire frame mode.
bufInfo	XDM_AlgBufInfo	Output	Input and output buffer information. See XDM_AlgBufInfo data structure for details.
decDynamicParams	IVIDDEC3_DynamicParams	Output	Current values of the decoder's dynamic parameters.

4.2.1.11 IVIDDEC3_OutArgs

Description

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

Fields

Field	Data Type	Input/ Output	Description
size	XDAS_Int32	Input	Size of the basic or extended (if being used) data structure in bytes.
extendedError	XDAS_Int32	Output	extendedError Field
bytesConsumed	XDAS_Int32	Output	Bytes consumed per decode call
outputID[IVIDEO2_MAX_IO_BUFFERS]	XDAS_Int32	Output	Output ID corresponding to displayBufs A value of zero (0) indicates an invalid ID. The first zero entry in array will indicate end of valid outputIDs within the array. Hence, the application

Field	Data Type	Input/ Output	Description
			can stop reading the array when it encounters the first zero entry.
decodedBufs	IVIDEO2_BufDesc	Output	The decoder fills this structure with buffer pointers to the decoded frame. Related information fields for the decoded frame are also populated. When frame decoding is not complete, as indicated by outBufsInUseFlag, the frame data in this structure will be incomplete. However, the algorithm will provide incomplete decoded frame data in case application may choose to use it for error recovery purposes.
freeBufID[IVIDEO2_MAX_IO_BUFFERS]	XDAS_Int32	Output	This is an array of inputIDs corresponding to the frames that have been unlocked in the current process call.
outBufsInUseFlag	XDAS_Int32	Output	Flag to indicate that the outBufs provided with the process() call are in use. No outBufs are required to be supplied with the next process() call.
displayBufsMode	XDAS_Int32	Output	Indicates the mode for #IVIDDEC3_OutArgs.displayBufs.
bufDesc [1]	IVIDEO2_BufDesc	Output	Array containing display frames corresponding to valid ID entries in the outputID array. See IVIDEO2_BufDesc data structure for more details.
*pBufDesc[IVIDEO2_MAX_IO_BUFFERS]	IVIDEO2_BufDesc *	Output	Array containing pointers to display frames corresponding to valid ID entries in the @c outputID[]

Note:

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

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

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

4.2.2 VC1 Decoder Data Structures

This section includes the following VC1Decoder specific data structures:

- IVC1VDEC_Params
- IVC1VDEC_DynamicParams
- IVC1VDEC_InArgs
- IVC1VDEC_Status
- IVC1VDEC_OutArgs
- IVC1VDEC_TI_MbInfo

4.2.2.1 IVC1VDEC _Params

‖ Description

This structure defines the creation parameters and any other implementation specific parameters for an VC1 Decoder instance object. The creation parameters are defined in the XDM data structure, IVIDDEC3_Params.

‖ Fields

Field	Data Type	Input/ Output	Description
viddec3Params	IVIDDEC3_Params	Input	See IVIDDEC3_Params data structure for details.
errorConcealmentON	XDAS_Int32	Input	This parameter is used to enable (or) disable the error concealment. Possible values are 0 (disable) & 1 (enable)
frameLayerDataPresentFlag	XDAS_Int32	Input	Possible values are 0 (Frame layer data not present) & 1 (Frame layer data present) This flag is used by the codec only if the bit-stream is in RCV format. Refer Chapter 9, section 9.1.2.1 for more details.
debugTraceLevel	XDAS_UInt32	Input	This parameter specifies the debug trace level Possible values are 0 to 4
lastNFramesTolog	XDAS_UInt32	Input	This variable specifies the number of most recent frames to log in debug trace Possible values are 0 to 10

4.2.2.2 IVC1VDEC_DynamicParams

‖ Description

This structure defines the run-time parameters and any other implementation specific parameters for an VC1 instance object. The run-time parameters are defined in the XDM data structure, `IVIDDEC3_DynamicParams`.

‖ Fields

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

4.2.2.3 IVC1VDEC_InArgs

‖ Description

This structure defines the run-time input arguments for an VC1 instance object.

‖ Fields

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

4.2.2.4 IVC1VDEC_Status

‖ Description

This structure defines parameters that describe the status of the VC1 Decoder and any other implementation specific parameters. The `status` parameters are defined in the XDM data structure, `IVIDDEC3_Status`.

‖ Fields

Field	Data Type	Input/ Output	Description
`viddec3Status`	`IVIDDEC3_Status`	Output	See `IVIDDEC3_Status` data structure for details
`extendedErrorCode0`	`XDAS_UInt32`	Output	`Bit 0 to 31 of the error status`
`extendedErrorCode1`	`XDAS_UInt32`	Output	`Bit 32 to 63 of the error status`

Field	Data Type	Input/ Output	Description
extendedErrorCode2	XDAS_UInt32	Output	Bit 64 to 95 of the error status
extendedErrorCode2	XDAS_UInt32	Output	Bit 96 to 127 of the error status
debugTraceLevel	XDAS_UInt32	Output	Specifies the debug trace level.VC-1 decoder will support till level 4.
lastNFramesTolog	XDAS_UInt32	Output	Specifies the number of most recent frames to log in debug trace.
extMemoryDebugTraceAddr	XDAS_UInt32 *	Output	Pointer to debug trace structure in external memory.
extMemoryDebugTraceSize	XDAS_UInt32	Output	Size of debug trace structure.

4.2.2.5 IVC1VDEC_OutArgs

‖ Description

This structure defines the run-time output arguments for the VC1 Decoder instance object.

‖ Fields

Field	Data Type	Input/ Output	Description
viddec3OutArgs	IVIDDEC3_OutArgs	Output	See IVIDDEC3_OutArgs data structure for details.

4.2.2.6 IVC1VDEC_TI_MbInfo

‖ Description

This structure defines the Mb info fields for the VC1 Decoder.

‖ Fields

Field	Data Type	Input/ Output	Description
mb_addr	XDAS_UInt8	Output	It is equal to the macroblock address (counter) in the picture.

Field	Data Type	Input/ Output	Description
error_flag	XDAS_UInt8	Output	This indicates that an error was detected while decoding the macroblock. . If error_flag = 1, the contents of macroblock header data are not ensured. This means ECD3 outputs right data for the first 64-bit of macroblock header, but the other parts of macroblock header data may be corrupted.
first_mb_flag	XDAS_UInt8	Output	This indicates that the current MB is the first MB in the slice.
pic_bound_b	XDAS_UInt8	Output	This indicates that the current MB is at the bottom edge of the picture
pic_bound_u	XDAS_UInt8	Output	This indicates that the current MB is at the upper edge of the picture
pic_bound_r	XDAS_UInt8	Output	This indicates that the current MB is at the right edge of the picture
pic_bound_l	XDAS_UInt8	Output	This indicates that the current MB is at the left boundary of the picture
mb_ur_avail	XDAS_UInt8	Output	This indicates whether the current MB has the upper right pixels available. (in the same slice).
mb_uu_avail	XDAS_UInt8	Output	This indicates whether the current MB has the upper pixels available. (in the same slice).
mb_ul_avail	XDAS_UInt8	Output	This indicates whether the current MB has the upper left pixels available. (in the same slice).
mb_ll_avail	XDAS_UInt8	Output	This indicates whether the current MB has the left pixels available. (in the same slice).
fmt_type	XDAS_UInt8	Output	This is always 0x08. which is Bi-4-MV Macroblock Header Format
codec_type	XDAS_UInt8	Output	This indicated the codec type. This is always 0x3 for VC1 decoder.
dc_coef_q_y[4]	XDAS_UInt8	Output	These are the 4 DC co-efficient values of each of the 8x8 Luma block
dc_coef_q_cr	XDAS_UInt8	Output	This is the DC co-efficient value for the 8x8 Cr block
dc_coef_q_cb	XDAS_UInt8	Output	This is the DC co-efficient value for the 8x8 Cb block

Field	Data Type	Input/ Output	Description
block_type_cr	XDAS_UInt8	Output	This is the block type of Cr block 0: Intra, 1: Inter 8x8, 2: Inter 8x4, 3: Inter 4x8, 4: Inter 4x4
block_type_cb	XDAS_UInt8	Output	This is the block type of Cb block 0: Intra, 1: Inter 8x8, 2: Inter 8x4, 3: Inter 4x8, 4: Inter 4x4
block_type_y[4]	XDAS_UInt8	Output	These are the 4 block type values of each of the 8x8 Luma block 0: Intra, 1: Inter 8x8, 2: Inter 8x4, 3: Inter 4x8, 4: Inter 4x4
end_of_slice	XDAS_UInt8	Output	This flag is used only in AP.This indicates that this is the last MB of this slice
cond_skip_flag	XDAS_UInt8	Output	This can be used to skip the MB if coded block pattern is 0
skip	XDAS_UInt8	Output	0: Non Skipped MB 1: Skipped MB
overlap	XDAS_UInt8	Output	Indicates that overlap filtering is in use for the macroblock. 0: overlap filtering is off 1: overlap filtering is on
acpred	XDAS_UInt8	Output	Indicates that AC prediction is in use for the macroblock. 0: AC prediction is off 1: AC prediction is on
b_picture_direction	XDAS_UInt8	Output	denotes inter-prediction direction for the macroblock in B-picture 0: direct 1: forward 2: backward 3: interpolated 4: switched to backward 5: switched to forward
mv_mode	XDAS_UInt8	Output	Denotes the number of motion vectors 0: Intra (no motion vector), 1: 1-MV, 2: 2-MV, 3: 4-MV

Field	Data Type	Input/ Output	Description
Fieldtx	XDAS_UInt8	Output	Indicates that the field transform is in use for the macroblock. 0: Frame transform, 1: Field transform
mv_type	XDAS_UInt8	Output	Indicates that field inter-prediction is in use (motion compensation is in field-mode). This field is used in interlace frames only. 0: Frame prediction mode, 1: Field prediction mode
Refdist	XDAS_UInt8	Output	This equals the reference frame distance. This field is valid for decoding interlace field only, and used for co-located macroblock in anchor frame
mquant_overflow	XDAS_UInt8	Output	Indicates that macroblock quantizer-scale (MQUANT) overflows. 0: MQUANT does not overflow, 1: MQUANT overflows
quant	XDAS_UInt8	Output	Equals the quantizer-scale for the macroblock
halfqp	XDAS_UInt8	Output	1 indicates that 0.5 shall be added to PQUANT in calculation of quantizer-scale. This field is valid for decoding only. 0: quantizer = PQUANT, 1: quantizer = PQUANT + 1/2
dc_step_size	XDAS_UInt8	Output	Equals the DC coefficient step size which is derived from MQUANT in the bit-stream
cbp_cr	XDAS_UInt8	Output	Denotes the coded sub-block pattern for cr block
cbp_cb	XDAS_UInt8	Output	Denotes the coded sub-block pattern for cb block
cbp_y[3]	XDAS_UInt8	Output	Denotes the coded sub-block pattern for luma blocks
mv_bw_ref_y[4]	XDAS_UInt8	Output	Contains the backward reference field picture
mv_fw_ref_y[3]	XDAS_UInt8	Output	Contains the forward reference field picture
mv_fw_y[4][4]	XDAS_UInt8	Output	Unclipped forward motion vectors for luma
mv_bw_y[1][1]	XDAS_UInt8	Output	Unclipped backward motion vector for luma
mv_bw_c[2]	XDAS_UInt8	Output	Unclipped backward motion vector for chroma
mv_fw_c[2]	XDAS_UInt8	Output	Unclipped forward motion vector for chroma
cmv_fw_y[4][4]	XDAS_UInt8	Output	Clipped forward motion vector for luma

Field	Data Type	Input/ Output	Description
cmv_bw_y[4][4]	XDAS_UInt8	Output	Clipped backward motion vector for luma
cmv_fw_c[4][4]	XDAS_UInt8	Output	Clipped forward motion vector for chroma
cmv_bw_c[4][4]	XDAS_UInt8	Output	Clipped backward motion vector for chroma

4.3 Default and supported parameters

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

- *IVIDDEC3_Params*
- *IVIDDEC3_DynamicParams*
- *IVC1VDEC_Params*
- *IVC1VDEC_DynamicParams*

4.3.1 Default and supported values of IVIDDEC3_params

Field	Default Value	Supported Values
Size	Sizeof(IVIDDEC3_Params)	❑ Sizeof(IVIDDEC3_Params) ❑ Sizeof(IVC1VDEC_Params)
maxHeight	1088	64 <= maxHeight <= 1080 [See Note below for additional constraint]
maxWidth	1920	64 <= maxWidth <= 1920 [See Note below for additional constraint]
maxFrameRate	30000	Don't Care
maxBitRate	10000000	Don't Care
dataEndianness	XDM_BYTE	XDM_BYTE
forceChromaFormat	XDM_YUV_420SP	XDM_YUV_420SP
operatingMode	IVIDEO_DECODE_ONLY	❑ IVIDEO_DECODE_ONLY ❑ IVIDEO_TRANSCODE_FRAMELEVEL
displayDelay	IVIDDEC3_DISPLAY_DELAY_1	❑ IVIDDEC3_DISPLAY_DELAY_AUTO ❑ IVIDDEC3_DECODE_ORDER ❑ IVIDDEC_DISPLAY_DELAY_1
inputDataMode	IVIDEO_ENTIREFRAME	IVIDEO_ENTIREFRAME
outputDataMode	IVIDEO_ENTIREFRAME	IVIDEO_ENTIREFRAME

numInputDataUnits	0	0
numOutputDataUnits	0	0
errorInfoMode	IVIDEO_ERRORINFO_OFF	IVIDEO_ERRORINFO_OFF
displayBufsMode	IVIDDEC3_DISPLAYBUFS_EMBEDDED	❑ IVIDDEC3_DISPLAYBUFS_EMBEDDED ❑ IVIDDEC3_DISPLAYBUFS_PTRS
metadataType[0]	IVIDEO_METADATAPLANE_NONE	❑ IVIDEO_METADATAPLANE_NONE ❑ IVIDEO_METADATAPLANE_MBINFO
metadataType[1]	IVIDEO_METADATAPLANE_NONE	❑ IVIDEO_METADATAPLANE_NONE
metadataType[2]	IVIDEO_METADATAPLANE_NONE	❑ IVIDEO_METADATAPLANE_NONE

4.3.2 Default and supported values of IVIDDEC3_DynamicParams

Field	Default Value	Supported Values
size	Sizeof(IVIDDEC3_DynamicParams)	❑ Sizeof(IVIDDEC3_DynamicParams) ❑ Sizeof(IVC1VDEC_DynamicParams)
decodeHeader	XDM_DECODE_AU	❑ XDM_DECODE_AU ❑ XDM_PARSE_HEADER
displayWidth	0	If YUV buffers are in RAW/TILED_PAGE region, Any value > = 0, which is a multiple of 128 bytes. If YUV buffers are in TILED region, then this parameter value is ignored.
frameSkipMode	IVIDEO_NO_SKIP	❑ IVIDEO_NO_SKIP
newFrameFlag	XDAS_TRUE	❑ XDAS_TRUE ❑ XDAS_FALSE
putDataFxn	NULL	NULL
putDataHandle	NULL	NULL
getDataFxn	NULL	NULL
getDataHandle	NULL	NULL

putBufferFxn	NULL	NULL
putBufferHandle	NULL	NULL
lateAcquireArg	IRES_HDVICP2_UNKNOWNLATEACQUIREARG	Any Value

4.3.3 Default and supported values of IVC1VDEC_Params

Field	Default Value	Supported Values
IVIDDEC3_Params	See Section 4.3.1	See Section 4.3.1
errorConcealmentON	0	❑ 0 - Disable ❑ 1 - Enable
frameLayerDataPresentFlag	0	❑ 0 – Frame layer data not present. ❑ 1 – Frame layer data present
debugTraceLevel	0	❑ 0 – Disable ❑ 1 – level 1 ❑ 2 – level 2 ❑ 3 – level 3 ❑ 4 – level 4
lastNFramesToLog	0	0 <= lastNFramesToLog <= 10

Note:
- ❑ The usage of debugTraceLevel and lastNFramesToLog are explained in detail in chapter 6.
- ❑ The frameLayerDataPresentFlag is explained in detail in the section 9.1.2.1 of chapter 9.

4.3.4 Default and supported values of IVC1VDEC_DynamicParams

Field	Default Value	Supported Values
IVIDDEC3_DynamicParaMs	See Section 4.3.2	See Section 4.3.2

4.4 Interface Functions

This section describes the application programming interfaces used in the VC1 Decoder. The VC1 Decoder APIs are logically grouped into the following categories:

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

You must call these APIs in the following sequence:

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

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

4.4.1 Creation APIs

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

‖ Name

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

‖ Synopsis

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

‖ Arguments

```
Void
```

‖ Return Value

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

‖ Description

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

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

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

‖ See Also

`algAlloc()`

‖ Name

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

‖ Synopsis

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

‖ Arguments

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

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

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

‖ Return Value

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

‖ Description

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

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

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

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

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

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

‖ See Also

`algNumAlloc(), algFree()`

4.4.2 Initialization API

Initialization API is used to initialize an instance of the VC1 Decoder. The initialization parameters are defined in the `IVIDDEC3_Params` structure (see Data Structures section for details).

‖ Name

`algInit()` – initialize an algorithm instance

‖ Synopsis

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

‖ Arguments

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

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

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

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

‖ Return Value

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

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

‖ Description

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

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

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

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

The last argument is a pointer to a structure that defines the algorithm initialization parameters. All fields in the `params` structure must be set as described in `IALG_Params` structure (see Data Structures section for details).

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

‖ See Also

`algAlloc(), algMoved()`

4.4.3 Control API

Control API is used for controlling the functioning of VC1 Decoder during run-time. This is done by changing the status of the controllable parameters of the decoder during run-time. These controllable parameters are defined in the `IVIDDEC3_DynamicParams` data structure (see Data Structures section for details).

‖ Name

`control()` – change run-time parameters of the VC1 Decoder and query the decoder status

‖ Synopsis

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

‖ Arguments

```
IVIDDEC3_Handle handle; /* handle to the VC1 decoder
instance */

IVIDDEC3_Cmd id; /* VC1 decoder specific control commands*/

IVIDDEC3_DynamicParams *params /* VC1 decoder run-time
parameters */

IVIDDEC3_Status *status /* VC1 decoder instance status
parameters */
```

‖ Return Value

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

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

‖ Description

This function changes the run-time parameters of VC1 Decoder and queries the status of decoder. `control()` must only be called after a successful call to `algInit()` and must never be called after a call to `algFree()`.

The first argument to `control()` is a handle to the VC1 Decoder instance object.

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

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

‖ See Also

```
algInit()
```

4.4.4 Data Processing API

Data processing API is used for processing the input data using the VC1 Decoder.

‖ Name

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

‖ Synopsis

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

‖ Arguments

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

‖ Return Value

```
Void
```

‖ Description

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

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

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

‖ See Also

`algDeactivate()`

‖ Name

`process()` – basic video decoding call

‖ Synopsis

```
XDAS_Int32 (*process)(IVIDDEC3_Handle handle, XDM1_BufDesc
*inBufs, XDM_BufDesc *outBufs, IVIDDEC3_InArgs *inargs,
IVIDDEC3_OutArgs *outargs);
```

‖ Arguments

```
IVIDDEC3_Handle handle; /* handle to the VC1 decoder
instance */

XDM1_BufDesc *inBufs; /* pointer to input buffer descriptor
data structure */

XDM_BufDesc *outBufs; /* pointer to output buffer descriptor
data structure */

IVIDDEC3_InArgs *inargs /* pointer to the VC1 decoder
runtime input arguments data structure */

IVIDDEC3_OutArgs *outargs /* pointer to the VC1 decoder
runtime output arguments data structure */
```

‖ Return Value

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

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

‖ Description

This function does the basic VC1 video decoding. The first argument to `process()` is a handle to the VC1 Decoder instance object.

The second and third arguments are pointers to the input and output buffer descriptor data structures respectively (see `XDM1_BufDesc and XDM_BufDesc` data structure for details).

The fourth argument is a pointer to the `IVIDDEC3_InArgs` data structure that defines the run-time input arguments for the VC1 Decoder instance object.

> **Note:**
>
> Prior to each decode call, ensure that all fields are set as described in `XDM1_BufDesc`, `XDM_BufDesc`, and `IVIDDEC3_InArgs` structures.

The last argument is a pointer to the `IVIDDEC3_OutArgs` data structure that defines the run-time output arguments for the VC1 Decoder instance object.

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

‖ See Also

`control()`

‖ Name

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

‖ Synopsis

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

‖ Arguments

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

‖ Return Value

```
Void
```

‖ Description

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

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

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

‖ See Also

`algActivate()`

4.4.5 Termination API

Termination API is used to terminate the VC1 Decoder and free up the memory space that it uses.

‖ Name

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

‖ Synopsis

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

‖ Arguments

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

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

‖ Return Value

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

‖ Description

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

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

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

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

‖ See Also

`algAlloc()`

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Chapter 5

Frequenty Asked Questions

This section answers frequently asked questions related to using VC1 Advanced Profile Decoder

5.1 Code Build and Execution

Question	Answer
Build error saying that code memory section is not sufficient	Make sure that project settings are not changed from the released package settings; such as making project setting as File -03 and no debug information, which throws an error that code memory section is not sufficient.
Application returns an error saying “Cannot open input file “….vc1” while running the host test app	Make sure that input bit-stream path is given correctly. If the application is accessing input from network, ensure that the network connectivity is stable.

5.2 Issues with Tools Version

Question	Answer
Which simulator version should I use for this release of VC1 Decoder on IVA-HD?	The IVAHD simulator version to be used is 5.0.16 and is available on the
Does this release support on IVA-HD FPGA?	Yes
What CG tools version should I use for code compilation?	The CG tools version used in this version of VC1 Decoder is 4.5.0

5.3 Algorithm Related

Question	Answer
What XDM interface does codec support?	Codec supports XDM IVIDDEC3 interface
Does VC1 Decoder support non-multiple of 16 frame height and width?	Yes
What are the levels VC1 decoder supports?	VC1 Decoder supports up to advanced profile level 3
Does this version of VC1 decoder, support RTV format?	No this not included in this version
Does this version of VC1 decoder expose motion vectors for a frame to the application?	No
Does this version of VC1 Decoder support additional tolls like Intensity compensation and Range Mapping?	Yes
Does decoder will support Range Mapping and Resolution scaling after frame decoding?	No. The Range Mapping and Resolution scaling parameters are informed with IVIDDEC3 XDM parameters to the application.
Does this version of decoder will support the display delay?	Only display delay, 1 or 0 is supported in this release. Display delay 0 means decoding order.
Does this version of VC1 decoder support, partial frame decode and header only decode features?	Yes
What is the Maximum bit rate supported by this version of VC1 Decoder?	This version of decoder supports up to 45Mbps
Does this version of decoder support meta-data parsing and provide the same to application?	This version of decoder will parse the Metadata present in bitstream but does NOT provide to application.
What is the maximum resolution supported by this version of VC1 Decoder?	This version of VC1 Decoder supports resolution up to 1920x1088.

Chapter 6

Debug Trace Usage

This section describes the debug trace feature supported by codec and its usage.

6.1 Debug Trace Memory format in the VC1 Decoder

Debug trace header
Debug Trace Parameters for Process Call 1
Debug Trace Parameters for Process Call 2
Debug Trace Parameters for Process Call 3
Debug Trace Parameters for Process Call 4
Debug Trace Parameters for Process Call N
Debug Trace Parameters for Process Call N+1

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

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

6.2 Method to configure decoder to collect debug trace

During decoder creation, application needs to set IVC1VDEC_Params::debugTraceLevel = IVC1VDEC_DEBUGTRACE_LEVEL1. And set IVC1VDEC_Params::lastNFramesToLog = N, where N refers to number of process calls for which trace needs to be collected. Note that the buffer for debug trace collection will be requested by decoder, in DDR, during create time and size of it will be linearly proportional to N.

6.3 Method for application to collect debug trace

Application can understand the address of the buffer by performing control call with `XDM_GETSTATUS` command. Base address of the buffer will be reported in IVC1VDEC_Status::extMemoryDebugTraceAddr. Total size of the buffer will be reported in IVC1VDEC_Status::extMemoryDebugTraceSize.

NOTE: Before collecting the contents from DDR, Application needs to perform cache write back of the header portion of the buffer from M3 side. M3_Cache_WriteBack needs to be performed at address IVC1VDEC_Status::extMemoryDebugTraceAddr and for a size equal to that of header (In this release, size of header is 48 Bytes) + lastNFramesToLog * size of debug trace params (size of debug trace params is 288 bytes)

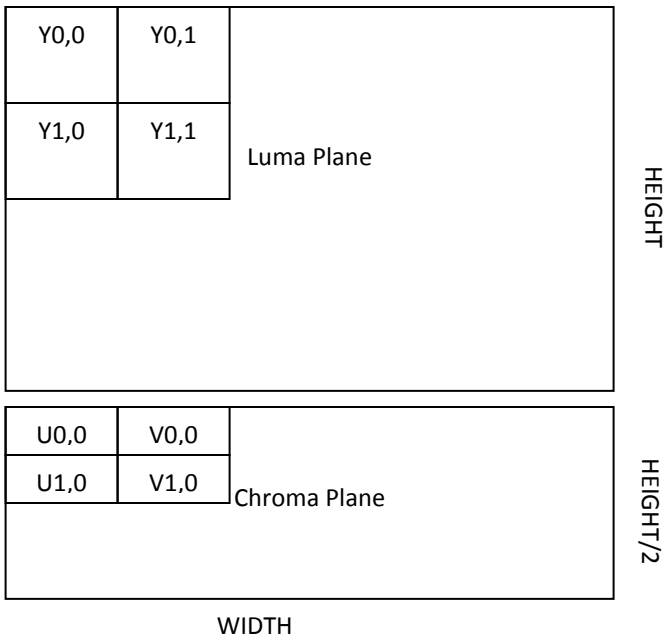
Chapter 7

Picture Format

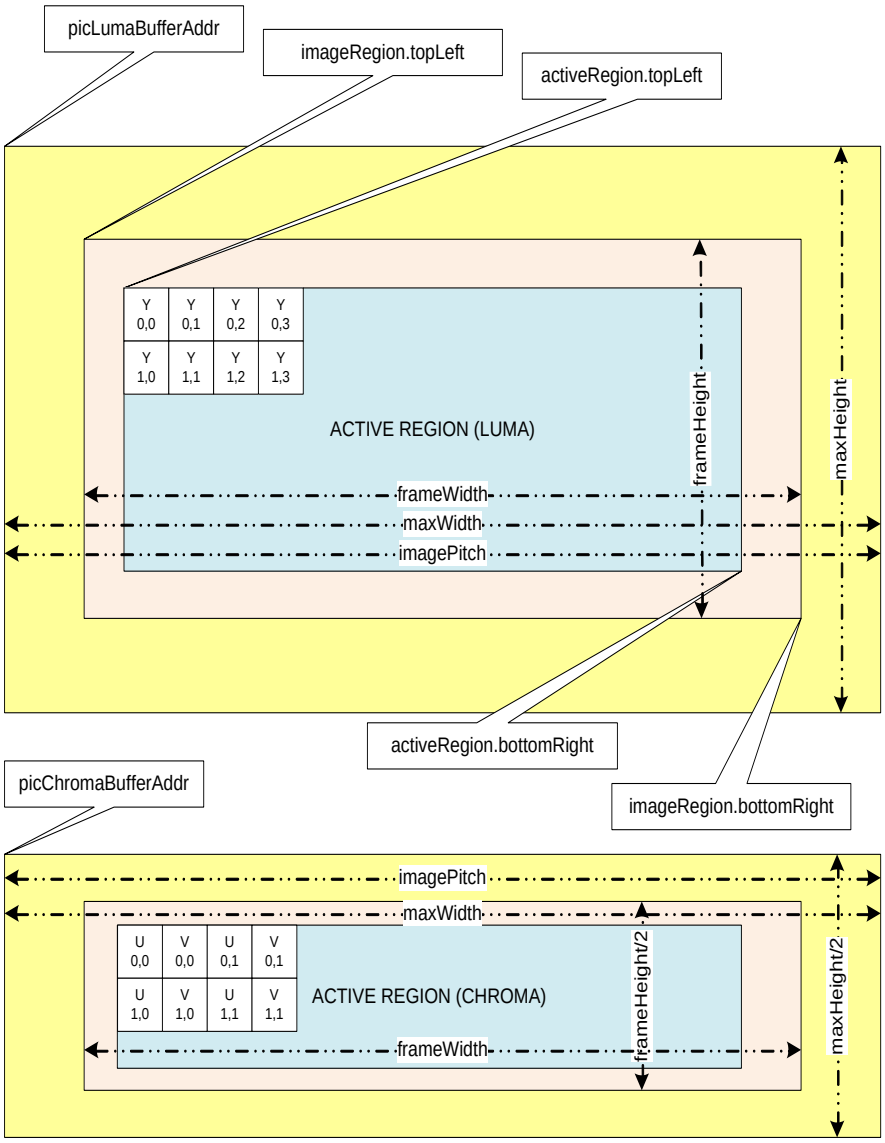
This Appendix explains picture format details for decoder. Decoder outputs YUV frames in NV 12 format.

7.1 NV12 Chroma Format

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



7.2 Progressive Picture Format



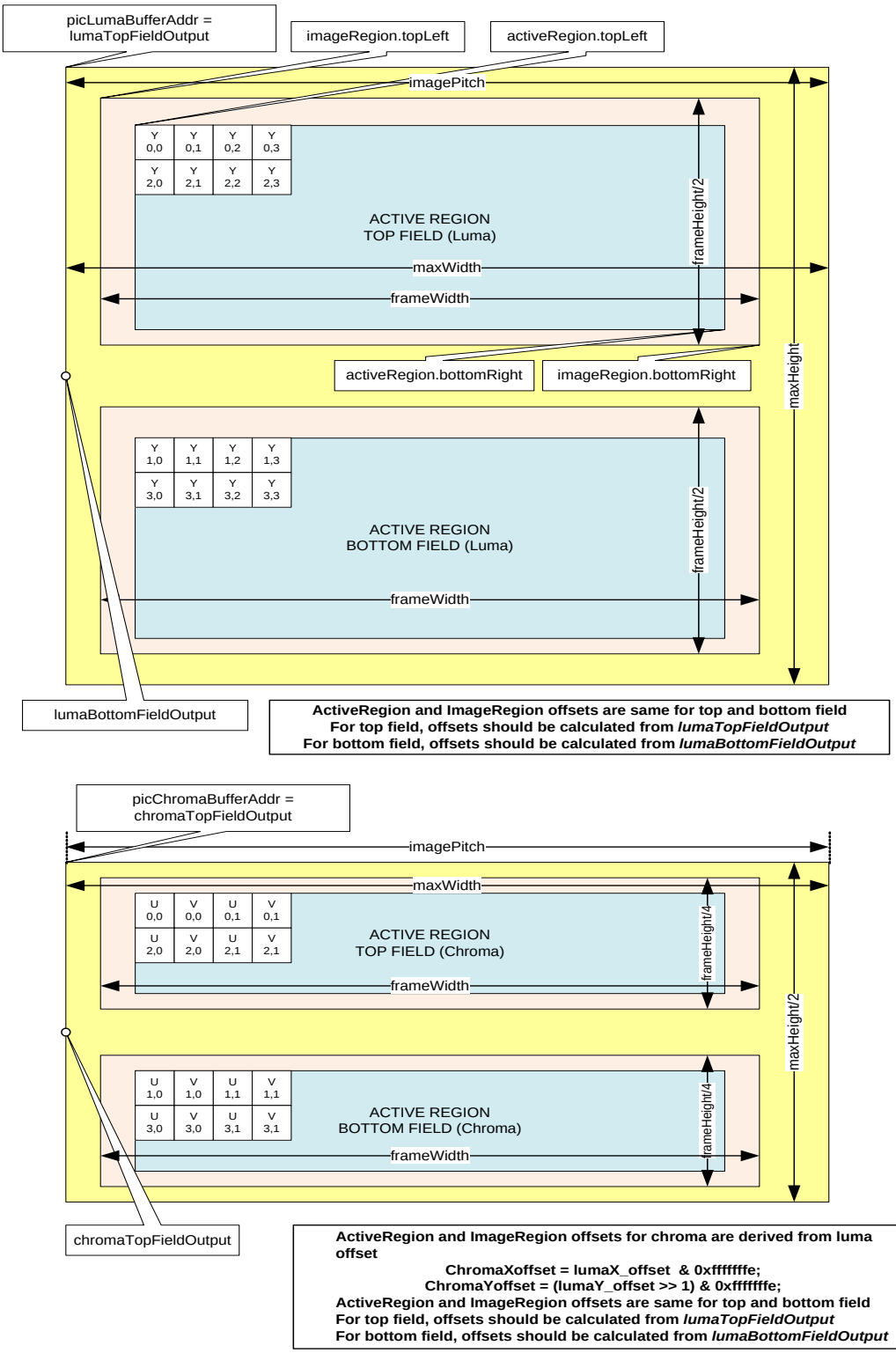
ActiveRegion and ImageRegion offsets for chroma are derived from luma offset
ChromaXoffset = lumaX_offset & 0xfffffffe;
ChromaYoffset = (lumaY_offset>>1) & 0xfffffffe;

Note that for decoder in case of progressive sequence:

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

- *Padding Amounts*
    - In horizontal direction left and right padding amounts are 32 pixels for both Luma and chroma buffers.
    - In vertical direction top and bottom padding amounts are 40 pixels for Luma and chroma buffers .

7.3 Interlaced Picture Format



Note that for decoder in case of interlaced sequence:

- Luma and chroma buffers can be allocated independently
- Field buffer allocation cannot be independent
- For every pair of top and bottom field, decoder shall expect a single buffer address from the application
- The outermost yellow coloured region is the minimum buffer that application should allocate for a given *maxWidth* and *maxHeight*
- *activeRegion*
    - The displayable region after cropping done by application.
    - The cropping information is derived from VUI information in the bitstream
- *imageRegion*
    - Image data decoded by the decoder.
    - Contains the activeRegion as a proper subset.
- *Picture Buffer (pic(Luma/Chroma)BufferAddr)*
    - Contains padded regions and extra region due to alignment constraints.
    - Contains the imageRegion as a proper subset.
- *imagePitch*
    - The difference in addresses of two vertically adjacent pixels
    - Typically equal to width of the picture Buffer.
- *Padding Amounts*
    - In horizontal direction left and right padding amounts are 32 pixels for both Luma and chroma buffers.
    - In vertical direction top and bottom padding amounts are 40 pixels for Luma and 20 pixels for chroma buffers for each interlaced fields.

7.4 Constraints on Buffer Allocation for Decoder

- *maxWidth* and *maxHeight* are inputs given by the decoder to the applications
  - Application may not know the output format of the decoder.
  - Therefore, application should allocate Image Buffer based on *maxWidth* and *maxHeight*
    - The extra region beyond the (maxWidth x maxHeight) requirements may be allocated by application due to alignment, pitch or some other constraints
- Application needs to ensure following conditions regarding *imagePitch*
  - *imagePitch* shall be greater or equal to the maxWidth.
  - *imagePitch* shall be multiple of 128 bytes (if the buffer is not in TILED region).
  - *imagePitch* shall actually be the tiler space width (i.e. depends on how many bit per pixel, for 8bpp 16bpp and 32bpp respectively 16Kbyte, 32Kbyte and 32Kbyte). (if the buffer is in TILED region).
  - Application may set *imagePitch* greater than *maxWidth* as per display constraints. However this value must be a multiple of 128 bytes (if the buffer is not in TILED region).
- *picLumaBufferAddr* and *picChromaBufferAddr* shall be 16-byte aligned address. (if the buffer is not in TILED region).
- *ActiveRegion.topLeft* and *ActiveRegion.bottomRight* are decoder outputs
  - Application should calculate actual display width and display height based on these parameters
  - *ActiveRegion.topLeft* and *ActiveRegion.bottomRight* shall be identical for both fields in case of interlaced format
- Maximum and Minimum Resolution is defined as below
  - Progressive
    - Minimum frameWidth = 64
    - Minimum frameHeight = 64
    - Maximum frameWidth = 1920
    - Maximum frameHeight = 1088
  - Interlaced
    - Minimum frameWidth = 64
    - Minimum (frameHeight / 2) = 32
    - Maximum frameWidth = 1920
    - Maximum (frameHeight / 2) = 544

- Typically picture buffer allocation requirements for decoder, after buffer addresses meet alignment constraints (depends on decoder's padding requirements), for both progressive and interlaced are as given below.
    - Luma buffer size = maxWidth x maxHeight and

      Chroma buffer size = maxWidth x maxHeight/2 where
        - maxWidth = frameWidth + 4 (progressive/interlaced)
        - maxHeight = frameHeight

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Chapter 8

Error Handling

This chapter describes the error codes reported by codec for different erroneous situation, and recommended action by application.

8.1 Description

This version of the decoder supports handling of erroneous situations while decoding. If decoder encounters errors in bit stream or any other erroneous situations, decoder shall exit gracefully without any hang or crash. Also decoder process call shall return IVIDDEC3_EFAIL and relevant error code will be populated in extendedError field of outArgs.

Different error codes and their meanings are described below.
Definitions of bits numbered 8-15 are as per common XDM definition.
Definition of remaining bits are VC1 Decoder specific and as given in below tabular column. Bit numbering in the 32 bit word extendedError is from Least Significant Bit to Most Significant Bit.

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

Some of the erroneous situations like pointer NULL, invalid memory types for input and output buffers are flagged as fatal errors. In such scenarios, the application may not have initialized valid values for them. Hence the expected behaviour from the application is to re-initialize the fields.

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

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

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

8.1.1 Error Codes used to set the extendedError field in IVIDDEC3_OutArgs and IVIDDEC3_Status

Bit	Error Code	Explanation	XDM Error Code Mapping	Recommended App Behavior
0	IVC1DEC_ERR_UNSUPPORTED_VIDDEC3PARAMS	This is deprecated	NA	NA
1	IVC1DEC_ERR_UNSUPPORTED_VIDDEC3DYNAMICPARAMS	Unsupported VIDDEC3 dynamic params	XDM_UNSUPPORTEDPARAM	Call set params with supported values of IVIDDEC3 dynamic params
2	IVC1DEC_ERR_UNSUPPORTED_VC1DECDYNAMICPARAMS	This is deprecated	NA	NA
3	IVC1DEC_ERR_IMPROPER_DATASYNC_SETTING	This is deprecated	NA	NA
4	IVC1DEC_ERR_NOSLICE	This is deprecated	NA	NA
5	IVC1DEC_ERR_SLICEHDR	Error in slice header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
6	IVC1DEC_ERR_MBDATA	Error in MB data	XDM_CORRUPTEDDATA	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
7	IVC1DEC_ERR_UNSUPPFEATURE	This is deprecated	NA	NA
8	XDM_PARAMSCHANGE	Sequence Parameters Change	XDM_PARAMSCHANGE	Refer codec specific error which causes this
9	XDM_APPLIEDCONCEALMENT	Applied concealment	XDM_APPLIEDCONCEALMENT	Refer codec specific error which causes this
10	XDM_INSUFFICIENTDATA	Insufficient input data	XDM_INSUFFICIENTDATA	Refer codec specific error which causes this
11	XDM_CORRUPTEDDATA	Data problem/corruption	XDM_CORRUPTEDDATA	Refer codec specific error which causes this
12	XDM_CORRUPTEDHEADER	Header problem/corruption	XDM_CORRUPTEDHEADER	Refer codec specific error which causes this
13	XDM_UNSUPPORTEDINPUT	Unsupported feature/paramete	XDM_UNSUPPORTEDINPUT	Refer codec specific error

		r		which causes this
14	XDM_UNSUPPORTEDPARAM	Unsupported input parameter	XDM_UNSUPPORTEDPARAM	Refer codec specific error which causes this
15	XDM_FATALERROR	Fatal error	XDM_FATALERROR	Refer codec specific error which causes this
16	IVC1DEC_ERR_STREAM_END	This is deprecated	NA	NA
17	IVC1DEC_ERR_UNSUPPRESOLUTION	This is deprecated	NA	NA
18	IVC1DEC_ERR_STANDBY	This is deprecated	NA	NA
19	IVC1DEC_ERR_INVALID_MBOX_MESSAGE	This is deprecated	NA	NA
20	IVC1DEC_ERR_SEQHDR	Error in the sequence header	XDM_FATALERROR or XDM_CORRUPTEDHEADER	If more bytes available in bit stream and not fatal error, then pass it to decoder. ELSE if bytes are not available call Flush operation.
21	IVC1DEC_ERR_ENTRYHDR	Error in entry point header	XDM_FATALERROR or XDM_CORRUPTEDHEADER	If more bytes available in bit stream and not fatal error, then pass it to decoder. ELSE if bytes are not available call Flush operation.
22	IVC1DEC_ERR_PICHDR	Error in picture header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
23	IVC1DEC_ERR_REF_PICTURE_BUFFER	Error bit for Ref picture Buffer	NO XDM Mapping	Pass the next frame in the stream
24	IVC1DEC_ERR_NOSEQUENNCEHEADER	No sequence header found in the input	NO XDM Mapping	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
30	IVC1DEC_ERR_BUFDESC	Input bytes in inargs is less than or equal to 0 or Input ID is 0	XDM_FATALERROR	Invoke process call with proper bytes in inargs and valid input ID
31	IVC1DEC_ERR_PICSIZECHANGE	Resolution of the picture changes	NO XDM Mapping	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.

8.1.2 Error Codes used to set the extendedErrorCode0, extendedErrorCode1, extendedErrorCode2, extendedErrorCode3 field in **IVC1VDEC**_*Status*

Bit	Error Code	Explanation	XDM Error Code Mapping	Recommended App Behaviour
0	VC1_DYNAMIC_PARAMS_SIZE_ERROR	Dynamic Params size is wrong	XDM_FATALERROR	Invoke control call again with proper DynamicParams structure.
1	VC1_DECODE_HEADER_ERROR	Decode header param in dynamic params is invalid	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
2	VC1_DISPLAY_WIDTH_ERROR	Display width is invalid	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
3	VC1_FRAME_SKIP_MODE_ERROR	Frame skip mode is invalid	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
4	VC1_NEW_FRAME_FLAG_ERROR	New frame falg is invalid	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
5	VC1_PUT_DATA_FXN_ERROR	The putDataFxn is non NULL	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
6	VC1_PUT_DATA_HANDLE_ERROR	The putDataHandle is non NULL	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
7	VC1_GET_DATA_FXN_ERROR	The GetDataFxn is non NULL	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
8	VC1_GET_DATA_HANDLE_ERROR	The GetDataHandle is	XDM_UNSUPPORTED PARAM	Invoke control call again with proper

		non NULL		DynamicParams structure or codec will continue with default settings of dynamic params
9	VC1_PUT_BUFFER_FXN_ERROR	The purBufferFxn is non NULL	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
10	VC1_PUT_BUFFER_HANDLE_ERROR	The PutBufferHandle is non NULL	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
11	VC1_LATE_ACQUIRE_ARG_ERROR	The late acquire argument is wrong	XDM_UNSUPPORTED PARAM	Invoke control call again with proper DynamicParams structure or codec will continue with default settings of dynamic params
12	VC1_NULL_INARGS_POINTER_ERROR	Inargs pointer is NULL	XDM_FATALERROR	Invoke process call again with proper inargs pointer
13	VC1_INARGS_SIZE_ERROR	Inargs size is NULL	XDM_FATALERROR	Invoke process call again with proper inargs size
14	VC1_INVALID_INPUT_BYTES_ERROR	Inargs input bytes is less than or equal to zero	XDM_FATALERROR	Invoke process call again with proper input bytes in the inargs structure
15	VC1_INVALID_INPUT_BYTES_IN_FLUSH_MODE_ERROR	This is deprecated	NA	NA
16	VC1_INVALID_INPUT_ID_ERROR	Input ID is 0	XDM_FATALERROR	Invoke process call again with proper input ID
17	VC1_NULL_INSTANCE_HANDLE_ERROR	Handle provided to process or control call is NULL	XDM_FATALERROR	Invoke process call again with proper pointer to the handle
18	VC1_DECODER_NOT_INITIALIZED_ERROR	This is deprecated	NA	NA
19	VC1_INVALID_INPUT_BUF_DESC_ERROR	Input buffer descriptor pointer given to the process call is NULL	XDM_FATALERROR	Invoke process call again with proper input buffer descriptor
20	VC1_INVALID_INPUT_BUFFER_POINTER_ERROR	Input buffer pointer given to process call is NULL	XDM_FATALERROR	Invoke process call again with proper input buffer pointer
21	VC1_INVALID_INPUT_BUFFER_SIZE_ERROR	Input buffer size given to process call is less than or equal to zero	XDM_FATALERROR	Invoke process call again with proper input buffer size
22	VC1_INVALID_NUM_OF_INPUT_BUFFERS_ERROR	No of input buffers is not equal to one	XDM_FATALERROR	Invoke process call again with correct

				number of buffer size
23	VC1_EXCESS_NUM_OF_INPUT_BUFFERS_ERROR	This is deprecated	NA	NA
24	VC1_INVALID_INPUT_BUFFER_MEMTYPE_ERROR	The input buffer memory type is not RAW or TILED_PAGE	XDM_FATALERROR	Invoke process call with input buffer properties as RAW or TILED_PAGE
25	VC1_INVALID_OUTARGS_POINTER_ERROR	The outargs pointer is NULL	XDM_FATALERROR	Invoke process call with proper outargs pointer
26	VC1_INVALID_OUTARGS_SIZE	The outargs size is invalid	XDM_FATALERROR	Invoke process call with proper outargs size
27	VC1_INVALID_OUTPUT_BUF_DESC_POINTER_ERROR	output buffer descriptor pointer given to the process call is NULL	XDM_FATALERROR	Invoke process call again with proper output buffer descriptor
28	VC1_INVALID_OUTPUT_BUF_DESC_ERROR	This is deprecated	NA	NA
29	VC1_INVALID_NUM_OF_OUTPUT_BUFFERS_ERROR	Number of output buffers given to the codec is invalid	XDM_FATALERROR	Invoke process call again with proper number of output buffers
30	VC1_INVALID_OUTPUT_BUFFER0_POINTER_ERROR	Luma pointer in the output buffer descriptor is NULL	XDM_FATALERROR	Invoke process call again with valid pointer to buffer 0
31	VC1_INVALID_OUTPUT_BUFFER0_SIZE_ERROR	This is deprecated	NA	NA
32	VC1_INVALID_OUTPUT_BUFFER0_MEMTYPE_ERROR	Luma buffer memory type is invalid		Invoke process call again with valid pointer memory type for buffer 0
33	VC1_INVALID_OUTPUT_BUFFER1_POINTER_ERROR	chroma pointer in the output buffer descriptor is NULL	XDM_FATALERROR	Invoke process call again with valid pointer to buffer 1
34	VC1_INVALID_OUTPUT_BUFFER1_SIZE_ERROR	This is deprecated	NA	NA
35	VC1_INVALID_OUTPUT_BUFFER1_MEMTYPE_ERROR	chroma buffer memory type is invalid		Invoke process call again with valid pointer memory type for buffer 1
36	VC1_INVALID_OUTPUT_BUFFER2_POINTER_ERROR	MB info pointer in the output buffer descriptor is NULL	XDM_FATALERROR	Invoke process call again with valid pointer to buffer 2
37	VC1_INVALID_OUTPUT_BUFFER2_SIZE_ERROR	This is deprecated	NA	NA
38	VC1_INVALID_OUTPUT_BUFFER2_MEMTYPE_ERROR	Mb info buffer memory type is invalid		Invoke process call again with valid pointer memory type for buffer 2
39	VC1_INVALID_BUFFER_USAGE_MODE	This is deprecated	NA	NA
40	VC1_INVALID_OUTPUT_BUFFER0_TILED_WIDTH_ERROR	This is deprecated	NA	NA
41	VC1_INVALID_OUTPUT_BUFFER0_TILED_HEIGHT_ERROR	This is deprecated	NA	NA

42	VC1_INVALID_OUTPUT_BUFFER1_TILED_WIDTH_ERROR	This is deprecated	NA	NA
43	VC1_INVALID_OUTPUT_BUFFER1_TILED_HEIGHT_ERROR	This is deprecated	NA	NA
44	VC1_INVALID_OUTPUT_BUFFER2_TILED_WIDTH_ERROR	This is deprecated	NA	NA
45	VC1_INVALID_OUTPUT_BUFFER2_TILED_HEIGHT_ERROR	This is deprecated	NA	NA
46	VC1_INVALID_REF_PICTURE_BUFFER	Invalid picture reference buffers	NA	Pass the next frame in the stream
64	VC1_SEQ_HDR_INVALID_PROFILE	Invalid profile found in the bit-stream	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
65	VC1_SEQ_HDR_INVALID_LEVEL	Invalid level found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
66	VC1_SEQ_HDR_INVALID_COLORDIFF_FORMAT	Invalid color format found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
67	VC1_SEQ_HDR_INVALID_MAX_CODED_WIDTH	Invalid max coded width found in the bit-stream	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
68	VC1_SEQ_HDR_INVALID_MAX_CODED_HEIGHT	Invalid max coded height found in the bit-stream	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
69	VC1_SEQ_HDR_INVALID_RESERVED	Reserved bits are set in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
70	VC1_SEQ_HDR_INVALID_ASPECT_RATIO	Invalid aspect ratio found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
71	VC1_SEQ_HDR_INVALID_FRAMERATENR	Invalid numerator value decoded for the frame rate in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
72	VC1_SEQ_HDR_INVALID_FRAMERATEDR	Invalid denominator value decoded for the frame rate in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.

73	VC1_SEQ_HDR_INVALID_COLOR_PRIM	Invalid color primary values found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
74	VC1_SEQ_HDR_INVALID_TRANSFER_CHAR	Invalid transfer characters found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
75	VC1_SEQ_HDR_INVALID_MATRIX_COEF	Invalid matrix co-efficients found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
76	VC1_SEQ_HDR_INVALID_LOOPFILTER	Invalid loop filter value found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
77	VC1_SEQ_HDR_INVALID_FASTUVMC	Invalid Fast UV motion compensation flag found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
78	VC1_SEQ_HDR_INVALID_EXTENDED_MV	Invalid extended MV found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
79	VC1_SEQ_HDR_INVALID_DQUANT	Invalid dquant value found in the bit-stream	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
80	VC1_SEQ_HDR_INVALID_SYNCMARKER	Invalid sync marker found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
81	VC1_SEQ_HDR_INVALID_RANGERED	Invalid range reduction value found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
82	VC1_SEQ_HDR_INVALID_MAXBFRAMES	Invalid value of maximum B frames found in the bit-stream	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
83	VC1_ENTRY_PNT_HDR_INVALID_DQUANT	Invalid Dquant found in the entry point header.	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit

84	VC1_ENTRY_PNT_HDR_INVALID_CODED_WIDTH	Invalid coded width found in the entry point header.	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
85	VC1_ENTRY_PNT_HDR_INVALID_CODED_HEIGHT	Invalid coded height found in the entry point header.	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
86	VC1_PIC_HDR_INVALID_PTYPE	Invalid picture type in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
87	VC1_PIC_HDR_INVALID_PQINDEX	Invalid PQ index in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
88	VC1_PIC_HDR_INVALID_MVRANGE	Invalid MV Range in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
89	VC1_PIC_HDR_INVALID_RESPIC	Invalid Residual Pic value in picture header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
90	VC1_PIC_HDR_INVALID_FCM	Invalid Frame coding mode in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
91	VC1_PIC_HDR_INVALID_RNDCTRL	Invalid Rounding control parameter in picture header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
92	VC1_PIC_HDR_INVALID_MVMODE	Invalid MV mode in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
93	VC1_PIC_HDR_INVALID_DMVRANGE	Invalid Direct MV range in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
94	VC1_PIC_HDR_INVALID_BFRACTION	Invalid Bfraction syntax element value in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
95	VC1_PIC_HDR_INVALID_REFDIST	Invalid reference distance in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
96	VC1_ERR_MBNUMB	Invalid number of MBs in picture header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
97	VC1_ERR_SCALERES	Invalid scaled resolution in picture header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
98	VC1_ERR_ALTPQUANT	Invalid ALTPQUANT syntax element in picture header	XDM_CORRUPTEDHEADER	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are

				not available call Flush operation.
99	VC1_VOPDQUANT_INVALID_ABSPQ	This is deprecated	NA	NA
100	VC1_SLC_HDR_INVALID_SLICE_ADDR	Invalid slice restart position in slice header	XDM_CORRUPTEDHEADER & XDM_FATALERROR	Application should exit
101	VC1_IMPROPER_RESET	The reset IVAHD function returned error.	XDM_FATALERROR	Application should exit
102	VC1_IMPROPER_STANDBY	The standby check on M3 failed	XDM_FATALERROR	Application should exit
103	VC1_ECD_MB_ERROR	MB level error detected by ECD3	XDM_CORRUPTEDDATA	If more bytes available in bit stream, then pass it to decoder. ELSE if bytes are not available call Flush operation.
104	VC1_NO_SEQUENCE_STARTCODE	This is deprecated	NA	NA

Chapter 9

Bitstream Format

This chapter explains the bitstream format of VC1 decoder for different profiles. In addition, it explains the constraints to the application, regarding bit-stream formats and corresponding codec behaviour.

9.1 Simple and Main Profile

Sequence Header occurs only once in the beginning of the stream and is in the format specified in the figure below. The same is explained in Table 265 in Annex L of VC1 standard. The sequence header is given to the codec during the XDM_PARSE_HEADER. During this command execution, the codec assumes that only the sequence header is present in the input buffer and it decodes the same.

9.1.1 Sequence header syntax

Table 265: Sequence Layer Data Structure

31 30 29 28 27 26 25 24	23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
0xC5	NUMFRAMES : 24	
0x00000004		
STRUCT_C (refer to Table 263 and Table 264)		
STRUCT_A (VERT_SIZE) (refer to Table 260 and Annex J.2)		
STRUCT_A (HORIZ_SIZE)		
0x0000000C		
STRUCT_B (LEVEL:3 | CBR: 1 | RES1: 4 | HRD_BUFFER:24) (refer to Table 261 and Table 262)		
STRUCT_B (HRD_RATE)		
STRUCT_B (FRAMERATE)		

Figure 9-1 Sequence Layer syntax

9.1.2 Frame header syntax

While the codec executes XDM_DECODE_AU command, the input buffer shall only contain the compressed frame data corresponding to the FRAMEDATA in the frame layer syntax of Table 266 in Annex L of VC1 standard. In addition, codec assumes that the buffer always contains one full frame-data in it.

Table 266: Frame Layer Data Structure

31 30 29 28 27 26 25 24	23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
KEY	RES	FRAMESIZE : 24
TIMESTAMP		
FRAMEDATA (byte aligned)		

Figure 9-2 Frame layer syntax

9.1.2.1 frameLayerDataPresentFlag for RCV streams

This flag should be used to notify the decoder that frame layer payload is provided in standard or non-standard format.

- Standard Format: All fields of the frame layer are present in the payload.(i.e KEY, RES, FRAMESIZE, TIMESTAMP, FRAMEDATA). This is specified by enabling the frameLayerDataPresentFlag in the IVC1VDEC_Params structure (Explained in Section 4.2.2.1) at create time.
- Non Standard Format: Only FRAMEDATA of the frame layer syntax is present in the payload. This is specified by disabling the frameLayerDataPresentFlag in the IVC1VDEC_Params structure (Explained in Section 4.2.2.1) at create time.

9.2 Advanced Profile

The bit-stream format for an advanced profile stream is as shown in the figure below.

During XDM_PARSE_HEADER, execution, the input bit-stream shall contain SEQ_SC and SEQ_HDR only.

During XDM_DECODE_AU, execution, the input bit-stream contains ENTRY_SC, ENTRY_HDR, FRAME_SC and FRAME_DATA. In an advanced profile stream, multiple SEQ_SC, SEQ_HDR, ENTRY_SC and ENTRY_HDR may occur.

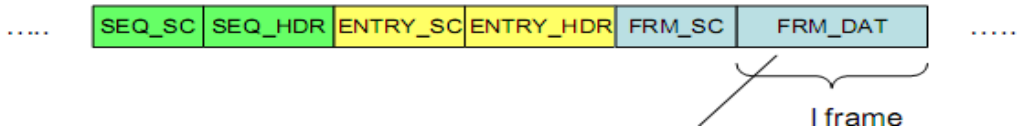

Figure 9-3 Bitstream syntax for an advanced profile stream

For an interlaced stream,

During XDM_PARSE_HEADER, execution, the input bit-stream shall contain SEQ_SC and SEQ_HDR only.

During XDM_DECODE_AU, execution:

- The input bit-stream for the first field data shall contain FRAME_SC, FRAME_HDR and FRM_DATA.
- The input bit-stream for the second field data shall contain FIELD_SC, HDR and FIELD_DATA.

The Frame-header syntax is explained in Table 18, 20 and 22 of VC1 standard. Also, frame start codes are explained in Annex G of the VC1 standard.

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Chapter 10

Meta Data Support

This version of the decoder supports writing out the MB Info data into application provided buffers.

For the details on MB Info data structures, See section 4.2.2.
This feature can be enabled/disabled through create time parameters IVIDDEC3_Params::metadataType[IVIDEO_MAX_NUM_METADATA_PLANES]. There can be maximum 3 (IVIDEO_MAX_NUM_METADATA_PLANES) metadata planes possible to be supported with one instance of the decoder.
Each element of metadataType[] array can take following enumerated values.

Enumeration	Value
IVIDEO_METADATAPLANE_NONE	-1
IVIDEO_METADATAPLANE_MBINFO	0
IVIDEO_METADATAPLANE_EINFO	1
IVIDEO_METADATAPLANE_ALPHA	2

This version of the decoder supports only following enumerated values:

```
IVIDEO_METADATAPLANE_NONE
IVIDEO_METADATAPLANE_MBINFO
```

If user wants to get the Mb info data, then IVIDDEC3_Params::metadataType[0] should be set to IVIDEO_METADATAPLANE_MBINFO.

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

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

- The order of the metadata buffer info supplied using status structure is same as the order set by the user in the metadataType[] array during

create time. For example if the user has IVIDDEC3_Params::metadataType[0] = IVIDEO_METADATAPLANE_MBINFO and then status->bufInfo.minOutBufSize[2] will have the Mb info buffer.

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

- When the application makes the process() call, the pointers to the buffers where Mb info should be stored needs to be provided to the codec in the output buffer descriptor [outputBufDesc.descs].
- OutBufs->numBufs = numBuffers forYUVPlanes + number of meta data enabled (This is = 3 if MB info is enabled)
    - outBufs->descs[0] -> Y plane
    - outBufs->descs[1] -> Cb/Cr plane outBufs.
    - outBufs->descs[2] -> Buffer allocated for Mb info
- Codec internally writes the meta data in appropriate buffer. When the decoder writes the MB info data, the number of metadata planes is indicated by outArgs->decodedBufs.numMetaPlanes (this is 1 if Mb info is enabled)
- Also, the respective buffer pointer is copied back in the first meta-plane pointer: outArgs->decodedBufs.metadataPlaneDesc[0].buf , again the ordering of the metadata is as per the order supplied by IVIDDEC3_Params::metadataType[] input parameter.

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

Decoder shares two types of information at MB Level:

MB Error Map: It's an array of bytes - One byte per MB (Refer Enum IVC1VDEC_ mbErrStatus). The byte indicates whether the MB is in error or not.

MB Info structure: It is a structure which defines properties of a MB. Refer structure IVC1VDEC_TI_MbInfo in ivc1vdec.h file. Size per MB = 192 bytes.

Case1: If the Application sets viddec3Params.metadataType[x] = IVIDEO_METADATAPLANE_MBINFO and IVIDDEC3_Params.operatingMode = IVIDEO_DECODE_ONLY, then

decoder will dump out MB Error Map at buffer location given for MB Info meta data.

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

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

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

Case 1a, Progressive Frame:

Error Map, Size in Bytes = Number of MBs in Frame

Case 1b, Interlaced Frame:

Error Map for Top Field, Size in Bytes = (Number of MBs in Frame / 2)

Error Map for Bottom Field, Size in Bytes = (Number of MBs in Frame / 2)

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

Case 2a, Progressive Frame:

Error Map, Size in Bytes = Number of MBs in Frame

MB Info structure for all MBs, Size in Bytes = 192 * Number of MBs in Frame

Case 2b, Interlaced Frame:

Error Map for Top Field, Size in Bytes = (Number of MBs in Frame / 2)

Error Map for Bottom Field, Size in Bytes = (Number of MBs in Frame / 2)

MB Info structure for all MBs of Top Field, Size in Bytes = 192 * (Number of MBs in Frame / 2)
MB Info structure for all MBs of Bottom Field, Size in Bytes = 192 * (Number of MBs in Frame / 2)

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