MPEG-4 Encoder on DM648

Datasheet

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Contents

1. Features and Validation

1.1 Description

MPEG-4 Simple profile encoder is extensively used for achieving good video quality over a wide range of bit-rates at reasonable computational complexity in applications such as entertainment, surveillance and video streaming.

This document covers the features supported by Ittiam's MPEG-4 Simple Profile encoder, along with the performance footprints.

1.2 Features Currently Supported by the Encoder

1.2.1 Toolsets Supported

The MPEG-4 Simple profile encoder supports the following toolsets -

- Compliant with MPEG-4 Simple profile.
- Support resolution upto D1.
- Supports YUV420, 422P and YUV422i raw video input formats.
- Supports Non Low delay Rate Control to generate a CBR stream over a configurable time window.
- Configurable search range to optimize the tradeoffs between the usage of the internal memory, encoder complexity and performance.
- Supports dynamic change in bitrate and frame rate.
- Support force I frame at run time.
- Supports random access of the bit-stream by inserting periodic headers.
- Supports a simple de-interlacer to encode sequences captured from an interlaced camera
- Supports down-scaling the sequence by a factor of 2 both in the horizontal and the vertical direction, to enable encode of a SIF sequence given a D1 sequence as input.

1.2.2 Interface

- Compliant with TI's XDMI (1.0) interface
- Compliant with TI's IDMA3 and ACPY3 callback function interfaces

1.3 Validation

1.3.1 Method Used

The encoder has been validated by running it on the DM648 platform and measuring the resource usage during this process. The output generated by this process is then decoded by the standard decoder, both to ensure stream correctness and to measure the quality of encoding.

1.3.2 Range Validation

The following table lists down the range of values of the parameters, which are visible to the user through the configuration file, over which the encoder has been tested.

Parameter	Minimum Bound	Maximum Bound

`i4_cap_width`
`i4_src_width`
`i4_tgt_width`
	176	720

`i4_cap_height`
`i4_src_height`
`i4_tgt_height`
	144	576

`i4_init_srch_rng_x`	16	64
`i4_init_srch_rng_y`	16	32
`i4_bit_rate`	32kbps	20000kbps
`i4_max_rc_delay`	500 ms	4000 ms
`i4_trgt_frm_rate` `i4_src_frm_rate`	5000	30000
`i4_num_P_frm_bet_I`	15	60

Table 1-1 Validation of the Ranges of Critical Parameters of Encoder

Note Please note that the ranges mentioned in table apply to each of the parameters individually and does not suggest that the encoder has been necessarily tested on a configuration formed by using the minimum or the maximum bounds of all the parameters mentioned in the table below.

2. Performance and Resource Usage

2.1 Settings Used

Since the performance is highly sensitive to the hardware and other settings, these are detailed below:

2.1.1 Clock Settings

The clock settings for the relevant modules of the DM648 are covered below. For more details refer [1].

Module	Clock Frequency (MHz)
C64x+	720
Coprocessors	360
DDR	266.5

Table 2-1 Clock Frequencies of Various Modules

2.1.2 Memory Layout

The sizes of the different types of memory used while measuring the performance of the encoder are given below:

Memory Name	Type	Size
L1P	Program Memory (Internal)	0 KB
L1P Cache	Instruction cache	32KB
L1D	Data Memory (Internal)	16 KB
L1D Cache	Lowest level Data cache	16 KB
L2 Cache	Cache at L2 level	128KB
L2	Program and Data Memory	384 MB
DDR	External memory (both program and data)	256 MB

Table 2-2 Memory Configuration used for Performance Benchmarking

The performance is highly sensitive to the size of all memory sections except that of DDR. The amount of DDR required depends on the system requirements as well as codec requirements.

2.1.3 Software Versions

The versions of the relevant software are mentioned below.

Software	Version
CCS	3.3.67
DSP CGTools	6.0.10

Table 2-3 Versions of all the Software

2.2 Resource Usage

2.2.1 Memory Usage for a single instance

The usage of memory by one instance of encoder is shown below.

Dimension	Code (KB)	Ext data (KB)		Int data (KB)		Tables (KB)	Stack (KB)
		Persistent	Scratch	Persistent	Scratch		
176 x 144	210	250	-	-	47	5	6
352 x 288	210	700	-	-	48	5	6
640 x 480	210	2000	-	-	50	5	6
720 x 480	210	2200	-	-	52	5	6
720 x 576	210	2500	-	-	52	5	6

Table 2-4 Memory Usage for a single instance

The following points should be noted about these numbers:

- Input / Output buffers are excluded from external memory numbers
- The internal memory is not used for storing the persistent data
- Code is dynamically downloaded to L1P memory within a process call
- Internal memory numbers are inclusive of the memory required for the ACPY library

2.2.2 Memory usage for N instances

The following table illustrates the memory usage by N instances of the encoder. The numbers in the **Table 2-5** should be interpreted in the same way as the numbers in the **Table 2-4**.

Dimension	Code (KB)	Ext data (KB)		Int data (KB)		Tables (KB)	Stack (KB)
		Persistent	Scratch	Persistent	Scratch		
176 x 144	210	250 x N	-	-	47	40	6
352 x 288	210	700 x N	-	-	48	40	6
640 x 480	210	2000 x N	-	-	50	40	6
720 x 486	210	2200 x N	-	-	52	40	6
720 x 576	210	2500 x N	-	-	52	40	6

Table 2-5 Memory Usage for N instances

2.2.3 Coprocessor Memory Usage

The memory usage for the coprocessor memories are mentioned as follows:

Memory	Usage (kilo bytes)
SEQ Data Memory	1
SEQ Program Memory	4
Image Buffers	32
iMX CMD Mem	16
iMX Working Mem	8

Table 2-6 Memory Usage for Coprocessors

The encoder treats these memories as scratch

2.2.4 DMA Usage

The codec requires 4 the following DMA resources.

- 4 EDMA handles
- 4 QDMA handles
- 21 PARam entries

2.3 Processor Loading

Content				MCPS	
Content	Dim	R (kbps)	fps	Avg	Peak
Mobcal	320 x 240	512	30	46	51
Parkrun	320 x 240	512	30	45	48
Shields	320 x 240	512	30	46	49
Mobcal	352 x 240	768	30	53	58
Parkrun	352 x 240	768	30	51	54
Shields	352 x 240	768	30	51	54
Mobcal	720 x 480	2000	30	187	207
Parkrun	720 x 480	2000	30	194	213
Shields	720 x 480	2000	30	191	204

Table 2-7 Processor Loading in Terms of Average and Peak MCPS

3. Glossary

Terms	Explanation
ACPY	Software module that abstracts DMA transfers from the codec
CAL	Codec Abstraction Layer. A library that abstracts the codec interface from the application, so that all the codecs have similar looking interfaces.
CBR	This term is used to characterize the output the encoder. It implies that the output of the encoder needs to be consumed at a constant rate.
DDRAM	Double Data Random Access Memory. It can transmit data with greater bandwidth since it pumps the data both at the rising and the falling edge of the clock signal.
DMAN	DMA Manager. This is responsible for managing the DMA resources in the system
Encoder	Software that takes in uncompressed content (in this case, video) and compresses it into data that is in accordance with a predefined specification
MCPS	Million Cycles Per Second. This parameter describes the performance of any software on a given processor. For example, when we say a codec takes 100 MCPS on a given processor, it means that it consumes 100 Million cycles of the processor every second.
PSNR	Peak Signal to Noise Ratio. This parameter characterizes the amount of distortion in an encoded video by comparing it with the original uncompressed video. The distortion is quoted by taking the ratio of peak signal strength of video to noise strength and converting the ratio to logarithmic scale (dB or Decibels)

4. References

[1] TMS320DM420 Digital Media System-on-Chip SPRS281-APRIL 2005

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