MPEG-2 Encoder on the DM642 EVM

Video and Imaging Systems

ABSTRACT

The software demonstrates real-time D1 MPEG-2 encoding on the DM642 EVM. The demonstration encodes the captured frames and displays all the frames from the reconstruction loop of the encoder.

The demonstration uses:

• MPEG-2 encoder library optimized for DM642 EVM capable of real-time D1 encoding

• MPEG-2 encoder library implemented using XDAIS interfaces

• Sample integration of the MPEG-2 encoder library using RF-5 framework

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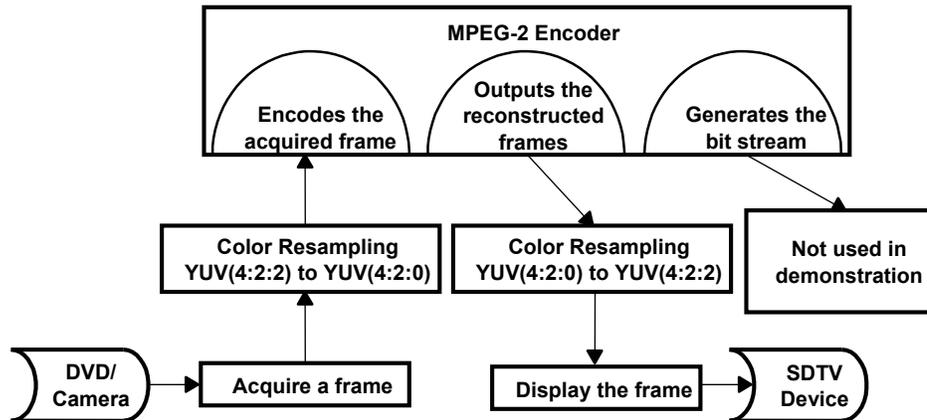
Figure 1.   Demonstration Data Flow for MPEG-2 Encoder

The demonstration data flow reflects the following sequence:

1. A frame is captured from the input source (DVD/camera).

2. The acquired frame data, which is in YUV 4:2:2 format, is resampled to YUV 4:2:0 format.

3. The frame is fed to the MPEG-2 encoder library.

4. The MPEG-2 encoder encodes the input frame.

5. The MPEG-2 encoder reconstructs all the coded frames to output the same.

6. The MPEG-2 encoder outputs the coded bit-stream, which is not used in the demonstration.
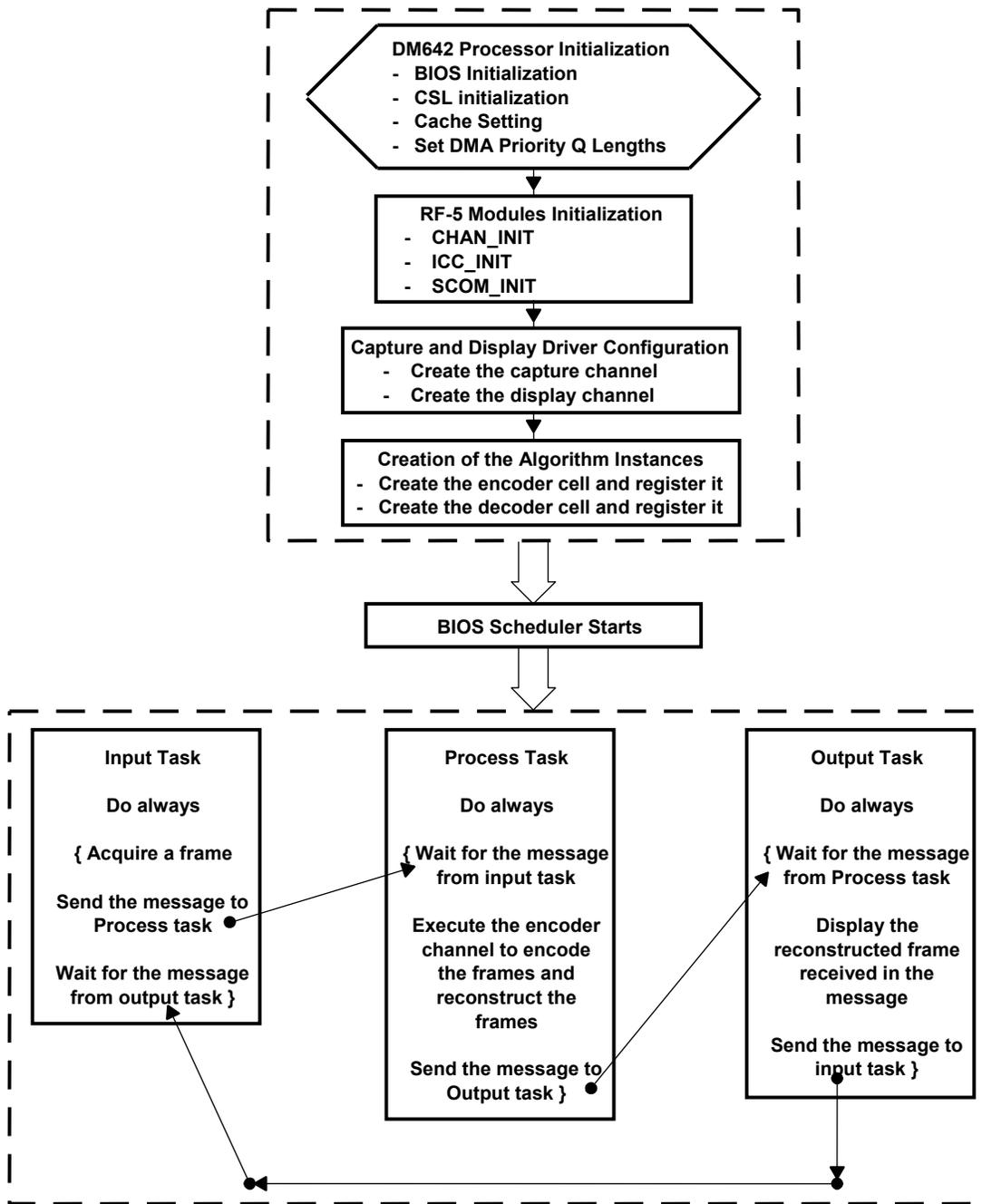
Figure 2. Framework Flowchart for MPEG-2 Encoder

The demonstration uses RF-5 framework to integrate the MPEG-2 encoder library. The demonstration uses a three-task setup. Before coming to the DSP BIOS™ task scheduler, the demonstration code initializes various modules used in the system:

• Board and processor

– DSP BIOS™ initialization and CSL initialization

– L2 cache mode set to 64K cache

– EMIFA CE0 and EMIF CE1 space enabled for caching

– Sets the DMA priority queue lengths set to maximum

– L2 request set as high

- RF- 5 modules

 – The system initializes the channel module of RF-5.

 – The system initializes ICC and SCOM modules of RF-5 required for intercell communication and messaging.

 – Channel setup is performed with the internal, external, and scratch heap buffers.

- Capture and display channels

 – An instance of capture channel is created and started.

 – An instance of display channel is created and started.

After these initializations, the system enters the three-task system managed by the DSP BIOS™ scheduler. These three tasks use the SCOM module of RF-5 to communicate with each other:

- Input task

 The input task acquiries the frames from the NTSC input device. It uses FVID_exchange calls provided by the driver to acquire a frame. The acquired frame is in YUV 4:2:2 format and is resampled to YUV 4:2:0. The task then sends the message to the process task with the frame pointer embedded in the message. The task then waits for the message from output task to continue.

- Process task

 The process task encodes frames by executing the MPEG-2 encoder channel. It waits until it receives the message, with input frame, from the input task. The MPEG-2 encoder channel encodes the frame and generates the encoded bitstream. The MPEG-2 encoder also outputs the reconstructed frame from the feedback loop of MPEG-2 encoder. It then sends the message to output task with the output frame pointer(reconstructed frame) embedded in the message. The task then waits for the message from input task to continue.

- Output task

 The output task displays the frames on the NTSC output device. It uses FVID_exchange calls provided by the driver to display a frame. The acquired frame is in YUV 4:2:0 format and is resampled to YUV 4:2:2 format. The task sends the message to the input task to continue, and then it waits for the message from the process task to continue.

System Requirements/Configuration

Software Requirements

- Microsoft Windows NT (SP6)/Microsoft Windows 2000 (SP1 and SP2)

- Code Composer Studio™ Integrated Development Environment (IDE) version 2.20.18

- Driver software (DDK 1.1)

Hardware Requirements

- Pentium machines with 450 MHz, 64MB RAM (minimum)

- DM642 EVM

- NTSC TV for display purposes

- Camera/DVD for NTSC capture purposes

- XDS 510/560 emulator

Hardware Setup
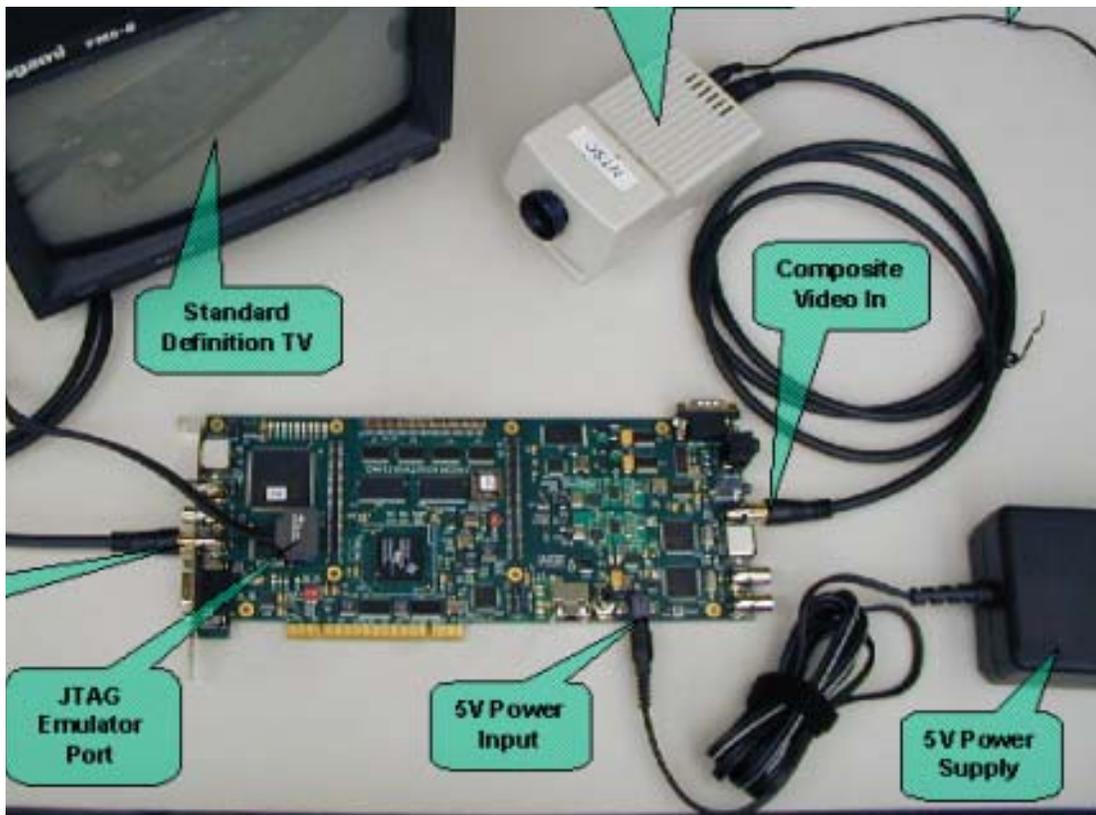
Figure 3.   Hardware Setup for MPEG-2 Encoder

To run the demonstration, set up the hardware as shown:

- Connect the XDS510/560 emulator to JTAG pins to download the demonstration code to the board and control it from Code Composer Studio™ IDE.

- Connect the input video port (for composite video) to the NTSC input source (DVD/camera) using RCA cable as shown.

- Connect the output video port (for composite video) to the NTSC output device (SDTV) using RCA cable as shown.

- Connect the DM642 EVM to the appropriate power source.

Demonstration Execution

To run the demonstration, perform the following steps:

1. Set up the hardware as described in the *Hardware Setup* section.

2. Power up the DM642 EVM board.

3. Start Code Composer Studio™ IDE (version 2.20.18).

4. Check the color bar on the output device.

5. Load the .out from the debug folder as shown in the directory structure figure.

6. Ensure the presence of encoder parameter file (test.par) in the same directory as the .out

7. Retain the name of the parameter as test.par, as this is hard-coded in the code. You can make the desired changes inside the parameter file with the restrictions as suggested in the *Known Bugs and Constraints* section.

8. Once the program is loaded, go to the Debug Menu and press Run option (or press F5).

9. On the output screen, watch the reconstructed output from the feedback loop of MPEG-2 encoder, with the TI logo on the top-right corner of the frames.

Demonstration Code and Build Procedure

The demonstration code for MPEG-2 Encoder is located in evmdm642\examples\ video\mpeg2_encoder directory.
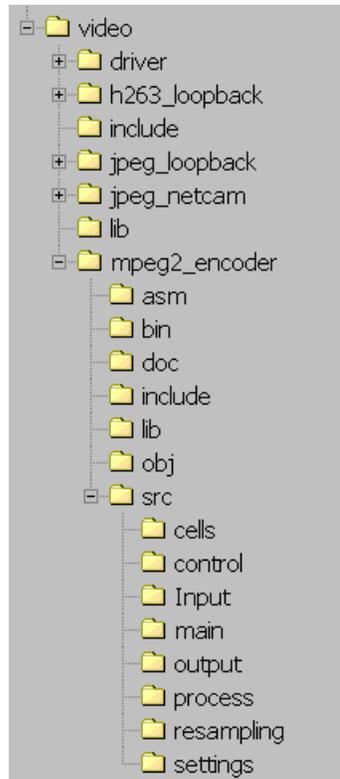
Figure 4.   Directory Structure for mpeg2_encoder

Build Procedure

1. Start Code Composer Studio™ IDE version 2.20.18

2. Open MPEG-2 encoder project (mpeg2enc.pjt) from examples\video\MPEG2_Encoder folder.

3. Go to Project->Build Options->Compiler->Preprocessor and define the symbols as required for appropriate demonstration setup.

    Default options: Always define the following for proper compilation of the demonstration –

    NTSC, CHIP_DM642, and C6000

4. If the C_DIR is not defined or the DDK package has been installed outside the Code Composer Studio™ IDE folder, modify the include paths to point to appropriate <ccs install dir>\ti\… paths in project build options. If the C_DIR is defined properly, there is no need to modify the include paths.

5. Build the project and load the executable mpeg2enc_dm642.out build in the examples\video\MPEG2_Encoder\bin directory.

6. Before running the executable, make sure the input (camera/DVD) and output (SDTV) are connected correctly. For all input purposes and for SDTV output purposes, RCA cables must be used.

7. Press F5 to watch the reconstructed output from the feedback loop of MPEG-2 encoder.

Known Bugs and Constraints

The MPEG2 libraries in the project have been compiled to work in conformance with the main profile @ main level (MP@ML) as suggested in the ISO/IEC document 13818-2:1995.

The encoder parameters in the test.par file can be modified with few restrictions:

- Options that are highlighted in bold italics can be changed according to the input and computation bandwidth available. All other parameters are either fixed or not fully tested.

```
- /* name of source files. */
- /* name of reconstructed images ("-": don't store) */
- /* name of intra quant matrix file ("-": default matrix) */
- /* name of non intra quant matrix file ("-": default matrix) */
- /* name of statistics file ("-": stdout ) */
1 /* i /* input picture file format: 0=*.Y,*.U,*.V, 1=*.yuv, 2=*.ppm */
1024 /* number of frames */
0 /* number of first frame */
00:00:00:00 /* timecode of first frame */
15 /* N (# of frames in GOP) */
3  /* M (I/P frame distance) */
0 /* ISO/IEC 11172-2 stream */
0 /* 0:frame pictures, 1:field pictures */
720 /* horizontal_size */
480 /* vertical_size */
2 /* aspect_ratio_information 1=square pel, 2=4:3, 3=16:9, 4=2.11:1 */
5 /* frame_rate_code 1=23.976, 2=24, 3=25, 4=29.97, 5=30 frames/sec. */
8000000.0 /* bit_rate (bits/s) */
112 /* vbv_buffer_size (in multiples of 16 kbit) */
0 /* low_delay */
0 /* constrained_parameters_flag */
4 /* Profile ID: Simple = 5, Main = 4, SNR = 3, Spatial = 2, High = 1 */
8 /* Level ID: Low = 10, Main = 8, High 1440 = 6, High = 4 */
0 /* progressive_sequence */
1 /* chroma_format: 1=4:2:0, 2=4:2:2, 3=4:4:4 */
2 /* video_format: 0=comp., 1=PAL, 2=NTSC, 3=SECAM, 4=MAC, 5=unspec */
5 /* color_primaries */
5 /* transfer_characteristics */
4 /* matrix_coefficients */
720 /* display_horizontal_size */
480 /* display_vertical_size */
0 /* intra_dc_precision (0: 8 bit, 1: 9 bit, 2: 10 bit, 3: 11 bit */
1 /* top_field_first */
0 0 0 /* frame_pred_frame_dct (I P B) */
0 0 0 /* concealment_motion_vectors (I P B) */
1 1 1 /* q_scale_type (I P B) */
1 0 0 /* intra_vlc_format (I P B)*/
0 0 0 /* alternate_scan (I P B) */
0 /* repeat_first_field */
0 /* progressive_frame */
0 /* P distance between complete intra slice refresh */
0 /* rate control: r (reaction parameter) */
0 /* rate control: avg_act (initial average activity) */
0 /* rate control: Xi (initial I frame global complexity measure) */
0 /* rate control: Xp (initial P frame global complexity measure) */
0 /* rate control: Xb (initial B frame global complexity measure) */
0 /* rate control: d0i (initial I frame virtual buffer fullness) */
0 /* rate control: d0p (initial P frame virtual buffer fullness) */
0 /* rate control: d0b (initial B frame virtual buffer fullness) */
6 5 63 63 /* P: forw_hor_f_code forw_vert_f_code search_width/height */
4 4 15 15 /* B1: forw_hor_f_code forw_vert_f_code search_width/height */
5 5 31 31 /* B1: back_hor_f_code back_vert_f_code search_width/height */
5 5 31 31 /* B2: forw_hor_f_code forw_vert_f_code search_width/height */
4 4 15 15 /* B2: back_hor_f_code back_vert_f_code search_width/height */
```

Figure 5.   MPEG-2 Encoder Parameter File

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