Jointwave H.264 Encoder Live Demo User Guide

Altera Development Kit Edition

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1. INTRODUCTION

Jointwave H.264 Encoder Live Demo provides an evaluation version of E240/E260, E340/E360, E440/E460, E540/E560, E640/E640 demo on Altera's standard FPGA development board.

Demos on Altera DK-DEV-3SL150N board:

Encoder Model	Profile	GOP	1920x1080p FPS	1280x720p FPS
E660	Main	I+P	0 to 60	0 to 144
E560	Baseline	I+P	0 to 60	0 to 144
E460	Main	I+P	0 to 60	0 to 144
E360	Main	I only	0 to 60	0 to 144
E260	Baseline	I only	0 to 60	0 to 144

Demos on Altera DK-DEV-3C120N board:

Encoder Model	Profile	GOP	1920x1080p FPS	1280x720p FPS
E640	Main	I+P	0 to 30	0 to 72
E540	Baseline	I+P	0 to 30	0 to 72
E440	Main	I+P	0 to 30	0 ~ 72
E340	Main	I only	0 to 30	0 to 72
E240	Baseline	I only	0 to 30	0 to 72

There are several limitations of evaluation version comparing with formal version:

- Logo : The evaluation encoder added a "*Jointwave*" logo on right-bottom position of the encoded video
- Time Limitation: The evaluation encoder can work continuously for *four hours* after power up or reset, then the encoder might stop working or the output data might be corrupted, Pressing an user button on the FPGA board to reset would resume the encoding to work continuously for another four hours.
- Bitrate Limitation: The demo only provides 4 different settings of bitrate for each Encoder Model by two switches on the FPGA board. You can set any bitrate in valid range by formal version.
- Resolution Limitation: The demo supports only two resolutions 1920x1080 and 1280x720. The formal version supports resolution from 176x144 to 4000x4000 or even larger.
- GOP Size: evaluation version is limited to 60 for I+P or 1 for I-only, formal version can be any value in valid range.
- Automatic Resume: The demo doesn't provide automatic resume on subsequent errors:
  - Signal Interrupt: Caused by video inputting cable disconnected and re-connected.
  - Entropy FIFO overflow

The formal version provides tools to resume from those errors.

2. REQUIREMENTS

1. All demos require a Bitec HSMC DVI daughter board, it can be purchased from Bitec's website:

    http://www.bitec.ltd.uk/hsmc_dvi.html

2. E440/E540/E560 Demo requires Altera DK-DEV-3C120N development board:

    http://www.altera.com/products/devkits/altera/kit-cyc3.html

    We recommend to install a 15mm to 20mm high heat sink for the DK-DEV-3C120N when the ambient temperature higher than 25 ° C. The CycloneIII FPGA runs at 133MHz, the total power consumption is 1W to 1.9 W to encode 1080p@30fps, including the encoder, peripheral modules, PLLs and I/O.

    E460/E560/E660 Demo requires Altera DK-DEV-3SL150N development board:

    http://www.altera.com/products/devkits/altera/kit-siii-host.html

    It's necessary to install a 20mm to 40mm high heat sink and a 40mmx10mm fan for the DK-DEV-3SL150N. Because the FPGA runs at 266MHz, the total power consumption is 4W to 5 W to encode 1080p@60fps, including the encoder, peripheral modules, PLLs and I/O. *Without heat sink and fan, the StratixIII will be overheated and function erroneously in a short time.*

    The 1GB DIMM in the DK-DEV-3SL150N package should be installed before running the Demo.

3. A video source able to output HDMI/DVI signal at 1920x1080p or 1280x720p resolution and at following refresh rate:

    ➢ 60, 50, 30, 25 or 24 Hz for E460/E560/E660 Demo
    ➢   30, 25 or 24 Hz for E440/E540/E640 Demo

4. A HDMI-DVI cable which complies with HDMI 1.3 standard.

5. A PC or laptop with subsequent configuration:

    ➢ CPU frequency should be at least 1.6GHz
    ➢ A Gigabit Ethernet adapter
    ➢ Windows XP or Windows Vista
    ➢ Optional, a screen with resolution 1920x1200 or 1920x1080, could be external.

    Thinkpad laptop T60, T61, T400, T500, X60, X61 are tested in Jointwave laboratory, all work well.

6. A 1 to 3 meter long CAT6 Ethernet cable to connect the FPGA board and the PC. The quality of cable and its RJ45 head is important, because the Demo doesn't have error correcting mechanism such as TCP in Ethernet transmission. A high quality cable is essential to guarantee that 100% Ethernet packets are transmitted and received successfully.

3. SETUP AND RUN PROCEDURE

1. Contact Jointwave to get the demo suit, which comprises of:

    A. A FPGA image file, SOF format for Altera
    B. Demo Supporting Package
        Following files are included in Jointwave demo supporting package:

        > win_pcap_XXXX.exe
        > vcredit_x86.exe
        > etherdump.exe
        > mplayer.exe

2. Install winpcap_XXXX.exe in Jointwave demo supporting package onto your PC

3. Install vcredist_x86.exe in Jointwave demo supporting package onto your PC

4. Install Bitec DVI daughter board on either Part A or Port B of the development board depending on the SOF file you get:

   If there is no "PortB" string in the SOF file name

    > HSMC port **A** on DK-DEV-3C120N
    > HSMC port **A** on DK-DEV-3SL150N

    If there is a "PortB" string in the SOF file name

    > HSMC port **B** on DK-DEV-3C120N
    > HSMC port **B** on DK-DEV-3SL150N

5. Check if a 1GB DIMM is firmly installed if your board is DK-DEV-3SL150N.

6. Connect video source, FPGA board and PC together as following picture.

Jointwave H.264 Encoder Demo Setup Diagram
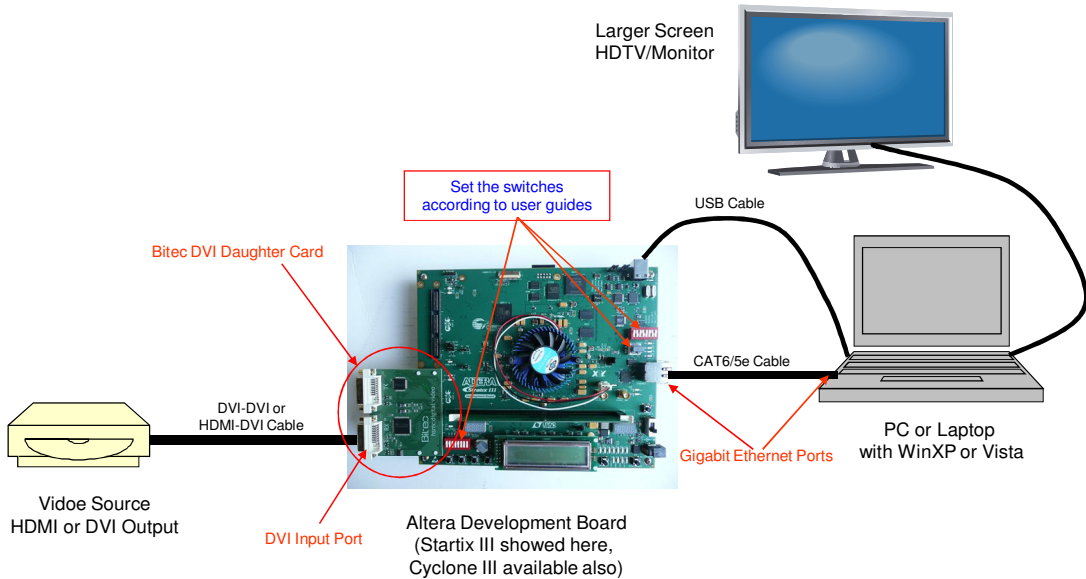
7. Set *USER DIPSWITCH* on FPGA board by your resolution, bitrate and other parameters, refer to Chapter 4 for details.

8. Power up the FPGA board and program the SOF file you want to run by *Altera QuartusII* or *QuartusII Programmer* software. Since the DK-DEV-3C120N board and DK-DEV-3SL150N all don't reset after programming, a reset is required after programming. On both boards, button *USER_PB0* does the resetting.

9. Power up your video source – which could be a blue-ray player or hard disk HD player. It's safe for some players to be powered up after the FPGA board has been powered up. Because some players need correct EDID information from the DVI or HDMI daughter board to set the HDMI output in adequate mode.

10. Open a command prompt window and run etherdump.exe in Jointwave demo supporting package, it will list all the network cards and prompt you to select the correct device as shown by following example (Note: If your operating system is Windows Vista, you need to run a command prompt windows "*as Adminstrator*" even you are the administrator, then run etherdump.exe in it):

> No adapter selected: printing the device list:
> 1. \Device\NPF_{9ADFE0B9-683F-446A-A962-EAEB5A2062D8}
>   (MS Tunnel Interface Driver)
> 2. \Device\NPF_{115E1410-4E51-4B9C-B62D-566359FCF6A5}
>   (Intel(R) PRO/1000 PL Network Connection)
> 3. \Device\NPF_{CAA92102-B1D4-4C95-AE49-ECBEC31B2B4A}
>   (Microsoft)
> Enter the interface number (1-3):

Select the correct device, in the example it's 2.

Next the program will prompt "Enter the dump-file-path:". Just input the file name to dump the h.264 stream from Ethernet cable, such as "a.264".   (Note: If the SOF file name contains "ts" string which means it's an h264+ts demo, the suffix of the stream name should be ".ts").

Then the program will prompt "Enter how many Ethernet packets per dump (valid range 1 to 16384):". Refer to following table to input an adequate value.

Target Bitrate (Mbps)	Suggested Packets Per Dump value
4 and lower	512
8	1024
16	2048
32	4096
64	8192
128 and larger	16384

Tip: After first running, you can combine the inputted answers to create a .bat file, for example:

File *myetherdump.bat:*
etherdump \Device\NPF_{115E1410-4E51-4B9C-B62D-566359FCF6A5} a.264 1024

Then you just type the command "myetherdump" to run it.

11. After a few seconds, you can see following text is printing and scrolling on the command windows:

0 * 1048576 S00 PktErr= 0
1 * 1048576 S01 PktErr= 0
2 * 1048576 S02 PktErr= 0
……….

Every time, the program etherdump.exe dumps "PacketPerDump" number of 1024bytes Ethernet packets onto the hard disk and prints one line text on command window.

Now you can play the dumped file by mplayer.exe in Jointwave demo supporting package, providing your file name is a.264 and the video source's frame rate is 30, the mplayer.exe command line is:

mplayer a.264 -fps 30

Or if the SOF name contains "ts", it's a h264+ts demo, the command line is:

mplayer –demuxer lavf a.ts

Note: If PktErr doesn't equal to 0, it means some Ethernet packets are already lost, thus mplayer will report error and some video frames might be partially corrupted too. The Demo doesn't have error correcting mechanism such as TCP in Ethernet transmission, but we designed etherdump.exe to make the possibility of packet loss infinitesimal.
Disabling SpeedStep of CPU on laptop helps to reduce packet loss further. It can be done in BIOS or by some software, e.g. RightMark CPU.

12. Refer to Chapter 4 for changing encoding parameters and observing status and error of the encoder by switches and LEDs on the FPGA board.

13. You can observe the live bitrate chart by Windows Task Manger.

Setup 1.   Open Windows Task Manger, then switch to page "Networking".
Setup 2.   Menu View → Network Adapter History → Bytes Received (Yellow).

4. FPGA BOARD CONFIGURATIONS

4.1.   Reset

On both DK-DEV-3C120N and DK-DEV-3SL150N board, button **USER_PB0** resets the FPGA.

4.2.   Configuring the Encoder by USER DIPSWITCH

On both DK-DEV-3C120N and DK-DEV-3SL150N board, **USER DIPSWITCH** configures the parameters of the Encoder:

SW0

1	Activate the encoder
0	Deactivate the encoder

SW1

1	Video source is 1920x1080p
0	Video source is 1280x720p

SW2

1	Constant Bitrate Mode rate control (CBR)
0	Const QP Mode rate control (CQR)

SW3 is not used

SW5, SW4 in CBR Mode (when SW2 == 1), Bitrate Configuration (Mbps)

The following table shows the output bitrate (in Mbps) for each board with different inputs.

Note 1: The encoder will adapt to the input frame rate if it's within the maximum limit, and the bitrate is proportional to the FPS. For example, SW5,SW4=1,0 on DK-DEV-3SL150N with 1080p@60fps input, the output is 16Mbps; when the input is 1080@30fps, the output is 8Mbps.

Note 2: These tables show the bitrate for standard demo. If you get a customized demo SOF, please refer to the email or readme file come with it for bit rate setting.

1. For **DK-DEV-3SL150N** board

    a)   **1080p@60fps** input

SW5	SW4	E260/E360/E560	E460/E660
0	0	128	50
0	1	64	32
1	0	32	16
1	1	16	8

    b)   720p@60fps input

SW5	SW4	E260/E360/E560	E460/E660
0	0	128	100

0	1	64	32
1	0	32	16
1	1	16	8

2. For **DK-DEV-3C120N** board

a) **1080p@30fps** input

SW5	SW4	E240/E340/E540	E440/E640
0	0	64	50
0	1	32	16
1	0	16	8
1	1	8	4

b) **720p@60fps** input

SW5	SW4	E240/E340/E540	E440/E640
0	0	128	Invalid
0	1	64	32
1	0	32	16
1	1	16	8

SW5,SW4 in CQR Mode (SW2 == 0)

SW5	SW4	QP
0	0	16
0	1	24
1	0	32
1	1	40

SW6

1	Invert DVI vsync signal's polarity
0	Keep DVI vsync signal's polarity

SW7 (E5X0/E6X0 Only)

1	I frame only *(note: CBR mode is unavailable in current E5X0/E6X0 demo's I-Only mode)*
0	I + P frame

4.3. LED

LED0	On: DDR2 controller is initialized successfully Off: DDR2 controller doesn't work
LED1	On: ERROR, Entropy FIFO overflows Off: good state
LED2	On: ERROR, Sensor's data rate is higher than the Encoder's encoding capacity Off: good state
LED3	Blinking: Encoder is sending output byte stream Off: No output from Encoder
LED4	connect to Vsync signal of video inputting interface
LED5	connect to Data Enable (or Href) signal of video inputting interface
LED6	connect to All Data signals' OR of video inputting interface
LED7	*Note: For H.264+TS demo only, If the SOF file name contains "ts" string, it's a*

	H.264+TS demo file. On: TS Mux is working Off: TS Mux is not working Button USER_PB1 is used to switch on/off TS Mux.
TX (Ethernet)	On to indicated encoded H.264 stream is outputting from the Gigabit Ethernet chip

4.4. Example of Setup and LEDs

Here is an example where you can start the demo with.

For E440 on Altera DK-DEV-3C120N board, when the input is 1080p 30fps video, and you want the output to be 4Mbps, set the DIP switches as following:

SW0	SW1	SW2	SW3	SW4	SW5	SW6	SW7
1	1	1	1	1	1	0	0

After programming the SOF file and connected video input, the LEDs status should be like this:

LED0	LED1	LED2	LED3	LED4	LED5	LED6	LED7
On	Off	Off	Flashing	Dim	On	On	Off

Near the RJ45 connector:

D1(10)	D3(100)	D4(1000)	D6(DUPLEX)
Off	Off	On	On

On the RJ45 connector:

Left	Right
Flashing	On

5. TROUBLE SHOOTING

Problem	Possible Cause(s)	Solution(s)
LED0 is off	The board is not programmed correctly.	1. Check the program cable 2. Double check if the correct SOF file is used.
LED4 is total off (It shall be dimly lit)	No DVI V-Sync	1. Check if the Bitec DVI card is firmly installed 2. Check if the video source is on and playing
LED4 is steadily and fully on	1. The resolution setting doesn't match 2. V-Sync polarity is wrong. 3. Bitec DVI card connection problem	1. Check if SW1 setting match the video source resolution 2. Change setting of SW6. (From 1 to 0 or from 0 to 1) 3. Check if the Bitec DVI card is firmly installed
D4(1000) and D6(DUPLEX) are off	4. The board is not programmed correctly. 5. The PC Ethernet port is not GE. 6. Ethernet cable connection is broken. 7. Ethernet PHY is damaged.	1. Check if the correct SOF file is used. 2. Make sure the PC Ethernet port is Gigabit Ethernet, not 10/100Base-T 3. Replace the Ethernet cable 4. Contact Development kit vendor for RMA
LEDs on RJ45 Jack are totally off	Problem in Ethernet cable connection	1. Replace the Ethernet cable
LEDs on PC Ethernet port are off	Problem in Ethernet cable connection	1. Replace the Ethernet cable
LED3 is not flashing	Encoder is not activated	1. Check if SW0 is set to "1".