

EXPERIMENTAL MODEL OF VIDEO AND AUDIO MPEG4 ENCODER WITH IP STREAMING AND TRANSPORT OVER FIBER OPTIC MEDIA

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Abstract

The goal of this paper is to show capabilities of MPEG4 encoder based on Hisilicon 3507 chip. Input live video feed is encoded and streamed into local area network. Two optical media convertors are included to extend maximum streaming distance. Different configurations are tested and results are shown. Practical applications are suggested.

Keywords: IPTV; IP Camera; CCTV; MPEG4 encoder.

INTRODUCTION

This experimental model of MPEG4 encoder is based on Hisilicon 3507 network solutions board, using the embedded Linux operating system, supporting 720P@25fps HD video, with industry-leading international standard H264 video compression algorithms, H264, MJPEG encoding, can easily achieve high-definition image of low transmission network bandwidth [1, 4].

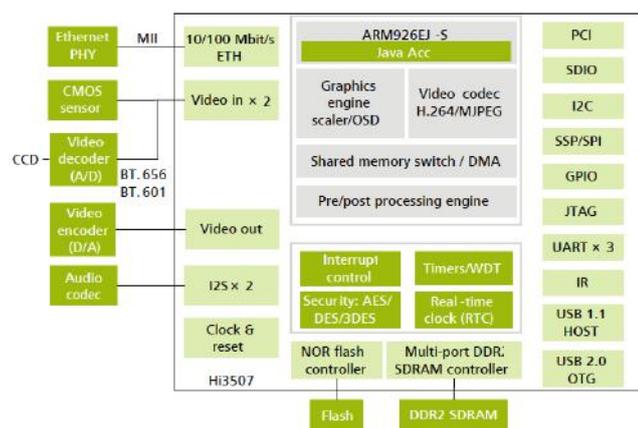


Fig. 1. Hi3507 block diagram

The Hi3507 is a high-performance communication media processor that has an ARM core and a video acceleration engine. With the features of high integration, programming, and compatibility with the protocols such as H.264 and MJPEG, the Hi3507 is applicable to instant video communication, digital image surveillance, and IP camera. The video processing unit supports H.264 baseline profile, MJPEG, and JPEG real-time encoding, 720p at 30

fps, and 3-megapixel JPEG snapshot. Block diagram of Hi3507 board is shown on Fig. 1. The H.264 encoding algorithm improves the video quality and supports encoding by field or frame, which facilitates the display of various display terminals. The video processing unit also supports dual-stream encoding. That is, MJPEG and H.264 streams can be encoded simultaneously. The graphics processing unit supports the deinterlace algorithm, motion detection, video/image scaling, and OSD [2, 3].

EXPERIMENTAL ARRANGEMENT

Experimental model consists of four modules as shown on Fig.2. Input data represent video and audio signal coming from CCTV camera or DVB-T set-top-box. First module is MPEG4 encoder and is responsible for encoding input signal. Then signal is transmitted to second module where it is streamed over local area network 1. Generated IP stream is send to Transceiver 1 witch is optical media convertor. There electrical signals are transformed to optical and send over fiber optic cable. Last module converts back optical signal to electrical and send IP traffic to local area network 2. Two transceiver modules are not essential for experimental model to work and they are only to represent different physical media types.



Fig. 2. Block diagram

Based on this block diagram is assembled experimental model board. All modules are presented on board and all inputs and outputs are bring out for easier connection of different modules. This gives opportunity to make changes

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on module connections on demand and connect external equipment to experimental board. Layout of the board is presented on Fig.3.

Two additional modules are presented. One is for unified power supply for all modules and the other is for connecting serial interface RS-232 to Hi3507 module. This interface can be used for command and control of CCTV camera or to manage DVB-T set-top-box.

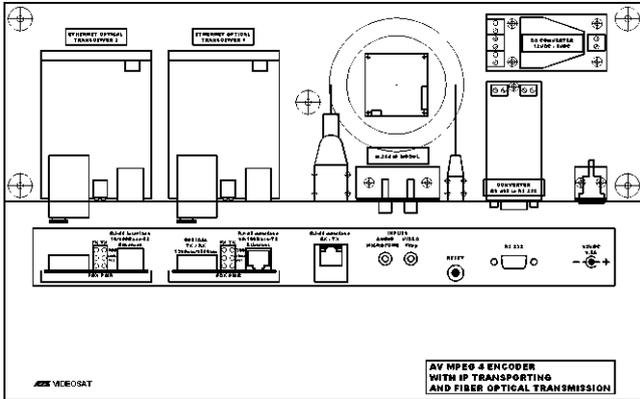


Fig. 3. Board layout

Board consists of following modules from left to right:

1. Optical Media Converter – 2 pcs
2. Hisilicon 3507 board
3. Converter RS-485 to RS-232
4. Power supply – DC Converter 12VDC/5VDC

Video and audio inputs are bring out with RCA connectors. Serial interface RS-232 is connected with DB9 interface with Standard Serial RS232 cable. IP streaming module and optical media convertor are connected with UTP Cat5E patch cable with RJ-45 connectors. Maximum length of this cable is 100 m. Two media convertor modules are connected with Optical Fiber patch cable with SC Fiber connectors. Maximum cable length with single-mode fiber is about 20 km. Power supply is external adaptor connected to AC 220 V power grid converting down to DC 12 V with 1,5 A max current and max power 18W. Full assembled board with patch cables is presented on Fig.4.



Fig. 4. Assembled model outlook

Operating system installed on Hisilicon 3507 board is open source Linux based. There is web interface embedded in board, client surveillance software and SDK for development of additional software. MPEG4 encoder parameters can be configured via web interface or client

software. Configuration example of encoder is shown on Fig. 5.

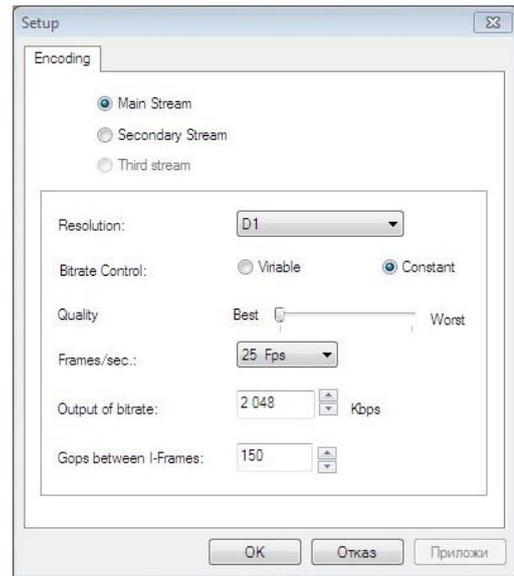


Fig. 5. Configuration screenshot

Web interface can be accessed from following URL:

$$\text{http://10.240.58.123/} \quad (1)$$

Where 10.240.58.123 is configured IP address of the board. Resulted video and audio feed can be reviewed. There is also buttons for CCTV camera control over serial interface.

Another way to access streamed video and audio signal is with media player like VLC [2] from client device on following URL:

$$\text{rtsp://10.240.58.123:554/ch0_0.h264} \quad (2)$$

Client device can be connected to LAN1 or LAN2 from Fig.2. The IP address of client device must be from the same network as encoder board or network router can be added for remote access. If there is firewall installed between encoder board and clients few rules must be added to allow web interface and streamed video traffic on ports 80 and 554.

RESULTS

All configuration parameters are changed via web interface of experimental board shown on Fig. 5. Following parameters are object of conducted experiments:

- Resolution
- Bitrate control
- Quality
- Frames/sec
- Gops between I-frames

Traffic measurement is conducted with PRTG Network Monitor Software [3]. PRTG Network Monitor is a powerful network monitoring application for Windows-based systems. It is suitable for small, medium, and large networks and capable of LAN, WAN, WLAN, and VPN monitoring. You can also monitor physical or virtual web,

mail, and file servers, Linux systems, Windows clients, routers, and many more. PRTG monitors network availability and bandwidth usage, as well as various other network parameters such as quality of service, memory load, and CPU usages.

Results from experiments are shown on Fig.6 to Fig. 9.

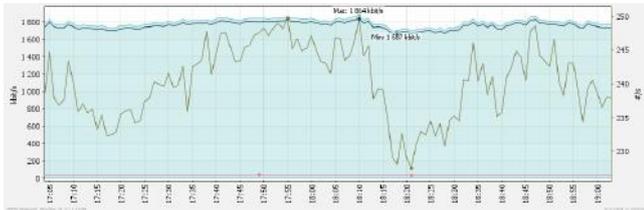


Fig. 6. 25 fps

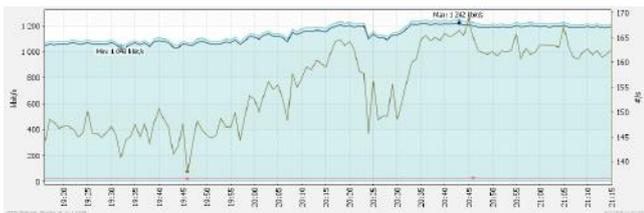


Fig. 7. 15 fps

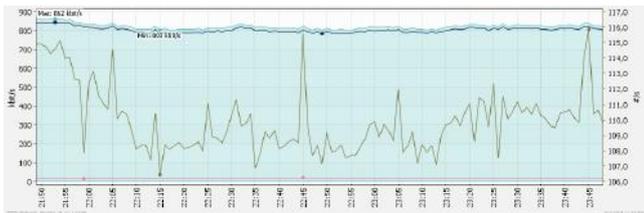


Fig. 8. 10 fps



Fig. 9. 5 fps

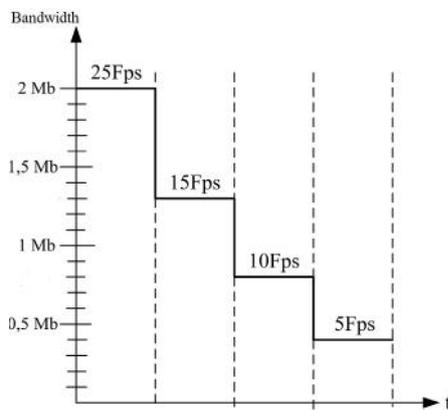


Fig. 10. Traffic bandwidth

On Fig.10 is presented average network traffic generated with different parameters of input signal. Packet loss is average 0,5% for entire network. Packet delay is in range from 2 to 5 milliseconds.

CONCLUSION

From conducted experiments it is clear that changing parameters of the input signal of the experimental model can affect the bandwidth of the generated video stream [5].

The following parameters: best picture quality, constant bitrate and maximum frames per second rate of the input signal will generate a video stream with a volume of about 2 Mbit/s.

It appears that the parameters picture quality and the number of frames per second are proportional to the bandwidth of the generated video stream. By increasing image quality or increase the number of frames increases and volume of stream flow.

When changing these parameters generated network traffic can be reduced to 0,4 Mbit/s but the picture quality deteriorates significantly.

Experimental model is using network interfaces at a maximum speed of 100 Mbit/s, which limits the maximum number of video streams to no more than 40 with the highest quality. If the network load becomes more than 80% unwanted delays and packet loss will appear.

To increase the number of video streams generated in the network is necessary to use the communication equipment (switches and media converters) with a maximum speed of 1000 Mbit/s, or to change the encoding configuration for input signal of the experimental model in order to reduce the volume of generated traffic [6,7].

The experimental stand is suitable for converting ordinary CCTV camera into IP camera or to stream a television program obtained from set-top-box in LAN.

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