A Cost Effective Multicast Video Streaming by Real Time Protocol using Sitara AM335x

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Abstract—The emergence of multimedia and wireless applications from cell phones to high performance system has created greater impact in embedded systems. In addition to this, the processors play a vital role to control various applications in order to achieve higher performance with low cost. This paper describes about the real time video streaming with greater advantages of high performance and low cost. Our new system adopted Sitara AM335x as a core and the Angstrom Linux distro as an operating system for software platform which makes this system suitable for multimedia, low cost applications.

Index Terms—Angstrom Linux, Beagle bone Black, Multicast streaming, RTP, Sitara AM355x.

1. INTRODUCTION

Every electronic device consists of processors that controls and process various functions. They designed for different use and vary in speed, instruction sets, size and shape. Time to market and cost are the two important factors for the success of the product in the market. As the market share of these products increases, there is an increase in system complex and cost. Various processors have been implemented with greater advantages in that arm cortex A8 based Sitara AM335x core makes the process easier.[1] Research has made on Risk Aware Scheduling For Multi User Video Streaming Through OMAP3530 using Linux that describes live video streaming is possible according to the network conditions and availability of bandwidth. Here Enhanced media codec protocol is used to transmit the live content so that quality of video is adjusted based on the resolution size of customer’s monitor.

In order to select various bit rates to the particular resolution sizes Adaptive bit rate streaming is used and Beagle Board-XM is used to control the various functions as it supports the multimedia applications. [2] In video streaming over wireless networks describes about the video streaming at one fixed quality level using TCP is compared against streaming on top of UDP. A distributed rate allocation protocol is used which allows cross-layer information to exchange between the video streaming agents at the application layer on the source nodes and the link state monitors at the MAC layer on the relay nodes. [3] In Multiple tree video multicast over wireless and ad hoc networks, proposed a multiple tree construction protocol which builds two nearly disjoint trees simultaneously in a distributed way that reduces the time and control overhead to construct a tree. During multicast operation, the application layer protocol sets a tree-flag in each packet’s header to determine to which tree the packet should be forwarded. This protocol forwards the packet in different trees according to the tree-flag.[4] Research has made on congestion-optimized multipath streaming of video over ad hoc wireless networks that analyze the benefits of optimal multipath routing on video streaming, in a bandwidth limited ad hoc network. The use of multiple routes reduces the frequency of path updates and increases robustness against changes in the network condition. Routing algorithms generally share the goal of minimizing the number of hops between source and destination. Path diversity is one important characteristic of the solutions to such problems.[5] In Optimized Video Streaming over 802.11 by Cross-Layer Signaling, that presents a communication architecture for video streaming over 802.11 and it is capable of adapting to changes in the link quality and sharing of the wireless channel in various scenarios. Link adaptation technique is used to handle the effects of changes in channel conditions and is typically employed at the link (MAC) level. In the research community, another class of rate control algorithms has been studied. These control algorithms use SNR-related information as feedback to improve the sensitivity to changes in link conditions. H.263 encoder supports a video rate control algorithm (VRCA) that tries to achieve a certain rate by adjusting the quantization step size.

The quantization step size is the main parameter that controls the compression of the video. This VRCA has been
designed for constant bit rate (CBR) encoding, but can also be used to dynamically change the bit rate produced by the encoder.[6] Research has made on video Transport over Ad Hoc Networks: Multi stream Coding with Multipath Transport that uses Multi Flow Real Time Transport Protocol and is an end-to-end transport service utilizing association of multiple flows and provides Flexibility in data partitioning at the application level. Here shuffling, thinning and striping could all be supported as data partitioning methods. [7]In smooth streaming, Cisco media processors have been used from the first continues today. The two major problems in live video streaming are that it affects the quality of video and reliability of play back. Prior to smooth streaming, media delivery on web has used two methods namely progressive download and traditional streaming. Separate processors are used for live streaming and on demand and also for SD, HD. [8]. Research has made based on delay constrained rate adaptation algorithm and is used to select an optimal bit rate at IEEE802.11b that shows there is a possibilities of better quality rate adaptation. Here live videos are captured and transmitted to the network after it is processed by Beagle bone black. Then the video is multicast to various users.

II. HARDWARE DESIGN

System includes webcam, beagle bone back which consist of Sitara AM335x as core, and system with network interface.

![Block Diagram of Beagle bone Black](image)

Beaglebone Black the central processor core model is shown in figure 2 take the SitaraAM335X which is based on ARM –Cortex A8 with clock frequency is about 1GHz. Three different types of memory like 512MB DDR3L which operates at a clock frequency of 303MHz yielding an effective rate of 606MHz on DDR3L bus allowing for 1.32 GB/S of DDR3L memory bandwidth. 32KB EEPROM is provided on I2C0 which holds the board information and 2GB eMMC on board memory.

![Block Diagram of Beagle bone Black](image)

TPS65217C provides various voltages required for the DDR3L which is used along with a separated LDO to provide power to the system. It require voltage level about 5VDC and various option are available for power supply through USB port on a PC this port is limited to 500mA by power management IC.TPS65217C makes it possible to change various power settings. It’s also equipped with 10/100 Ethernet interface for network interfacing figure 3.
shows the Ethernet and processor interface

![Fig 3. Processor interface with Ethernet](image)

### III. REAL TIME TRANSPORT PROTOCOL

RTP is used extensively in communication and entertainment systems that involve streaming media that is used in conjunction with RTCP (Real Time Control Protocol). RTP carries the media streams such as audio and video and RTCP is used to monitor transmission statistics and quality of service (QoS). It standardizes the packet format for delivering audio and video over IP networks. RTP is an end-to-end transfer of data in real-time. In that RTSP is a network control protocol used in communication to control streaming media servers.

RTP has four sub-protocols, but two are optionally used. The sub-protocols are as follows:

- **Data Transfer** – the transfer of data from server to client and includes the following:
  - Timestamps – aids in synchronization
  - Payload – audio/video data
  - Sequencing numbers – order frame payload in proper sequence
- **Real-time Transport Protocol Control Protocol (RTCP)** – controls flow by Quality of Service (QoS) and aids in synchronization of data. The bandwidth of RTCP is about 5%.
- **Session Description Protocol (SDP)** – an optional sub-protocol for media description information
- **Session Initiation Protocol (SIP)** – an optional sub-protocol for signaling between the client and server

When an RTP session is opened between a client and server, a port number is used with the IP Address. An RTCP session is also established with the same IP Address and the next Port number is used.

The RTP Server captures the audio/video and then encodes the data into the appropriate profile. The payload or coded data is then encapsulated into a frame with the necessary timestamp and sequence number. The frames are then sent over the network media and received at the client. The packets travel over the network or Internet as any other TCP/IP information and routed to the designated client by the IP Address. Once the client receives the frame, the data is removed from the payload and placed into proper sequence order. The client application being used to view the audio/video information can be set to buffer the information providing better flow of the multimedia stream.
IV. SOFTWARE DESCRIPTION

The real time streaming requires the system to be well defined and prompt therefore we require such operating system which enhance the sole purpose of real time streaming, so here we adopt to Angstrom Linux Distribution which also ensures the reliability.

It is an open source operating system uses opkg for packet management, monolithic kernel. The TDA19988 HDMI interface supports various resolutions; video4linux is a responsible for real time video capturing which is a driver framework for Linux kernel. Isis provides a simplified interface to V4L2 for doing video capture. The function `void init_devices()` initialize the interfaced devices, and also prompt the error messages about device compatibility. `void start_capturing()` initialize the buffers and the capturing methods. `void int_devices()` also responsible for resolution `void open_device()` and `void close_device()` is for opening and closing of capturing device. `void stop_capturing()` terminates the capturing process.

```c
static void start_capturing(void)
{
    unsigned int i;
    enum v4l2_buf_type type;

    switch (io) {
        case IO_METHOD_READ:
            break;
        case IO_METHOD_MMAP:
            for (i = 0; i < n_buffers; ++i) {
                struct v4l2_buffer buf;
                CLEAR(buf);
                buf.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
                buf.memory = V4L2_MEMORY_MMAP;
            }
    }
}
```
buf.index = i;
if (-1 == xioctl(fd, VIDIOC_QBUF, &buf))
    errno_exit("VIDIOC_QBUF");
}

for (i = 0; i < n_buffers; ++i) {
    struct v4l2_buffer buf;
    CLEAR(buf);
    buf.type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    buf.memory = V4L2_MEMORY_USERPTR;
    buf.index = i;

    type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
    if (-1 == xioctl(fd, VIDIOC_STREAMON, &type))
        errno_exit("VIDIOC_STREAMON");
    break;
}
}

static void stop_capturing(void)
{
    enum v4l2_buf_type type;
    switch (io) {
    case IO_METHOD_READ:
        break;
    case IO_METHOD_MMAP:
    case IO_METHOD_USERPTR:
        type = V4L2_BUF_TYPE_VIDEO_CAPTURE;
        if (-1 == xioctl(fd, VIDIOC_STREAMOFF, &type))
            errno_exit("VIDIOC_STREAMOFF");
        break;
    }
}

V. RESULTS AND DISCUSSION

Fig 5. Interfacing of camera with Beagle bone black
The outputs are shown in the figures 5 & 6. The processor board and the pc are connected through the network where the camera is interfaced with the boards, captured video from the camera are displayed on the screen.

VI. CONCLUSION

The low cost real time multimedia streaming analyzed in this paper adopts ARM as a processing chip; the results reflected that the capturing and streaming of videos are in efficient level. With the help of high precision camera the quality of the videos are maintained in prominent level.

REFERENCES


AUTHOR BIOGRAPHY

P. Saravanan, received his B.Eng degree in Electronics and Communication Engineering from Anna University in 2009 and Master of Technology in Embedded System from Hindustan University Chennai in 2012. His research area includes Distributed algorithms, Embedded OS, Automotive Embedded Systems, and Embedded System Designs. Currently he is working as an Assistant Professor at the Department of Electrical and Electronics Engineering, Ganadipathy Tulsi’s Jain Engineering College, Vellore. He published his papers in various journals and conferences.