Development of Optimization Techniques on ARM based Embedded Systems for Telecom Application

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Abstract – *The performance of customized hardware systems known as embedded systems for telecom applications are determined by many factors. If performance is not meeting telecom application developer requirements we need to customize hardware or optimize application software to meet constraint of the telecom requirement. Optimization and Performance analysis is extremely important stage for telecom application developers who are working on customized hardware system platforms. There are different types of approaches to be optimization, which are greatly differing from each other techniques. This paper describes the optimization techniques for LAYER1 in IPBTS protocol stack application. It is used to increase the performance of task allocation on LAYER1 by reducing the density of code and to improve the performance and execution time of the on ARM11 Raspberry Pi processor board. The optimization and task allocation of real-time embedded systems are analyzed and optimized using functions, structures and pointers with results.*

Key Words: Embedded Systems, Performance Analysis, Optimization, ARM11 Raspberry Pi Processor Boar, LAYER1.

1. INTRODUCTION

Embedded Systems are characterized by the presence of processors running application specific programs. Typical examples of embedded systems are printers, cellular phones and automotive engine controller units. In embedded systems, with the flexibility of software and increasing application specific logic solution makes embedded systems an attractive solution. As system complexity grows and processor increases, the embedded system design approach for application specific systems is becoming more appealing. This makes many researchers to make efforts in the design and analysis of embedded systems.

Here, we are comparing the developing and analysis of optimization technique for LAYER LI module of IP-BTS application on Raspberry Pi board. The main aim to choose this project is to describe the optimization techniques that are used to increase the performance of task allocation on LAYER L1 by reducing the density of code and to improve the performance and execution of the LAYER1 telecom application . The optimization and task allocation of hard real-time embedded systems are analyzed and developed by using sample functions, structures and pointers that are used to optimize the code efficiency and improve the performance of the LAYER L1 of IPBTS At present Embedded Linux has become heart of research in embedded system fields so we are using Linux as an operating system with kernel version 4.0.6.

The embedded platforms for our experiment setup are ARM11, IP BTSController, LAYER1and linux operating system, By evaluating and analysis of these optimization technique results at the early stages for their performances telecom application user can decide which processor is suitable for required application. Thus we can reduce the efficiency, task allocation, code by investigating the performance of processor board and increasing the quality of embedded real time system for different telecom applications discussed with the results.

2. RELATED WORK

Optimization and Performance analysis is extremely important stage for telecom application developers who are working on dedicated platforms like embedded systems. There are different types of approaches to be optimization, which are greatly differing from each other techniques. This optimization technique measures results for a large number of high-end systems and gives the sustainable performance, requirements and latency measurements. Pham Van Huong Nguyen Ngoc Binh presents a new approach to design and optimize embedded systems in the design phase based on Pareto multi objective optimization. They defined two Domain Specific Languages and developed the framework that is to design thearchitecture model and the component diagram of embedded systems also to domulti-objective optimization [1]. Koh Minghao, Khong Yun Chyang, and

Ettikan Kandasamy Karuppiah describes concept that in-kernel implementations give lesser CPU load. By implementing UDP server and clientas modules in the kernel, the clock ticks (CPU load) needed torun the program reduces from 20% up to 50% depending on the buffer size [2]. Shuhaizar Daud1 R. Badlishah Ahmad 2 Nukala S. Murhty3 study the effects ofcompiler optimizations on embedded systems energyusage and power consumption in real time situationsand the importance ofrunning efficient binary codes inrealizing a more power efficient, and better performing embedded system[3]. Jianfeng He1, Yufeng Li1, Wei Zhang1 Fang Fang and Hongkun Xu2 analyzed real-time scheduling policy and clock mechanism on Linux2.6.12 kernel,a new optimization for embedded ARM-S3C2440 framework is introduced into kernel scheduling module. LSF scheduling algorithm is proposed to improvescheduling policy. At additional, four aspects: processscheduling mechanism, kernel preempt, clock mechanism,virtual memory mechanism are made simple modifications. Atfinal, new kernel is compiled and tested[4].Bassem Ouni, C´ecile Belleudy, S´ebastien Bilavarn, Eric Senn presented overhead of one of most important services of the embedded system which is the context switch. We execute the bench marks and we measure the context switch energy overhead with varying a set of hardware and software parameters, then we extract the energy models and traces the results to characterize and optimize the energy consumed and we will take into account these results in modeling the deployment of complex applications on hardware platforms using the Architecture Analysis [5]. This paper we are developed optimization methodology is developed and successfully applied to LAYER1 in IPBTS protocol stack application and discussed with results.

3. SYSTEM DESIGN AND OPTIMIZATION METHODOLOGY

IP-BTS is designed to implement the different functions like Channel Encoding & Decoding, Multiplexing & De-multiplexing, Call establishment, Speech communication through full rate speech channel, Transmission of Speech through RTP on Abis interface and supporting transmission of signaling over TCP/IP on Abis interface on linux operating system ported on different processor boards.The block diagram of existing system IP-BTS protocol stack is shown in Fig 1. In this project we have developed a methodology to optimize code to increase performance of IPBTS application software. This optimization techniques are required to improve the performance of LAYER L1 of IP-BTS platform to reduce the code and to improve the efficiency. For optimized implementation of IP-BTS software, telecom application developer should characterize the early performance details of hardware and operating system of the processor board.

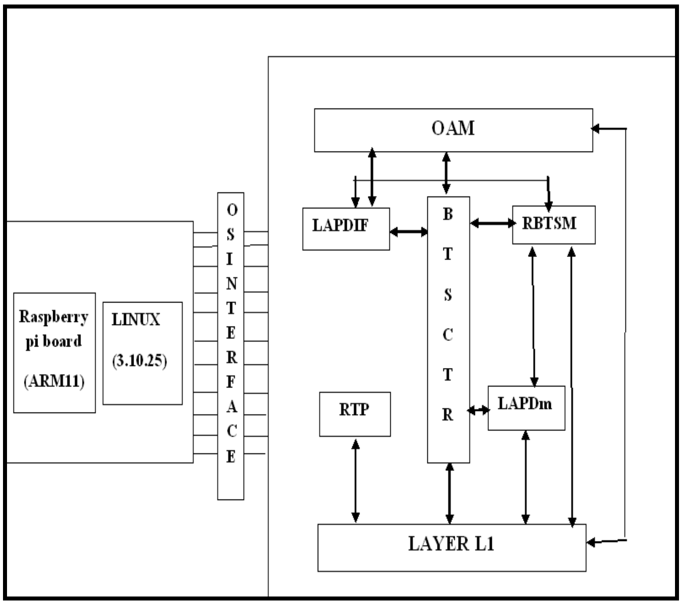


Fig -1: IPBTS Protocol Stack

Here, We are building and transplanting linux kernel onto raspberry pi board and running optimization techniques used in LAYER L1 of IP-BTS platform and analyzing the performance results. The design flow of optimization methodology or LAYER L1 of IP- BTS based telecom applications is specified in Fig 2.

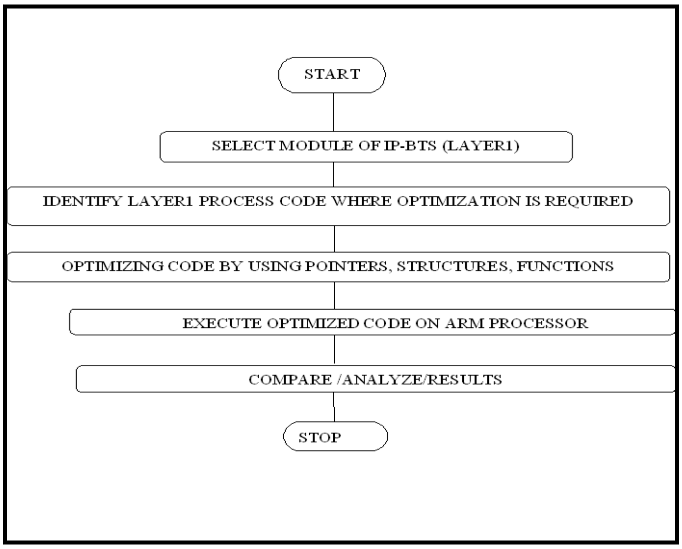


Fig -2: Optimization Methodology

The process starts with the LAYERL1 Initialization by using structures, pointers functions then it will check for the task to be performed and evaluate the get message from the task which is gone to be send and then received the message and then executes the message in to the L1 main and then if required message is not obtained it kill the message and then continues the L1 process till the message obtained and then stop the procedure. The sample code for structure, pointer and function code is shown in the Fig 3 with and with optimization.

Before Optimization

Structure function and pointers are define as

```
struct Data
{
     *char bytes[16];
};
Data demofun()
{
     Data result = {};
  // generate result
     return result;
}
int main()
{
     Data d = demofun();
}
```

After Optimization

```
struct Data
{
     char bytes[16];
};

Data * demofun(Data * _hiddenAddress) {
  Data result = {};
  // copy result into hidden object
  *_hiddenAddress = result;
  return _hiddenAddress;
}
int main() {
  Data _hidden; // create hidden object
  Data d = *demofun(&_hidden); // copy the result into d
}
```

Fig -3: Sample Code for Optimization Methodology

4. RESULTS AND DISCUSSIONS

The result for defining the optimization techniques for Task Allocation in the IP-BTS platform on LAYER L1 can be obtained by executing the following commands on linux based raspberry processor board as shown in the Fig 4
Login as pi
Enter password:raspberry
pi@ raspberry pi:$ cd
pi@ raspberry pi:$ ls
pi@ raspberry pi:$ BTSSSOFT
pi@ raspberry pi:$ BTSCONTROLLORI
pi@ raspberry pi: LAYER1
pi@ raspberry pi: objdump –d LAYER1MAIN.o the compiling process starts

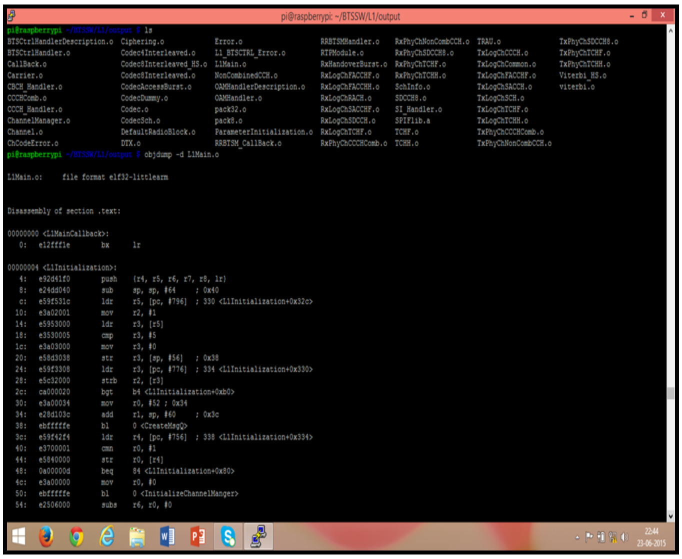


Fig -4: ARM 11 Environment.

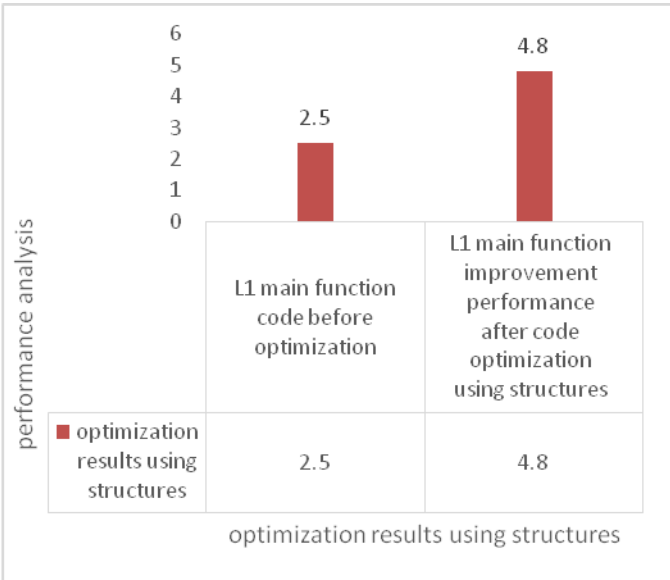


Chart -1: Optimization with Structures

Optimization resulted are simulated and drawn in From the above results we can say that there is increase in the performance of L1 Main initialization by optimizing code we can improve performance from 20% to 40%. As increasing the performance we can increase the execution time will be decreased and reduce the code density.

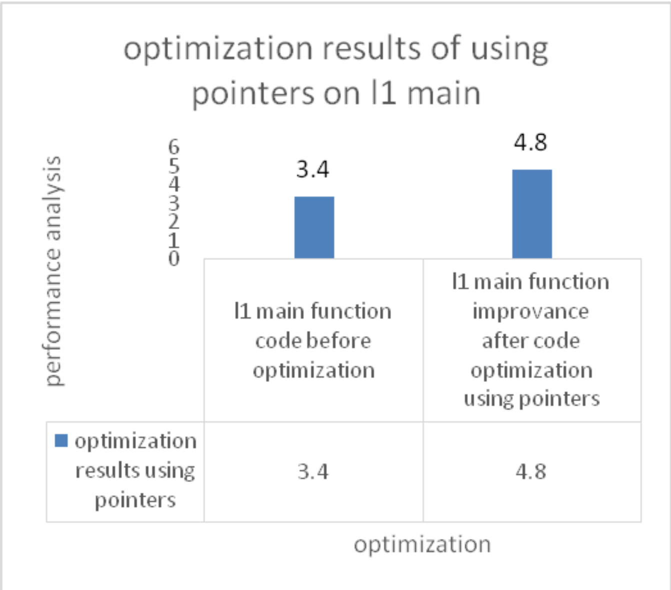


Chart 2: Optimization with Pointers

From the above results we can say that there will be an increase in the simulation results after using pointers and function in the code optimization from 30% to 40%.from the above results we can say that there is an increase in the execution time will be decreased and density of the code can be decreased and performance speed is increased.

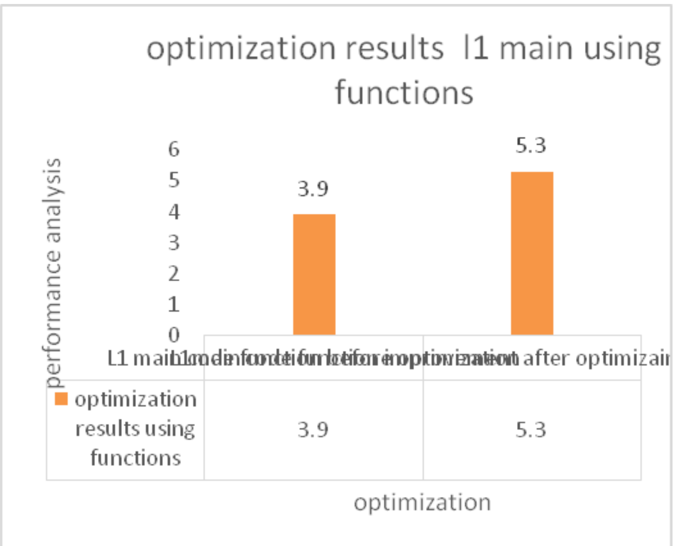
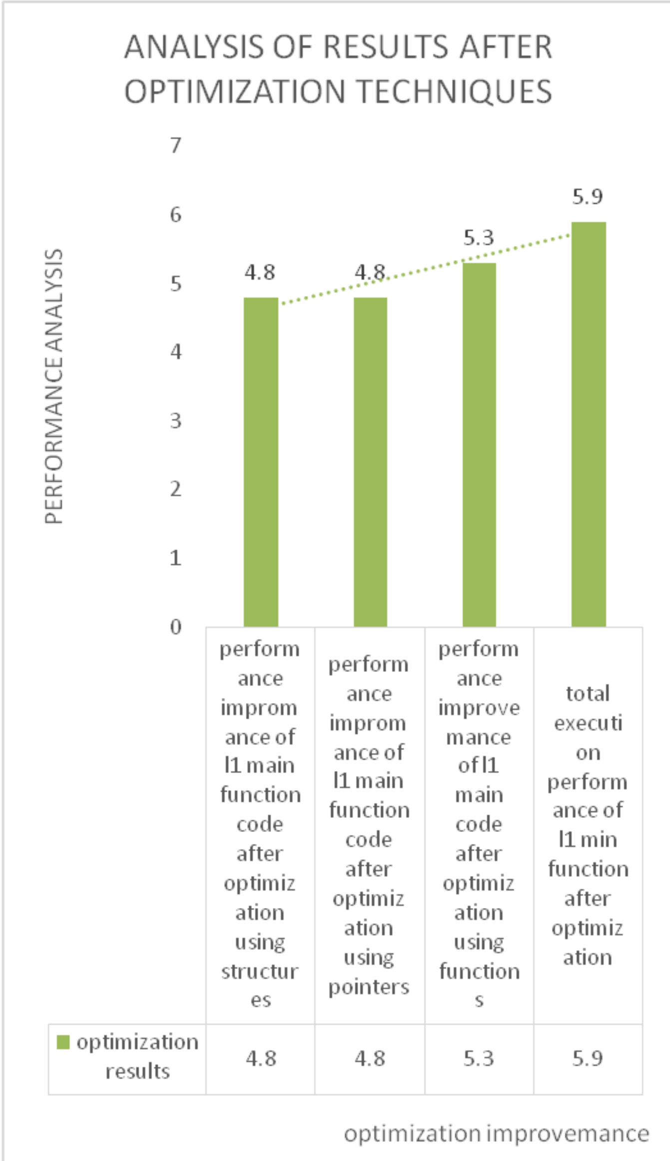


Chart 3: Optimization with Functions

From the above result analysis we can say that the process execution is increased from 20to 50% after code optimization and increase the overall performance and we can decrease the code density and we improve the execution time and overall performance



From the above results we can say that the simulation results that are performed after optimization techniques in the layer L1 shows that there is increase in the performance from 30% to 60% by which we can say that we can improve the density of code and execution timewill be decreased.

5. CONCLUSION

The project "Development of Optimization Techniques for ARM Based Embedded Systems" has been designed and tested. It has been developed by integrating features of all the hardware components and software used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced Raspberry pi board and with the help of growing technology the project has been successfully implemented.

When deciding whether to optimize a specific part of the program, Amdahl's Law should always be considered: the impact on the overall program depends very much on how much time is actually spent in that specific part, which is not always clear from looking at the code without a performance analysis.

A better approach is therefore to design first, code from the design and then profile/benchmark the resulting code to see which parts should be optimized. A simple and elegant design is often easier to optimize at this stage, and profiling may reveal unexpected performance problems that would not have been addressed by premature optimization.

In practice, it is often necessary to keep performance goals in mind when first designing software, but the programmer balances the goals of design and optimization.

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BIOGRAPHIES

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