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Development of ARM Based IPv6 Embedded Platform for Mobile Applications

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Abstract – *Embedded system is a special purpose customized hardware system that is designed to perform dedicated software applications. Presently they are widely used in network equipment such as firewall,* ***router, switch and so on. Now a day's mobility of internet*** *devices is increasing rapidly, but there are not enough IP addresses for mobile users, hence IPv6 is proposed to resolve this issue.IPv6 is the currently proposed standard for Internet Communications. The Internet protocol version 6 (IPv6)-enabled network architecture has recently attracted much attention. In this project, we address the issue of connecting mobile ad hoc networks (MANETs) to global IPv4 networks and these issues can be resolved by developing IPv6 based embedded platforms for MANETS. In this paper, we propose a self-organizing, self-addressing, self-routing IPv6 based embedded platform for a MANETS/AAA Servers. AAA server allocates mobile IPv6 addresses when ACCESS REQUEST is received from home agent (HA).In this paper, a highly customized hardware platform is developed with IPv6 networking support for Linux operating system (latest kernel version 4.0.7)on ARM-11 based processor board. This platform is essential to run authentication, authorization and accounting (AAA) Server /MANET applications. This paper also elaborates the procedure to implement and test IPv6 based embedded platform for MANET/AAA Server application with results.*

Key Words: Embedded Systems, mobile ad hoc networks (MANETS),IP version 6(IPv6),ARM11 Raspberry Pi Processor Board.

1. INTRODUCTION

An embedded system is a system that has embedded software and computer-hardware,which makes it a system dedicated for an application or specific part of an application or a part of a larger system.Every embedded system is unique and the hardware as well as the firmware is highly specialized to application domain. Embedded systems are becoming an inevitable pat of any product or equipment in all field including household appliances, telecommunications, industrial control and also consumer electronics like cell phones, pagers, printers, digital cameras etc. Internet Protocol version 6 (IPv6) is the most recent version of the Internet Protocol (IP), the communications protocol[1] that provides an identification and location system for computers on networks and routes traffic across the Internet. IPv6 was developed by the Internet Engineering Task Force (IETF) to deal with the long-anticipated problem of IPv4 address exhaustion. IPv6 is intended to replace IPv4.

Every device on the Internet is assigned an IP address for identification and location definition. With the rapid growth of the Internet after commercialization in the 1990s, it became evident that far more addresses than the IPv4 address space has available were necessary to connect new devices in the future. By 1998, the Internet Engineering Task Force (IETF) had formalized the successor protocol. IPv6 uses a 128-bit address, allowing 2128, or approximately 3.4×1038 addresses, or more than 7.9×1028 times as many as IPv4, which uses 32-bit addresses and provides approximately 4.3 billion addresses. The two protocols are not designed to be interoperable, complicating the transition to IPv6. However, several IPv6 transition mechanisms have been devised to permit communication between IPv4 and IPv6 hosts. In this paper we develop anIPv6 protocol based embedded system for MANET/AAA server ad discussed with results.

2. RELATED WORK

Development of the IPv6 was primarily driven by the limited address space offered by IPv4. With an increasing number of networked devices, there was a very real threat of address space exhaustion that was successfully averted by the much larger address space offered by the IPv6. It also offered a simplified header structure. Yihua Huang, Zhiping Jia, Xin Li, Hui XiaSchool of Computer Science and TechnologyShan dong UniversityJinan, China," EIPv6: A Reduced IPv6 Protocol Stack for Embedded Systems.Because of the IPv4 address exhaustion problem, IPv6 is not only an appropriate but also a preferable choice for this purpose. This paper

proposes a light-weight IPv6 protocol stack, EIPv6, for embedded systems. It is efficient and fast enough for time-critical applications, and highly portable and configurable to satisfy resource requirements of various platforms [1].

Taghi.Mohamadi Iran University of Science and Technology (IUST), Tehran, Iran, "Designing an Embedded System for Interfacing with Networks Based on ARM This paper presents a method to design a smart circuit to interface with some protocols such as RS232, USB, CAN, and the most important of all: Ethernet. The main feature in the designed circuit is using Real Time Operating System (RTOS) on ARM series 32-bit processors: LPC2478. Compared with the customary ways to control and data acquisition, the device based on the embedded system offers better features and flexibility, with an overall design for reliability, durability and ease of installation. This paper has illustrated hardware architecture and real time multi-task software process based on µC/OS-II. There are too many usages for such designed system in control and data acquisition systems. Especially, in network interfaces with different protocol layers, it can be used as a smart gateway or router and so forth.[2]

Shah Yash KumarElectrical and Electronic EngineeringNanyang Technological University Singapore, "Design and Development of a IPv6-based SmartParking System" this paper proposes a Smart Parking System, which embeds charging facilities in the parking slots of shopping malls or residential area, and continuously updates the parking slot status and shopping information for end-user to access through a smart-phone application using a designated IPv6 address. Such a Smart Parking System will ease the trouble of locating a parking slot, facilitate car charging and payment, and proffer the necessary shopping information. In short, the proposed system aims to make travel easier and more enjoyable[3]

I K Appleton, "THE GSM PROTOCOL STACK"[4],1998 The Institution of Electrical Engineers.Printed and published by the IEE, Savoy Place, London WCPR OBL, UK The protocol stack for GSM follows the basic concepts of the ISO OSI 7 layer stack in so much as it is a layered architecture. The relationship between the three layers as defined in the OSI model and those in GSM are described along with a breakdown of the functions performed by each layer. GSM Layer 1 is normally understood to mean the control software which controls the radio and baseband hardware-the physical layer. Layer 1 multiplexes the physical access to the radio channel and provides a number of logical channels which can be used for signalling. Layer 2 is responsible for establishing a data link on these logical channels to allow reliable transmission of Layer 3 signalling messages. Layer 3 is subdivided into a number of separate tasks including the radio resources manager, the mobility manager, and the connection manager[4]

Che-Hua Yeh1, Quincy Wu2, and Yi-Bing Lin11 Department of Computer Science & Information Engineering,National Chiao Tung University,"SIP Terminal Mobility for both IPv4 and IPv6",Proceedings of the 26th IEEE International Conference on Distributed Computing Systems Workshops Session Initiation Protocol (SIP) supports application layer mobility during a session. In this paper the architecture design on the protocol stack implementation of SIP terminal mobility is described, and the performance of SIP user agents developed with open-source libraries are measured from empirical experiments. The experiments are performed in both IPv4 and IPv6 environment. In the best case, the delay of SIP mobility only takes 38ms in SIP signaling exchange, for both IPv4 and IPv6. Therefore, SIP mobility is suitable for supporting seamless handover in VoIP communications. [5]

3. HARDWARE & SOFTWARE SYSTEM DESIGN

The main objective of this paper listed below

- To develop IPv6 based platform on ARM-11 processor board for efficient routing and packet processing.
- Transplanting IPv6 based linux kernel on raspberry pi processor board
- To test MANET/AAA Server application on IPv6 based developed

  The IPv6 embedded platform is developed on Raspberry Pi Processor Board.

The system diagram of IPv6 based embedded system running MANET/AAA Server application is shown in the figure 1.

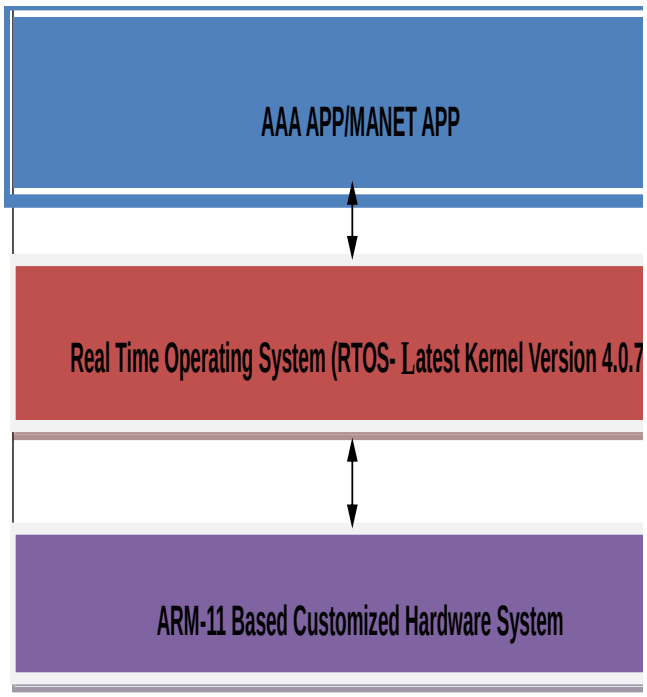

Fig -1: IPv6 Embedded Platform

- **Raspberry Pi Processor Board:**

The Raspberry Pi is a credit card sized computer and costs approximately £25. It is developed in the UK by the Raspberry Pi Foundation.Raspberry Pi has a Broadcom BCM2835 system on a chip(SoC), which includes an ARM1176JZF-S(ARM11 using an ARMv6-architecture core) 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB, but it uses an SD cardfor booting and persistent storage as shown in the figure 2 .

Fig -2: Raspberry Pi Processor Board

It provides HD quality video playback, sports high quality audio and has the ability to play 3D games. It does not does not have a hard drive like traditional computers. Only SD card is needed for starting up and storing information. The SD card contains the operating system, programs and the data needed to run the board.

Building Embedded Platform for AAA Server/MANET Application

- **Configuring latest kernel for IPv6**

There is a need of kernel sources for the currently running kernel to successfully build kernel modules for the Raspberry Pi. More specifically, only parts of the complete source, the so called kernel headers are needed. There are two ways to arrive at a state from which you can build kernel modules on the Raspberry Pi. The kernel configurations for IPv6 are shown in the figure 3.

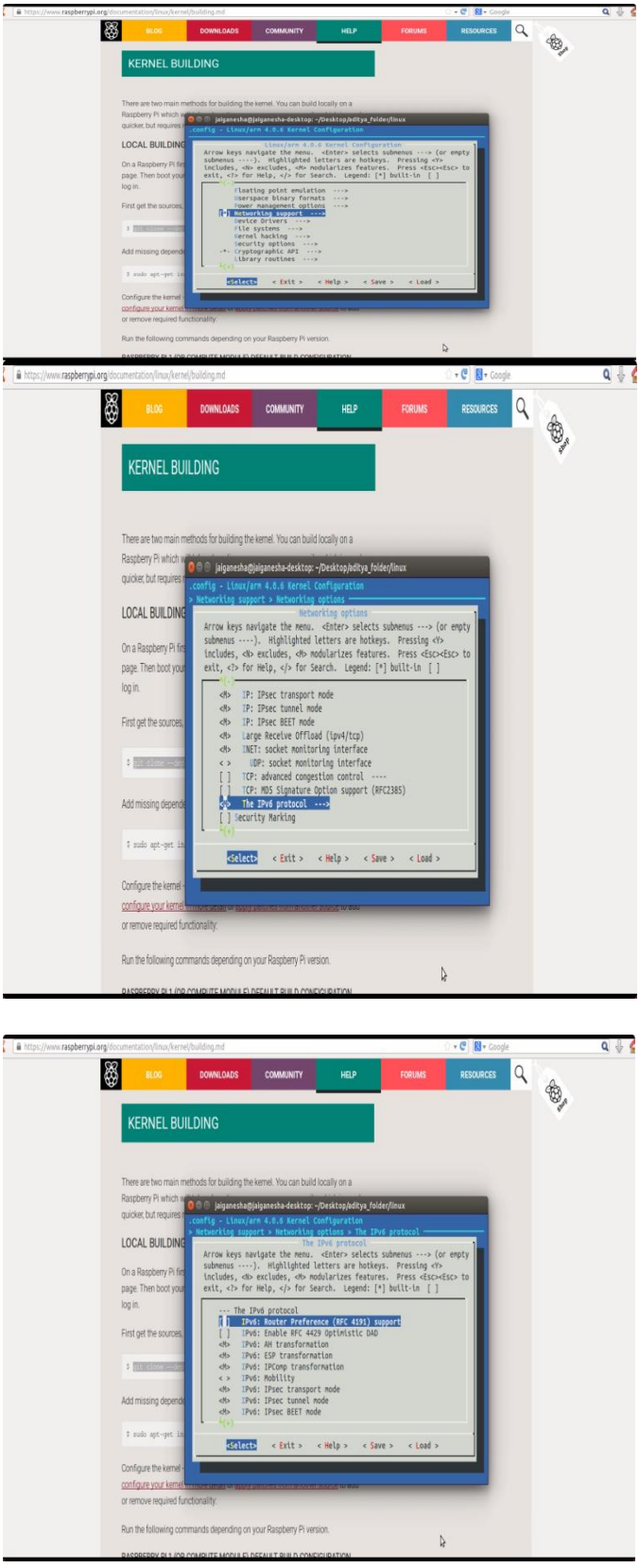

Fig -3: IPv6 configuration for Embedded System

- **Development of IPv6 Kernel Image**

After all the process of configuration ,compilation ,testing, configuring settings and saving it .and also installing heads and modules ,then a zimage is generated which is after loaded into the sd card which preinstalled with raspbian or noobs as shown in the figure 4.

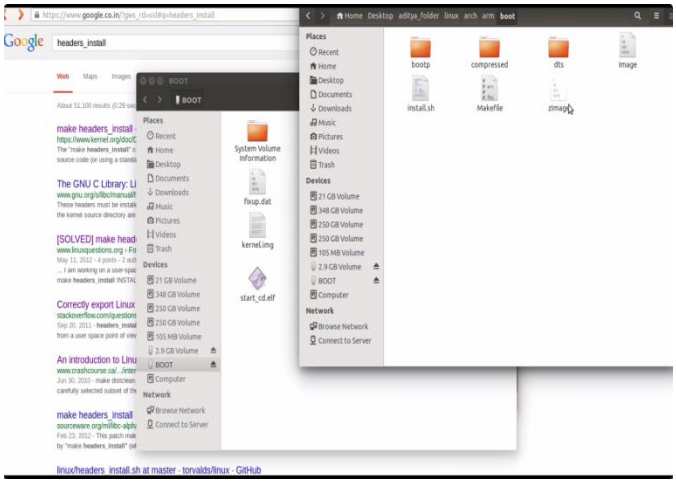

Fig -4: Building IPv6 kernel images

4. RESULTS AND DISCUSSIONS

The result of developed IPv6 protocol baesd embedded system for MANET/AAA server can be shown by the following results.

- **Connecting raspberry pi to display**

Raspberry pi which is loaded with a latest kernel image and enabled with Ipv6 andhdmi cable is used to connect the display. After connecting raspberry pi to monitor, the raspberry directly loads with all the default settings and display command request prompt. Now the loading is complete, we can observe the statement waiting for a command as shown in the figure 5

Fig -5 Connection of raspberry pi to PC

pi@raspberrypi_by default)
pi@ipv6embeddedplatform_
After that a command "lxsession" is used to open the desktop version of processor board is shown in the figure 6.This view is used to develop/add/congigure any operating system feature to processor board.

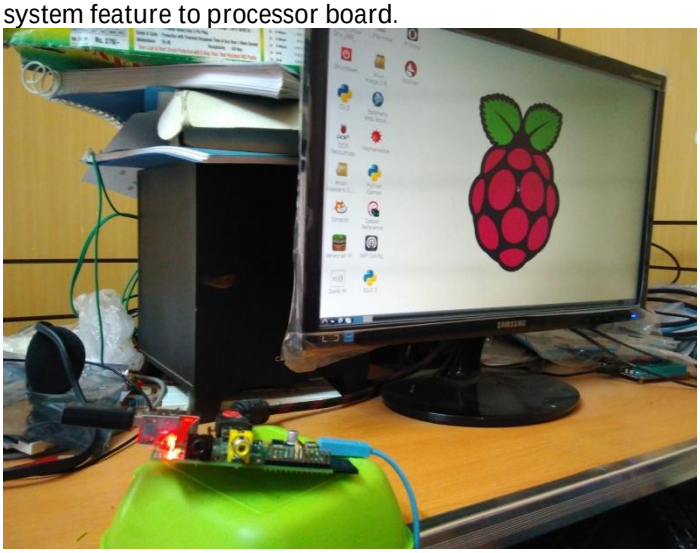

Fig -6 Desktop view of Raspberry pi

By typing the command uname –a will reveal the version of kernel version Here latest version 4.07 is booted as shown in the figure 7

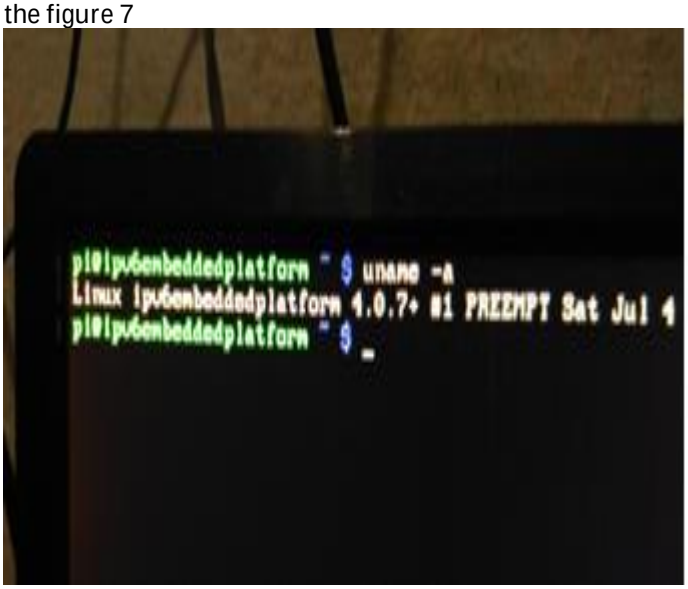

Fig -7 Linux kernel Version Desktop on Raspberry pi

IPv6 feature is added to kernel for Rasberry Pie board as shown in the figure This can be tested by the command

"ifconfig" as shown in the figure IPv6 address is highlited in the figure 8.

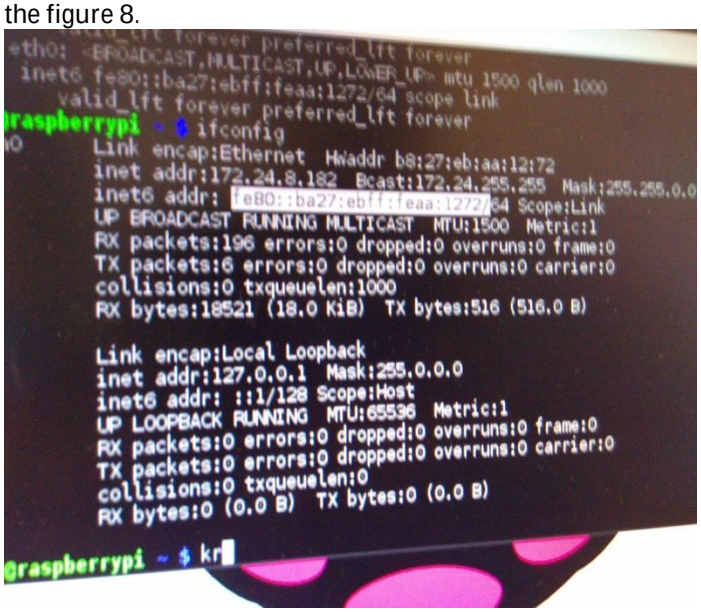

Fig -8 IPv6 ARM based Embedded System

Now we can observe the Ipv6 address in the raspberry pi. Now as we developed a system for MANET/AAA server after running it in that system we get the Ipv6 address in that log file generated as shown in the figure 9

Fig -9 Log file of AAA Server on Raspberry Pie

5. CONCLUSION

This project describes the procedure to develop an embedded platform for Ipv6 networking support based mobile applications like AAA server.When an embedded system is not supportive for Ipv6 networking feature this project elaborates on the detailed transplanting procedure to make Ipv4 embedded platform we are able to get portable IP(Ipv6) using LAN API. Certainly the time for ignoring Ipv6 is past. It is now more significant to understand it,recognize it and deploy its advantages.If this networking feature is not supportive for embedded platform the detailed procedure to enhance the embedded platform with Ipv6 networking feature has been described in this project.

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BIOGRAPHIES

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