

# Wired and Wireless Online Transaction System on ARM9

Chandan G.N.

Assistant Professor  
ATMECE, 13<sup>th</sup> K M Stone  
Bannur Road, Mysuru.

S.R.Bhagya Shree

Associate Professor  
ATMECE, 13<sup>th</sup> K M Stone  
Bannur Road, Mysuru.

Pavithra A.C.

Assistant Professor  
ATMECE, 13<sup>th</sup> K M Stone  
Bannur Road, Mysuru

## ABSTRACT

Of late online Data transmission and reception, has become the need of the day. Online Transaction Processing (OLTP) applications are client/server applications. They provide direct access to the user. The existing system servers used for small applications are bulky, expensive and consume more power. The current work focuses on the methods to overcome some of these shortcomings. The proposed work is an embedded system with ARM processor as core (S3C2440). It provides complete communication interface which is very essential to the development of OLTP applications. Embedded Linux is chosen as operating system with an option of Ethernet or GSM as the communication media. Online Transaction processing system has the advantages of low cost, high compactness and high performance.

## General Terms

Embedded Linux, Network control protocol, Point to point protocol, Link control protocol, GSM and Ethernet.

## Keywords

OLTP, ARM9 mini 2440 and S3C2440AL.

## 1. INTRODUCTION

Online transaction processing (OLTP) facilitates and manages transaction-oriented applications; one such application is data entry and retrieval transaction. This also refers to processing of users requests without any time delay. An automatic teller machine (ATM) used in the bank is an example of a commercial transaction processing application. Embedded equipment has infiltrated to the fields of traditional Ethernet. If user has permission to access server, then he can refer the relative information, this gives a great convenience to the administrator to manage and vindicate the equipment. Accessing server by client through IP is a challenging task. The solution for this problem is accessing internet through embedded system. The core of the system is S3C2440AL and its operating system is Linux which is scalable and compatible.

### 1.1 Online Transaction Process

Due to rapid growth in technology data transmission between the systems has become the requirement of the day. The data transmission can be done either online or offline. The online transaction process offers low processing speed and reduces paper trails.

Online Transaction Processing (OLTP) applications are client/server applications which provide users an access to retrieve the real time information. The OLTP applications are called transactions. For example, if we consider the online transaction of bank, the request may be in the form of checking the balance, updating the account status, transferring of fund. A single transaction might be a request for checking the bank balance, updating the account status etc.

In a transaction processing system, execution of a request is a

single transaction. End users have online access to the system as well as to the data. The users can directly initiate transactions. In a transaction processing environment, many users repeatedly process similar transactions and look for immediate response for each of their transaction.

Examples of such users are order entry clerks, Airline reservation clerks or bank tellers. They share an environment of programs and data. In a typical transaction processing system:

- Many end users run the same or similar transactions, sharing the same databases and files.
- The system schedules transactions on the basis of priority attributes.
- The transactions are invoked by online input and generate online output.
- The transactions are designed for a good user interface and fast response time.

Transaction processing is an effective solution when end users want to:

- Process, unscheduled items in unpredictable volumes and sequence.
- Have immediate access to data that has been updated to reflect all previous transactions.
- Change data immediately to reflect the process of a transaction.

Predefinition of transactions and data allows transaction processing to be controlled efficiently. The execution of a transaction causes the execution of one or more application programs that are written especially to minimize computational time and deadlocks. A lock prevents transactions from accessing data while it is being updated by another transaction.

The basic requirements that must be met by a transaction processing system are:

- Online processing
- High availability
- Rapid response
- Low cost per transaction

### 1.2 Offline Banking System

Figure 1.1 shows a centralized offline banking system used for banking application. In case of an 'off line' system all the records of the dbase file are read one at a time. During each and every read operation, the process checks for the activated record. If an activated record is found, the transaction is done to that record. After the completion of the transaction, updating takes place in the master dbase file. In the next process remaining records are copied to the master dbase file without any modifications.

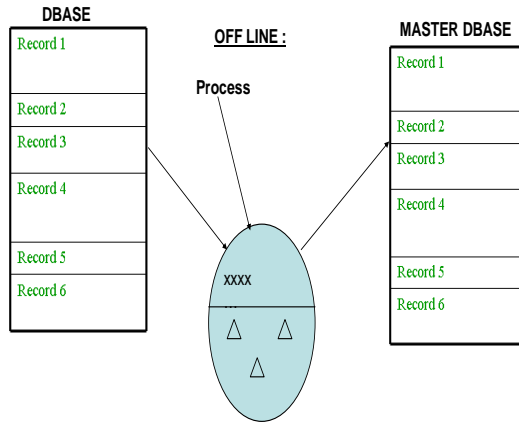


Figure 1.1: centralized offline banking system

Figure 1.2 shows decentralized off line approach used for banking application. Initially, the process copies the data from Dbase to record file and later on it modifies the data in the record file. The edited data is copied from record file to Dbase file.

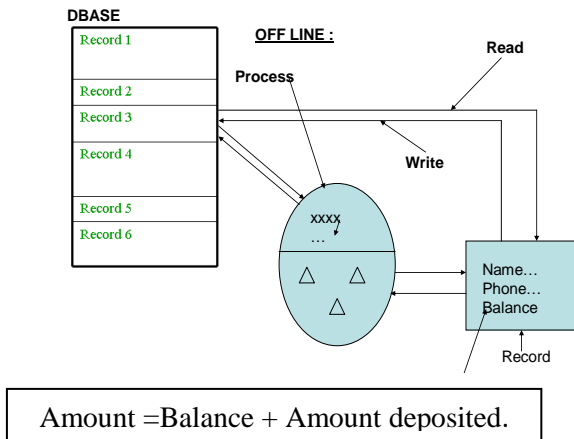


Figure 1.2: Decentralized offline system

In case of online, the transaction is done to the particular record by using physical pointer. This is a direct approach and requires less time compared to offline system.

### 1.3 Protocol

The PPP and TCP/IP are the two protocols used for wireless and wired connections respectively.

#### 1.3.1 Point to Point Protocol

PPP is widely used protocol, In this one end is connected to the personal computer and the other end is connected to internet service provider. The functions of PPP are as follows.

- The Point-to-Point Protocol (PPP) was designed to transport multi-protocol packets between two peers connected by simple links.
- These links provide full-duplex, simultaneous and Bi-directional operation.

In the process of configuring, maintaining and terminating the point-to-point link, the PPP link goes which shown in Figure 1.3 through several distinct phases which are specified in the following simplified state diagram Figure 1.3.

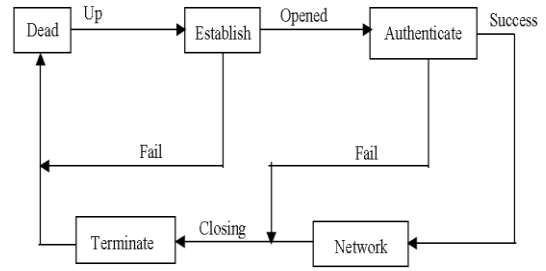


Figure 1.3: Point to point protocol state diagram.

#### 1.3.2 Ethernet TCP/IP Protocol

Ethernet is a network related technologies used for local area networks (LANs), which use TCP/IP protocol. TCP is a connection-oriented Transmission Control Protocol; it provides end-to-end connection, re-sequences and controls the flow of information. TCP enables two hosts to establish a connection and exchanges data, which are treated in bytes. It assures reliable communication between transmitter and receiver.

## 2. SYSTEM OVERVIEW

The extensive use of Open Source tools and software for the device development has reduced overall cost of the system. This section describes an overview of implementation of OLTP using ARM architecture with other hardware requirement.

### 2.1 Hardware Requirement

The Selection of hardware has to be done to fulfill the requirements of the application. Some of the requirements are as follows.

- GSM module and Ethernet interface should be supported by the hardware for communication.
- Sufficient memory should be available on the hardware for maintain database.
- The hardware should not be bulky as the final aim is to develop a portable device.
- The overall cost of the board should not be too costly as the system is being aimed for low cost.

### 2.2 System Architecture

Figure 2.1 shows the block diagram of the system, it consists of target board and a Host PC which are used as server and client respectively. ARM9 mini 2440 is processor is being used in the server. The server and client are interconnected either through Ethernet or GSM. If GSM is used, then the module is connected to the server through USB or serial port. Wireless communication between client and server is established through GPRS (GSM). The baud rate of GSM module needs to be set to make it compatible with ARM. GSM uses point to point protocol; once PPP is turned on, it provides a dynamic IP address. The system uses IP address for online transaction. Similarly the wired communication is take place through Ethernet with 100Mbps data rate by TCP/IP protocol.

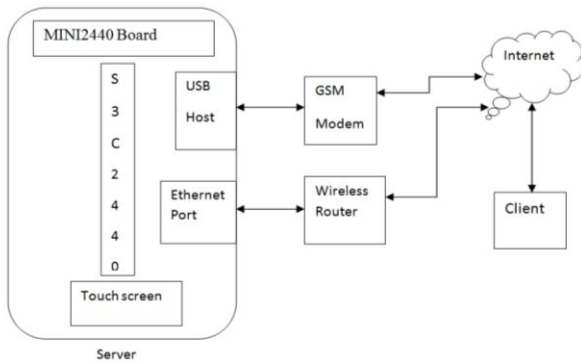


Figure 2.1: Block diagram of the system.

## 2.3 Working Principle

The server creates a data base for maintaining records of accounts holders. Each account has account holder name, balance, contact details etc. Client has to place a request to the server to have an access to the database. For example, if client wants to create an account, he sends a create request along with the necessary details to the server. The server processes clients request and creates an account. Then server places all the information related to the account in the database after the completion of this process the server sends an acknowledgment to the client. If server is unable to create an account or unable to process clients request, then the server will send an error message to the client. By using the same approach the client can also check the balance, gets the account details, deletes the account number and can change the account holder's contact details. The process status can be viewed on a touch screen.

## 3. SOFTWARE IMPLEMENTATION

Software is set of machine-readable instruction that directs a processor to perform specific operation. This section gives selection, configuration of Linux operating system and packages to bring up an OLTP system on ARM mini2440. These are available in World Wide Web. It also explains the system calls for communication between client and server in online banking transaction process.

### 3.1 Transplantation of Linux Operating System

The transplant of Linux operating system is related with the hardware. Linux operating system features have to be altered to fulfil the requirements of the hardware. The Linux operating system's transplant needs to complete three works: Bootloader transplant, Linux kernel transplant and filing system transplant. Bootloader starts before the operating system kernel. The main role is initialize hardware equipment (including I/O, the special function register), establishing the memory space map and bringing the environment of the system's hardware and software to an appropriate state.

The transplanted Linux kernel has to provide support to the hardware used; therefore modify the kernel according to the practical application. This process is called kernel scaling. It loads only required modules and hence the size of the kernel reduces and also it occupies less space on the device.

### 3.2 Linux Kernel Configuration to Support PPP

By default Kernel is not configured with point to point protocol. To make the system compatible with PPP, we compile PPP driver module into the Linux kernel. Input

compile command "make menuconfig" in the list of kernel which is under Linux, choose network device support. In that load PPP support, save the configuration file and exit. Similarly Ethernet supporting TCP/IP protocol can also be configured. Then generate a kernel image, with TCP/IP module and PPP module which are necessary for OLTP application.

## 3.3 Execution Steps

### 3.3.1 Transfer of Boot loader, Kernel and File system to the target board

For deployment of the Bootloader, kernel and file system to the board, an USB push utility is used. The Kernel and root file system can be transferred to the NAND memory on the SBC. On SBC, there is a small 2MB NOR memory which holds the BIOS which can be used to transfer the Bootloader, kernel and root file system to the mini2440. When the mini2440 is boot up in BIOS mode from the NOR flash, a menu appears which has USB push utility to transfer files to NAND in addition to setting boot parameters etc. Using this utility, the OS files created are written in the following order in NAND after setting up boot parameters:

1. Bootloader - Supervivi, S3C2440's boot loader given by Samsung
2. Kernel Image - ZImage
3. Root File system - rootfs.img

### 3.3.2 Transfer of PPP supporting Files

Along with kernel PPP module, system needs other PPP supporting files for operation such as pppd, pppdump, scripts, chat etc. This is also performed by using zmodem. These files are responsible for activation and deactivation of PPP.

### 3.3.3 Initialization of GSM Modem

Default baud rate of GSM module is 9600. ARM9 works at the baud rate of 115200. Hence GSM module's baud rate should be set to the target machine's baud rate by using the command AT+IPR=115200. Once it is adjusted, modem has to be removed from system terminal and connect it to ARM board through USB hub.

### 3.3.4 TCP connection/socket

A TCP connection is done with a 3-way handshake between a client and a server. The following is a simplified explanation of this process.

- a. The client asks for a connection by sending a TCP segment with the SYN control bit set.
- b. The server responds with its own SYN segment that includes identifying information that was sent by the client in the initial SYN segment.
- c. The client acknowledges the server's SYN segment.

The connection is then established and is uniquely identified by 4- tuple called a socket or socket pair. The TCP needs to have the information of Destination IP address, Destination port number, Source IP address and Source port number

### 3.3.5 Run banking application

Run the compiled program on the board. Similarly at the client end also run the application. Different actions are performed at the client end and server processes. Those actions are processed by either wired or wireless.

Then system is configured. After this, the server will be waiting for client request, if any request comes from client,

server will process the request. Figure 3.1 shows the flow chart of the process of the system. At the beginning system starts with power on reset.

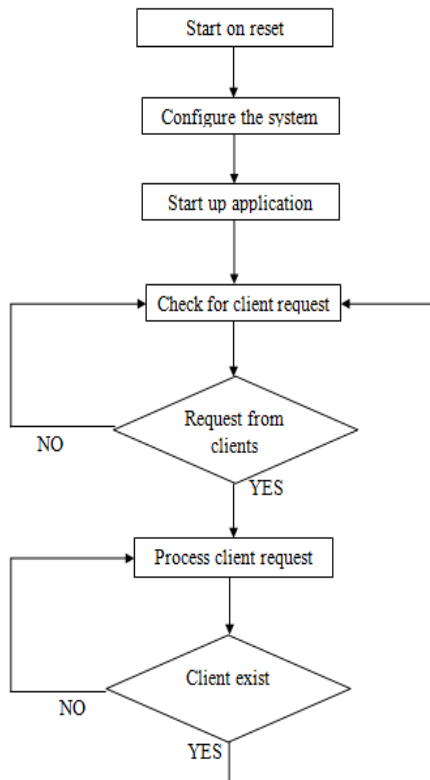


Figure 3.1: System flow.

At the beginning, the process starts with Link-Dead state. When the physical layer is ready for communication (e.g., two analog modems are connected to each other), PPP will proceed to the Link Establishment state. The LCP is used to establish the connection through an exchange of Configure packets. When this is completed, it enters the LCP opened state. Once the opened state is reached, the two peers are authorized to continue with further process with each other. If authentication is successful, each network layer protocol must be configured separately by the appropriate NCP. Once this is done, the two ends can begin sending packets. PPP may terminate the link any time. The Figure 3.2 shows sequence of the PPP operation is illustrated in the following:

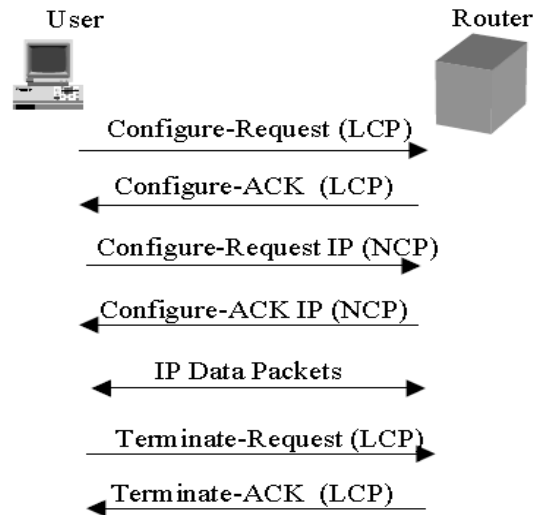


Figure 3.2: Hand shaking signal in PPP.

#### 4. RESULTS AND DISCUSSION

The Figure 4.1 shows system implementation, the ARM board connected to either GSM module or Ethernet. This constitutes server. The client interacts with server using wired or wireless protocols. The connection is terminated only when client explicitly sends termination signal.

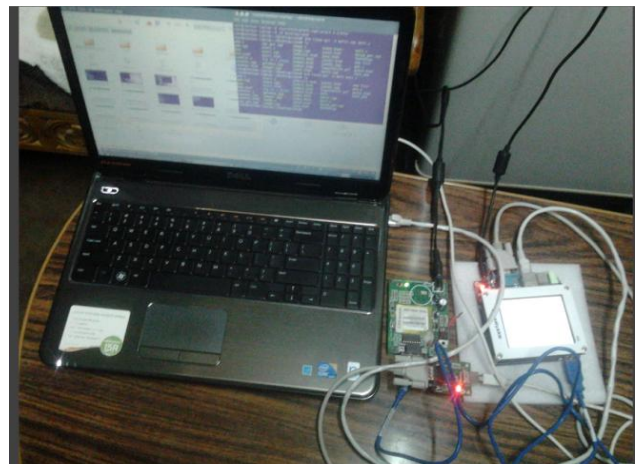
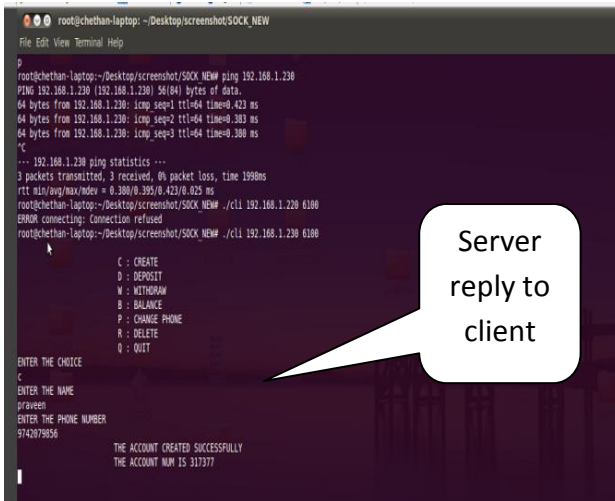


Figure 4.1: System implementation

After running client program, the client interacts with server for creating an account, deposit, withdraw, and so on. In return server sends "Account created successfully" message to the client which is as shown in Figure 4.2.



```
root@chethan-laptop: ~/Desktop/screenshot/SOCK_NEW
File Edit View Terminal Help
p
root@chethan-laptop:~/Desktop/screenshot/SOCK_NEW ping 192.168.1.238
PING 192.168.1.238 (192.168.1.238) 56(84) bytes of data:
64 bytes from 192.168.1.238: icmp_seq=1 ttl=64 time=0.423 ms
64 bytes from 192.168.1.238: icmp_seq=2 ttl=64 time=0.303 ms
64 bytes from 192.168.1.238: icmp_seq=3 ttl=64 time=0.308 ms
^C
---- 192.168.1.238 ping statistics ----
3 packets transmitted, 3 received, 0% packet loss, time 1998ms
rtt min/avg/max/ndev = 0.380/0.395/0.423/0.025 ms
root@chethan-laptop:~/Desktop/screenshot/SOCK_NEW ./c11 192.168.1.229 6108
ERROR connecting: Connection refused
root@chethan-laptop:~/Desktop/screenshot/SOCK_NEW ./c11 192.168.1.238 6108

C : CREATE
D : DEPOSIT
W : WITHDRAW
B : BALANCE
P : CHANGE PHONE
R : DELETE
Q : QUIT

ENTER THE CHOICE
c
ENTER THE NAME
praveen
ENTER THE PHONE NUMBER
9743079856

THE ACCOUNT CREATED SUCCESSFULLY
THE ACCOUNT NUM IS 317377
```

Figure 4.2: Showing client server interactions

ARM9 based server is designed successfully for online transaction process. An Online banking transaction process application is executed. The server creates the database and maintains the accounts of users.

## 5. CONCLUSIONS AND FUTURE WORK

An online transaction process system supports sharing of database and files between server and clients through communication media. It is more user friendly compared to offline system. Today OLTP based systems (power PC based) have high cost and large size. ARM9 based OLTP system is developed to overcome these short comings.

The result reveals that the system employs fewer resources. The system is stable, occupies less area, consumes less power and economical. In addition, it is also easy to expand towards small client minimal requirements. It is Portable and user friendly. The system has worked efficiently for multi client requests.

The ARM9 boards have small inbuilt secondary memory so it applicable for small OLTP systems. The secondary memory has to be increased by interfacing additional memory for large systems. Additional security can be provided by using encryption techniques. The mini2440 have additional hardware like LCD screen, VGA port, and so on. All these resources are used in this application. The size and cost of server can be reduced by avoiding these modules. This device finds applications in industries, banking, airlines and supermarkets.

## 6. ACKNOWLEDGEMENT

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## 7. REFERENCES

- [1] Divyasharma, Kamal kant, “PORTING THE LINUX KERNEL TO ARM DEVELOPMENT BOARD”, International Journal of VLSI and Embedded Systems - IJVES, Volume 04, Issue 02, March - April 2013.
- [2] Ravindra PrasadBonthu and Subrahmanyam VenkataVeeraghanta, “RTOS – RT Linux Porting On S3Cmini2440 ARM9 Board”, International Journal of Engineering Research and Development ISSN: 2278-067X.
- [3] Karim Yaghmour, “Building Embedded Linux Systems”, O’Reilly Publishers, First edition, pp. 107-237, April 2003.
- [4] Ashfaq A.Khan, “Practical Linux Programming: Device Drivers, Embedded Systems and the Internet”, Charles River Media, Inc, First Edition, 2002.
- [5] “The C Programming language”, Brian W. Kernighan, Dennis M. Ritchie, 2nd edition, Prentice-Hall India.
- [6] “The Design of UNIX Operating System”, Maurice J.Bach, second edition. Prentice-Hall India.
- [7] P.Raghavan, Amol Lad and Sriram Nelakandan, “Embedded Linux System Design and Development”, Auerbach Publications, New York, pp. 89-124, 2006.
- [8] Alessandro Rubini and JohnathanCorbett, “Linux Ethernet Network Device Driver A flow of code”, July 2006, (White Paper).
- [9] Andrew N. Sloss, Dominic Symes and Chris Wright “ARM System Developer’s Guide Designing and Optimizing System Software”, Morgan Kaufmann Publishers is an imprint of Elsevier, San Francisco.
- [10] HansH.Bauer, “A transaction process-based approach for capturing service quality in online shopping”, Journal of Business Research Volume 59, Issue 7, July 2006, Pages 866.
- [11] Samsung. S3C2440A 32Bit CMOS Microcontroller User’s Manual [Z]. Samsung Electronics Corp.