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DHCP INPLEMENTATION IN A NIOS PROCESSOR

Spoorthi Y[1] , Nalina H D [2]

[1]*Assistant Professor, Department of ECE, GSSSIETW Mysuru (INDIA)*
[2]*Assistant Professor, Department of ECE, GSSSIETW Mysuru (INDIA)*

ABSTRACT
Operating System is a collection of programs which acts as a interface between the user and the sytem. It also helps to communicate with the other system in the network. For communicating in a network, the main requirement is an IP address which is unique for all the system in the network. This IP address is assigned by the server which is connected to the network. Initially, when a system is connected to the network, to get an IP address from the server, exchange of message between the server and the client i.e, the system takes place. At the client side, Operating System will deals with the assignment of IP address through a set of packets of data. Many embedded systems are required for customised applications in which operating system cannot be installed. But the device should get an IP address to enable proper communication with the other IP network elements. As most of the systems are FPGA based, In this paper we implement set of messages to get an IP address to the system. This is an Altera FPGA in which a NIOS, i.e, a Soft Processor is used to implement these set of messages. As a server we are using DHCP the master of the network, which assigns IP address to the device/system in the network.To initialize the elements in the FPGA, Quartus II software is used and to program the message flow to the NIOS processor NIOS II IDE is used. To view the message flow the Wireshark software is used.

Keywords—BOOTP (Bootstrap protocol), ASIC (Application specific integrated circuit), ASSP (Application specific standard product), GIADDR (Gateway IP Address), DHCP (Dynamic Host Configuration Protocol)

I. INTRODUCTION

The main objective of this paper is to assign the IP address for the equipments like, Customer Premises Equipment (CPE) into which operating system cannot be loaded. The IP address assignment to the client is done by the master of the network, i.e., Server. This has to be done automatically as soon as the equipment is connected to the particular network

A network is any collection of independent computers that communicate with one another over a shared network medium**.** A computer network is a collection of two or more connected computers. When the computers are joined in a network, people can share files and peripherals such as modems, printers, tape backup drives, or CD-ROM drives. When networks at multiple locations are connected using services available from phone companies, people can send e-mail, share links to the global Internet, or conduct video conferences in real time with other remote users. As companies rely on applications like electronic mail and database management for core business operations, computer networking becomes increasingly more important. All computers that are on

a TCP/IP network must have an IP address on the network to work correctly. An IP address is a unique numeric identifier for a computer or other device on a TCP/IP (transmission control protocol/Internet protocol) network. TCP/IP is the set of protocols (i.e., agreed-upon formats) that is used by the Internet as well as for most LANs (local area networks) and other computer networks. Dynamic IP addresses are assigned by the dynamic host configuration protocol (DHCP), which is one of the key protocols in the TCP/IP protocol suite. Dynamic IP addresses contrast with static IP addresses, which are assigned manually and semi-permanently to a device.

II.THEORY BACKGROUND

A. DHCP (Dynamic Host Configuration Protocol)

DHCP was first defined as a standards track protocol in RFC 1531 in October 1993, as an extension to the Bootstrap Protocol (BOOTP). The motivation for extending BOOTP was that BOOTP required manual intervention to add configuration information for each client, and did not provide a mechanism for reclaiming disused IP addresses. This means that connecting a computer to the internet was a manual process. DHCP Server allots the IP addresses to computers. It is needed to avoid manual maintain of IP Addresses or when IP Addresses available are less than number of machines, as dynamic DHCP Server will recycle IP Addresses on machines. DHCP is useful for fast delivery of client network configuration.

When configuring the client system, the administrator can choose DHCP and not have to enter an IP address, net mask, gateway, or DNS servers. The client retrieves this information from the DHCP server. DHCP is also useful if an administrator wants to change the IP addresses of a large number of systems. Instead of reconfiguring all the systems, he can just edit one DHCP configuration file on the server for the new set of IP address. If the DNS servers for an organization changes, the changes are made on the DHCP server, not on the DHCP clients. Once the network is restarted on the clients (or the clients are rebooted), the changes will take effect. Furthermore, if a laptop or any type of mobile computer is configured for DHCP, it can be moved from office to office without being reconfigured as long as each office has a DHCP server that allows it to connect to the network.

B. SOPC Builder (System on a Programmable Chip Builder)

SOPC Builder is a powerful system development tool (software) made by Altera that automates connecting soft-hardware components to create a complete computer system that runs on any of its various FPGA chips. SOPC Builder incorporates a library of pre-made components (including the flagship Nios II soft processor, memory controllers, interfaces, and peripherals) and an interface for incorporating custom ones. SOPC Builder enables to define and generate a complete system-on-a-programmable-chip (SOPC) in much less time than using traditional, manual integration methods. SOPC Builder is included in the Quartus II software. Many designers already know SOPC Builder as the tool for creating systems based on the Nios II processor. However, SOPC Builder is more than a Nios II system builder; it is a general-purpose tool for creating systems that may or may not contain a processor.

SOPC builder components can use either Avalon-MM or Avalon-ST interfaces or both.

C. Nios II IDE (Integrated Development Environment)

The Nios II IDE is the primary graphical software development tool for the Nios II family of embedded processors. The Nios II IDE provides a consistent development platform that works for all Nios II processor systems. All software development tasks within the Nios II IDE, including editing, building, debugging, and profiling programs can be accomplished. The IDE allows creating single-threaded programs as Well as complex applications based on a real-time operating system (RTOS) and middleware libraries available from Altera and third-party vendors.

The IDE also allows importing and debugging the projects created from the Nios II command shell with the Nios II software build tools, such as the Nios II BSP generator. There are two typical design flows involving the Nios II IDE. One can work entirely within the IDE, or can work with the Nios II software build tools in the Nios II command shell and then import the work into the IDE for debugging

III.BLOCK DIAGRAM AND WORKING PRINCIPLE

As shown in figure 3.1, the block diagram mainly consists of DHCP Client, IP Cloud & DHCP Server. DHCP is built on a client-server model. A DHCP client is any network-enabled device that supports the ability to communicate with a DHCP server for the purpose of obtaining dynamic leased IP configuration and related optional information. It consist of Flash memory, NIOS processor RJ45, RS 232-Serial interface, Serial buffer, Ethernet interface, Ethernet buffer, voltage regulator. The DHCP server maintains a database of available IP addresses and configuration information. When the server receives a request from client, the DHCP server connected to the RJ45. These connectors are most commonly seen with Ethernet cables and networks. Then it is connected to the Ethernet interface and stored in the Ethernet Buffer in the SRAM. Then fed to the NIOS processor it process the request based on the code in the processor. The flash memory enables the Nios processor to access unused flash memory through AS memory interface. The unused memory locations of the serial configuration device can be accessed to store or retrieve data through the Nios processor and SOPC Builder. The response from NIOS processor stored in the ethernet buffer in the SRAM and then sends back to the DHCP server via Serial Interface which is connected through RJ 45. To display any responses or assigned IP address on PC, the messages stored in serial buffer is fed to RS 232 via serial interface, which in turn connected to the system.

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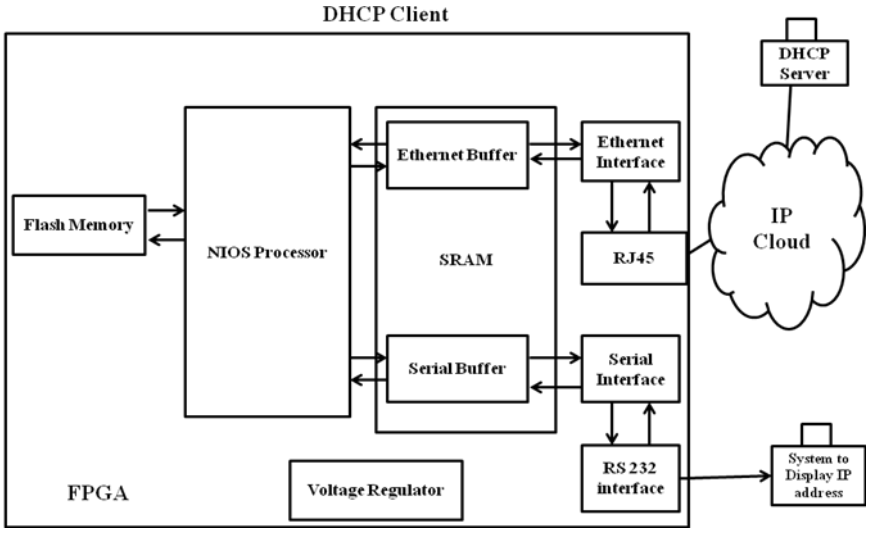
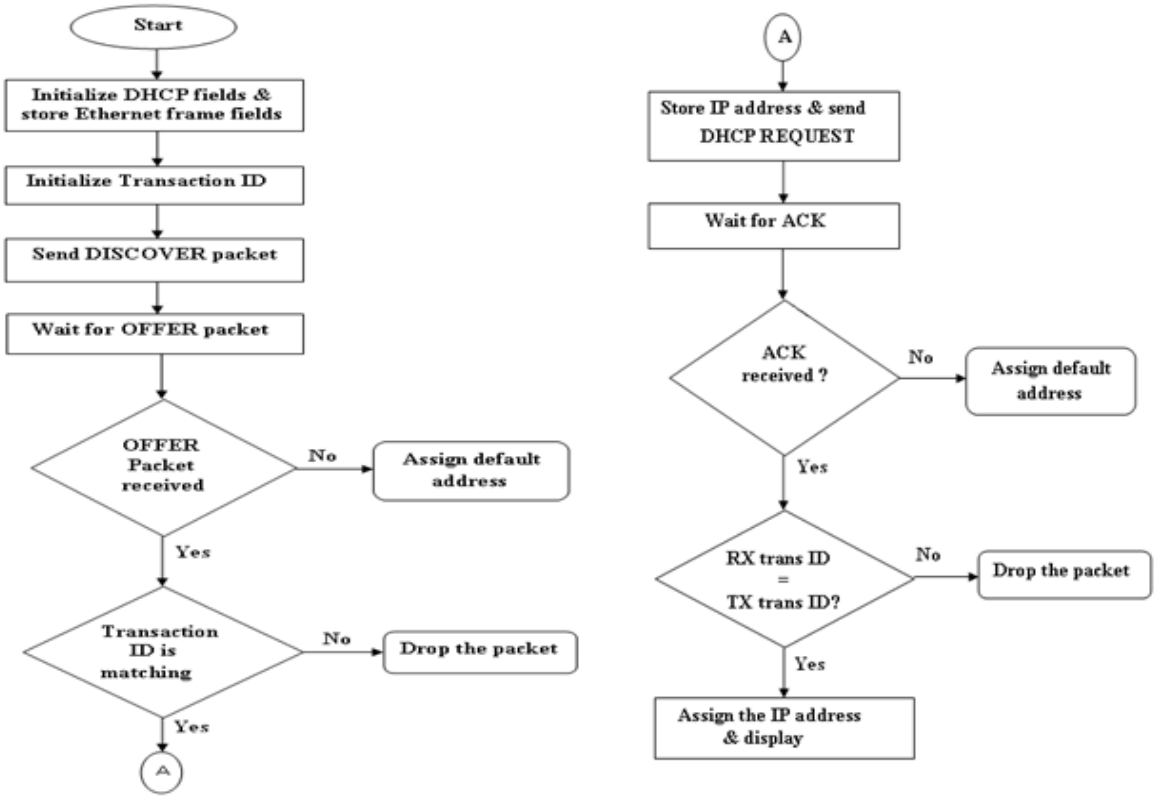


Figure 3.1: Block Diagram

D.Main program



Flow chart 1

E. Discover

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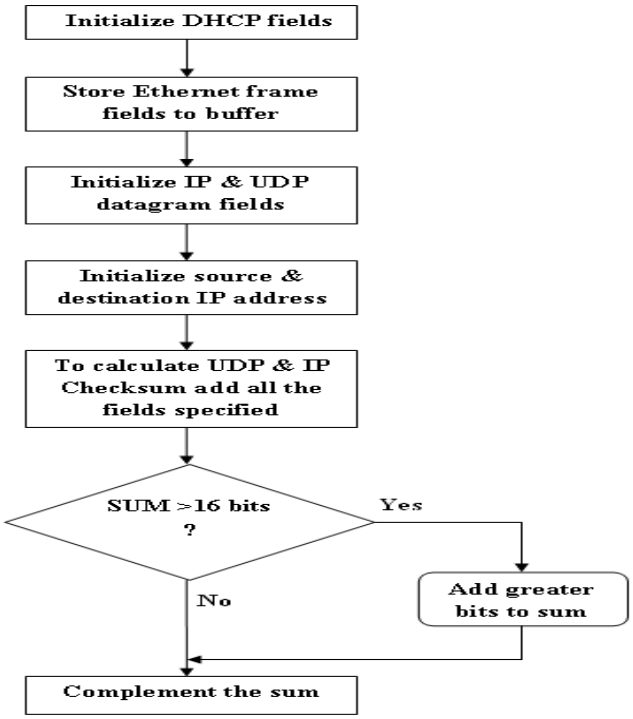
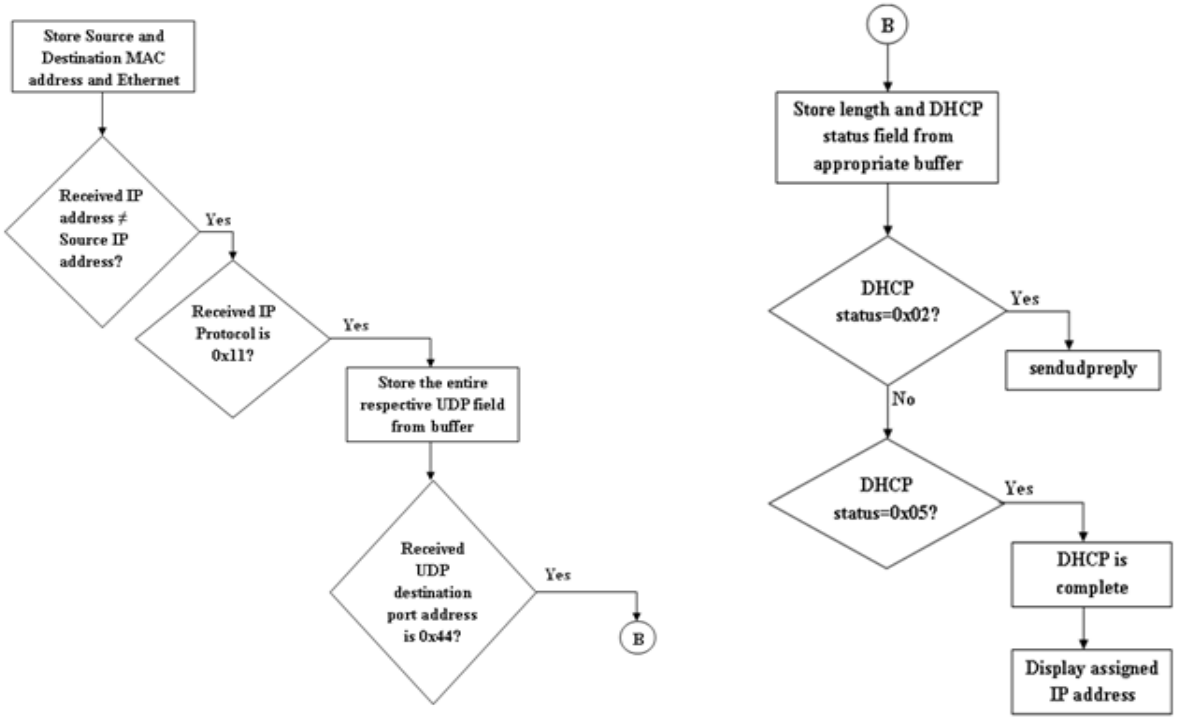


Flow chart 2

F .Executelanpkt



Flow chart 3

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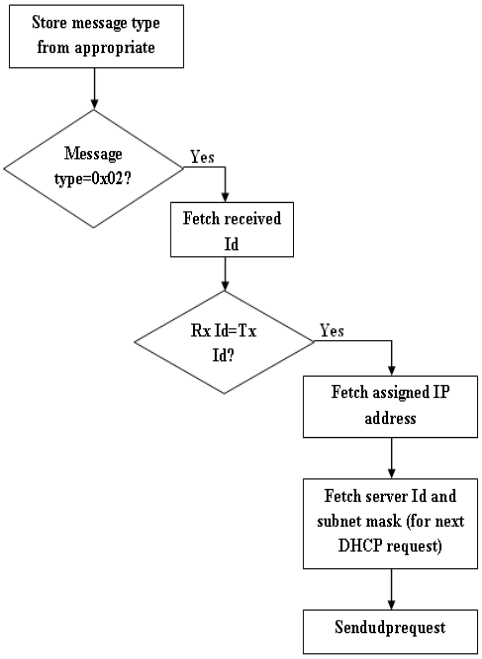
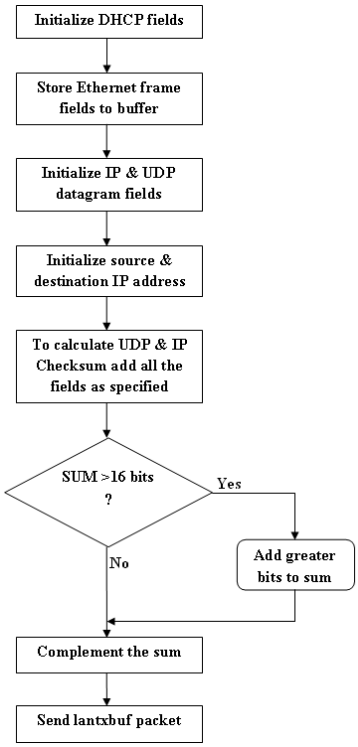
G. Sendudpreply



Flow chart 4

H. Sendudprequest



Flow chart 5

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IV.RESULTS

The results can be viewed and analyzed both on wireshark and HyperTerminal. In wireshark the packets flow can be seen. On HyperTerminal the assigned IP address, Transaction ID and other information can be displayed. As seen in figure 4.1, two messages which are broadcasted by server to client can be seen. The messages are broadcasted because; the client doesn't have IP address. The transaction ID remains same thought conversation between server and client which can be noticed in the figure 4.1.

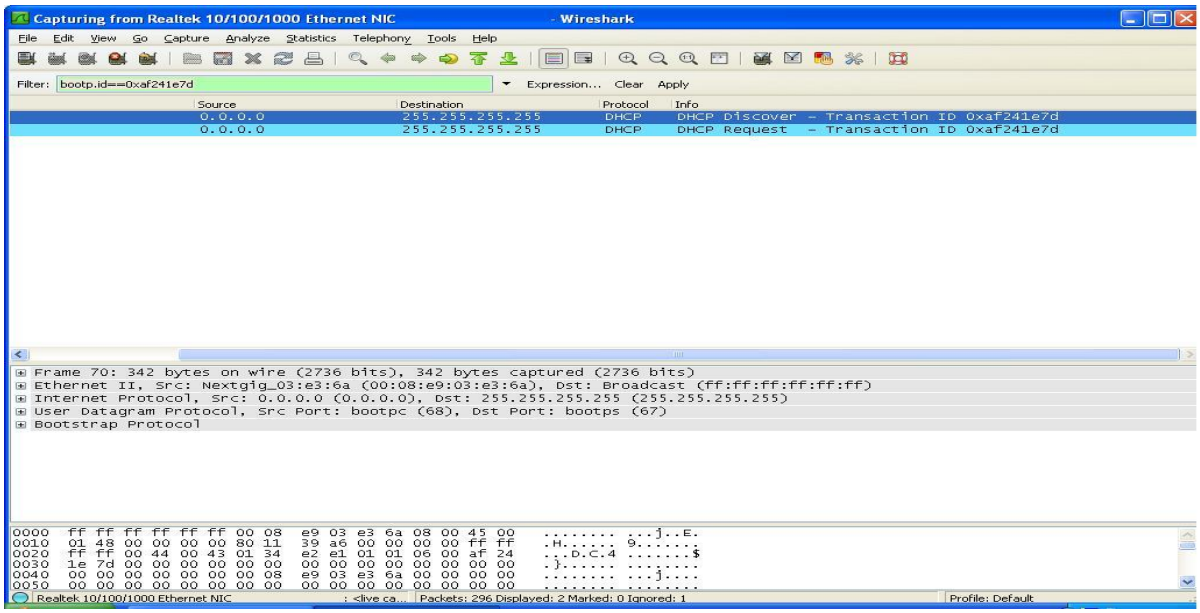

Figure 4.1: DHCP messages sent by server to client

The transaction ID is 0xaf241e7d. When the server responds/sends any packet, if the transaction ID matches, the client will receive that packet. Otherwise it will discard that packet. This is the case prior to the IP address assignment.

Figure 4.2 shows the DHCP message intended for client from server.

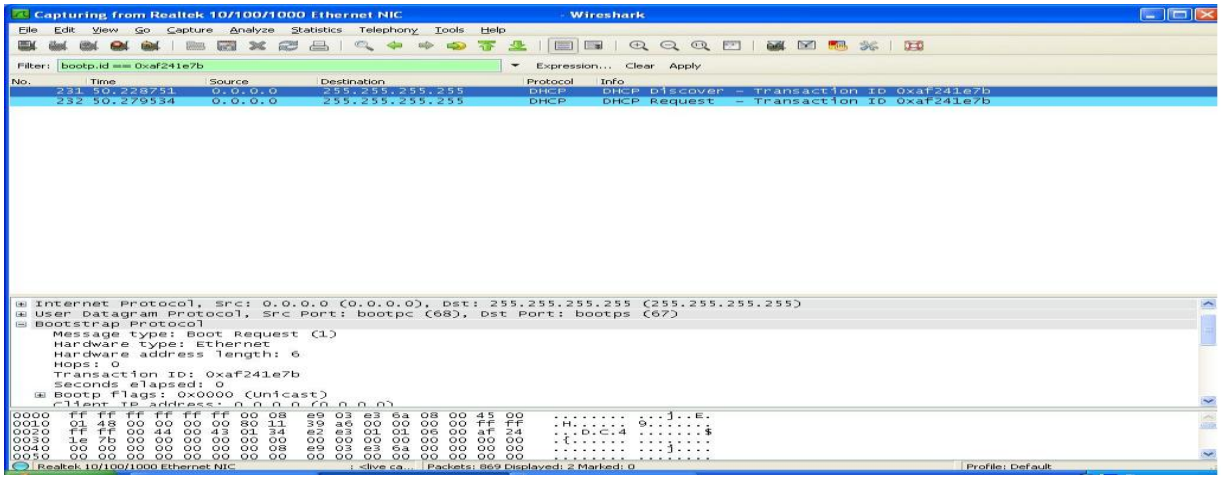

Figure 4.2: DHCP messages sent by server to client

Figure 4.3 shows the display of transaction ID, assigned IP address, Subnet mask and Default Gateway on the HyperTerminal.

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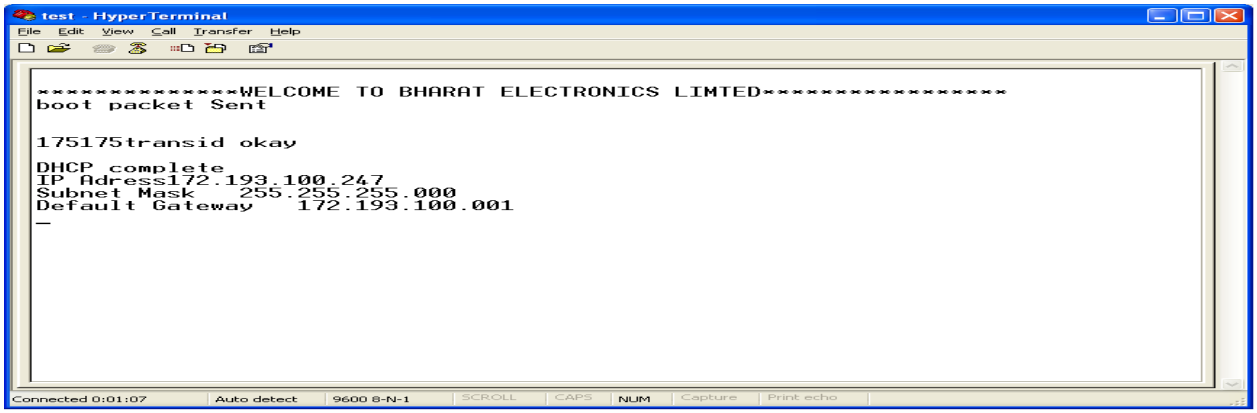

Figure 4.3: Display of messages and network related information

V. ADVANTAGES AND APPLICATIONS

- The main advantage of this paper is assignment of IP address for the device which does not have OS and want to get IP address to communicate in the network. Also, maintenance is easy as the attack of viruses can be eliminated as the OS is not there.
- A primary advantage of assigning IP address using DHCP is easier management of IP addresses. In a network without DHCP, must manually assign IP addresses, must be careful to assign unique IP addresses to each client and to configure each client individually. If a client moves to a different network, must make manual modifications for that client. When DHCP is enabled, the DHCP server manages and assigns IP addresses without administrator intervention. Clients can move to other subnets without manual reconfiguration because they obtain new client information appropriate for the new network from an appropriate DHCP server.
- Clients can use DHCP to obtain the information that is needed to boot from a server on the network. The DHCP server can give a client all the information that the client needs to function, including IP address, boot server, and network configuration information. Because, DHCP requests can be relayed across subnets.
- Networks with millions of DHCP clients can use DHCP. The DHCP server uses multithreading to process many client requests simultaneously.
- It provides enhanced security for individual users because their IP address is different every time they log into the network.
- It minimizes configuration errors caused by manual IP address configuration, such as typographical errors, as well as address conflicts caused by a currently assigned IP address accidentally being reissued to another computer.
- Each computer gets its configuration from a pool of available numbers automatically for a specific time period. When a computer has finished with the address, it is released for another computer to use.
- The main application of this paper is in security fields where the client moves between many networks.
- In general, it can be used for the devices which will move to different places and want to communicate with the device for transfer of information.

VI. FUTURE SCOPE AND CONCUSION

The paper can be extended by implementing all other DHCP messages such as Decline, Negative acknowledgement, Release, Inform and considering the timing conditions for each message flow.

As in our paper, it works only with DHCP server; it can be extended by implementing for other servers in the application layer. Also, implemented in the scenario of multiple server of different types and multiple slave in the network

All the devices on the network must have an IP address to communicate efficiently. So earlier the assignment of IP address done by using Bootstrap protocol. The motivation for extending BOOTP was that BOOTP required manual intervention to add configuration information for each client, and did not provide a mechanism for reclaiming disused IP addresses. This means that connecting a device to the internet was a manual process.

To overcome this problem, in our paper DHCP is implemented. The DHCP is a network protocol that is used to configure devices which are connected to a network so that they can communicate on an IP network.

The DHCP architecture consists of DHCP Client and server. The DHCP server may have three methods of allocating IP-addresses to computers are Static allocation, Dynamic allocation & Automatic allocation. Here, we are using automatic allocation method, in that DHCP server permanently assigns a free IP address to a requesting client from the range defined by the administrator.

DHCP server and DHCP client communicate through a series of DHCP messages. To obtain a lease, the DHCP client initiates a conversation with a DHCP server using a series of these DHCP messages are DHCP Discover, DHCP Offer, DHCP Request & DHCP Ack. When a client needs to start up operations, it broadcasts a request for address information. The DHCP server receives the request, assigns a new address. This information is acknowledged by the client, and used to set up its configuration.

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