Assignment 2: DHCP Server and Client using Java Sockets

The goal of this assignment is to learn UDP Socket programming and get familiarized with the basics of distributed programming. In addition, this assignment also helps to understand the Dynamic Host Configuration Protocol (DHCP), which is one of the widely used protocols in computer networks.

Assignment Description

This assignment consists of two parts. In the first part, you will implement a UDP server and client. And, in the second part of the assignment, you will extend the UDP server and client with DHCP protocol specifications.

UDP Server and Client

In this part, you will build a UDP server and client. You are only allowed to use DatagramSocket, DatagramPacket and Multicast Socket packages of Java.

DHCP Server and Client

In the second part, you will extend your UDP server and client implementations to demonstrate the operation of DHCPv4 protocol. DHCP protocol is widely used in computer networks to assign IP address and other configurations to host computers. Your implementation must follow the protocol specifications and should support the following transactions:

- DHCPDISCOVER
- DHCPOFFER
- DHCPREQUEST
- DHCPACK
- DHCPNAK
- DHCPRELEASE

You must follow the message format described in the protocol specifications. Your implementation should demonstrate dynamic allocation. Your server implementation must maintain a pool of addresses, which it leases to clients. All the interactions between the client and server should follow the protocol specifications. You should consult with your teaching assistants if you have any doubts or questions about the specifications.

> According to RFC specifications, a DHCP client must do UDP broadcast to discover a DHCP server on the network. But, **you are not authorized** to broadcast UDP messages on the lab network, since doing so would disrupt the network infrastructure. Therefore, you **MUST NOT** do UDP broadcast from your DHCP client software. As an alternative, we provide a test DHCP server in the lab. The test DHCP server has the following configuration: IP address-10.33.14.246, and port-1234. Your DHCP client should be tested using this server.

Both the client and server should print the type of messages sent and received by each other, along with the contents. In addition, the server should show the list of leased addresses along with their associated MAC addresses, after each transaction.

The configuration of the server may be provided in the form of a text file. Your design choices should be motivated during the demonstration session.

Testing Guidelines

For testing your DHCP client implementation, we provide a test DHCP server in the lab. The test server is running at 10.33.14.246 (IP address), and it is listening at port 1234. All your interactions with this server must happen through unicast messages. And, you must not broadcast messages from your client.

Your DHCP server should be tested your client implementation. Your server must use a port number above 1023 on the localhost.

General Guidelines

- You are only allowed to use DatagramSocket, DatagramPacket and Multicast Socket packages of Java. For other packages, you should get the approval from your supervisor.
- You should document your code. During the evaluation, we will go through your code and may ask you to explain how a certain method works in your code.
- You should know the protocol specifications of DHCPv4 as defined in IETF draft [1,2]. During the demonstration, you should explain how you have handled different specifications in your code.

Practical Information

- You should either work alone or in groups of two. You should email your group details i.e. names and student numbers to gowrisankar.ramachandran@cs.kuleuven.be on or before 06-03-2016. The subject of this email should be [CN:Assignment2].
- You are strongly encouraged to use the computers in the lab.
- You have **three** weeks to complete the assignment. In the 4th week, you should demonstrate your assignment to the teaching assistants. You will be marked based on your performance in the demonstration.
- For students working in groups, both the students should be prepared to demonstrate the assignment. If you cannot explain your code, we will assume that you did not write it.
- The fourth session is only meant for marking your assignment. Therefore, you should be ready to demonstrate your code at the start of the 3rd practical session. You will only be marked in your assigned session.

Marking Specifications

The following specifications will be used during the marking session.

DHCP Client Marking (worth 8 out of 20 marks)

Mark	Expected Functionality
Below 4 (D)	Client is not functional or sufficiently demonstrated.
4-5 (C)	Client works partially.
5-7 (B)	Client works correctly.
8 (A)	As (B) with elegant and documented code.

DHCP Server Marking (worth 12 out of 20 marks)

Mark	Expected Functionality
Below 5 (D)	Server is not functional or sufficiently demonstrated.
5-9 (C)	All transactions works, but with leasing problems.
9-11 (B)	As above, without leasing problems and good design choices.
12 (A)	As above with elegant and documented code.

References:

1. Dynamic Host Configuration Protocol (RFC 2131).
   - ❖ https://www.ietf.org/rfc/rfc2131.txt
2. DHCP Options and BOOTP vendor extensions (RFC 2132).
   - ❖ https://www.ietf.org/rfc/rfc2132.txt
3. Bootstrap protocol (RFC 951).
   - ❖ https://tools.ietf.org/html/rfc951
4. Host configuration protocols.
   - ❖ http://www.tcpipguide.com/free/t_HostConfigurationandTCPIPHostConfigurationProtocol.htm