4. Dynamic Host Configuration Protocol (DHCP)

4.1 DHCP Principle
4.2 DHCP Server Configuration
4.3 DHCP Options, Scope, Reservation and Relaying
4.4 DHCP Troubleshooting

4.1 DHCP Principle

- ❖ Dynamic Host Configuration Protocol (DHCP) is basically an automated means of managing and assigning Internet IP addresses to client workstations on the network.
- ❖ This protocol saves the system administrator much time having to manually configure each host workstation manually, and to maintain large databases storing IP assignment details.
- ❖ When any of the network settings change (like allocating a new default gateway or new DNS server), then the details can be configured at the DHCP server as opposed to manually changing the settings of many client systems
- ❖ The network related information that DHCP server provides to clients includes the following
  - ➢ IP address
  - ➢ Subnet mask
  - ➢ Default gateway
  - ➢ DNS servers
  - ➢ NTP servers
  - ➢ Broadcast address, etc
- ❖ The lease time of the address and network information are based on predefined values for example
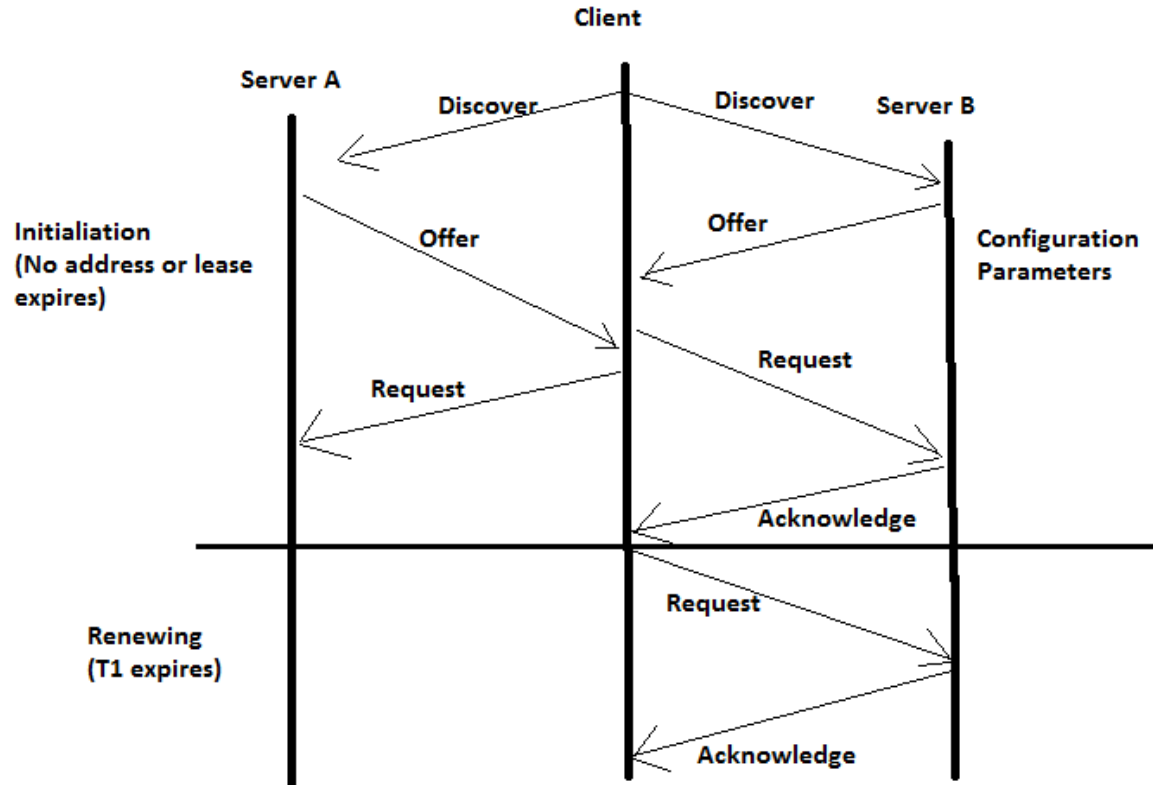 - ➢ 1 day, 1 week, 1 month

❖ DHCP uses UDP protocol and layer 2 information to request/assign address between client and server.
  ➢ DHCP server uses UDP port 67
  ➢ DHCP client uses UDP port 68

❖ **DHCP Client Server Communication Process**

  ➢ DHCP client server communication process can be well explained as DORA process where
    • **D** stands for **D**iscover:- Client that requires IP and network information broadcasts messages on the network in search of available DHCP server
    • **O** stands for **O**ffer:- The server response to the client "Discover" with the offer of network configuration parameters.
    • **R** stands for **R**equest:- The client again broadcast to the server, requesting the offered parameters from one server specifically.
    • **A** stands for **A**cknowledge:- The server accept the request and acknowledge with DHCP parameter and update the information on its lease database.

➢ The above process can be clearly expressed by following flow diagram.

DHCP Flow Diagram

Client

Server A

Discover | Discover | **Server B**

Offer

**Initialiation
(No address or lease
expires)**

Offer

**Configuration
Parameters**

Request

Request

Acknowledge

Request

**Renewing
(T1 expires)**

Acknowledge

4.2 DHCP Server Configuration

❖ DHCP server configuration contains basic following parameters on main DHCP configuration file

```
###########DHCP Sample Configuration############################
lease-file-name "/var/lib/dhcpd/dhcpd.leases";
authoritative;
option  domain-name          "acd.edu.np";
default-lease-time     86400;
max-lease-time         172800;

subnet 192.168.200.0  netmask  255.255.255.0  {
        range  192.168.200.100  192.168.200.200;
        option routers                  192.168.200.1;
        option subnet-mask          255.255.255.0;
        option domain-name-servers          192.168.200.10, 8.8.8.8;
        option ntp-servers              192.168.200.20;
}
################################################################
```

These are basic parameters used on DHCP configuration and their definition is as show on the table below

DHCP Parameters	Definition
lease-file-name	Filename that stores list of active IP lease allocations
authoritative	Set as master server, protects against rouge DHCP server
option domain-name	Specifies the Domain name
option domain-name-servers	The DNS servers the client should use for name resolution
option routers	Specified the gateway for the client to use
option subnet-mask	The subnet mask to be used
option ntp-servers	Network time protocol servers for client
range	The range of valid IP address available for client
default-lease-time	The default time in seconds that the IP is leased
max-lease-time	The max time in seconds that the IP is leased

4.3 DHCP Options, Scope, Reservation and Relaying

DHCP Options:

➢ Option field in DHCP configuration is used to define various parameters such as subnet mask, DNS server, domain name, NTP server, default gateway(router IP) etc.

DHCP Scope:

➢ DHCP scope is a range of IP addresses that a DHCP server can lease out to a subnet.

➢ This can also include additional info / DHCP options such as subnet mask, default gateway, DNS, WINS, etc.

DHCP Reservation:-

➤ DHCP reservation is a feature in the DHCP server that allows the DHCP administrators to reserve one or more IP addresses for particular mission-critical computers only such as hosted servers, printers etc..

➤ In order to configure DHCP reservation, the administrators are required to know the physical addresses ie. MAC addresses of the target computers for which the particular IP addresses are to be reserved.

➤ Once the MAC addresses are known, the administrators can then reserve the appropriate IP addresses by mapping them with the MAC addresses.

For example, if computer A is playing the role of a print server, and has MAC address of 00:A1:FB:12:45:4C and you want that the computer should always get 192.168.200.7 as its IP address, you can map the MAC address of the computer A with the IP for reservation.

```
###########DHCP Reservation Sample Configuration######################
host  printserver {
        hardware ethernet  00:A1:FB:12:45:4C;
        fixed-address  192.168.200.7;
}
################################################################
```

DHCP Relaying:-

➢ A **DHCP relay** agent is any host that forwards **DHCP** packets between clients and servers.
➢ **Relay** agents are used to forward requests and replies between clients and servers when they are not on the same physical subnet.
➢ **DHCP relay** has a significance importance in a large network like service provider when DHCP services are required to provide for many different network subnets.
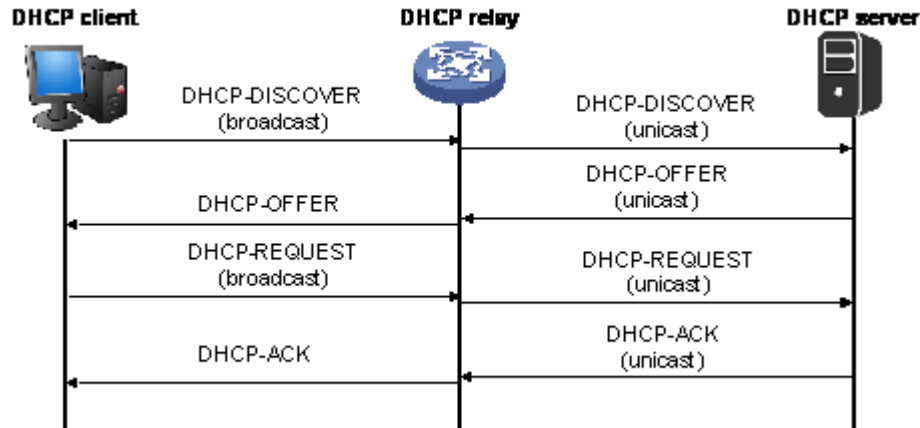
4.4 DHCP Troubleshooting

➢ For troubleshooting DHCP issues, check following log file, where all the error messages are displayed.

"/var/log/messages"

➢ To search more specific messages for example dhcp messages use following command

"#tail /var/log/messages | grep dhcp"

➢ To verify DHCP leases, check following file in DHCP server

"/var/lib/dhcpd/dhcpd.leases"

➢ To verify DHCP IP received by client, check following file in client
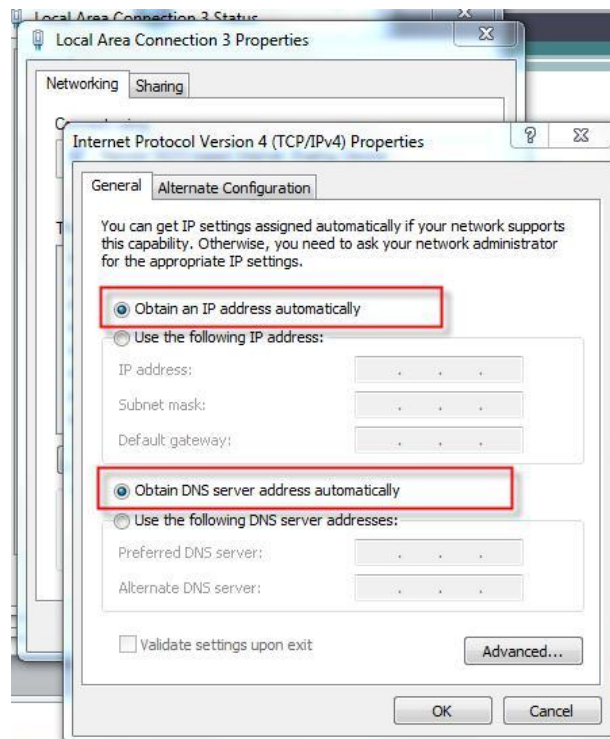
"/var/lib/dhclient/dhclient-eth0.leases"

DHCP Client Configuration

- ➤ In Linux
  - ▫ Interface should use dhcp
    - ▫ /etc/sysconfig/network-scripts/ifcfg-eth0
      - ▫ DEVICE=eth0
      - ▫ BOOTPROTO=dhcp

- ➤ In Windows

DHCP LAB:

Title: DHCP Server Configuration and Troubleshooting

1) Package Required
   - *"dhcp-common-4.1.1-53.P1.el6.centos.3.i686"*   -- DHCP package for Client
   - *"dhcp-4.1.1-53.P1.el6.centos.3.i686"*   -- DHCP package for Server
2) Verify if the required package for DHCP server is installed on your system or not by using following command
   - *#rpm –qa | grep dhcp*
3) If package does not exits, install it by using *rpm* command if package is locally available or by using *yum* if you are online
   - *#yum –y install dhcp*
4) DHCP Server Configuration file
   - *"/etc/dhcp/dhcpd.conf"*   -- Main configuration file
   - *"/usr/share/doc/dhcp-4.1.1/dhcpd.config.sample"*   -- Sample configuration file
5) Backup Main configuration file
   - *#cp /etc/dhcp/dhcpd.conf /etc/dhcp/dhcpd.conf.backup.18Apr2018*
6) Edit main configuration file

   ####DHCP Server Configuration on 18th April 2018 by abc########

   #vi /etc/dhcp/dhcpd.conf

   lease-file-name "/var/lib/dhcpd/dhcpd.leases";
   authoritative;
   option domain-name"acd.edu.np";
   default-lease-time   86400;
   max-lease-time   172800;

   subnet 192.168.200.0 netmask 255.255.255.0 {
   *   range 192.168.200.100 192.168.200.200;*
   *   option routers   192.168.200.1;*
   *   option subnet-mask   255.255.255.0;*
   *   option domain-name-servers   192.168.200.10, 8.8.8.8;*
   *   option ntp-servers   192.168.200.20;*
   }

   ####DHCP Reservation Lists ####
   host file_server {
   *   hardware ethernet 00:A1:FB:12:45:4C;*
   *   fixed-address 192.168.200.7;*
   }
   host abc_pc {
   *   hardware ethernet AA:BB:CC:DD:EE:FF;*
   *   fixed-address 192.168.200.250;*

}

Save and exit

esc

:wq

7) Since you are configuring your server as DHCP, change your interface configuration mode to "static" and set IP address if it is on "dhcp" mode earlier
   - *#vi /etc/sysconfig/network-scripts/ifcfg-eth0*
     i to insert
     BOOTPROTO="static"
     IPADDR="192.168.200.1"
     NETMASK="255.255.255.0"

8) Save and exit and restart network service by "service network restart"

9) Check and start dhcpd service
   > *#service dhcpd status*   if stopped, start it by using following
   > *#service dhcpd start*

10) Check DHCP service on start-up
    > *#chkconfig --list | grep dhcp*

11) If the DHCP service is turn off on system start-up on run levels 3 and 5 enable it using following command.
    > *#chkconfig --level 35 dhcpd on*

12) Connect the server and clients on network and verify if client is getting IP and other network related information, make sure that client interface is configured on dhcp mode.

13) Verification of IP address on client and lease database on server
    - On client PC
        i. *#ifconfig*
        ii. *#less /var/lib/dhclient/dhclient-eth0.leases*
    - On DHCP Server to verify IP address lease to clients
        i. *#less /var/lib/dhcpd/dhcpd.leases*

14) Troubleshooting
    - If you get error while starting dhcpd service, check the logs files stored on server on the following file
      #tail -f /var/log/messages | grep dhcp