Teldat Router

DHCP Protocol

Doc. *DM730-I* Rev. *10.00*
February, 2003

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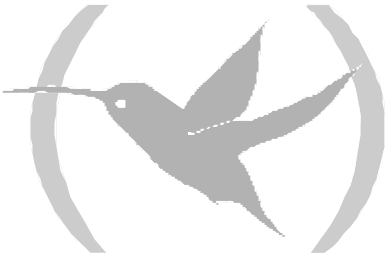
Chapter 1
Introduction



1. Introduction to the DHCP Protocol

The DHCP protocol (Dynamic Host Configuration Protocol) provides a mechanism for the exchange of configuration information between distinct clients in a TCP/IP network. DHCP has two main components: a protocol to deliver the configuration data to the various clients from a DHCP server and a mechanism to store all the network addresses for the clients.

DHCP is built over a client-server model where a designated DHCP server stores network addresses and delivers the configuration parameters to the clients who are going to be dynamically configured. The DHCP in the Teldat devices support two mechanisms in order to store the IP addresses. Dynamic storing where the DHCP assigns an IP address for a period of time or until the client releases this address and manual storing where the addresses are assigned by a network manager and the DHCP transmits these to the client.

Dynamic storing is the only one of these mechanisms permitting automatic reuse of the addresses that are no longer going to be used by the client they were assigned to. This is a particularly useful mechanism for assigning addresses to a client who only connects to the network for a limited period of time or who shares a group of IP addresses within a group of clients who again, do not require permanent addresses. This can also be an excellent option for assigning addresses to a new client who is permanently connected to a network where the IP addresses are limited, in order to reclaim them when old clients resign.

Manual storing permits the DHCP protocol to avoid client manual configuration errors for those being assigned IP addresses and who are in environments where the administration of the IP addresses is outside the scope of the DHCP protocol.

The DHCP protocol for the Teldat devices define two basic types of behavior: the first as a relay agent which transmits messages within the same network segment to a known DHCP server and secondly, the functionality as a server itself.

The DHCP protocol is designed to support DHCP clients with parameter configuration defined in the Host Specifications RFCs. Once the configuration parameters have been obtained through the DHCP protocol, the clients should be able to exchange packets with other Intranet hosts or even with Internet providing they have those addresses available. Not all of these parameters however are required for a client newly initializing. A client and a server can negotiate the transmission of only those parameters required by the client or those specified for a determined subnet.

The DHCP also permits, although they are not required, parameter configuration which are not directly related with the IP protocol, e.g. the DNS (Domain Name System).

2. Protocol

The DHCP protocol is constructed over a client/server architecture. The interaction between them is described below. Some steps are omitted in cases where the client already knows his address.

The first step for the client is to send a DHCPDISCOVER broadcast message in his physical subnet. This message may have address lease time options or values for the address. If the server is not in the same subnet, this is sent to it via a relay (this is a device that transmits petitions to the server in the subnet it is connected to).

Each server can respond with a DHCPOFFER message that includes a valid network address and other configuration parameters.

The possible DHCP messages are the following:

MESSAGE	**USE**
DHCPDISCOVER	Client broadcast to locate the servers.
DHCPOFFER	From the server to the client in response to the DHCPDISCOVER with configuration parameters.
DHCPREQUEST	From the client to the servers a) requesting some parameters offered by one of the servers b) confirming the stored address correction after reinitiating the system or c) extending the lease for the assigned address.
DHCPACK	From the server to the client with the configuration parameters that include the assigned network address.
DHCPNAK	From the server to the client indicating that the client network address is incorrect or its lease has expired.
DHCPDECLINE	From the client to the server indicating the address is in use.
DHCPRELEASE	From the client to the server releasing the assigned network address and canceling the granted lease.
DHCPINFORM	From the client to the server requesting local configuration parameters. The client has already received the address externally.

The DHCP client receives one or more DHCPOFFER messages from one or more servers. The client can expect multiple responses. The client selects a server from whom he requests the configuration parameters, basing this on the configuration parameters the server has offered in the DHCPOFFER messages. The client broadcasts the DHCPREQUEST message indicating the identity of the selected server in it. The value for the received address should be in the yiaddr field of the server's DHCPOFFER message. The DHCPREQUEST message should be sent to all the servers who received the DHCPDISCOVER message so that they can reuse the originally offered address.

The selected server permanently stores the information on the lease and responds with a DHCPACK containing the configuration parameters. If it cannot do this for any reason, the server responds with a DHCPNAK.

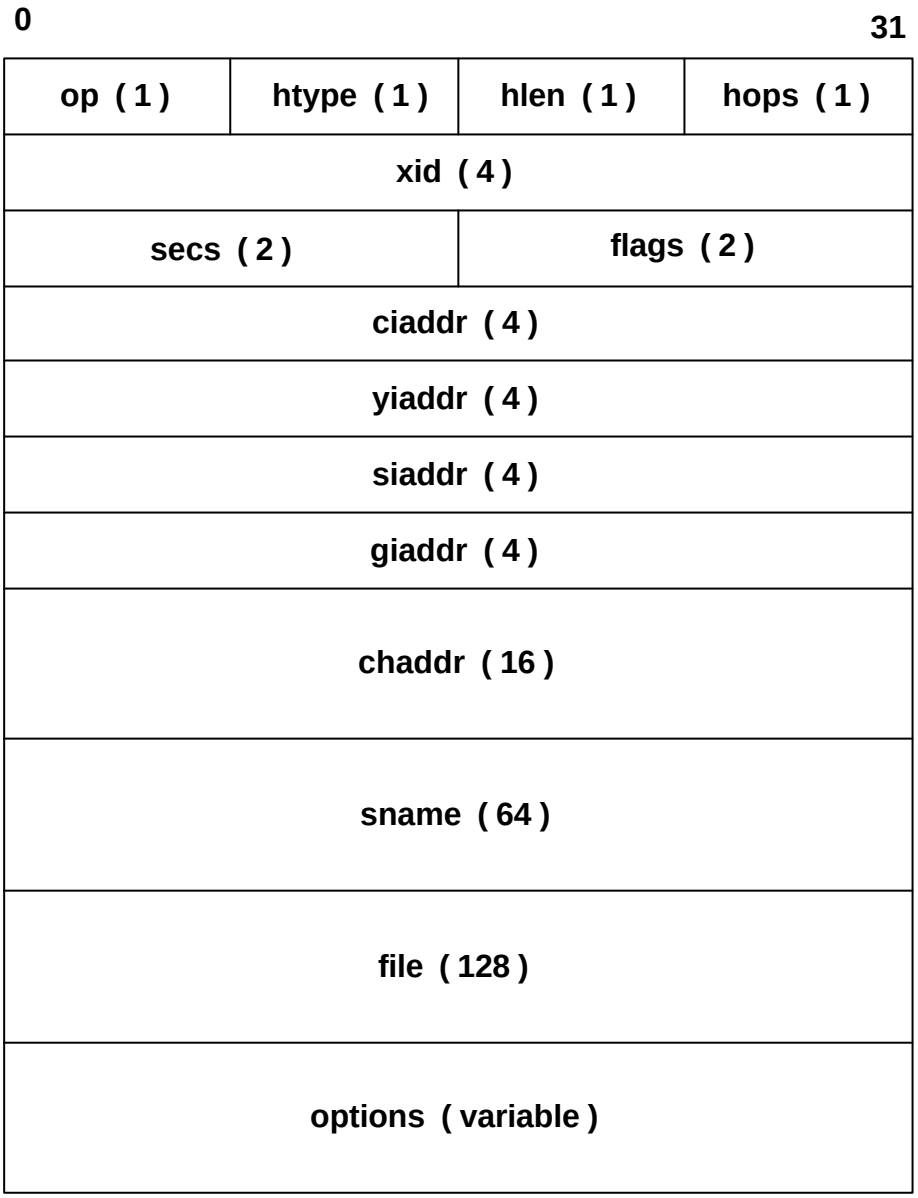
The client receives the DHCPACK confirmation message and configures once he has validated the assigned address. If he cannot validate the address, he sends a DHCPDECLINE message informing the server. If he receives a DHCPNAK messages, the process begins anew.

The client can release the address lease provided by the server by simply sending a DHCPRELEASE message to the server containing the information on the assigned address.

All the messages mentioned above are UDP packets. The format for these packets is explained below.

2.1. Message Format

The DHCP protocol exchanges messages with the following format:



The meaning of each of the fields is as follows:

a) *OP (TYPE OF MESSAGE)*

1 octet. Type of DHCP message being sent.

b) *HTYPE (TYPE OF HARDWARE ADDRESS)*

1 octet. Indicate the type of hardware address (Ethernet, Token Ring etc.).

c) *HLEN (LENGTH OF HARDWARE ADDRESS)*

1 octet. Length of hardware address (6 in the cases of Ethernet and Token Ring).

d) *HOPS*

1 octet. The client is set to zero. Sometimes however, this value changes when a messages is sent via a relay agent.

e) XID (TRANSACTION IDENTIFIER)

4 octets. Random identifier to associate the messages and responses between a client and a server.

f) SECS (SECONDS)

2 octets. Filled out by the client, this indicates the seconds from the point the client initiates the petition process or configuration renewal.

g) FLAGS

2 octets.

h) CIADDR (CLIENT ADDRESS)

4 octets. Client IP address. This is only filled out if the client is in renewal procedure and can respond to ARP petitions.

i) YIADDR (ASSIGNED IP ADDRESS)

4 octets. IP address assigned to the client. This is filled out in the server responses.

j) SIADDR (NEXT SERVER IP ADDRESS)

4 octets. IP address for the next server used in the starting process (when the client is told to download certain files from a specific server).

k) GIADDR (RELAY AGENT IP ADDRESS)

4 octets. IP address for the relay agent when addresses are being assigned through a Relay.

l) CHADDR (CLIENT HARDWARE ADDRESS)

16 octets. Client hardware address.

m) SNAME (SERVER NAME)

64 octets. Optional parameter: DHCP server name.

n) FILE (FILE NAME)

128 octets. Boot file name. This is only filled out in DHCPOFFER.

o) OPTIONS

Variable field length where the configuration options are specified. The minimum length should be 312 octets so that the packet is equal to a minimum IP packet size.

Chapter 2
Configuration

1. DHCP protocol configuration

The **Teldat Router** can be configured as servers or DHCP relays.

The function of a DHCP relay is to capture the DHCP messages in a LAN generated by the possible clients who are connected to it and send them to a known DHCP server situated outside the LAN. The relay is needed as the messages generated by the clients are sent through a broadcast within the LAN as the clients have not yet been configured (they are going to be configured through DHCP) and do not know either their IP address or the server address. This means, if there is no server in the LAN itself, a relay is needed to convert the messages sent through broadcast to unicast which can then be rerouted to a known server outside the LAN. Consequently, for the **Teldat Router** to function as relay, all it needs to know is the list containing one or more DHCP servers.

The configuration of a router in order to behave as a DHCP server is more complex. On one hand it must be able to represent the *subnets* topology to those who are going to provide DHCP service bearing in mind that some of the *subnets* may not be directly connected (those that are accessed through a relay); on the other hand a policy for assigning addresses must be set.

In order to represent the subnets topology to those who are going to provide DHCP service, concepts for *Shared Network*, *Subnet* and *Host* are available. Normally each router interface supporting DHCP has to create a *shared network*. E.g. if the device has a Token Ring interface and another one has Ethernet, two *shared networks* are created. Additionally, you can create as many *shared networks* as physical segments accessed through relays you wish to configure. As you can see, this concept is intimately tied to each physical segment over which the DHCP is going to act.

Once you have created as many *shared networks* as necessary, you can associate each one to distinct *subnets* and *hosts*. Normally there is one single *subnet* in each *shared network*, but it is also possible that one physical segment can support various *subnet*s so diverse *subnet*s can be configured. The *hosts* identify the possible DHCP clients present in a physical segment (*shared network*). It is not necessary identify each and all of the possible clients who are going to send petitions in the server. Identifying them or not is part of the address assignment policy which must be set. On the other hand it is possible to configure a *host* for various different *shared networks*. This is very useful when the same *host* can connect to various distinct physical segments.

Once the server is operating, it responds to the client's petitions and provides an IP address for a specified time. This is known as a *lease*. Depending on the physical interface where the client petition enters, the server assigns a *shared network* address or another one. The server has a wide range of address in each *shared network* that it can distribute. It is also possible to set a specific address for a determined client (this can be configured at the same time as creating the *host*). In this case, the address is not reused for other clients when the owner is not connected as it is permanently assigned to the latter.

When a client receives a *lease* from a server, he not only receives an IP address but also other configuration parameters. These parameters are known as options and are encoded in DHCP packets. You can configure various options at both a global level as well as a *subnet* and *host* level in the **Teldat Router**. Naturally if the *host* has a determined option configured, it is this value which prevails over those values configured at a *subnet* level. Similarly, those options configured at a *subnet* level prevail over those configured at a global level. E.g. an option value configured at a global level is only sent if there is no value configured for this option in the *subnet* or in the *host*.

There do exist other parameters which are not options and which can also be configured. These parameters permit you to set for example, the maximum time an address *lease* can last, the possibility of distributing addresses to unknown clients or not (i.e. clients who are not declared in the configuration as *hosts*), etc. These parameters are important for the protocol operation as for example, the duration time for the *lease* determines the frequency with which the clients try to renew it.

Another parameter (configurable at the *subnet* level) is the *Server Identifier*; this is the DHCP server IP address. This address is used by the client to communicate with the server from the moment he receives an address e.g. to renew it when the *lease* time has expired. The server by default sets an address from its interface as a *server identifier*. This address is from the same *subnet* where the *lease* is assigned. However, there are times when this parameter must be manually configured e.g. when you wish to configure a client through a relay. In this case you normally configure the address pertaining to the relay in the client's LAN as the *server identifier*.

2. DHCP protocol configuration commands

In this section, all the steps required to configure the DHCP protocol in the **Teldat Router** are explained. Once the DHCP protocol configuration has been completed, you must save it and restart the device so the configuration takes effect.

In order to access the DHCP protocol configuration environment, introduce the following commands:

```
*P 4
User Configuration
Config>PROTOCOL DHCP

-- DHCP Configuration --
DHCP config>
```

The following commands are available within the DHCP protocol configuration environment:

Command	Function
? (HELP)	Lists the available commands or their options.
DISABLE	Command to disable the relay or the server.
ENABLE	Command to enable the relay or server.
LIST	Lists the information for the router operation mode (relay or server).
RELAY	Enters the configuration of the relay configuration parameters.
SERVER	Enters the configuration of the server configuration parameters.
EXIT	Exits the DHCP configuration prompt.

As a norm, if you do not introduce all the parameters required to complete a command in the command line, the device will request them.

2.1. ? (HELP)

This command is used to list the valid commands at the level the router is programmed. You can also use this command after a specific command in order to list the available options.

Syntax:

```
DHCP config>?
```

Example:

```
DHCP config>?
DISABLE
ENABLE
LIST
RELAY
SERVER
EXIT
DHCP config>
```

2.2. DISABLE

The **DISABLE** command permits you to disable the **Teldat Router** behavior as a DHCP relay agent or a DHCP server.

a) DISABLE RELAY

Disables the DHCP Relay in the **Teldat Router**.

Syntax:

```
DHCP config>DISABLE RELAY
```

Example:

```
DHCP config>DISABLE RELAY
 DHCP Relay: disabled
DHCP config>
```

b) DISABLE SERVER

Disables the DHCP Server in the **Teldat Router**.

Syntax:

```
DHCP config>DISABLE SERVER
```

Example:

```
DHCP config>DISABLE SERVER
 DHCP Server: disabled
DHCP config>
```

NOTE: If you disable both types of behavior at the same time, the Teldat Router will ignore all messages related to the DHCP protocol.

2.3. ENABLE

The **ENABLE** command permits you to enable the **Teldat Router** behavior as a DHCP relay agent or a DHCP server.

a) ENABLE RELAY

Enables the DHCP Relay in the **Teldat Router**.

Syntax:

```
DHCP config>ENABLE RELAY
```

Example:

```
DHCP config>ENABLE RELAY
 DHCP Relay: enabled
DHCP config>
```

b) ENABLE SERVER

Enables the DHCP Server in the **Teldat Router**.

Syntax:

```
DHCP config>ENABLE SERVER
```

Example:

```
DHCP config>ENABLE SERVER
 DHCP Server: enabled
DHCP config>
```

NOTE: The Teldat Router can only function with one type of behavior. I.e. if you wish to enable the relay agent, the server must be deactivated and vice versa. Activating both types of behavior is not permitted (an informative message is also displayed to this effect).

Example:

```
DHCP config>ENABLE SERVER
Can't enable SERVER, DHCP RELAY enabled previously
DHCP config>
```

2.4. LIST

The **LIST** command permits you to list the **Teldat Router** operation mode: as a DHCP relay agent or as a DHCP server (or as nether should the DHCP be completely disabled).

Syntax:

```
DHCP config>LIST
```

Example:

```
DHCP config>LIST
 DHCP Relay: disabled
 DHCP Server: disabled

DHCP config>
```

2.5. RELAY

This command permits you to enter in the DHCP Relay configuration menu where you can configure the DHCP Relay own parameters.

Syntax:

```
DHCP config>RELAY
```

Example:

```
DHCP config>RELAY

-- DHCP Relay Configuration --
DHCP-Relay config>
```

2.6. SERVER

You can access the DHCP Server configuration menu through this command.

Syntax:

```
DHCP config>SERVER
```

Example:

```
DHCP config>SERVER

-- DHCP Server Configuration --
DHCP-Server config>
```

2.7. EXIT

Exits the DHCP protocol configuration environment. Returns to the general configuration prompt.

Syntax:

```
DHCP config>EXIT
```

Example:

```
DHCP config>EXIT
Config>
```

3. DHCP Relay Configuration Commands

3.1. RELAY mode configuration commands

Once in the configuration menu for the Relay functionality mode, the following options are presented:

Command	Function
? (HELP)	Lists the commands or their available options.
DHCP-SERVER	Adds a DHCP server.
LIST	Lists the information on the Relay operation mode.
EXIT	Command to exit the Relay agent configuration menu.

As a norm, if you do not introduce all the parameters required to complete a command in the command line, the device will request them.

3.2. ? (HELP)

Displays all the available configuration commands for the server mode.

Syntax:

```
DHCP-Relay config>?
```

Example:

```
DHCP-Relay config>?
DHCP-SERVER
LIST
NO
EXIT
DHCP-Relay config>
```

3.3. DHCP-SERVER

The **DHCP-SERVER** command adds a DHCP server so the RELAY agent can transmit DHCPDISCOVER messages listened to in the network segment where this is found. The server is specified through the name and the IP address.

Syntax:

```
DHCP-Relay config>DHCP-SERVER <number, IP address>
```

Example:

```
DHCP-Relay config>DHCP-SERVER
DHCP Server Name (32 c.)[]? my.dhcp.server
DHCP Server address [0.0.0.0]? 192.168.156.3
DHCP-Relay config>
```

In order to eliminate a DHCP server, use the **NO DHCP-SERVER <IP address>** command.

Example:

```
DHCP-Relay config>NO DHCP-SERVER 192.168.156.3
DHCP-Relay config>
```

3.4. LIST

Lists the information associated to the RELAY (Lists the DHCP servers, options and the status of the Relay agent).

Syntax:

```
DHCP-Relay config>LIST
```

Example:

```
DHCP-Relay config>LIST
DHCP Relay: enabled
DHCP Servers:
 192.168.156.3   - my.dhcp.server
 10.1.1.1        - another.server
DHCP-Relay config>
```

3.5. EXIT

This command permits you to exit the DHCP Relay agent configuration menu.

Syntax:

```
DHCP-Relay config>EXIT
```

Example:

```
DHCP-Relay config>EXIT
DHCP config>
```

4. DHCP Server Configuration Commands

4.1. SERVER mode configuration commands

Once in the configuration menu for the *DHCP Server* functionality mode, the following options are presented:

Command	Function
? (HELP)	Lists the available commands or their options.
CLEAR	Clears all the DHCP server configuration parameters.
GLOBAL	Configures the DHCP server global parameters.
HOST	Configures the parameters for the *Hosts*.
LIST	Lists the DHCP server information.
SHARED	Creates a *Shared Network*.
SUBNET	Configures the parameters for the *Subnets*.
EXIT	Command to exit the DHCP server configuration menu.

4.2. ? (HELP)

Displays the available commands or their options.

Syntax:

```
DHCP-Server config>?
```

Example:

```
DHCP-Server config>?
CLEAR
GLOBAL
HOST
LIST
SHARED
SUBNET
EXIT
DHCP-Server config>
```

4.3. CLEAR

Deletes all the DHCP Server configuration information.

Syntax:

```
DHCP-Server config>CLEAR
```

Example:

```
DHCP-Server config>CLEAR
DHCP-Server config>
```

4.4. GLOBAL

This command permits you to configure the DHCP server's own parameters at a global level and the options that will be sent to the DHCP clients.

This section will explain the configuration of the DHCP server's specific parameters at a global level. The *Options* configuration will be explained in later sections.

Syntax:

```
DHCP-Server config>GLOBAL <parameter, value>
```

The DHCP server's specific parameters at a global level are as follows:

a) boot-unknown-clients

Through this parameter you indicate if the server should assign addresses to unknown clients (i.e. those who have not specifically been configured).

YES by default, permits the server to assign addresses to unknown clients. To disable this option, use **global no boot-unknown-clients**.

This parameter can only be configured at a global level (global parameters).

b) bootfile

Specifies (at global level) the boot filename which has to be "downloaded" by the client.

This parameter is usually configured at the same time as configuring the *next-server*.

You can configure this at any level or scope: global, subnet or host.

c) default-lease-time

This establishes a default time where an address is assigned; time in seconds for which an address is assigned to a client if the client making the petition does not request a specific time out period.

This parameter can only be configured at a global level (global parameters).

Default value for this parameter is 43200 seconds.

d) max-lease-time

This is the maximum amount of time (in seconds) that an address is assigned if the client making the petition requests a determined expiry period. An address is never assigned for a longer period than the *max-lease-time*.

This parameter can only be configured at a global level (global parameters).

The default value is 86400 seconds.

e) next-server

Indicates (at global level) the server's IP address from which you should load the initial booting file indicated by the *filename* parameter. If there is no *next-server* indicated, the clients "download" the file from the DHCP server itself.

You can configure this at any level or scope: global, subnet or host.

f) one-lease-per-client

This establishes if each client is going to be assigned a maximum of one address. Should this be activated, only one address per client will be assigned.

This parameter is enabled by default. In order to disable it, use **global no one-lease-per-client**.

This parameter can only be configured at a global level (global parameters).

g) server-name

This parameter is used to indicate the DHCP server name to the client.

This parameter can only be configured at a global level (global parameters).

Example:

```
DHCP-Server config>global no boot-unknown-clients
DHCP-Server config>global default-lease-time 36000
DHCP-Server config>global max-lease-time 72000
DHCP-Server config>global server-name my.dhcp.server
DHCP-Server config>global bootfile defaultfile.cfg
DHCP-Server config>global next-server 192.168.1.1
DHCP-Server config>list global

 ============================
 =    GLOBAL Parameters     =
 ============================

   Server Name: my.dhcp.server
   Next Server: 192.168.1.1
   Lease time: Default 36000, Maximum 72000
   Boot Unknown clients: No
   One Lease Per client: Yes
   Bootfile: defaultfile.cfg

DHCP-Server config>
```

4.5. HOST

This command permits you to configure the parameters for a determined *host* to which an IP address will be assigned. A host must be explicitly declared when you always wish to assign the same IP address to it or when you only wish to assign addresses to known hosts (or clients). This prevents the DHCP server from assigning addresses to other non-specified clients. The following parameters always need to be indicated for this:

- Host Identifier.
- Shared Network Number.

The same host can be defined in distinct Shared Networks (depending on where it is connected, it receives one configuration or another), for this reason you must correctly identify which one is being configured.

Syntax:

```
DHCP-Server config>HOST <identifier, shared network> <parameter, value>
```

To eliminate a host and all the associated configuration parameters, use **NO HOST <identifier, shared-network>**.

The specific configuration parameters for the HOSTs are as follows:

a) bootfile

Specifies the boot filename for the specified host.

This parameter is usually configured at the same time as configuring the *next-server*.

You can configure this at any level or scope: global, subnet or host.

b) ethernet

Specifies the host Ethernet MAC address. This implicitly indicates the type of hardware for the host (ethernet).

c) fixed-ip

Configures a fixed IP address to be assigned to the host. If you do not specify any address, an available address will be assigned from within the range of configured addresses.

IMPORTANT! When you assign a fixed IP address to a Host, you must check that the said address is not from within one of the ranges used by the server to assign addresses. Contrariwise, this address could be assigned to any DHCP client.

d) next-server

Indicates (for the specified host) the server's IP address from which you should load the initial booting file indicated by the *bootfile* parameter. If there is no *next-server* indicated, the clients "download" the file from the DHCP server itself.

You can configure this at any level or scope: global, subnet or host.

e) token-ring

Specifies the host Token Ring MAC address. This implicitly indicates the type of hardware for the host (token-ring).

Example:

```
DHCP-Server config>host eth-host 0 ethernet 00aa11bb22cc
DHCP-Server config>host eth-host 0 fixed-ip 192.168.1.7
DHCP-Server config>host eth-host 0 bootfile ethfile.cfg
DHCP-Server config>host eth-host 0 next-server 192.168.1.3
DHCP-Server config>host tkr-host 1 token-ring 33dd44ee55ff
DHCP-Server config>host tkr-host 1 bootfile tkrfile.cfg
DHCP-Server config>list host

 ============================
 =      HOST List    0      =
 ============================

 HOST: eth-host
   Ethernet hw: 00AA11BB22CC, Fixed Address: 192.168.1.7
   Next Server: 192.168.1.3
   Bootfile: ethfile.cfg


 ============================
 =      HOST List    1      =
 ============================

 HOST: tkr-host
   Token Ring hw: 33DD44EE55FF, No Fixed IP Address
   Bootfile: tkrfile.cfg

DHCP-Server config>
```

4.6. LIST

The **LIST** command is used to display the DHCP Server configuration.

Syntax:

```
DHCP-Server config>LIST <option>
```

The **<option>** field indicates the type of information you wish to list.

Example:

```
DHCP-Server config>LIST ?
ALL
GLOBAL
HOST
SHARED
SUBNET
DHCP-Server config>
```

a) LIST ALL

Displays *all* the *DHCP Server* configuration information.

Example:

```
DHCP-Server config>LIST ALL

 ============================
 =    GLOBAL Parameters     =
============================

   Server Name: dhcp.server
   Next Server: 0.0.0.0
   Lease time: Default 43200, Maximum 86400
   Boot Unknown clients: Yes
   One Lease Per client: Yes



 ============================
 =   SHARED NETWORK List    =
 ============================

   Shared Network: 2


 ============================
 =     SUBNET List    0     =
 ============================

 SUBNET: sevilla
   Address: 172.27.0.0, Mask: 255.255.0.0
   Range: 172.27.15.10    --> 172.27.15.250
   - Router: 172.27.0.2

 SUBNET: sevilla-2
   Address: 172.35.156.0, Mask: 255.255.255.0
   Range: 172.35.156.77   --> 172.35.156.80
   - Router: 172.35.156.3
   - Static Route to 192.157.252.0   via 172.35.156.111


============================
 =     SUBNET List    2     =
 ============================

 SUBNET: lugo
   Address: 168.252.57.0, Mask: 255.255.255.0
   Range: 168.252.57.25   --> 168.252.57.30
   Next Server: 168.252.57.6
   Server Identifier: 168.252.57.6
   Bootfile: lugofile.conf
```

```
 ============================
 =      HOST List    0      =
 ============================

   No Host defined


 ============================
 =      HOST List    2      =
 ============================

 HOST: myhost
   Ethernet hw: 0020AF4452EE, No Fixed IP Address
   - Router: 168.252.57.6

DHCP-Server config>
```

b) LIST GLOBAL

Displays information on the DHCP Server's *global* parameters and options.

Example:

```
DHCP-Server config>LIST GLOBAL

 ============================
 =    GLOBAL Parameters     =
 ============================

   Server Name: dhcp.server
   Next Server: 0.0.0.0
   Lease time: Default 43200, Maximum 86400
   Boot Unknown clients: Yes
   One Lease Per client: Yes
   - IP Forwarding: Disabled

DHCP-Server config>
```

c) LIST HOST

Displays information relevant to all the configured hosts (including all hosts in the shared networks, the corresponding shared network number is indicated in the header).

Example:

```
DHCP-Server config>LIST HOST

 ============================
 =      HOST List    0      =
 ============================

 HOST: hredondo
   Ethernet hw: 00105A2F0B02, Fixed Address: 192.136.21.64

 HOST: jlperez
   Ethernet hw: 00500433DDAF, Fixed Address: 192.136.21.134
   - Router: 192.136.21.198

 HOST: fuentes
   Ethernet hw: 0000383D3148, No Fixed IP Address
   - Router: 192.136.21.198

 HOST: lgomez
   Ethernet hw: 0060973E4EF5, No Fixed IP Address
```

```
 ============================
 =      HOST List    2      =
 ============================

 HOST: probe-server
   Token Ring hw: 0000C91EED5C, No Fixed IP Address

DHCP-Server config>
```

d) LIST SHARED

Displays the configured *shared networks.* Apart from the configured shared networks, there always exists the default shared network (0).

Example:

```
DHCP-Server config>LIST SHARED

 ============================
 =   SHARED NETWORK List    =
 ============================

   Shared Network: 2

DHCP-Server config>
```

e) LIST SUBNET

Displays the information on all the subnets configured in the device. Those for each shared network are also listed (the associated shared network number is indicated in the header).

Example:

```
DHCP-Server config>LIST SUBNET

 ============================
 =     SUBNET List    0     =
 ============================

 SUBNET: 192.16
   Address: 192.16.1.0, Mask: 255.255.255.0
   Range: 192.16.1.162     --> 192.16.1.163
   - Router: 192.16.1.57
   - NetBios Node Type: P-node
   - Static Route to 172.27.0.0      via 192.16.1.133
   - Static Route to 202.5.0.0       via 192.16.1.176

 SUBNET: 192.19
   Address: 192.19.75.0, Mask: 255.255.255.0
   Range: 192.19.75.250   --> 192.19.75.254


 ============================
 =     SUBNET List    2     =
 ============================

 SUBNET: 172.27
   Address: 172.27.0.0, Mask: 255.255.0.0
   Range: 172.27.0.10     --> 172.27.0.100

DHCP-Server config>
```

4.7. SHARED

Creates a *Shared Network* with the specified identifier.

Syntax:

```
DHCP-Server config>SHARED <identifier>
```

To eliminate a shared network and all the associated configuration parameters (subnets, host, etc) use **no shared <identifier>**.

Example:

```
DHCP-Server config>SHARED 3
 New Shared Network: id = 3
DHCP-Server config>
```

4.8. SUBNET

This command permits you to configure the various subnet options and parameters. In order to do this, you need to indicate the following parameters:

- Subnet Identifier.
- Shared Network Number.

The same subnet identifier can be defined in distinct shared networks which means you must correctly identify which one you are configuring.

Syntax:

```
DHCP-Server config>SUBNET <identifier, shared network> <parameter, value>
```

To eliminate a subnet and all the associated configuration parameters use **no subnet <identifier, shared-network>**.

The specific configuration parameters for the SUBNETS are as follows:

a) address

Configures the address for the defined subnet.

b) bootfile

Specifies the boot filename for the specified subnet.

This parameter is usually configured at the same time as configuring the *next-server*.

You can configure this at any level or scope: global, subnet or host.

c) mask

Configures the mask for the defined subnet.

d) next-server

Indicates (for the specified subnet) the server's IP address from which you should load the initial booting file indicated by the *bootfile* parameter. If there is no *next-server* indicated, the clients "download" the file from the DHCP server itself.

You can configure this at any level or scope: global, subnet or host.

e) range

Defines a range of IP addresses which will be assigned to the DHCP clients.

For each subnet in which IP addresses are dynamically assigned through a DHCP server, there must be at least one specified range of addresses. If none is specified, only those hosts who have been explicitly configured with a fixed address from this subnet are attended to.

The range of addresses must pertain to the subnet where it has been defined.

The range is specified through an initial IP address and a final IP address. You can define various ranges in the same subnet as well as specified individual addresses.

f) server-identifier

This parameter is used to define the value sent in the "DHCP Server Identifier" option for a determined subnet. The DHCP server identifier is specified through the IP address and must be reachable for all the clients in this subnet.

We recommend that this parameter is not configured (the router by default will set the adequate value) except in cases where it is absolutely necessary to use it in order to ensure correct performance:

- Assigning addresses to subnets that arrive through a Relay DHCP. In this case you must specify the address of the Relay DHCP agent as *SERVER-IDENTIFIER*.
- When the DHCP server has two subnets defined in a LAN interface and only has one IP address configured in this interface, you must specify the address possessed by the server configured in the LAN as *SERVER-IDENTIFIER*. However, if the server has an IP address pertaining to each subnet defined, it is **NOT** necessary to specify the *SERVER-IDENTIFIER* as the router by default configures the adequate value for each.

This parameter can only be configured at the subnet layer.

Example:

```
DHCP-Server config>subnet mynet 0 address 192.168.7.0
DHCP-Server config>subnet mynet 0 mask 255.255.255.0
DHCP-Server config>subnet mynet 0 range 192.168.7.50 192.168.7.200
DHCP-Server config>subnet mynet 0 server-identifier 192.168.7.1
DHCP-Server config>list subnet

 ============================
 =     SUBNET List    0    =
 ============================

 SUBNET: mynet
   Address: 192.168.7.0, Mask: 255.255.255.0
   Range: 192.168.7.50    --> 192.168.7.200
   Server Identifier: 192.168.7.1

DHCP-Server config>
```

4.9. Configuring the OPTIONS

The options can be configured in any scope, "inheriting" those from a superior scope, i.e. the shared networks and the hosts have the options globally configured by default, while the subnets have their shared network options by default.

The configured options determine the client behavior and functionality.

To configure an option at a global level:

```
DHCP-Server config>GLOBAL <option, value>
```

To configure an option in a subnet:

```
DHCP-Server config>SUBNET <identifier, shared network> <option, value>
```

To configure an option in a host:

```
DHCP-Server config>HOST <identifier, shared network> <option, value>
```

The available options (at all levels) are as follows:

a) BROADCAST-ADDRESS <ip address>

This option specifies the broadcast address in the client's subnet. The legal values for broadcast addresses are specified in the RFC 1122.

Example:

```
DHCP-Server config>GLOBAL BROADCAST-ADDRESS 255.255.255.255
DHCP-Server config>
```

b) DEFAULT-IP-TTL <ttl>

This value specifies the default TTL (*time-to-live*) which the client must use when sending datagrams.

Example:

```
DHCP-Server config>subnet localsubnet 0 default-ip-ttl 250
DHCP-Server config>
```

c) DNS-DOMAIN <name of domain>

This option specifies the domain name which must be used by the client when resolving the host names via DNS.

In determined scopes, only one domain name can be specified.

Example:

```
DHCP-Server config>subnet develop 0 dns-domain development.teldat.es
DHCP-Server config>
```

d) DNS-SERVER <ip address>

Permits you to specify a DNS servers list available for the client. The servers must be specified in order of preference.

Example:

```
DHCP-Server config>global dns-server 200.200.200.200
DHCP-Server config>
```

e) INTERFACE-MTU <mtu>

This specifies the MTU (*maximum-transfer-unit*) to be used in this interface. The minimum permitted value is 68 bytes.

Example:

```
DHCP-Server config>global interface-mtu 2048
DHCP-Server config>
```

f) IP-FORWARDING <enabled/disabled>

Specifies if the client is going to carry out IP packet routing.

Example:

```
DHCP-Server config>host myhost 1 ip-forwarding enabled
DHCP-Server config>
```

g) MAX-DGRAM-REASSEMBLY <size>

Specifies the maximum datagram size that the client must be prepared to reassemble. The minimum value permitted is 576 bytes.

Example:

```
DHCP-Server config>global max-dgram-reassembly 16000
DHCP-Server config>
```

h) NETBIOS-NAME-SERVER <ip address>

This option configures a list of NetBIOS server names (NBNS), specified in order of preference.

Example:

```
DHCP-Server config>subnet localsubnet 3 netbios-name-server 172.24.0.1
DHCP-Server config>
```

i) NETBIOS-NODE-TYPE <type>

The NetBIOS node type option permits you to configure the NetBIOS clients over TCP/IP as described in the RFC 1001 and RFC 1002. The value is specified as one octet which identifies the type of node.

The permitted values are:

- **b-node: Broadcast**
- **p-node: Point-to-point**.
- **m-node: Mixed**.
- **h-node: Hybrid**.

Example:

```
DHCP-Server config>subnet localsubnet 3 netbios-node-type m-node
DHCP-Server config>subnet othersubnet 3 netbios-node-type b-node
DHCP-Server config>
```

j) NETBIOS-SCOPE <scope>

Specifies the client NetBIOS scope parameter as specified in the RFC 1001 and RFC 1002.

Example:

```
DHCP-Server config>subnet localsubnet 3 netbios-scope netbios.com
DHCP-Server config>
```

k) NTP-SERVER <ip address>

This option specifies the NTP IP addresses list (RFC 1035) available for the client. These servers are indicated in order of preference.

Example:

```
DHCP-Server config>host myhost 1 ntp-server 192.168.99.23
DHCP-Server config>
```

l) ROUTER <ip address>

This option specifies a list of router IP addresses in the client's subnet. The client's default gateway is determined through this option.

The routers should be configured in order of priority or preference.

Example:

```
DHCP-Server config>host myhost 1 router 192.168.0.254
DHCP-Server config>
```

m) STATIC-ROUTE <destination ip, next hop>

A series of static routes that the client must install in his routing cache is established through this command. If you specify various routes to the same destination, these are configured in a decreasing order of priority.

On configuring a route, you must first indicate the destination address and subsequently the router used to reach this destination.

You cannot configure a default route through a static router; in order to specify a default route, you must use the **ROUTER** option.

Example:

```
DHCP-Server config>global static-route 200.0.0.0 192.168.0.252
DHCP-Server config
```

n) SUBNET-MASK <mask>

Configures the client subnet mask (in compliance with the RFC 950 norm). If you do not configure the subnet mask option in any scope, the subnet mask appearing in the subnet definition is used as a last resort.

Example:

```
DHCP-Server config>host myhost 1 subnet-mask 255.255.255.0
DHCP-Server config>
```

4.10. EXIT

This command permits you to exit the DHCP Server configuration menu and return to the DHCP general configuration prompt.

Syntax:

```
DHCP-Server Config>EXIT
```

Example:

```
DHCP-Server config>EXIT
DHCP config>
```

Chapter 3
Monitoring

1. DHCP protocol monitoring

The DHCP protocol monitoring displays information relative to the router function as either Relay or DHCP Server.

When the **Teldat Router** is in the DHCP Relay mode, the configured DHCP servers are displayed.

If, instead of behaving as a Relay, the router acts as a DHCP Server, the corresponding monitoring menu displays the non-volatile storing of the addresses assigned by the server and for the duration of the lease these cannot be reused.

In order to access the DHCP protocol monitoring menu, you need to enter the following commands at the general monitoring prompt:

```
*p 3
Console Operator
+PROTOCOL DHCP

DHCP Protocol monitor
DHCP>
```

2. DHCP protocol monitoring commands

Within the DHCP protocol monitoring prompt, the following options appear:

```
DHCP>?
RELAY
SERVER
EXIT
DHCP>
```

2.1. RELAY

Through this command you can access the DHCP Relay monitoring menu.

Syntax:

```
DHCP>RELAY
```

Example:

```
DHCP>RELAY
DHCP-Relay>
```

The following commands are available in the DHCP Relay monitoring menu:

```
DHCP-Relay>?
LIST
EXIT
DHCP-Relay>
```

a) LIST

Displays the router which are sent the DHCP petitions received from the clients.

Syntax:

```
DHCP-Relay>LIST
```

Example:

```
DHCP-Relay>LIST
DHCP Servers
cebra.teldat.es     1.2.3.4
DHCP Options
 DHCP Relay:   enabled
DHCP-Relay>
```

b) EXIT

Exits the DHCP Relay monitoring menu.

Syntax:

```
DHCP-Relay>EXIT
```

Example:

```
DHCP-Relay>EXIT
DHCP>
```

2.2. SERVER

Accesses the DHCP Server monitoring menu.

Syntax:

```
DHCP>SERVER
```

If the DHCP server is not enabled and initialized, you cannot access the DHCP Server monitoring menu and the following message is displayed:

```
DHCP Server NOT initialized
```

Example:

```
DHCP>SERVER
DHCP-Server>
```

The following commands are available in the DHCP Server monitoring menu:

```
DHCP-Server>?
LEASES List
EXIT
DHCP-Server>
```

a) LEASES List

Displays the information relative to the assigning and releasing of the network addresses as well as the time during which the leases are active. This information changes each time the server sends a DHCPACK message or receives a DHCPRELEASE.

Syntax:

```
DHCP-Server>LEASES
```

Example:

```
DHCP-Server>LEASES

Leases to show?[0]? 2

Leases List
------------------------------------------------------------------------
IP Address         Starts                 Ends
------------------------------------------------------------------------
172.27.0.201       Thu 13/04/00  16:15:36 Fri 14/04/00  00:15:36
  HWD: TKR, 00:00:c9:1e:ed:5c UID: 06:00:00:c9:1e:ed:5c
192.6.6.135        Thu 13/04/00  15:51:35 Thu 14/04/00  23:51:35
  HWD: ETH, 00:60:97:3e:4e:f5 UID: 01:00:60:97:3e:4e:f5

DHCP-Server>
```

b) EXIT

Exits the DHCP Server monitoring menu.

Syntax:

```
DHCP-Server>EXIT
```

Example:

```
DHCP-Server>EXIT
DHCP>
```

2.3. EXIT

Exits the DHCP protocol monitoring menu and returns to the general monitoring prompt (+).

Syntax:

```
DHCP>EXIT
```

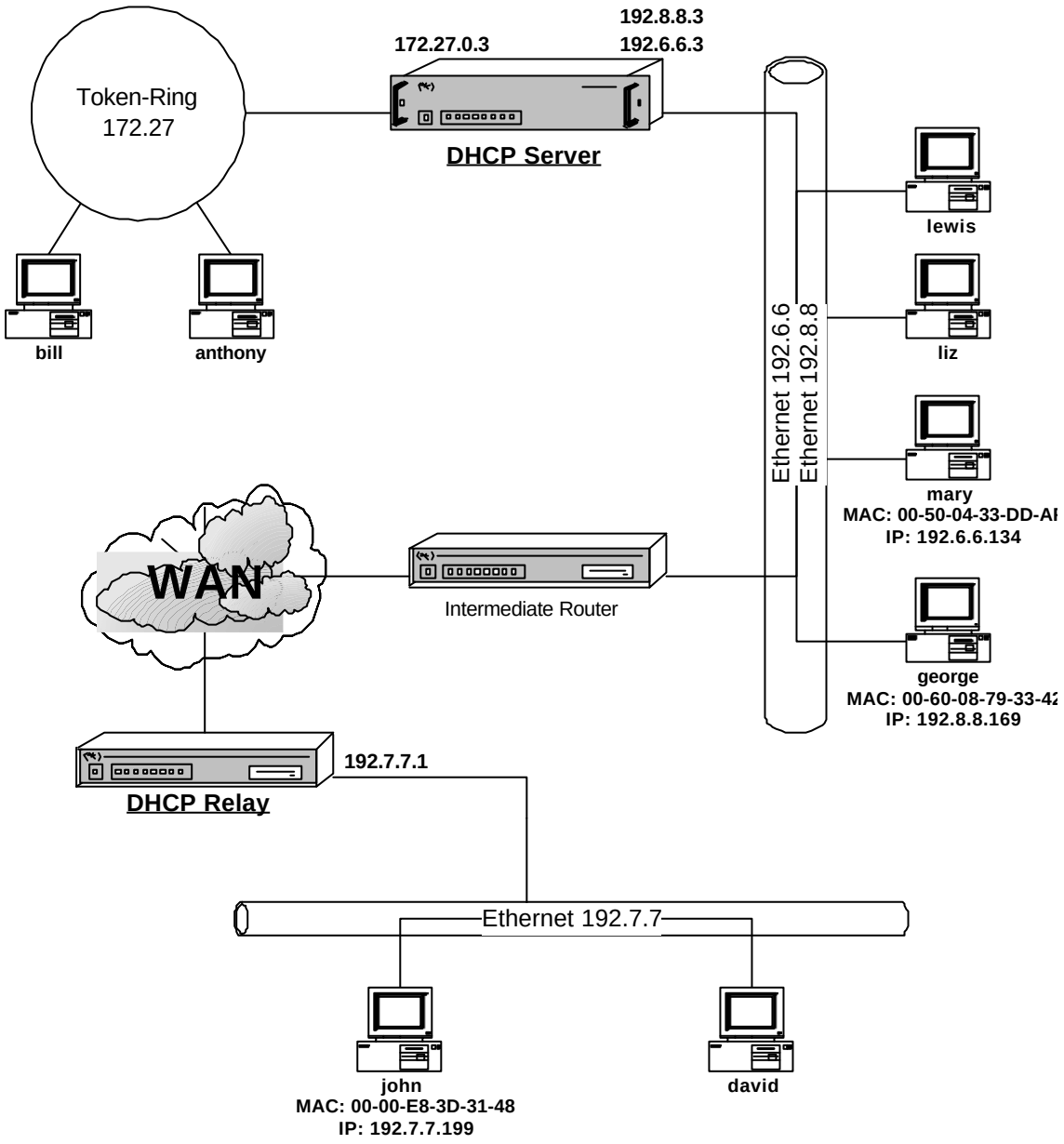
Example:

```
DHCP>EXIT
+
```

Chapter 4
DHCP Configuration Example

1. Scenario

The scenario given as an example is as follows:



A DHCP Server assigns addresses (together with other configuration elements) to the devices connected to the subnets 172.27.0.0, 192.6.6.0, 192.8.8.0 and 192.7.7.0.

There is also a DHCP Relay which sends the DHCP messages originating from the DHCP clients found in the subnet 192.7.7.0 to the DHCP server which assigns addresses to the devices.

Physically, you can distinguish 3 distinct networks in this scenario: Token Ring, Ethernet directly connected to the DHCP server (which supports 2 "logical" subnets) and Ethernet connected to the DHCP Relay. A determined number of devices (those devices which present their MAC address together with an IP address) are specifically configured so they are assigned *this particular* address.

2. DHCP Relay Configuration

We assume that the configuration not related to the DHCP protocol operation has been correctly carried out and that the *DHCP Relay* LAN interface has the IP address 192.7.7.1.

In order to configure the router so it behaves as a *DHCP Relay*, you need to carry out the steps described below.

2.1. Enable DHCP Relay and access the Relay menu

To access the DHCP configuration prompt:

```
*P 4
Config>PROTOCOL DHCP

-- DHCP Configuration --
DHCP config>
```

To enable the *DHCP Relay*:

```
DHCP config>ENABLE RELAY
 DHCP Relay: enabled
DHCP config>
```

To access the *DHCP Relay* configuration menu:

```
DHCP config>RELAY

-- DHCP Relay Configuration --
DHCP-Relay config>
```

2.2. Aggregate the DHCP Server

The DHCP server is added at the DHCP Relay configuration prompt. The DHCP messages originating from the subnet 192.7.70 will be sent to this server:

```
DHCP-Relay config>DHCP-SERVER xample-dhcp-server 192.6.6.3
DHCP-Relay config>
```

Check that it has been corrected aggregated.

```
DHCP-Relay config>LIST
DHCP Relay: enabled
DHCP Servers:
 192.6.6.3       - xample-dhcp-server
DHCP-Relay config>
```

You need to save the configuration and restart the *DHCP Relay* router.

3. DHCP Server Configuration

We assume that the configuration not related to the DHCP protocol operation has been correctly carried out and that the *DHCP Server* has the IP addresses 192.6.6.3 and 192.8.8.3 in the Ethernet LAN interface and the 172.27.0.3 address for the Token Ring LAN interface.

In order to configure the router so it behaves as a *DHCP Server*, you need to carry out the steps described below.

3.1. Enabling the DHCP Server and accessing the Server menu

In order to access the DHCP configuration prompt:

```
*P 4
User Configuration
Config>PROTOCOL DHCP

-- DHCP Configuration --
DHCP config>
```

To enable the *DHCP Server*:

```
DHCP config>ENABLE SERVER
DHCP Server: enabled
DHCP config>
```

To access the *DHCP Server* configuration menu:

```
DHCP config>SERVER

-- DHCP Server Configuration --
DHCP-Server config>
```

3.2. Configure the parameters and global options

Configure the *DHCP Server* name:

```
DHCP-Server config>global server-name Xample-dhcp
DHCP-Server config>
```

This establishes the default lease time for the addresses at 8 hours (28800 seconds) while the maximum time is one day (86400 seconds):

```
DHCP-Server config>global default-lease-time 28800
DHCP-Server config>global max-lease-time 86400
DHCP-Server config>
```

Check the global parameter configuration:

```
DHCP-Server config>LIST GLOBAL

 ============================
 =    GLOBAL Parameters     =
 ============================

   Server Name: Xample-dhcp
   Next Server: 0.0.0.0
   Lease time: Default 28800, Maximum 86400
   Boot Unknown clients: Yes
   One Lease Per client: Yes

DHCP-Server config>
```

3.3. Aggregate Shared Networks

In order to be able to assign addresses to all the segments of the example scenario, you need to have 3 *shared networks* available. You always have the default *shared network* (this cannot be eliminated) with the identifier 0. As you need 2 additional *shared networks*, these must be added.

```
DHCP-Server config>SHARED 1
 New Shared Network: id = 1
DHCP-Server config>SHARED 2
 New Shared Network: id = 2
DHCP-Server config>
```

Now you have 3 *shared networks* available, 0, 1 and 2. The network segment corresponding to the Ethernet LAN containing the subnets 192.6.6 and 192.8.8 is configured in the *shared network* 0. The part corresponding to the network segment Token Ring LAN is configured in the *shared network* 1 and the segment reaching the server through the DHCP Relay in is configured *shared network* 2.

3.4. Configuration of Subnets and Hosts

a) Shared Network Subnets and Hosts

This *shared network* "contains" two subnets: 192.6.6.0 and 192.8.8 (both with the mask 255.255.255.0), and wishes to assign addresses in each one. As the server has an address for each of the subnets in its LAN through which it assigns addresses, it is unnecessary to specify a *SERVER-IDENTIFIER.*

Creating the subnets.

```
DHCP-Server config>subnet 192.6.6-subnet 0 address 192.6.6.0
DHCP-Server config>subnet 192.6.6-subnet 0 mask 255.255.255.0
DHCP-Server config>subnet 192.8.8-subnet 0 address 192.8.8.0
DHCP-Server config>subnet 192.8.8-subnet 0 mask 255.255.255.0
DHCP-Server config>
```

A range of addresses which the server will assign to the clients according to petitions received (from 192.6.6.125 to 192.6.6.149) is configured in subnet 192.6.6. The default router in this subnet is 192.6.6.2 (for example). It is further established that pc "mary" exclusively and permanently has the address 192.6.6.134. In order to resolve the problem of the exclusive address for this pc being within the desired address range, two ranges are defined.

```
DHCP-Server config>subnet 192.6.6-subnet 0 server-identifier 192.6.6.3
DHCP-Server config>subnet 192.6.6-subnet 0 range 192.6.6.125 192.6.6.149
DHCP-Server config>subnet 192.6.6-subnet 0 router 192.6.6.2
DHCP-Server config>
```

Now you configure pc "MARY".

```
DHCP-Server config>host mary 0 ethernet 00500433ddaf
DHCP-Server config>host mary 0 fixed-ip 192.6.6.134
DHCP-Server config>host mary 0 route 192.6.6.2
DHCP-Server config>
```

A range of addresses from 192.8.8.55 to 192.8.8.74 is configured in the subnet 192.8.8 and pc "GEORGE" with the IP address 192.8.8.169. In this case, the default router is the 192.8.8.57.

```
DHCP-Server config>subnet 192.8.8-subnet 0 server-identifier 192.8.8.3
DHCP-Server config>subnet 192.8.8-subnet 0 range 192.8.8.55 192.8.8.74
DHCP-Server config>subnet 192.8.8-subnet 0 router 192.8.8.57
DHCP-Server config>host george 0 ethernet 006008793342
DHCP-Server config>host george 0 fixed-ip 192.8.8.169
DHCP-Server config>host george 0 router 192.8.8.57
DHCP-Server config>
```

b) Shared Network 1 Subnets and Host

In this *shared network*, there is a single subnet. A range of addresses is defined, a default router (which will be the DHCP server itself) and there is no requirement to configure a host with a fixed IP address.

```
DHCP-Server config>subnet 172.27-tkr 1 address 172.27.0.0
DHCP-Server config>subnet 172.27-tkr 1 mask 255.255.0.0
DHCP-Server config>subnet 172.27-tkr 1 range 172.27.0.200 172.27.1.10
DHCP-Server config>subnet 172.27-tkr 1 router 172.27.0.3
DHCP-Server config>
```

c) Shared Network 2 Subnets and Host

This *shared network* corresponds to the physical segment accessing the DHCP server through the DHCP Relay. A range of addresses and a host with a specific IP address ("JOHN") is defined in this *shared network*.

In this case you need to indicate the DHCP Relay LAN interface address as the *SERVER-IDENTIFIER* so the client's successive DHCP messages reach the server.

You also need to establish that the default router is the DHCP Relay itself.

```
DHCP-Server config>subnet 192.7.7-relay 2 address 192.7.7.0
DHCP-Server config>subnet 192.7.7-relay 2 mask 255.255.255.0
DHCP-Server config>subnet 192.7.7-relay 2 server-identifier 192.7.7.1
DHCP-Server config>subnet 192.7.7-relay 2 range 192.7.7.50 192.7.7.198
DHCP-Server config>subnet 192.7.7-relay 2 router 192.7.7.1
DHCP-Server config>host john 2 token-ring 0000e83d3148
DHCP-Server config>host john 2 fixed-ip 192.7.7.199
DHCP-Server config>
```

3.5. Complete Configuration List

This verifies the configuration through a complete configuration list.

```
DHCP-Server config>LIST ALL

 ============================
 =    GLOBAL Parameters     =
 ============================

   Server Name: Xample-dhcp
   Next Server: 0.0.0.0
   Lease time: Default 28800, Maximum 86400
   Boot Unknown clients: Yes
   One Lease Per client: Yes



 ============================
 =   SHARED NETWORK List    =
 ============================

   Shared Network: 1
   Shared Network: 2



 ============================
 =     SUBNET List    0     =
 ============================

 SUBNET: 192.6.6-subnet
   Address: 192.6.6.0, Mask: 255.255.255.0
   Range: 192.6.6.125     --> 192.6.6.149
   Server Identifier: 192.6.6.3
   - Router: 192.6.6.2

 SUBNET: 192.8.8-subnet
   Address: 192.8.8.0, Mask: 255.255.255.0
   Range: 192.8.8.55      --> 192.8.8.74
   Server Identifier: 192.8.8.3
   - Router: 192.8.8.57


 ============================
 =     SUBNET List    1     =
 ============================

 SUBNET: 172.27-tkr
   Address: 172.27.0.0, Mask: 255.255.0.0
   Range: 172.27.0.200    --> 172.27.1.10
   - Router: 172.27.0.3


 ============================
 =     SUBNET List    2     =
 ============================

 SUBNET: 192.7.7-relay
   Address: 192.7.7.0, Mask: 255.255.255.0
   Range: 192.7.7.50      --> 192.7.7.198
   Server Identifier: 192.7.7.1
   - Router: 192.7.7.1



 ============================
 =      HOST List    0      =
 ============================

 HOST: mary
   Ethernet hw: 00500433DDAF, Fixed Address: 192.6.6.134
   - Router: 192.6.6.2
```

```
 HOST: george
   Ethernet hw: 006008793342, Fixed Address: 192.8.8.169
   - Router: 192.8.8.57


 ============================
 =      HOST List    1      =
 ============================

   No Host defined


 ============================
 =      HOST List    2      =
 ============================

 HOST: john
   Token Ring hw: 0000E83D3148, Fixed Address: 192.7.7.199

DHCP-Server config>
```

Now you need to save the configuration and restart the *DHCP Server*.