DHCP Server
Configuration Guide

4.0

DHCP Server

Internet

LAN client

LAN client

LAN client

Contents

Part I
Introduction to DHCP

1 Introduction

DHCP (Dynamic Host Configuration Protocol) is a protocol that allows a central computer to automatically assign the TCP/IP network configuration to individual work-stations on a private network.

With DHCP enabled it suffices to enable the "Obtain an IP address automatically" in the TCP/IP configuration on the private network. The DHCP Server then takes over the responsibility of assigning the TCP/IP parameters, significantly lowering the task of network maintenance.

Configuring a full-blown DHCP Server can however be complicated and may require more time than the benefit of having it might justify. To simplify the task, the InJoy products include an extremely simple DHCP Server Plugin, supporting assignment of all the basic DHCP parameters.

The InJoy DHCP Server Plugin installs seamlessly and is shipped with fully functional default values — just waiting to be enabled.

1.1. Document Scope

Before reading this document you should be familiar with the InJoy product of choice and also have basic knowledge of the TCP/IP protocol – i.e. know what an IP address is. Additionally, a network connection should exist between any hosts that you plan to make DHCP-enabled.

To ease your navigation, this document has been divided into several distinct parts according to the amount of information different types of readers are likely to need:

Part I.	Introduction to DHCP
Part II.	Setting up the DHCP Server
Part III.	References

Part II by itself contains enough information to successfully install and use the InJoy DHCP Plugin. Users who want a better understanding of DHCP can consult the remaining parts for additional information.

2 Understanding DHCP

This section provides you with a quick overview of DHCP and its capabilities.

Step 1:	Step 2:	Step 3:
Understanding what DHCP is, why it's needed, and how it may benefit your network.	Understanding how DHCP works and an example of a typical DHCP session.	Understanding the InJoy specific DHCP implementation and supported parameters.

2.1. What is DHCP?

The most common networking protocol in use today, TCP/IP, requires that each network-capable computer have a unique 4-byte number (an IP address) assigned to it. As previously mentioned, DHCP is a protocol that allows individual computers on the network (LAN clients) to get their configuration from a DHCP Server. The most significant part of the information that a DHCP Server provides to its clients is the IP address, the DNS servers and the default gateway IP address.

DHCP Server

The DHCP Server automatically provides each LAN client with an IP address, a default gateway (route) and DNS server IP addresses.

LAN client

LAN client
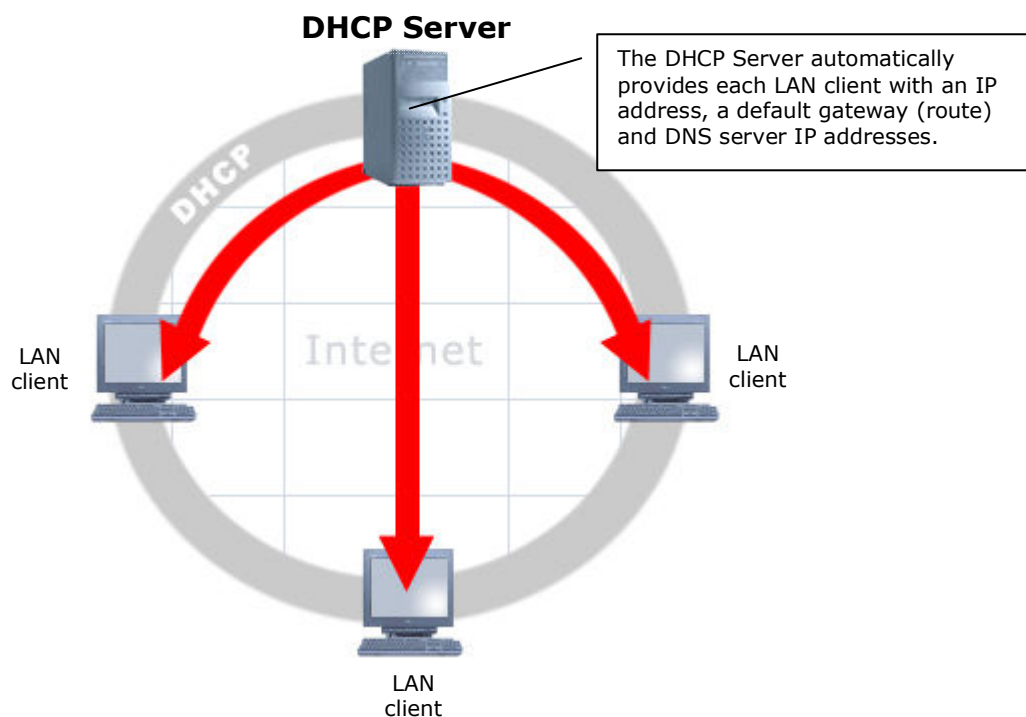
LAN client

The overall purpose of DHCP is to reduce the amount of time required to plan, configure and administer a network.

DHCP uses a client-server model to provide safe and reliable TCP/IP network configuration. At the same time, DHCP prevents possible address conflicts and human errors in the many TCP/IP LAN client configurations. Typical DHCP Server use is by companies of all sizes, Internet Service Providers, and whenever minimal configuration and maintenance of network parameters is required.

Other applications include networks with mobile PCs, e.g., laptops, notebooks and other mobile devices. These PCs are ideal DHCP clients as they need not be manually re-configured when they move.

2.2. How Does DHCP Work?

At boot time the computer has no network parameters assigned to it. The following list provides an overview of the typical network parameters:

- IP address and network mask
- Default route/gateway – an IP address which will be used for forwarding packets whose destinations are beyond local network
- DNS servers for resolving Internet names (e.g. internet.com) to IP addresses
- Workstation parameters, e.g., domain name or workgroup/workstation name
- Static routes
- IP forwarding setting
- MTU size
- Other settings (a complete list can be found in the DHCP RFCs)

Whether the network parameters are configured statically or obtained from a DHCP Server is controlled in the operating system. On Windows, the "Internet Protocol TCP/IP Properties" dialog allows you to control this – as shown below.
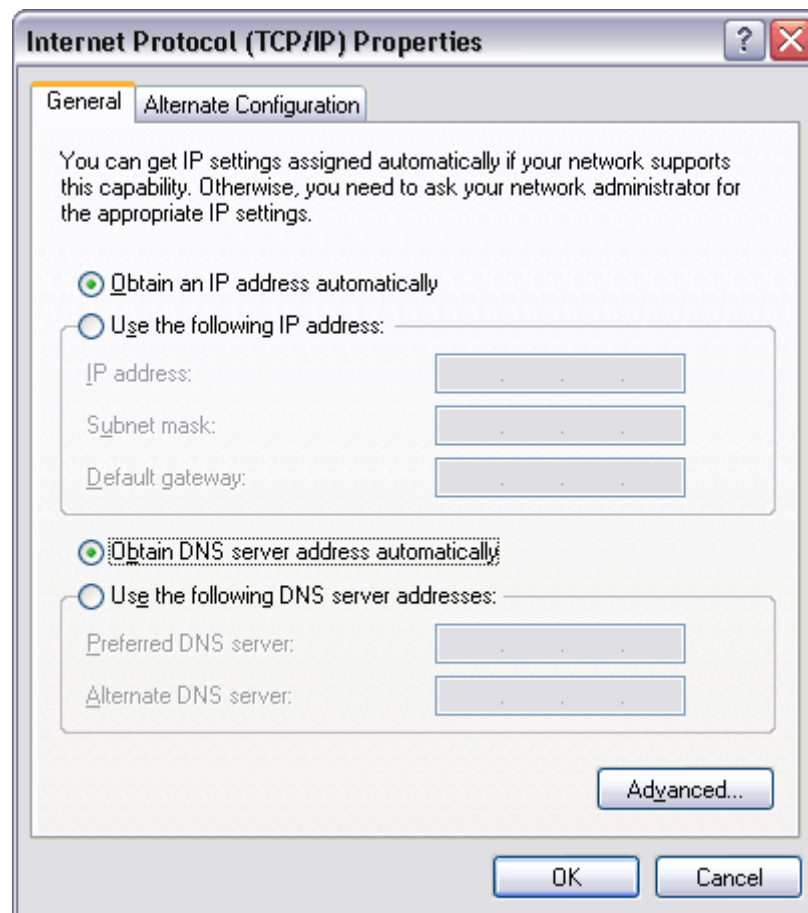
- **Static configuration.**
  With static configuration, the client computer uses pre-configured network parameters. The disadvantages of this approach include the possibility of IP address conflicts and the administrative issues possible when manually configuring many internal clients.

- **DHCP configuration (automatic).**
  With automatic configuration, the computer obtains its network parameters from the DHCP Server. This way the IP addresses are automatically managed and accordingly address conflicts are avoided.

If manual and automatic network configurations are used together, the administrator must ensure that the DHCP Server won't assign IP addresses used by manually-configured computers.

A Typical DHCP Session (for the experts)

At the technical level, the typical DHCP protocol is a collection of protocol blocks. Below is an example of a typical DHCP Session:

1 A LAN client issues a DHCP request by sending out a Discover message to the 255.255.255.255 broadcast address. The 255.255.255.255

address indicates that all work-stations on the LAN receive the request. This request includes a MAC address (a 6-byte identifier which uniquely identifies the DHCP client's network card).

2   One or more DHCP Servers broadcast back a DHCP offer message with an IP address that it temporarily reserves.

3   If more than one DHCP Server has replied with offers, the client chooses the best offer based on the number and type of parameters that the DHCP Server can configure. The client then broadcasts a request with the IP address of the chosen DHCP Server. All DHCP Servers but the chosen one can then cancel the reserved IP addresses.

4   The chosen DHCP Server replies with a DHCP Acknowledge message which contains a full network configuration for the requesting computer.

5   When the client no longer needs the IP address, it notifies the DHCP Server (e.g. when the workstation is shutting down or the workstation operator decides to renew the IP address).

DHCP Leases

The DHCP lease is the length of time that the DHCP Server allows the client to use a particular assigned IP address.

When the client determines that it is about to run out of allowed IP address use time, it sends a request to the server asking to increase the lease time. The server extends the lease if the DHCP policy allows it. Should the server not allow this extension or fail to respond to the request, the client must restart the discovery process.

2.3. InJoy DHCP Features

The InJoy DHCP Server implementation has been intentionally designed to be extremely simple to configure and administer. It is compatible with the majority of available DHCP clients and it is available on all operating systems supported by the InJoy products.

This section describes the operational details of the InJoy DHCP Server implementation.

## IP Address Management (Leases)

In the InJoy DHCP Server implementation, the lease is for an infinite amount of time; e.g., after the IP address is assigned to a particular PC, it can use it forever. This is sometimes called "permanent lease type".

The DHCP Server attempts to always establish a static binding between the individual DHCP clients and the IP address initially assigned to it. To accommodate this, the DHCP Server stores the DHCP client's MAC address and IP number in the file DHCPD/LEASES.DHC. You may manually edit this file to change these bindings. For more information about the leases file, refer to the reference section.

If the DHCP Server runs out of free IP addresses, it searches for currently unused IP addresses and, if found, assigns one to the PC that requested it. The InJoy DHCP Server ensures that the IP address is unused by pinging it. For reliable operation, the DHCP clients must be able to respond to pings - i.e. be able to receive Echo Request and send Echo Reply ICMP messages.

IP Pools

An IP pool is a list of IP addresses which are available to the LAN clients. Each IP pool is defined by a starting IP address and an ending IP address -- both inclusive. An IP pool with the starting IP address of 192.168.1.10 and the ending IP address of 192.168.1.20 represents 11 IP addresses.
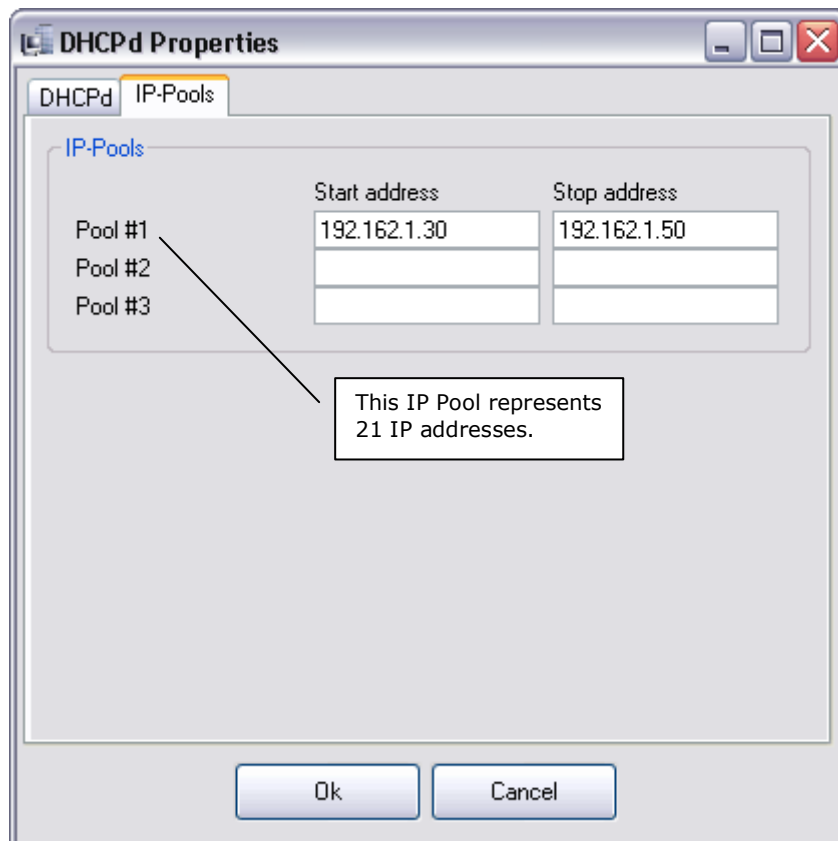
The DHCP Server can use several pools of IP addresses, as illustrated by the above screen-shot.

Supported DHCP Parameters

The InJoy DHCP Server implementation currently supports assignment of the following TCP/IP networking parameters:

- IP address and network mask
- Default Gateway route IP
- DNS servers (up to three)
- WINS servers (up to three)

More parameters may become available in future versions.

Part II
Setting up the DHCP Server

3 Preparing for DHCP

Before deploying a DHCP network, it is recommended that you consider the information in this section.

3.1. Preparing Your Network for DHCP

Before you set up your network to use DHCP, you must do the following:

- Map out the network and determine how many DHCP Servers will be needed.

- Determine which machines that are the best candidates for running a DHCP Server.

- Determine IP addressing for clients and configure IP pools for the DHCP Servers.

- Configure DHCP client network parameters (i.e., default gateway, DNS and WINS servers).

3.2. Planning your DHCP Server Configuration

If not already determined, the structure of the network should first be laid out. This will help determine the IP addressing, the machine(s) to run DHCP Server(s) and the network parameters for the individual DHCP clients.

While planning the network, make sure that the DHCP Server always remains accessible for the DHCP clients or provide a backup DHCP Server for times when the primary DHCP Server cannot be reached.

Single or Multiple DHCP Servers

An important decision to make is the number of DHCP Servers to run on the network.

- **Multiple DHCP Servers.**
  The biggest advantage in having more than one DHCP Server serving the network is that when one DHCP Server fails, the other(s) continue to work. Another example would be where multiple separated network segments need DHCP service.

  The disadvantage of multiple DHCP Servers running on the network is that the administrator would need to keep track of the parameters of each DHCP Server and ensure that their IP pools don't overlap.

- **Single DHCP Server.**
  The main advantage of having a single DHCP Server on the network is that the network is easily maintained.

The disadvantage of a single DHCP Server is potential network malfunction when the DHCP Server is down. For example, if your DHCP Server is down, Windows-based computers will (by default) use 169.254.x.x IP addresses and not function properly. In other operating systems, DHCP Server unavailability may cause other random IP numbers to be used or cause long delays when booting.

It is recommended that the DHCP Server is set up on the PC that is most likely to be available and that a mirrored fail-over DHCP Server is provided when network availability/stability is of key importance. The best candidates for running DHCP Servers are of course server-type machines.

If you decide to configure more than one DHCP Server to manage a particular network, it is your responsibility that IP pools don't overlap.

3.3. Preparing the DHCP Clients

To prepare the LAN clients for DHCP, only a few options must be enabled. The process of enabling these options is slightly different on the various operating systems, but generally what you need to do is:

1 Stepping into the TCP/IP configuration

2 Enable the options to automatically obtain the IP addresses

The above is detailed further by your operating system manuals.

Note: Most operating systems – when just installed – by default will be configured to obtain their IP address automatically.

DHCP and Firewalls

DHCP utilizes UDP port 68 and firewalls running in front of DHCP clients must therefore allow traffic on this port. In the InJoy Firewall™, a feature exists to easily "punch a hole" in the firewall security for DHCP. The feature is called "DHCP Pass Through" and can be enabled in the configuration, as shown below:
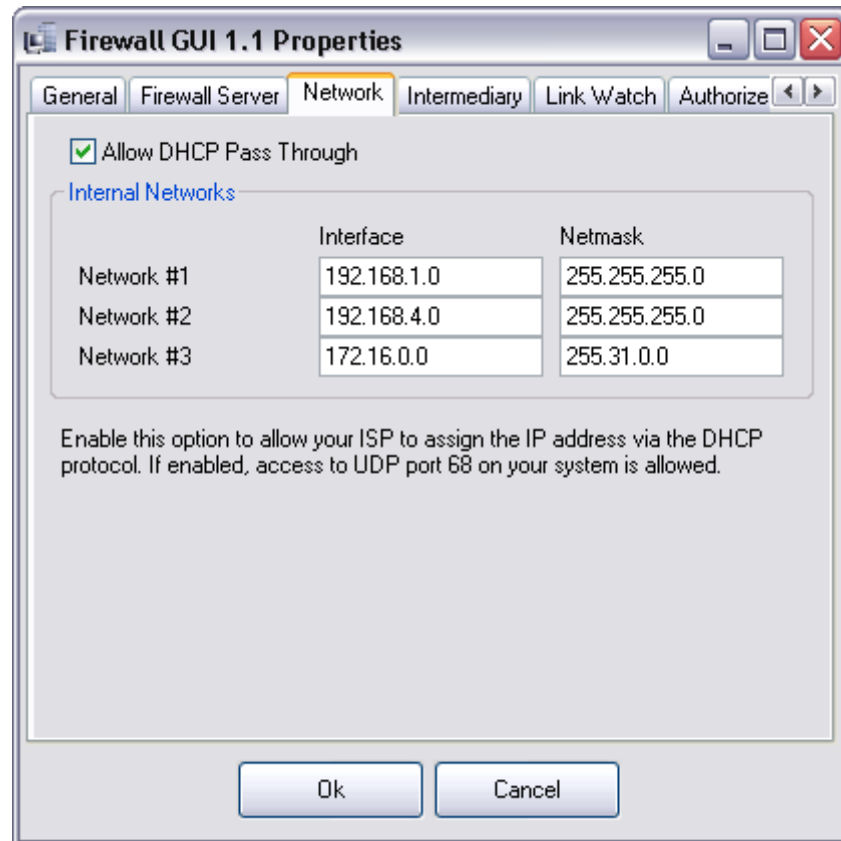
4 Configuring the DHCP Server

Once you have considered the implications of DHCP in your network, you are ready to get started with the simple configuration.

Step 1:	Step 2:	Step 3:	Step 4:
Enabling the DHCP Server.	Configuring the DHCP Server.	Allocating IP addresses.	Applying the configuration changes.

For a small network, the configuration of the DHCP Server is not very challenging and the InJoy DHCP Server Plugin is deliberately designed to be extremely simple. In fact, in the InJoy Firewall™, you can immediately enable the DHCP Server and have it operational in less than a minute. Here is how.
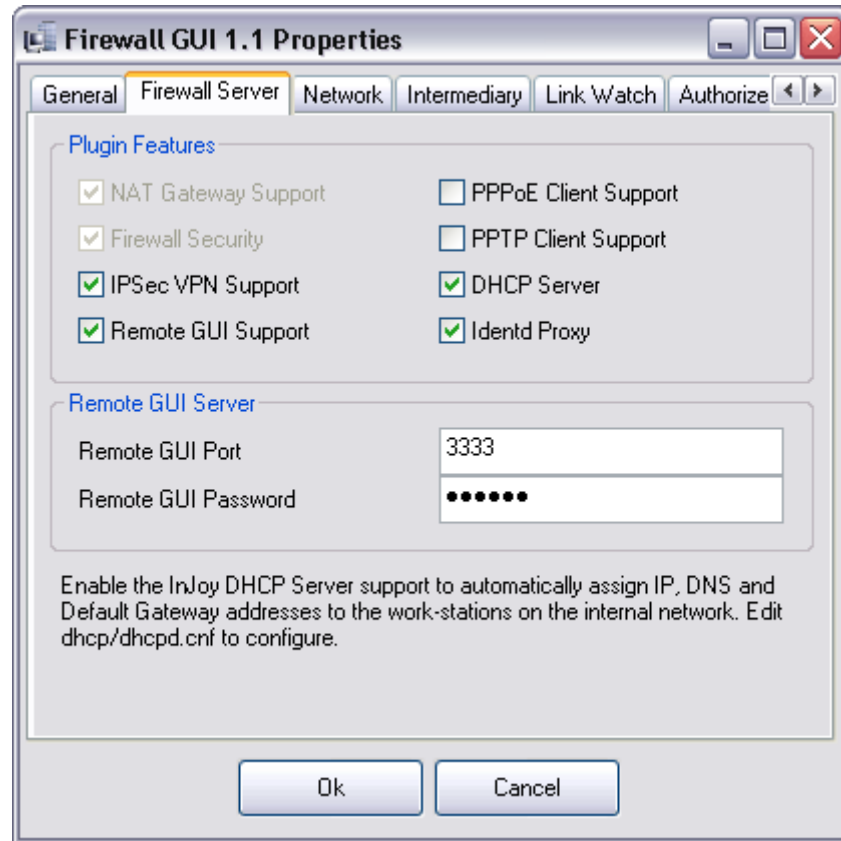
4.1. Enabling the DHCP Server

To enable the DHCP Server in InJoy Firewall™ and set up a fully functional DHCP network, you will need to perform these simple steps:

1 Enable the DHCP Server in the InJoy product

2 Configure the DHCP Server

3 Configure the DHCP client

Each step is described below.

Enabling the DHCP Server in the InJoy Firewall™

In the InJoy Firewall™ , enable the DHCP Server Plugin by going into the Firewall GUI Properties and enable the "DHCP Server" on the "Firewall Server" page - as shown below:

Press the **OK** button and restart InJoy Firewall™, as directed.

After restarting, ensure that the DHCP Server is running by pressing the right mouse button in the Firewall GUI to see if the "DHCP Server" menu item is present in the pop-up menu.
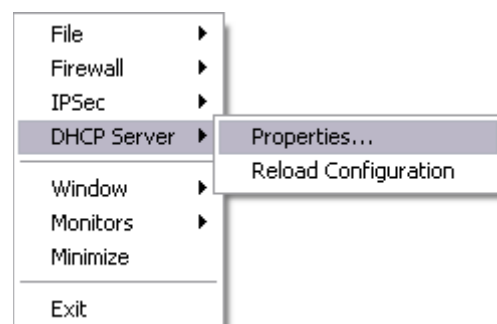
4.2. Configuring the DHCP Server

In the InJoy Firewall™, you can use the DHCP Server configuration GUI to set up the DHCP Server. To start the GUI configuration, bring up the Firewall GUI pop-up menu and select "**DHCP Server | Properties**".

The following dialog will appear:

In this dialog you configure the parameters that are assigned to the individual DHCP Clients.

The default configuration serves as a valid production example, however give special attention to the IP Address and the DNS addresses.

- The **IP address** is used when a DHCP client selects the best DHCP Server among those that replied to the initial DHCP Discovery message (from the DHCP Client). It is recommended that you set the IP Address to the IP address of your internal LAN interface – i.e. the IP address of the network adapter connected to your local net.

- The **Primary and Secondary DNS** can be set either to the public IP addresses of the DNS servers, or you can enable the DNS forwarding feature of the InJoy Product. With NAT forwarding enabled, the InJoy product will translate connections to 1.1.1.1 and 1.1.1.2 to the respective public DNS servers. For more information about DNS forwarding, refer to the InJoy product information.

For a description of the remaining DHCP parameters, also those not included in the GUI, please refer to the reference section.

4.3. Allocating IP Addresses

The IP addresses used by the DHCP Server are divided into IP pools, each specified with a beginning and an ending IP address.

The benefit of IP pools over a single range of IP addresses is that multiple pools allow you to use addresses in a non-linear fashion.

In the "IP-Pools" notebook tab of the DHCP Server properties, you can configure up to 3 IP pools – as shown below:
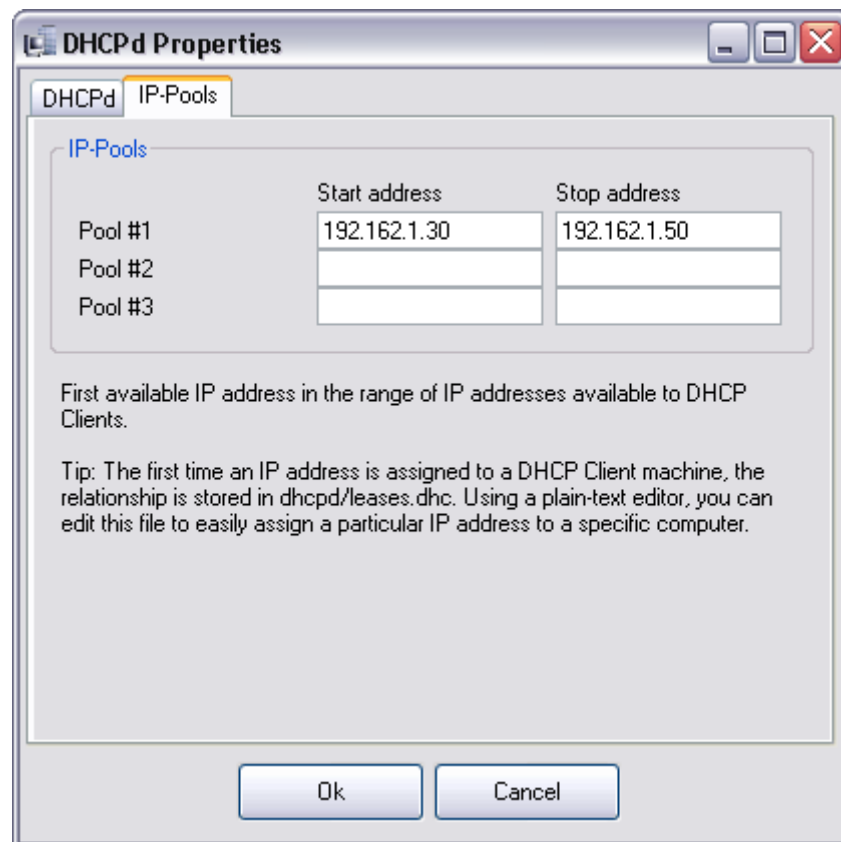
Both the beginning IP address and the ending IP address are inclusive.

IP addresses recommended for internal use

Each network in the world requires a number of IP addresses – typically one per computer. These IP addresses rarely need to be routable on the public Internet, but instead they are used internally. For this purpose, a number of network addresses are reserved for free, unrestricted use on internal networks. They include the following IP ranges:

- **Class A:** 10.0.0.0 through 10.255.255.255
- **Class B:** 172.16.0.0 through 172.31.255.255
- **Class C:** 192.168.0.0 through 192.168.255.255

17

Note: Even though the above IP addresses are reserved only for internal use, then through the NAT (Network Address Translation) feature – offered by most firewalls – the addresses are also usable for use on the Internet.

4.4. Applying Configuration Changes

To make configuration changes active in the DHCP Server Plugin, you need to reload its settings in one of these ways:

- Choose "Reload Configuration" from "DHCP Server" sub-menu of the Firewall GUI popup menu

- Issue the following command in the command prompt: "sync –dhcpd".

After the configuration change the DHCP Server will continue managing IP addresses, using the new configuration. The DHCPD\LEASES.DHC file, which holds the currently allocated DHCP leases, should be manually deleted if the IP Pools were changed.

Part III
References

5 Configuration Files

The DHCP Server uses the following configuration files:

- **DHCPD\DHCPD.CNF**
  This file uses a single record to define all the basic network parameters;
  i.e. those that are to be assigned to the DHCP clients.

- **DHCPD\IP-POOL.CNF**
  This file is made up of one or more records, each defining a pool of IP
  addresses.

- **DHCPD\LEASES.DHC**
  This file contains the already assigned IP numbers and the MAC
  addresses to which they belong.

The files are further detailed below.

5.1. DHCPD.CNF

Below an example of the DHCPD\DHCPD.CNF file:

```
# Libra's DHCP Server
#

DHCPd         Description = "Working DHCPd",
              Interface = "192.168.1.1",          ; LAN interface to serve
              Netmask = "255.255.255.0",
              Router = "192.168.1.1",
              DNS-1 = "1.1.1.1",
              DNS-2 = "1.1.1.2",
```

Characters following '#' and ';' are comments and are ignored by the DHCP
Server Plugin.

For more information about the individual configuration attributes and their
possible values, refer to the table below.

Attribute	Possible Values	Description
Description	String	General description.
Log-Level	Trace-Critical Trace-Error Trace-Warning Trace-Full	Controls the amount of information to log in the LOGS\DHCPD.LOG file. It is recommended to have it set to Trace-Warning for everyday use and Trace-Full for debugging and tracing purposes.

Interface	An IP address enclosed in double-quotes	Typically the address of the internal interface of the InJoy machine. This IP address is used when a client selects the best DHCP Server among those that replied to initial DHCP Discovery message.
Netmask	A network mask (in IP address form) enclosed in double-quotes	The network mask to provide to the DHCP clients. A network mask is the number that is combined with an IP address to determine in which network segment the computer resides.
Router	An IP address enclosed in double-quotes	The default gateway/route to provide to the DHCP clients. A default route is the IP address to which the packets that have a destination address beyond the current network are forwarded.
DNS-1 DNS-2 DNS-3	An IP address enclosed in double-quotes	The DNS servers to provide to the DHCP client. Leave one or more DNS entries blank if it is not to be set. A DNS server is a server which resolves domain names into IP addresses and vice versa.
WINS-1 WINS-2 WINS-3	An IP address enclosed in double-quotes	The WINS servers to provide to the DHCP clients. Leave one or more WINS entries blank if it is not to be set. A WINS server is a server which assists the File and Printer sharing protocol in resolving workstation names into IP addresses and vice versa.

5.2. IP-POOL.CNF

This file defines the pools of IP addresses. Below an example of the DHCPD/IP-POOL.CNF file:

```
# Libra's IP pools
#

pool1       Description  = "Sample Pool 1",
            Start-Address = "192.168.1.10",
            Stop-Address = "192.168.1.20",

pool2       Description  = "Sample Pool 2",
            Start-Address = "192.168.1.50",
             Stop-Address  = "192.168.1.60",
```

Characters following '#' and ';' are comments and are ignored by the DHCP Server Plugin.

For more information about the configuration attributes and their possible values, refer to the table below.

Attribute	Possible Values	Description
Start-Address	An IP address enclosed into double-quotes	A starting address of the IP pool (inclusive).
Stop-Address	An IP address enclosed into double-quotes	An ending address of the IP pool (inclusive).

5.3. LEASES.DHC

In order to keep track of leases, the DHCP Server maintains a list of already assigned leases in the plain-text file: DHCPD\LEASES.DHC.

DHCP Server leases are kept in the following format:

000021E0495B00000000000000000000 192.162.5.30

Where the MAC address (a unique identifier of the DHCP Client LAN adapter) is on the left and the assigned IP address is on the right.

The next time a LAN client with same MAC addresses requests an IP address from the DHCP Server, the same IP address (192.162.5.30) is reused. If there is no IP address already leased to the LAN client then the DHCP server allocates a new address from the IP pool and saves a new line in the leases file.

You can edit the leases file manually, which is useful when you prefer to assign special IP addresses to certain LAN clients. In the above example, if you change 192.162.5.30 to 192.162.5.31 – then the next time the same LAN client request a lease, the DHCP Server will assign 192.162.5.31 instead. When you manually edit this file, keep in mind that the same IP address may only be listed once.

It is also possible to find lines in the leases file where the MAC address is made up of zeroes, like shown below:

00000000000000000000000000000000 192.162.5.35

This indicates that the last time the DHCP server tried to assign the IP address of 192.162.5.35, the IP address was already in use by an unknown LAN client. In such cases, the DHCP Server stores the IP address in leases to avoid duplicate use and then tries to allocate another free address from the IP pool(s).