DHCP (Dynamic Host Configuration Protocol)

Technology Primer v1.1c

> . **Why do I need DHCP?**
> . **How does DHCP work?**
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Introduction : IP Address Assignment

We are familiar with the Internet as its reach continues to pervade even the most remote of homes worldwide. Yet, one of the biggest challenges facing us in such a TCP/IP network is assigning IP addresses and other configuration parameters for each device. No two devices on the same network may use the same IP address without one being denied access, but this process of assigning and managing the IP address resources can be a laborious and painstaking job for the network administrator. Hence, the arrival of the Dynamic Host Configuration Protocol, or DHCP in short!

DHCP automatically allocates reusable network addresses, reducing the headache involved in the issuing of new IP addresses and keeping track of the present set up. It also helps administrators make more efficient use of limited IP address resources.

Why do I need DHCP?

With the advent of many Internet appliances and peripherals, and the added connectivity between computers within and without a business, assigning a unique IP address to each of these devices has become an increasingly laborious task. In fact, without DHCP, the network administrator will have to keep a manually-updated DNS database and assign addresses as required. It is also required that the addresses be manually entered at each client computer, thus necessitating significant effort network-wide.

The typical network in an office has numerous desktop PCs and pockets of notebook/PDA users that will require a very able network administrator who will keep track and manage the pool of available IP addresses. Without a means to dynamically allocate IP addresses to these clients, whenever a client PC or a notebook user goes offline, the IP address allocated to the user will never expire even though he may no longer be around. This inevitably consumes a scarce network resource.

At a glance, DHCP has a number of advantages over manually entering addresses:

- It eliminates the need to visit each desktop for IP address maintenance.
- It reduces support time due to standardized IP numbering schemes.
- It improves control over access to DNS resources, since the DHCP server can assign which DNS name server to use.

Hence, as a network administrator of the modern-day computer network with inhomogeneous make-up, DHCP would help you better manage the otherwise scarce range of IP addresses and reduce the occurrences of potential IP address conflicts.

How does DHCP Work?

To start off, DHCP is based on a client-server model consisting two components: a mechanism for allocating IP addresses, and a protocol for delivering specific configuration parameters from a DHCP server to a client. A client can be any device on the network, for example, your very own workstation or a notebook computer, or even printers. These clients can be running operating systems like Windows 95/NT/3.x or others and as they start up and attach to the network, they will obtain their allocated IP addresses and configuration parameters from the DHCP server which you can set up.

When discussing DHCP, it is important to distinguish between static and dynamic IP addresses:

- A *static address* is an IP address that is entered directly into the DNS database and does not change once it is assigned to a host machine. Most network services like file servers and Web servers have static addresses to ease administration and increases reliability of their services.

- A *dynamic address* is an IP address that is dynamically assigned to a client workstation on start-up. Using dynamic addresses dramatically reduces administration on the network because it eliminates the need to constantly update the DNS manually. Typically this method is used for client devices.

There are three basic ways IP addresses can be allocated on a network:

- *Manual allocation.* As a network administrator, you will maintain a manually-updated DNS database and assign addresses as required, and keeping in mind that each of these addresses must be manually entered at each client computer.

- *Automated allocation.* This is an automation usually linked to a centrally-administered DNS database that keeps track of addresses. The host assigns an IP address to a client on a permanent basis (i.e. lease for the IP address does not expire).

- *Dynamic allocation.* A host assigns an IP address to a client for a limited period of time or until the client states that it no longer needs the address and gives it back.

Having noted these distinct differences, DHCP uses the third method of Dynamic allocation to provide IP addresses and configuration parameters dynamically to clients and services. However, to obtain an optimal network setup, you may use a flexible mix of static IP and dynamically assigned IP addresses within your administration.

The Delicate Art Performed

DHCP servers hold a "pool" of addresses, from all of the free IP addresses (addresses not assigned statically) within your organization's allocated range, which they can hand out to clients. Once the DHCP server allocates an address to a client, it guarantees not to give that address to any another client within a specified time. Additionally, the DHCP server tries to return the same IP address to the client each time it requests an address.

You might be interested to learn that each dynamically-assigned IP address has a *lease* time and a *renew* time. The lease time is the length of time that the client may use the assigned address before having to check with the DHCP server to see if the address is still valid; while renew time, which is expressed as a percentage of the lease time, is the interval after which the client checks with the DHCP server to renew the existing lease.
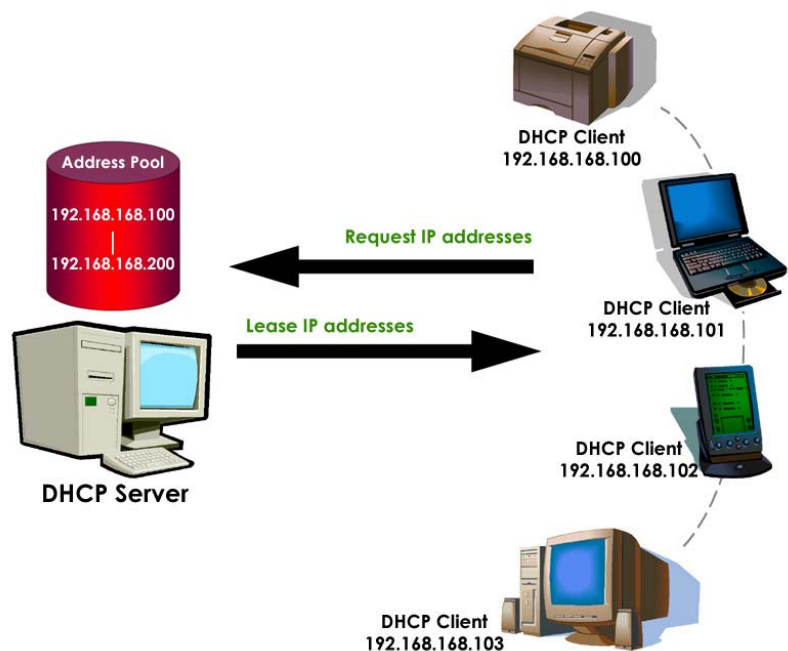
To illustrate, if a client has an 8 hour lease time with a 75% renew time, the client will check after 6 hours to see if it can keep the address for another 8 hours. A given DHCP address can thus remain standard on a client instead of changing at the end of each lease time.

Considering the ease of implementation and the potential benefits that can be reaped using DHCP, the network administrator would be pleased to note that a built-in DHCP server is found in the complete range of Ethernet router, wireless broadband gateway and access point products. Through a clever mix of advanced features and user-friendly configuration interfaces, administering the DHCP-capable products is a straightforward leap to simplify the modern day network management job.

To Get Going

Now that we have a good overview of the technology and understanding how DHCP can make our computing experience more fruitful, let us take a peek at how a few easy steps can bring us a long way to make these technologies work for us. Check out the walkthrough guides below:

Example 1: Let it all be Dynamic!

You have a volatile network of personal computers and mobile users. You may manually configure the TCP/IP settings for each of these computers whenever they require to be connected to your local network, you may decide to put the built-in DHCP server to good use. The DHCP server will allocate IP addresses automatically to them and it appears to be the best choice for you. Here's how we go about doing it:

1 First, you will need to set up the PCs to obtain IP addresses from the DHCP server. Go into the "Properties" page of the network adapter that provides you the network connection -> then select "Internet Protocol (TCP/IP)" before clicking on "Properties". On the next dialog box, set both radio buttons to "Obtain an IP address automatically" and "Obtain DNS server address automatically"
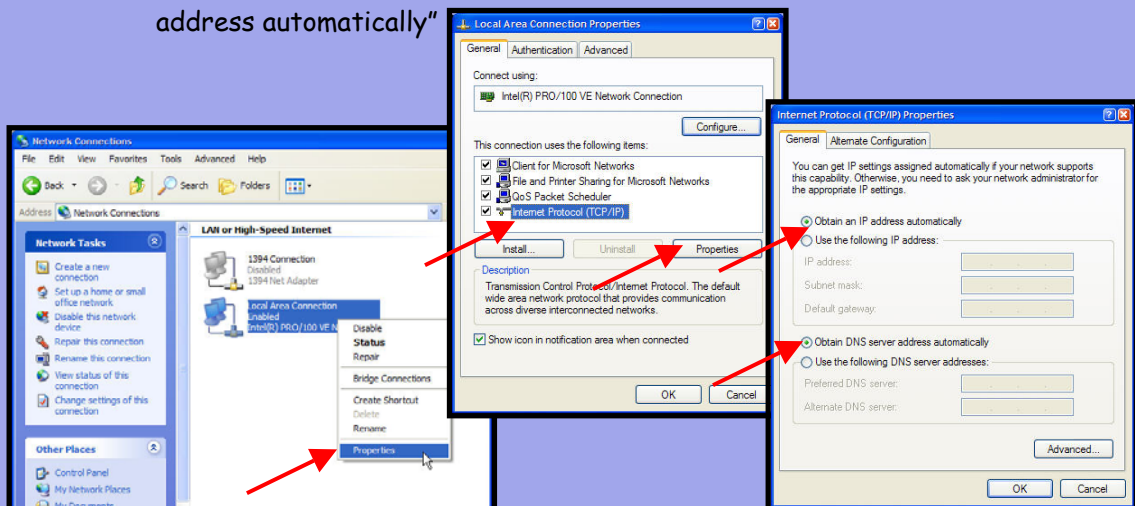
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In step 1, you have set up a single PC to obtain an IP address from the DHCP server. You can make similar changes to other PCs on the network. The next step will take you to enable the built-in DHCP server on the router device:

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LAN Setup

IP Address	192	168	168	1
Network Mask	255	255	255	0
DHCP Start IP Address	192	168	168	100
DHCP End IP Address	192	168	168	254
DHCP Gateway IP Address	0	0	0	0

☐ Always use these DNS servers:

Primary DNS IP Address

Secondary DNS IP Address

DHCP Server   ⦿ Enable ◯ Disable

Note: Changes made will only take effect after rebooting.

[Save] [Reboot] [Help]

In the second step, all it takes for you is to go into the "LAN Setup" menu in your router's web-browser configuration.

You may define a range from 1 to 254 for the "DHCP Start IP Address" and "DHCP End IP Address" (or choose to leave it as the default 100 to 254).

Finally, simply click "Enable" DHCP Server, "Save" and then "Reboot".

Example 2: A Mix of Fixed and Dynamic IP addressing!

Surely, this is not an uncommon situation. You need to set up a publicly accessible FTP server that resides within your private LAN. At the same time, you have to manage and keep a healthy group of users comprising workstations and mobile roadwarriors. Hence, you will need to allocate a fixed IP address for the FTP server (e.g. 192.168.168.99), while leaving the rest of the workstations and notebook PCs to automatically obtain IP addresses from the DHCP server.

The only catch is this: you will need to tell the DHCP server, in this case the one built-in with your router, to reserve that particular IP fixed for the FTP server. This ENSURES that the DHCP server will not lease 192.168.168.99 to other PCs, which will render your FTP server inaccessible. Here's how we do it in 3 simple steps:
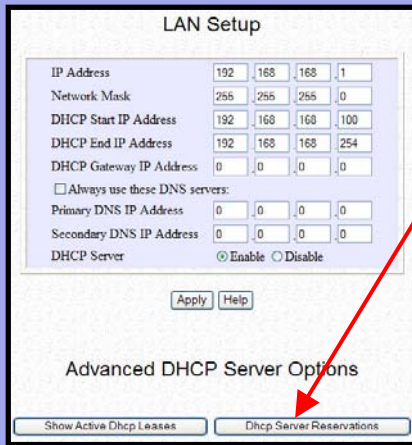
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To begin, you may set up the dynamic portion of DHCP as per "Example 1" above. BUT, you must ensure that the IP address to be reserved does not lie in the range of the DHCP Start and End IP Addresses.

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LAN Setup

IP Address	192	.168	.168	.1
Network Mask	255	.255	.255	.0
DHCP Start IP Address	192	.168	.168	.100
DHCP End IP Address	192	.168	.168	.254
DHCP Gateway IP Address	0	.0	.0	.0

☐ Always use these DNS servers:

Primary DNS IP Address	0	.0	.0	.0
Secondary DNS IP Address	0	.0	.0	.0
DHCP Server	⊙ Enable ○ Disable			

[Apply] [Help]

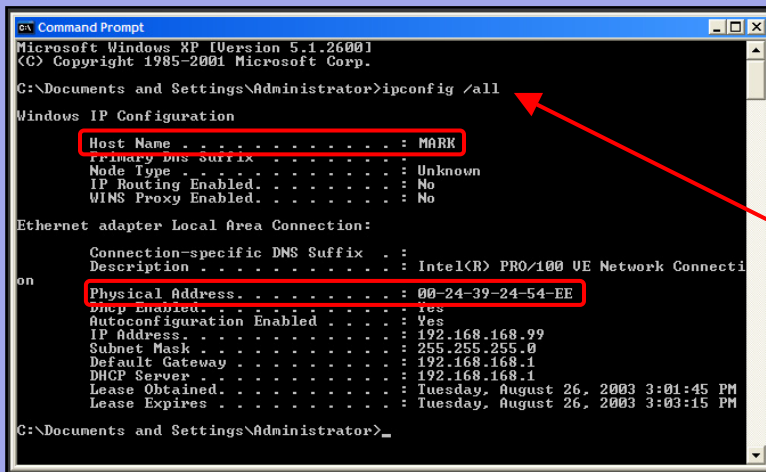### Advanced DHCP Server Options

[Show Active Dhcp Leases] [Dhcp Server Reservations]

For step 2, within the LAN Setup screen, you should click on "DHCP Server Reservations" under the "Advanced DHCP Server Options".

DHCP Server Reservations

IP Address	Host Name	Hardware Address

[Apply]

IP Address: 192.168.168. 99   Host Name: MARK

Hardware Address: 00 24 39 24 54 EE

[Add] [Help]

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For this example, key in 192.168.168.99 as the IP to reserve. You will also need to key in the Host Name and Hardware Address corresponding to the machine you intend to run as the FTP server. Then hit the "Add" button.
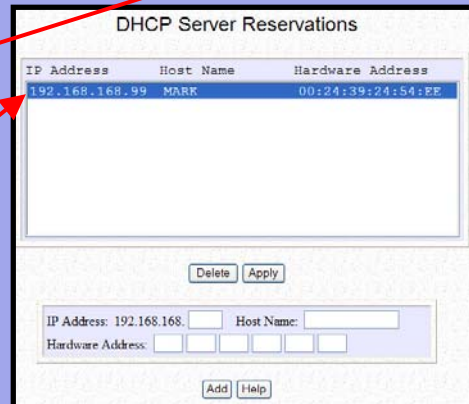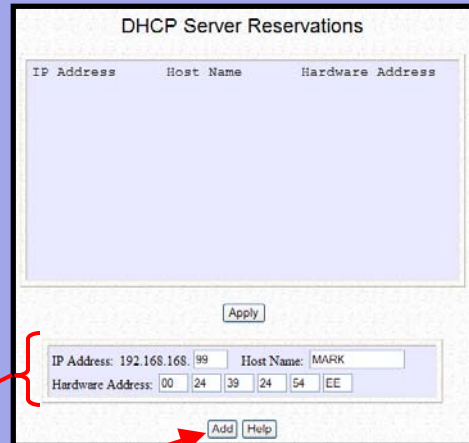
You will then note the following entry. *(Please see note below on how to obtain the corresponding Host Name and Hardware Address on the machine)*

DHCP Server Reservations

IP Address	Host Name	Hardware Address
192.168.168.99	MARK	00:24:39:24:54:EE

[Delete] [Apply]

IP Address: 192.168.168.   Host Name:

Hardware Address:

[Add] [Help]

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Command Prompt                                               _ □ X
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Administrator>ipconfig /all

Windows IP Configuration

        Host Name . . . . . . . . . . . . : MARK
        Primary DNS Suffix  . . . . . . . :
        Node Type . . . . . . . . . . . . : Unknown
        IP Routing Enabled. . . . . . . . : No
        WINS Proxy Enabled. . . . . . . . : No

Ethernet adapter Local Area Connection:

        Connection-specific DNS Suffix  . :
        Description . . . . . . . . . . . : Intel(R) PRO/100 VE Network Connecti
on
        Physical Address. . . . . . . . . : 00-24-39-24-54-EE
        Dhcp Enabled. . . . . . . . . . . : Yes
        Autoconfiguration Enabled . . . . : Yes
        IP Address. . . . . . . . . . . . : 192.168.168.99
        Subnet Mask . . . . . . . . . . . : 255.255.255.0
        Default Gateway . . . . . . . . . : 192.168.168.1
        DHCP Server . . . . . . . . . . . : 192.168.168.1
        Lease Obtained. . . . . . . . . . : Tuesday, August 26, 2003 3:01:45 PM
        Lease Expires . . . . . . . . . . : Tuesday, August 26, 2003 3:03:15 PM

C:\Documents and Settings\Administrator>_
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Important Note: You can go into the Command Prompt on the workstation you wish to operate as an FTP server, and execute the "ipconfig /all" command to view the following settings. Simply use the Host Name and the Physical Address indicated in the red boxes.

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