Network Station Manager Version2

DHCP and DDNS Concepts

Network Station Education
IBM Network Computer Division
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Objectives/Summary

- **Understand the basics of DHCP and DDNS**
  - What is DHCP?
  - Using or not using DHCP
  - Why use it?
  - How does DHCP work?
  - What are DHCP options?
  - What is DNS and DDNS?
  - How does DDNS work?
  - How does the station get its DNS info
  - How to configure DHCP?
  - DHCP Administration
  - How to configure DDNS?

Notes

This presentation provides an overview of Dynamic Host Configuration Protocol, DHCP, and Dynamic Domain Name System, DDNS.

The objective of this particular topic is to understand the basic concepts of DHCP and DDNS, mainly for the benefit of those who have not been exposed before to this subject.

We could spend hours on this topic alone because there is quite a lot to be explained, but my objective is to give you only an overview of what it is, why you should use it, and how it works, what are these things called "DHCP options" that we need to configure when we use Network Station configuration, and what is DNS - domain name systems and DDNS - dynamic domain name systems and how does it impact our environment when we talk about Network Stations.

What is DHCP?

- Dynamic Host Configuration Protocol (DHCP)
- A client/server protocol enabling central control and administration of IP addresses and other configuration data
- Based on the Bootstrap (BOOTP) protocol, with additional capabilities
- IP address allocation by a DHCP server can be:
  - **Dynamic** - IP addresses allocated to clients from a range of available addresses (pool)
  - **Static** - IP addresses reserved for a specific clients
- IP address can be leased to a client:
  - **Temporarily**, for a specified period of time
    - The client must renew the lease at specified intervals
  - **Permanently** - Lease is forever

Notes

So what is DHCP?

DHCP stands for Dynamic Host Configuration Protocol. It's a client/server protocol enabling central administration and control of IP addresses, and configuration data, from a central location.

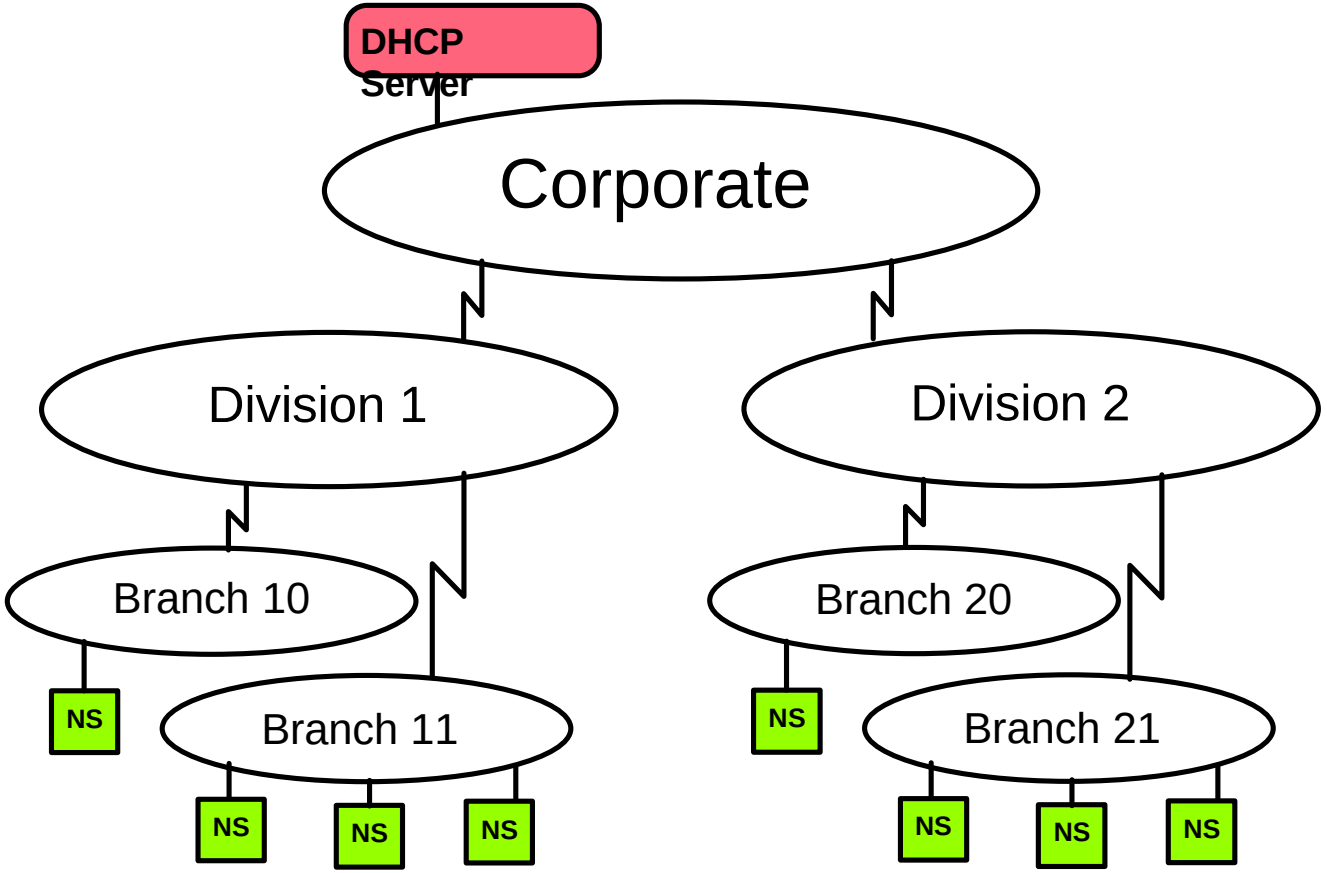
It is based on the Bootstrap Protocol (BOOTP) but with additional capabilities. In particular, the IP address allocation can be dynamic; that is, you can allocate IP addresses to clients from a range of available addresses that you have in a pool so that when a client comes in and requests an IP address, he might get a certain address one day and a different address the next day.

This allows the reuse of IP addresses and to reclaim addresses that are no longer used, and it is therefore a much more efficient use of the resources. IP Address allocation can also be done on a static basis where addresses are reserved for specific clients.

An IP address can be leased to a client on a temporary basis - that is for 5 minutes or 5 hours or 25 days - or it can be leased to that client permanently.

Why Use DHCP?

- Centralized (or decentralized) management of IP resources
- Global changes easier
- More efficient use of IP resources
- Avoid manual intervention at the Network Stations



Notes

So why would anyone use DHCP?

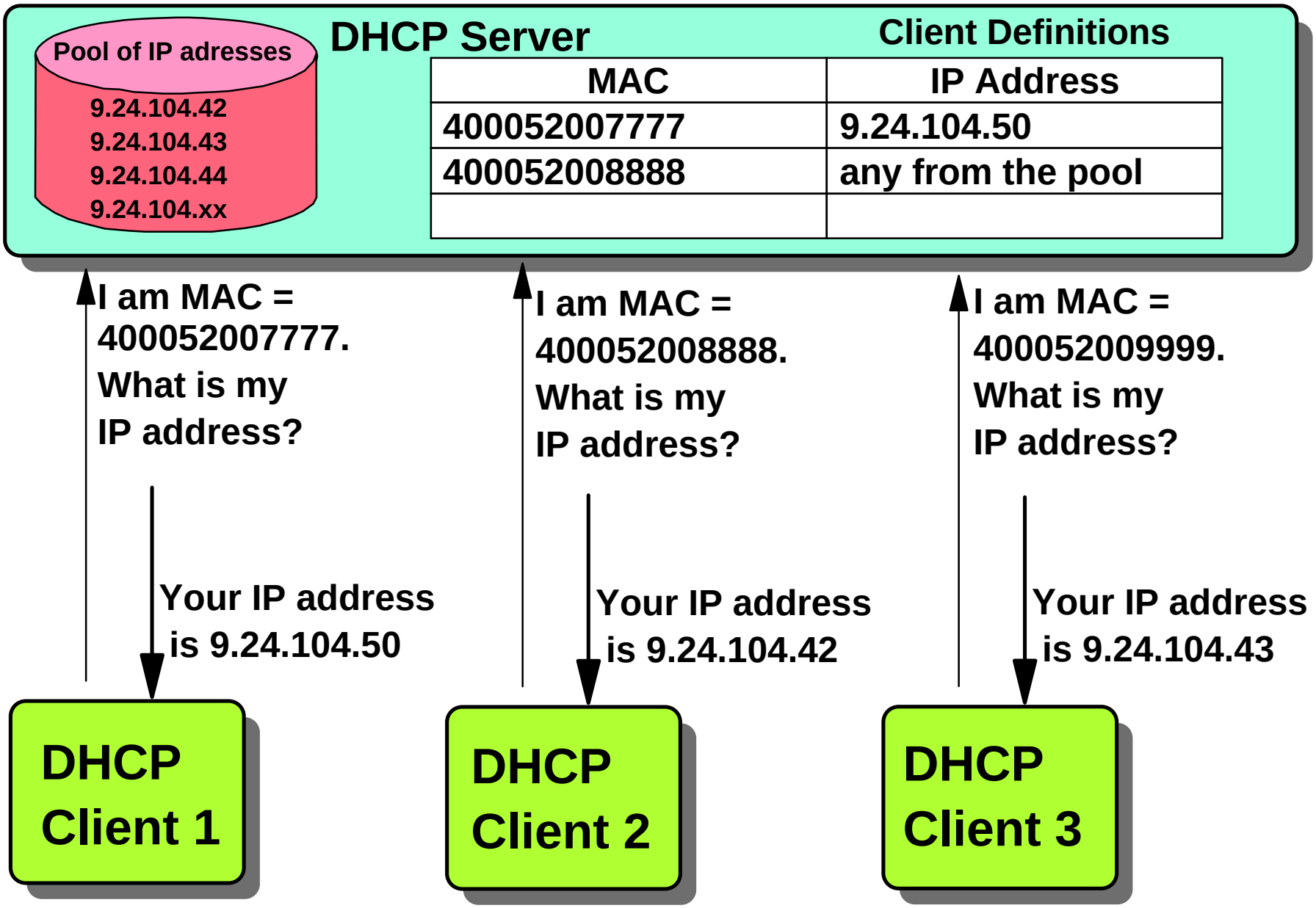
There are many specific advantages to using DHCP but in general, it is simply a much more efficient way of managing IP resources because everything can be done from a central location.

DHCP allows not only the management of IP addresses but also allows the management of all the other configuration parameters that are required by thin clients such as IBM Network Stations.

These configuration parameters can be set at a central location and transmitted to the Network Stations when they request their IP address.

Making any global changes to a network of Network Stations becomes a lot easier that way, and a lot less expensive, than having to send someone on site to each Network Station in order to change configuration parameters.

How does DHCP Work?



Notes

How does DHCP work? This diagram illustrates a simplified example.
At the top of the chart is a DHCP server configured with a pool of IP addresses that are available for allocation to clients that come in requesting an IP address.

On the right are some client definitions, represented as a table. Clients in this case are identified by their MAC address. For example, if a client identofying himslef as having MAC address 7777 comes in asking for an IP address, the server will give him the address 9.24.104.50. But if it identifies itself as having MAC address 8888, the server will give it the first available address from the pool.

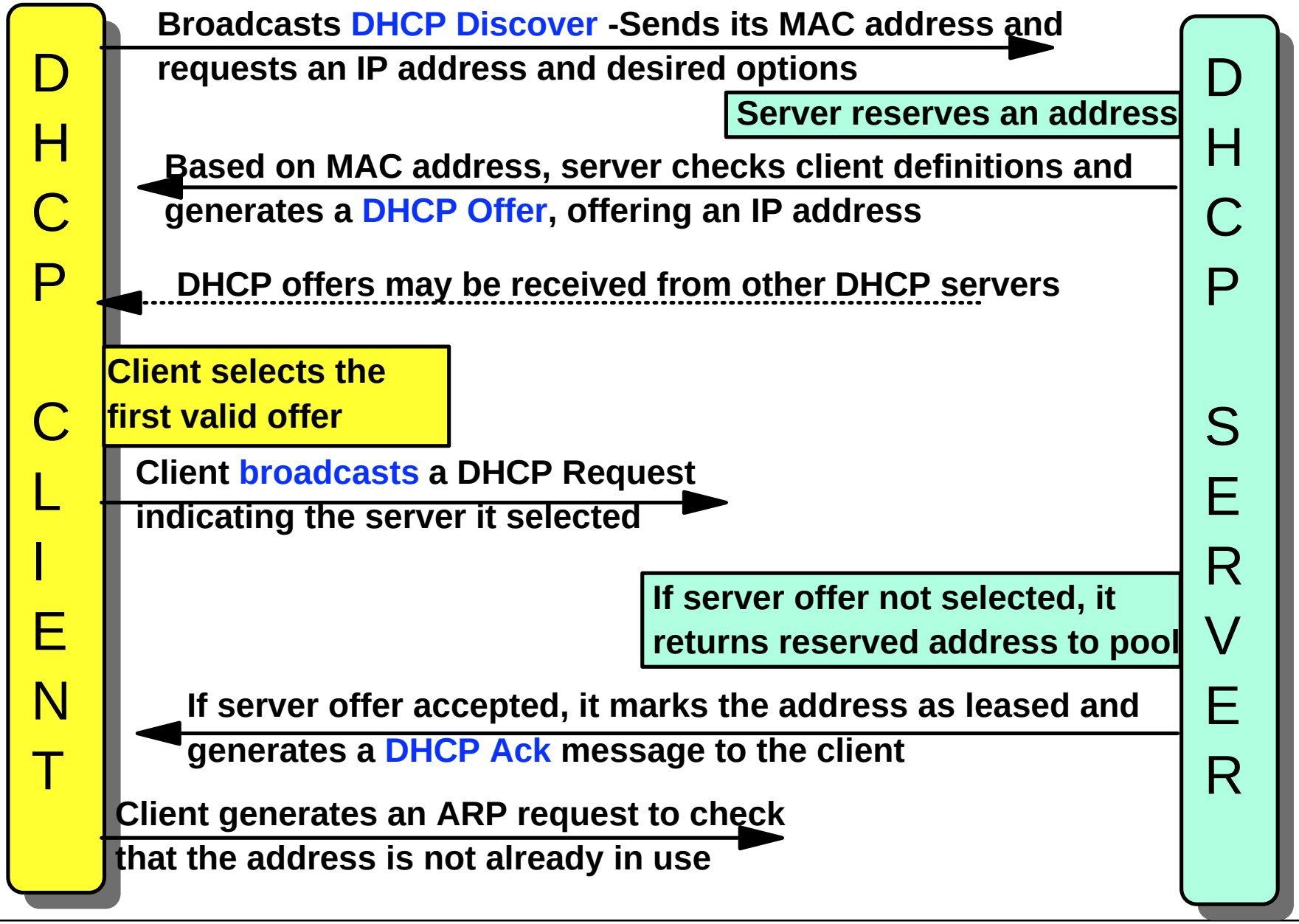
If we look at DHCP client number 1 at the bottom left-hand corner of the diagram, that client issues a request, a DHCP broadcast, to the DHCP server and says, "My MAC address is 7777. Please give me an IP address?". The server returns the one that has been configured by the administrator in the DHCP server configuration file, that is 104.50.

If DHCP client number 2 comes in now with a request for an IP address, because his MAC address is 8888, he will get the first address out of the pool which, in this case, happens to be .42.

On the right, the third client says, "my MAC address is 9999. What's my IP address?" In this case, because the server does not have this particular MAC address configured in its configuration file, you would expect that it would not respond.

However, there is a feature called "unlisted client support" available on most DHCP servers that allow any client to be allocated an address even if their MAC address is not defined in the DHCP configuration tables. So, in this case, this third client gets the next available address out of the pool which is .43, assuming that the server is configured to allow unlisted clients. If the unlisted client support is not enabled, the DHCP server does not reply to a request from an unlisted client.

DHCP Client/Server Communication



Notes

What are the exchanges that tale place specifically?

The process is started by the DHCP client that broadcasts a DHCPDISCOVER frame, sending its MAC address and requesting an IP address.

The server, on receipt of this DHCP discover request takes an address out of the pool or one which is configured specifically and reserves that address and then replies with a DHCPOFFER frame back to the originating client offering a specific IP address.

Notice that this client might also receive offers from other servers because if there are multiple servers on the same LAN segment, every one of those servers, if they are supporting unlisted clients, might generate an offer. A Network Station Manager V1R3 client selects the first acceptable offer that it receives whereas a V2R1 client only accepts the first offer that contains the options that it needs as a Network Station.

The client then broadcasts a DHCP request back indicating the server that it has selected. It uses a broadcast because it needs to notify other DHCP servers that might have also made an offer that it has selected an offer from a specific server. If this server happens to be not the one that was selected, if returns any reserved address to the pool of available addresses.

On the other hand, the selected server sends the address it had reserved back to the client in a DHCP acknowledge frame saying, "All right. Mr. Client, you are now allowed to use this address for a specified period of time." And the client generates an ARP request on the network to check that this address that has been given is not actually in use by anybody else and then continues operating in a normal environment.

What Are DHCP Options?

- **DHCP options are basically data fields**
- **They provide a way to transmit configuration information to a client**
- **Options are coded using a numeric code**
- **0-127 and 255 are architected (pre-defined)**
- **128-254 are user-defined**
- **For example, 211-214 are defined used for the separation of servers function**

Sample Options

Option 1 - Subnet Mask
Option 3 - Default Router
Option 4 - Time Server
Option 6 - Domain Name Server
Option 12 - Host Name
Option 15 - Domain Name
Option 51 - IP Address Lease Time
Option 66 - Boot Server Address
Option 67 - Boot File name
Option 211 - Base Code Server Protocol
Option 212 - Configuration Server Address
Option 213 - Configuration Files Directory
Option 214 - Configuration Server Protocol

Notes

What are these DHCP options that we've mentioned up to now in a few places, specifically when we were talking about configuring the Network Station?

DHCP options as basically just data fields. They contain configuration information to be sent to a client. Here are listed some sample options.

Option number 1 is a subnet mask. Option number 3 is the default router. Option number 12 is the IP host name.

All these options have been coded. They use a numeric code. Zero to 127 and 255 are architected. That is, they are predefined. Everybody uses the same coding which means that option 3 for everybody is always the default router.

Options number 120 to 254 are user defined and they can be assigned to anything that you want, as long as the client and the server agrees on what that is.

In fact, in V1R3, we have used option 211, 212, 213, and 214 in order to implement new fields that were necessary for the separation of servers function. Those are listed in blue at the bottom of the sample options shown in this chart.

What is DNS and DDNS?

- DNS stands for Domain Name System and DDNS for Dynamic Domain Name System
- A Domain Name System is like a telephone directory of IP host names and IP addresses
- Humans work with names and computers work with addresses
- Easy to remember Mary Higgins but hard to remember 10.24.104.47
- DNS is a static list of names and addresses
- DDNS is a dynamic list of names and addresses
- A DNS system contains multiple DNS servers, arranged in a hierarchical fashion, working together to resolve names into addresses
- DNS clients query DNS server(s) asking to resolve names

Notes

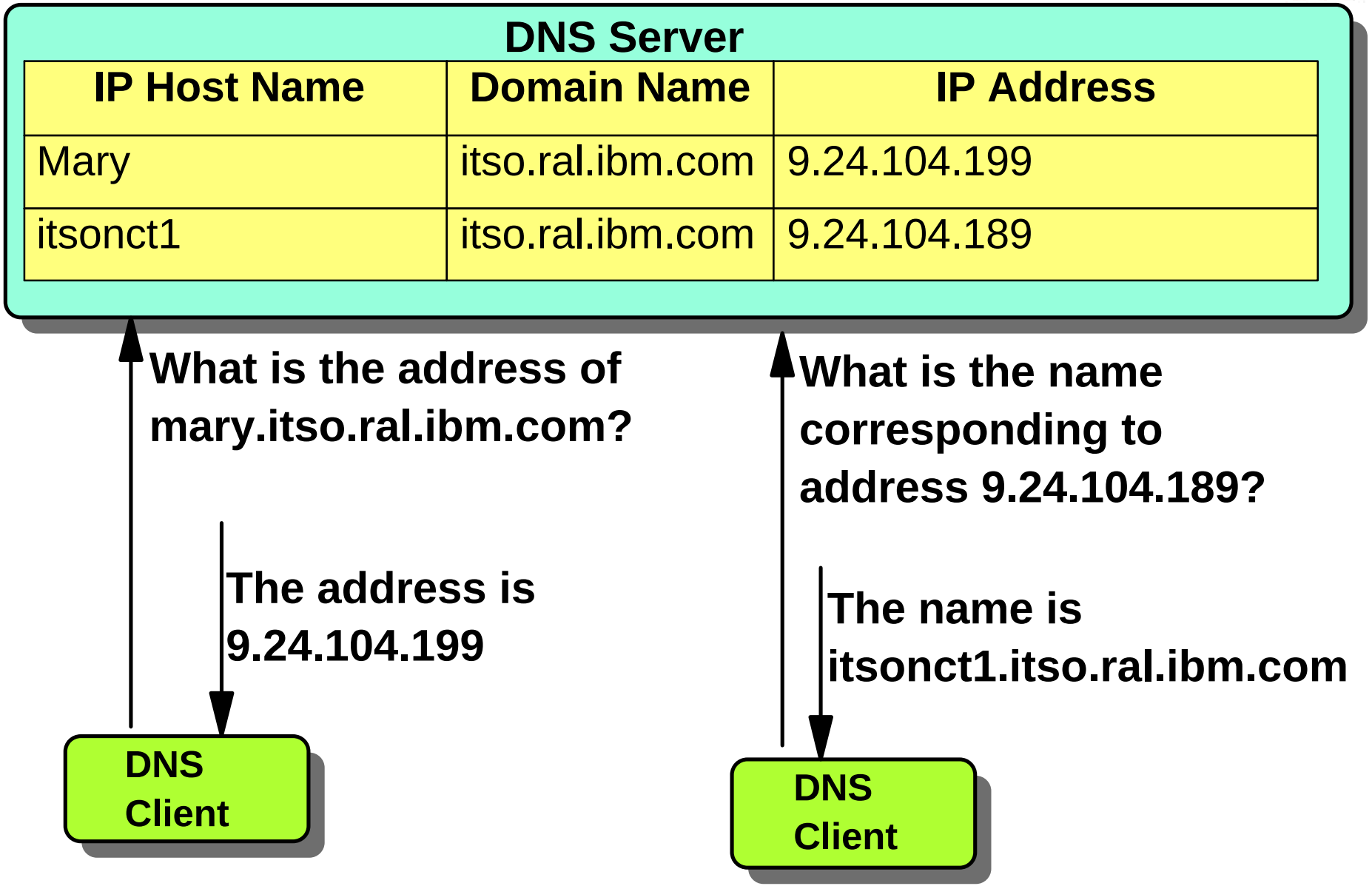
What is DNS and DDNS? DNS stands for Domain Name System and DDNS for Dynamic Domain Name System.

Think of a domain name system simply as a telephone directory of IP host names and IP addresses. We humans work with names, but computers work better with numbers. I much prefer to remember Mary Higgins than 10.24.104.47. When we talk about a domain name system, we usually refer to a static list of names and addresses.

In other words, these names and numbers are configured in a DNS server which an administrator must manually update if there are any changes, but with a DDNS, which stands for dynamic domain name system, the names and addresses in the directory can be dynamically and automatically updated.

A DNS system in total is usually made up of many DNS servers arranged in a hierarchical order working together to resolve requests from clients for names. Typically, you specify is a name and you want to get back an IP address; this is called resolving a name to an IP address. And many DNS servers might be involved in that process.

Example of a DNS Server?



Notes

Here's an example of a DNS server.

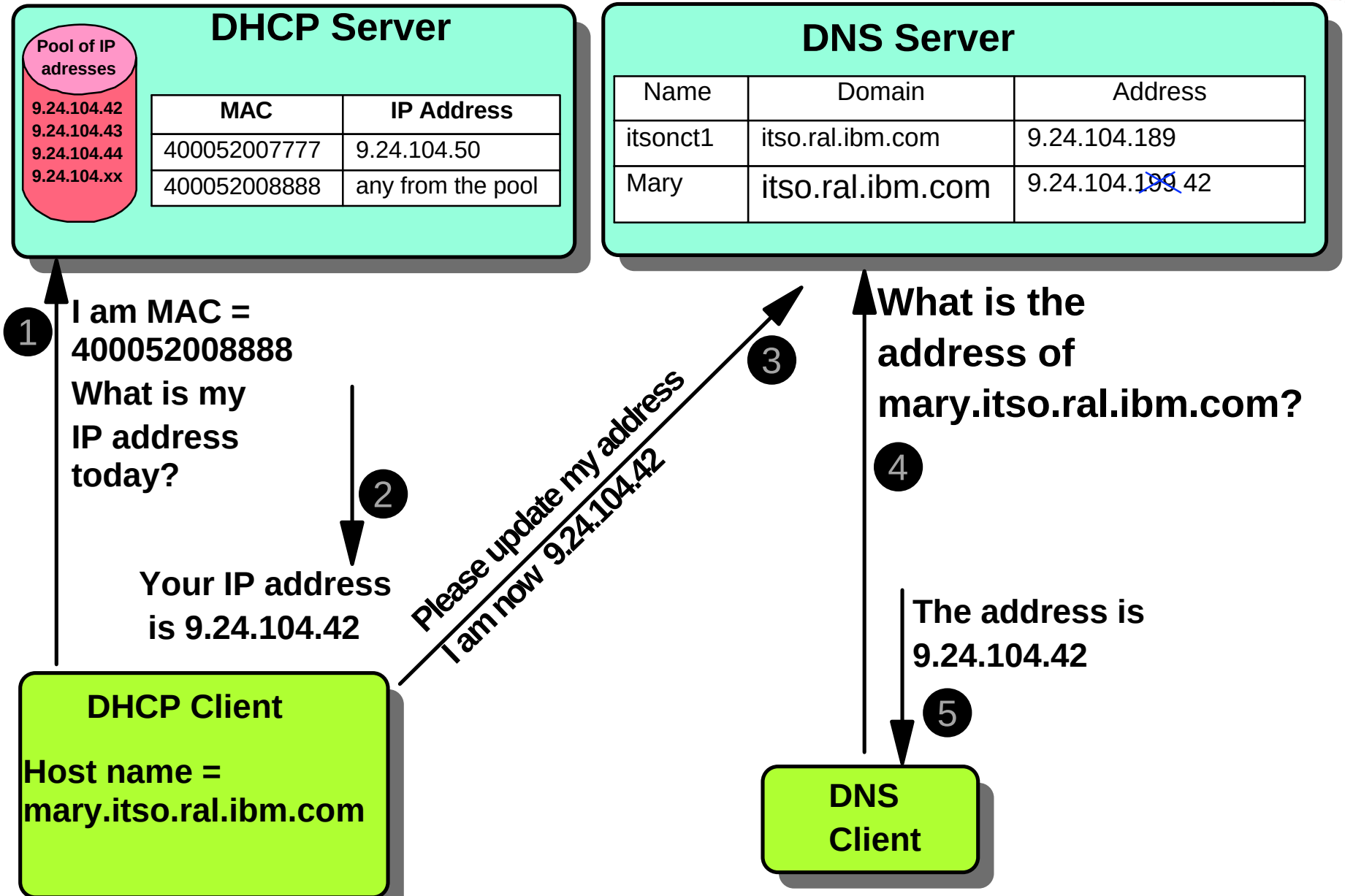
This simple telephone list is configured in a server. There is an IP host name called Mary, the domain name is itso.ral.ibm.com and the IP address is 9.24.104.199.
There is also another entry called itsonct1.

When a client, any client, sends a DNS resolve request to this DNS server. it is basically asking for the IP address of mary.itso.ral.ibm.com.

The server responds with 9.24.104.199 as being the address of that particular host.

You can also do the reverse and request to know what name corresponds to an address. In this case, the example on the right shows a request to find the name that corresponds to the address 104.189 and the DNS server responds with itsonct1. This is called a reverse name lookup.

How Does DDNS Work?



Notes

How does dynamic DNS work then?

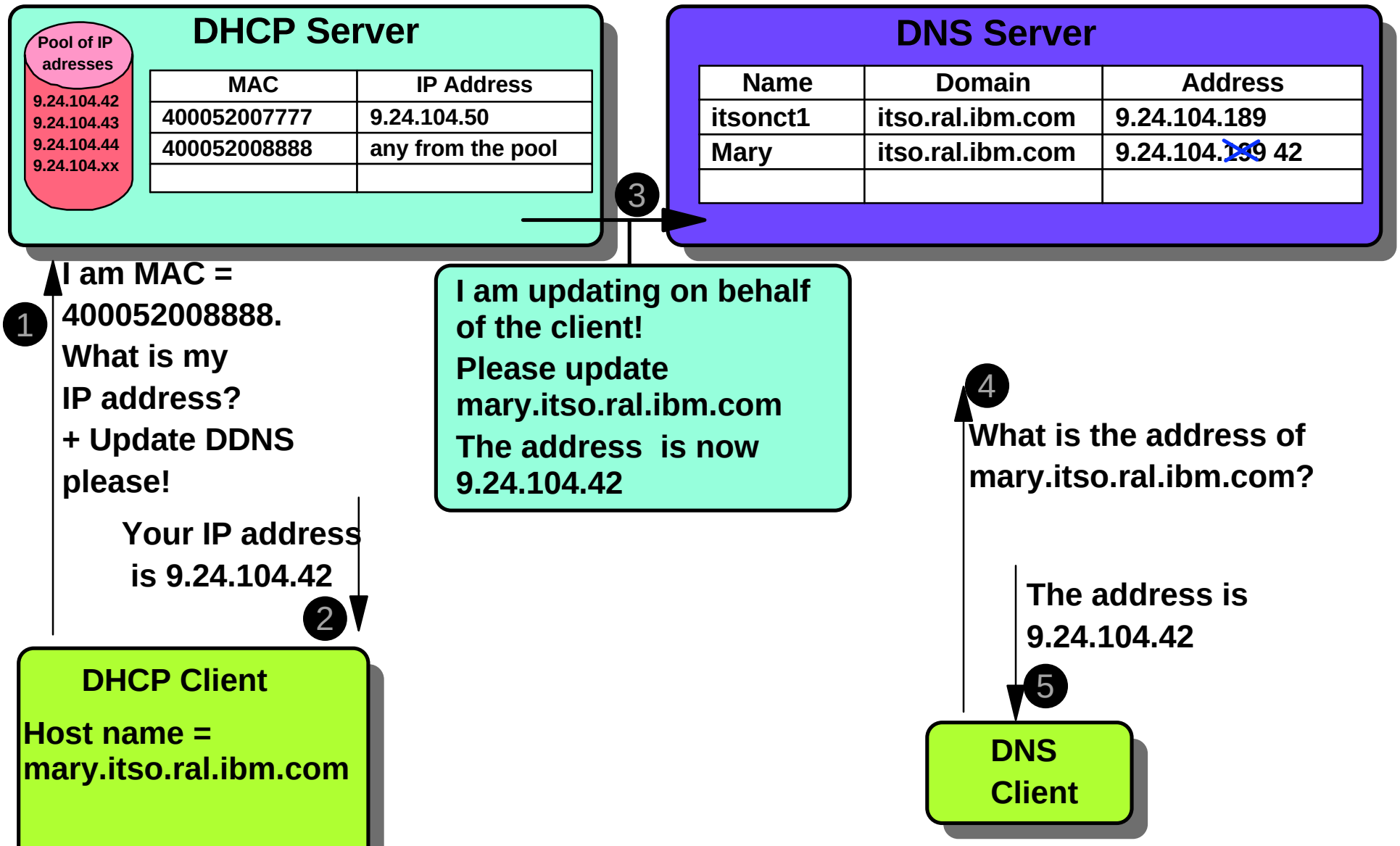
This diagram shows in the top portion on the left a DHCP server; on the right, a DNS server which is a dynamic server. Typically the DHCP client on the left goes to the DHCP server and says, "This is my MAC address. Please give me an IP address."

The DHCP server responds, "All right. Today, your address is 9.24.104.42." The client, at this time, if it has the ability, sends an update request to the DNS server and tell the DNS server that his host name is mary.itso.ral.ibm.com and the corresponding IP address is now 9.24.104.42.

As shown in the top right-hand corner of the chart, Mary previously had an address of 9.24.104.199. It is now 42, such that any client on the network now requesting the address of Mary would get 42 as an answer from the DNS server.

That is all fine if the DHCP client has the ability to request a dynamic update or to send a dynamic update request to a DNS server. But not all clients do and, in particular, the Network Station client does not have this capability.

DHCP Server Updating DDNS



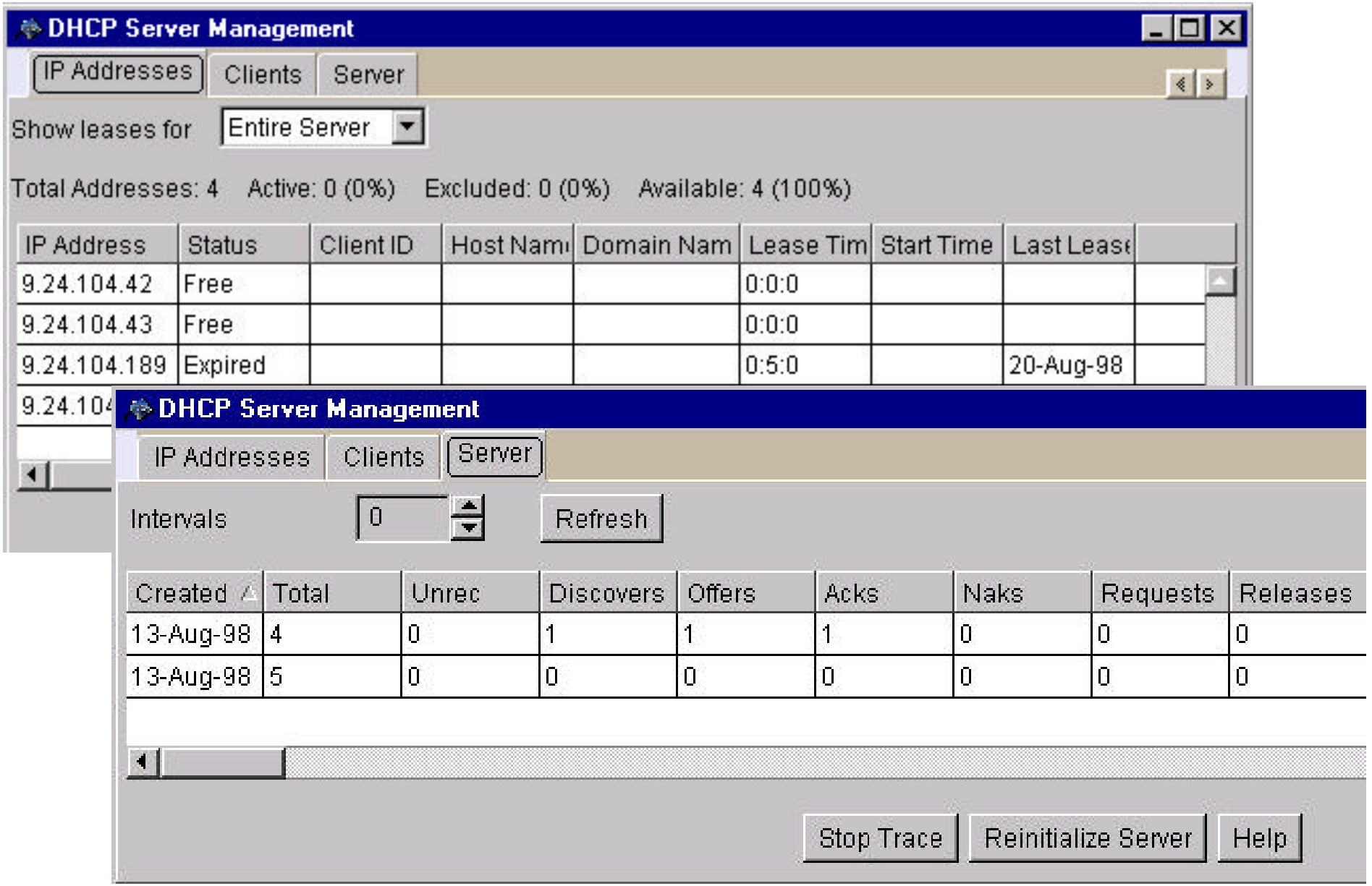
Notes

In this case then, the DHCP server can be asked to update the DNS server on behalf of the client.

This case is illustrated here, using the same example as in the previous chart, except that in this case, the DHCP client, at the time that it made the request to the DHCP server, indicated to the server that it was not able to do a dynamic DNS update and asked the DHCP server to do the update on its behalf.

The DHCP server contacts the DNS server and sends an update request that updates the address for Mary to 42.

DHCP Server Management GUI



Notes

The panels shown here are the DHCP server management panels from the IBM DHCP server on Microsoft Windows NT.

The panel at the top lists all the IP addresses that are currently available and the status of each of the IP addresses, whether it's free to be allocated by the DHCP server. In this case, there is one address, 189, which shows as being expired. It had been allocated and the last time it was leased was on the 20th of August. And the lease time was 5 minutes. This is because this one was used to make a test about a lease renewal which is why the lease time was so short.

A clcik on the server tab brings up the panel shown in the lower portion of this chart which displays the total number of offers that were made. For example, under the discover column, it indicates that the DHCP server has received one DHCP discover frame from a client. It has sent one offer and it has acknowledged one. This is very little activity indeed but this was only a test machine; if this was a real production environment you would get a lot more statistics here.

Notice at the bottom of that panel as well that you have a Stop Trace button that allows you to start or stop automatically a trace so that in the log of the DHCP server you get a lot of details about the activity that occurred. You can also very easily re-initialize the server by just a click on this button.

Where to Go for More Information

- **Redbook SG24-5280 Beyond DHCP - IBM'sGuide to Network Communications with TCP/IP**
- **Redbook SG24-5844 NSM V2R1 Guide**
- **Redbook SG24-5221 NSM R3 Guide for Windows NT**

- **Product Publications**
  - **SC41-0684 Installing NSM for AS/400**
  - **SC41-0685 Installing NSM for RS/6000**
  - **SC41-0688 Installing NSM for Windows NT**
  - **SC41-0690 Using NSM**
  - **IBM Network Station Advanced Information (On the Web Site)**

- **IBM Network Station Home/Information Web Site**
  - http://www.ibm.com/nc

Notes

There's a lot more that can be said about DHCP, so I've listed here a few publications where you can go to get more information.

In particular, if you look at the SG24-5280 redbook, Beyond DHCP, IBM's guide for communication with TCP/IP, you can get a full tutorial on the domain name system and how the hierarchical system of multiple DNS server can be used to resolve addresses.