

Understanding DHCP

Setting up TCP/IP on a network is essential if you wish to build an intranet. However, defining an addressing system and setting up the correct address on each workstation and server is far from trivial. Dynamic Host Configuration Protocol can be a great help.

By Howard Richards

With the growth of the Internet, TCP/IP has now become a must-have protocol for most computer networks. It provides a single network protocol that is supported by almost every type of computer system, a plethora of applications that use it, and it is well suited to both large and small networks. It's also essential if you wish to set up an intranet.

The downside of TCP/IP is that, unlike protocols such as IPX, it needs addresses and configuration settings to be defined on each computer or peripheral on the network. This can entail an immense amount of system administration work.

DHCP stands for Dynamic Host Configuration Protocol, and is used to centrally allocate and manage TCP/IP configurations of client nodes. If you've got more than a handful of computers to manage, then DHCP can help to save a great deal of time and trouble in setting up and administering a TCP/IP network. DHCP offers the following features:

- It allows you to define "pools" of TCP/IP addresses, which are then allocated to client PCs by the server. These pools are called scopes in DHCP terminology.
- Not only are the TCP/IP addresses handed out, so are all the related configuration settings like the subnet mask, default router, DNS server, that are required to make TCP/IP work correctly.
- DHCP works across most TCP/IP routers and allocates IPs according to the subnet the request came from. This means you won't need to reconfigure a PC that is moved from one subnet to another.
- Addresses can be leased for periods

of time - so an IP address that is not used for the duration of the lease is put back into the unallocated pool. This helps recover TCP/IP addresses that are no longer used.

What Do I Need?

To use DHCP you need a DHCP server (to allocate the addresses and maintain a database) and DHCP clients, which will be discussed later.

A DHCP server is included in Windows NT Server 3.51 and 4.0. Although this article is concentrating on NT Server, DHCP isn't a Microsoft standard and is available from other vendors for NT (such as MetaInfo), and on other platforms. For more information see the DHCP FAQ, which is discussed below.

How Does DHCP Work?

When a DHCP client is first switched on, it sends a broadcast packet on the network with a DHCP request. This is picked up by a DHCP server, which allocates an IP address to the PC, from one of the scopes (the pools of addresses) it has available.

Each DHCP scope is used for a different TCP/IP network segment. On networks with routers that support DHCP, extra information is added to the request by the router to tell the server which network the request came from. The DHCP server uses this information to pick an address from the correct scope. The server replies to the client, allocating it the TCP/IP address and settings required.

However, DHCP doesn't allocate the address permanently. It tells the client that it has "leased" the address to it for a specific time period, which you as administrator can control. By default DHCP is installed with a three-day lease period. When the lease expires, the client can ask the server to renew the lease. If the DHCP server doesn't hear from the client beyond the expiry of the lease period, it will put that address back in the pool ready to be re-used.

When the DHCP client obtains a lease on an address, it knows how long the lease period is. So it knows that it can use the address without reference to the DHCP server until the lease expires. When it does expire, it can request a renewal. The implication of this

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is that changing DHCP settings on the server won't instantly change all your DHCP client PCs, as they won't find out about the changes until they ask the server to renew their lease. This is one factor you need to consider when you decide your lease period.

Before You Install

Tempting as it might be to install DHCP right now and start setting it up, there are a few things you'll need to investigate to make sure it will work. The first is to check whether DHCP is supported on the network clients you have on your network. At present, the following are known to support DHCP:

- Windows NT and Windows 95 (built-in).
- Windows for Workgroups (using Microsoft's 32-bit TCP/IP stack).
- HP's JetDirect range of network printer cards.
- Some other third-party TCP/IP stacks.
- Some versions of Unix, such as Solaris 2.6.

There is a DHCP FAQ at <http://web.syr.edu/~jmwobus/comfaqs/dhcp.faq.html> that includes a more comprehensive list of DHCP-supported clients. If a particular client doesn't support DHCP, you'll need to manually allocate a TCP/IP address and ensure that your DHCP server doesn't try to hand that address out by excluding it from the relevant scope.

The second item to check is router support for DHCP if you have a wide-

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area network. DHCP clients use a broadcast packet to find a DHCP server, so if a client is on one side of a router, and the server on the other, it is possible the router will filter out those broadcasts. The recent software revisions on many routers include support for DHCP-forwarding (see the list below), but it isn't normally enabled by default, so you'll need to get this feature switched on. Routers that do support DHCP are:

- Cisco revisions 9.21 and 10.0 (and above).
- 3Com: version 8.0 includes support for DHCP.
- Wellfleet/Bay networks: Enabling BOOTP on version 9.00 (and above) of BayRs.

Search your router documentation for more details of DHCP support and how to enable the service. Note that if you're connected to the Internet, your firewall and router should be configured to block all DHCP-related traffic.

DHCP uses the same TCP/IP port as BOOTP, so blocking port 67 for the UDP protocol will allow this.

Finally you'll need to consider the impact of DHCP on any domain name servers (DNS) you have. The dynamic allocation of TCP/IP addresses under DHCP means that clients can change their TCP/IP addresses. If you have a domain name server with a static text file of IP addresses and host names, this will require maintenance to keep it in sync with DHCP. A more efficient method is to use the domain name server service that is built into NT Server version 4.0, as this can be linked to DHCP, so that it automatically knows about DHCP changes of TCP/IP addresses. Such a service is known as DDNS (Dynamic Domain Name Server).

If you are still using NT server 3.5 and you don't want to upgrade to NTS 4.0 for this feature, you might consider a third-party solution such as Meta-Info's TCP/IP suite which incorporates linked DHCP and DDNS servers.

Tips

- A recommendation to anyone who is converting an existing TCP/IP network to use DHCP is to start small, with just one or two clients, and restrict the DHCP scopes to two or three verified unused addresses for testing purposes. This helps avoid the possible problem of DHCP allocating the IP addresses of existing network nodes. Once you've got DHCP working for the test clients, you can alter the scopes to cover the full range of addresses, and convert the remaining clients to use DHCP.
- The DHCP Manager utility can be run remotely on NT workstations, so you don't have to work at the NT Server when managing DHCP servers. You can install it from the NT Server CD-ROM from the \SUPPORT\CLIENTS\SRVTOOLS\WINNT\i386 directory.

An Example

Let's follow an example to see this in action. I have two network segments (Marketing and Finance) linked by a TCP/IP router. The Marketing segment is a class B network (130.1.0.0), and the Finance segment is a class C network (192.2.2.0). My router connects these together, and uses the addresses 130.1.0.1 and 192.2.2.1. My NT server that I'm installing DHCP on was installed as 130.1.0.32, and I've got a Unix server that doesn't support DHCP at address 130.1.0.33.

DHCP

Step 1

The first step is to document all the network addresses already in use, establish what ranges DHCP will use, and check you know what TCP/IP settings each network requires. I've decided that I want to keep a few addresses (241-254) spare in each network that I can allocate to other clients which don't support DHCP in future. So, for Marketing, the range of addresses I can use is 130.1.0.2 to 130.1.0.240 (excluding 130.1.0.32 and 130.1.0.33). For Finance, it's 192.2.2.2 to 192.2.2.240.

As you can see, I've avoided the addresses used by the router, and the non-DHCP hosts. I've excluded the router because that should have a fixed TCP/IP address. The DHCP server cannot also be a DHCP client, so I have to manually configure this NT Server's TCP/IP address. NT servers that are not running DHCP or WINS services can be configured using DHCP.

Step 2

Now, we install the DHCP server software on the NT Server. It's under the Networks control panel, by selecting the Add Software button, under the "TCP/IP and related components" heading. After rebooting the server, you can administer it from the DHCP Manager tool (see Figure 1), which should be available on either the Start Menu or the Program Manager. The left-hand pane shows DHCP servers and the scopes that are defined. The right-hand pane shows the DHCP options set for the selected scope.

Step 3

Now, Create one scope for each network segment. I've got two segments, so I create two scopes (Marketing and Finance) using the Scope/Create menu option. To define a scope you fill in the dialog box as shown in Figure 2.

The start and end addresses for the Marketing scope are 130.1.0.2 and 130.1.0.240. As this is a class B network, the subnet mask is 255.255.0.0. In this scope, I also have to define the exclusion of the two servers, so a DHCP client won't get allocated those addresses. You can have single-address exclusions or ranges, as shown here.

Next I have to define the lease duration - in this example the default of three days is used. The name and comment are just for descriptive purposes. Once you've defined the scope and clicked OK, you'll be prompted to make the scope active.

The length of the lease period depends on your environment. If it's not rapidly changing you can set longer lease periods (more than three days), so that leases are re-assigned only if computers leave the network. If your environment is continually changing you might consider using shorter lease periods, so that changes to the DHCP options (discussed below) are distributed quickly. When you first start to use DHCP it's best to stick to short leases of a few hours, so any problems in your DHCP settings are changed without needing to visit all the DHCP clients to force renewals. Once things are stable, you can gradually increase the lease periods on the server.

Step 4

Define the TCP/IP options for DHCP - options can be set globally for DHCP, individually for each scope, or as a default. A global option will apply to any DHCP scope, whereas the scope-level option is defined differently for each scope. An example here is the router address, which will differ for the Marketing and Finance scopes. Default options can be used to define something globally that can be overridden by a scope setting for exceptions. In this example, all the DHCP options except the Router address are the same for both scopes, so I'll use the Global settings. DHCP supports a large range of options that can be defined, but most installations will only require the following:

- 003 Router.
- 006 DNS Servers.
- 015 Domain Name.
- 044 WINS/NBNS servers.
- 046 WINS/NBT node type.

If you look again at Figure 1, you can see (from the "map of the world" icons) that all these settings have been defined as "Global" for DHCP, except for the router address, which is different for each network. You'll only need options 044 and 046 if you're using a WINS server - if you're not using WINS, you don't need to define either of options 44 and 46.

When you set option 044, you'll get the following message:

Warning : In order for WINS to function properly, you must now set option 46 (WINS/NBT Node Type), and set it to either 0x02 (P-Node), 0x04 (M-Node) or 0x08 (H-Node)

The various node types tell Microsoft network clients how to register and look up computer names on Microsoft networks. The best option to use is 0x08 (H-Node). This mode tells the client PC to use the WINS server when finding the address of another computer or a share, but that it should fall back to using broadcasts if the WINS server isn't available. This means that it reduces the number of

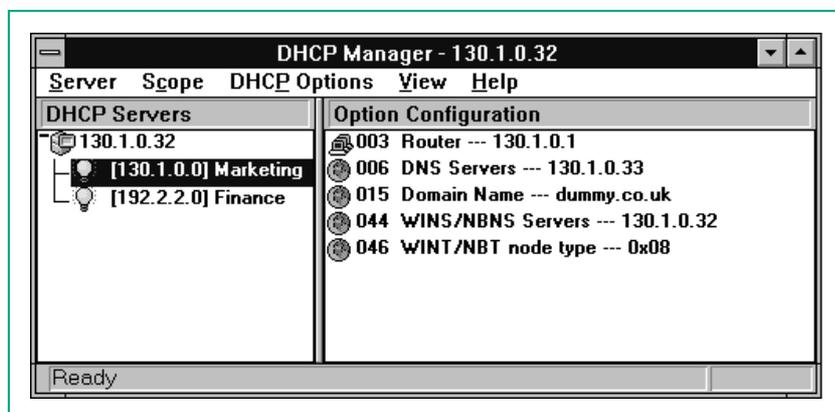


Figure 1 - The DHCP Manager tool.

broadcasts on your network, and speeds up browsing shares, printers and so forth. For more detail on node types, see the NT Server documentation (the TCP/IP section, chapter 3), or search the Microsoft TechNet database online at www.microsoft.com for article Q119493.

Step 5

Test some DHCP clients by changing these to use DHCP. If you've already got manually configured TCP/IP settings on existing computers, you'll need to clear these first as they can override the settings that DHCP uses. Once you've changed the PC to use DHCP, reboot and the DHCP client should request and receive the DHCP-allocated address and settings. You can check that DHCP is working on Windows 95 by using the WINIPCFG.EXE utility (from the Start/Run menu). This shows the TCP/IP settings, and also has options to force the PC to renew or release its DHCP settings.

There is a similar utility available for Windows NT, included in the NT Resource Kit, or alternatively you can use the built-in command-line utility IPCONFIG.

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Other Issues

You can run more than one DHCP server on a network. You must not, however, define the overlapping or identical scopes on different DHCP servers, as NT's DHCP servers (unlike WINS) don't communicate with each other. This could result in two nodes being allocated the same TCP/IP address. MetaInfo produces a DHCP server for NT which does support communication between servers for added resilience should you desire this feature - check their company web site at www.metainfo.com for more information.

If you have problems with getting

DHCP to work, don't forget to use the Microsoft TechNet database available for free at Microsoft's web site, as well as the books online on the NT Server CD-ROM for reference.

DHCP is a very stable service, and once you've set it up, it requires very little maintenance. You should check it at least once each month to see how many free addresses are available, to plan your network growth and prevent the server from running out. Best of all, you will rarely need to visit a workstation ever again to configure its TCP/IP settings.

Figure 2 - Defining a scope.

PCNA

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