Adventures With HP Printers in a Large Enterprise

BY JAMES BARRY

This article examines the mechanics of connecting an HP printer directly to the network via a network print server, a task which has become increasingly complex in today's heterogeneous computing environments.
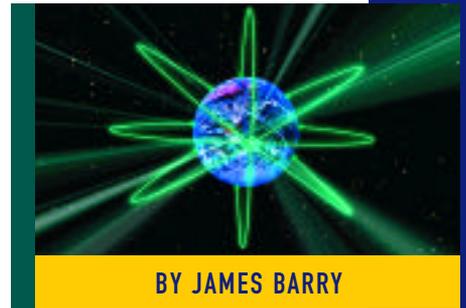
A little more than a decade ago most PCs were configured as standalone machines on the desktop. Set up of an HP printer consisted of connecting a parallel cable from the printer to the PC. Simply turn on the PC and the printer, and you could print. Applications included drivers for various print devices to enable the use of multiple fonts or to support graphical output. Since that time, printer setup, configuration and troubleshooting have become increasingly complex. In a large networked enterprise with a heterogeneous mix of hardware and operating systems, this increase is especially apparent.

Modern operating systems, such as Windows NT, and the ability to attach HP printers to the network, account for most of the increase in complexity. Instead of attaching a single cable, you must now consider such things as direct network connections using internal or external network print servers, the use of network printer management software such as JetAdmin, network protocols (TCP/IP, IPX/SPX and DLC), DHCP and WINS, LPR, the use of TCP/IP utilities such as Telnet, and security.

This article will examine the mechanics of connecting an HP printer directly to the network via a network print server. Additionally, I will review the issues mentioned above from the perspective of a systems or network administrator in an enterprise using Microsoft operating systems, with an emphasis on practical administration and troubleshooting.

CONNECTING HEWLETT–PACKARD (HP) PRINTERS TO A NETWORK

Using a JetDirect Card

If an HP printer is designed to accept an HP JetDirect Card (an internal network print server), it can be directly connected to a network via that device. The card fits in a slot in the back or on the side of an HP printer and has a single network port. Depending on the model, the port connector type can be an RJ45, a BNC, an 8-pin mini-DIN, a 9-pin DB9 or a combination. Again, depending on the model, an HP JetDirect Card can be used on a 10Base-2, 10Base-T or 100Base-TX Ethernet LAN, or on a LocalTalk or token ring LAN. Except for the token ring model, all of the models support the TCP/IP, DLC, IPX/SPX and LocalTalk network protocols. In the factory default configuration all four protocols are enabled.

JetDirect Cards are compatible with most minicomputer and microcomputer operating systems. HP printers that can accept a JetDirect Card are referred to as MIO (modular input/output) printers. Most of the HP printers used in the enterprise are MIO printers, including models of LaserJet, DeskJet, CopyJet and DesignJet printers.

HP makes a second type of internal network print server called a JetDirect 600 N card. HP printers that accept this type of card are referred to as EIO printers. This type of card is used in the LaserJet 4000 series of printers.

Using an External HP Network Print Server

HP also makes external network print servers. HP external network print servers connect to a printer via a parallel cable and are available with differing numbers of output ports.

Alternatives

HP printers can also be attached to the network via other makes of internal HP compatible and external network print servers.

In addition, you are not limited to HP printers when using network print servers. Printers by other manufacturers, as well as other types of print devices, such as plotters, can be connected to a network via these devices. And, external network print servers are available with serial ports to support serial print devices.

ADMINISTERING HP PRINTERS ON THE NETWORK

HP JetDirect Cards and DHCP

DHCP was developed to reduce the errors and administrative burden associated with the manual assignment of IP addresses. Errors included duplication of IP addresses, and incorrect IP addresses, gateway addresses and subnet masks. The administrative burden consisted of troubleshooting the problems caused by the errors and documenting in-use and available IP addresses.

DHCP is included with Windows NT Server 4.0, and Microsoft operating systems beginning with DOS can be configured to acquire an IP address from a DHCP server (DOS and Windows for Work-groups 3.11 require additional software that is included on the Windows NT Server 4.0 CD-ROM).

Depending on the model, some JetDirect Cards can also be configured to acquire an IP address from a DHCP server (all current models support this capability). In a large enterprise you will probably have cards of both types. Once the card is installed in the printer, you can select or deselect the use of DHCP from the printer control panel by choosing "Yes" or "No" for the BOOTP menu item.

If the card supports DHCP and you select "Yes" for the BOOTP menu item, no further TCP/IP protocol configuration is required. The printer will use the IP address and subnet mask supplied by a DHCP server. In addition, if DHCP is configured to supply the address of a WINS server, the printer will register its name and IP address with that server. This enables dynamic resolution of printer names to IP addresses.
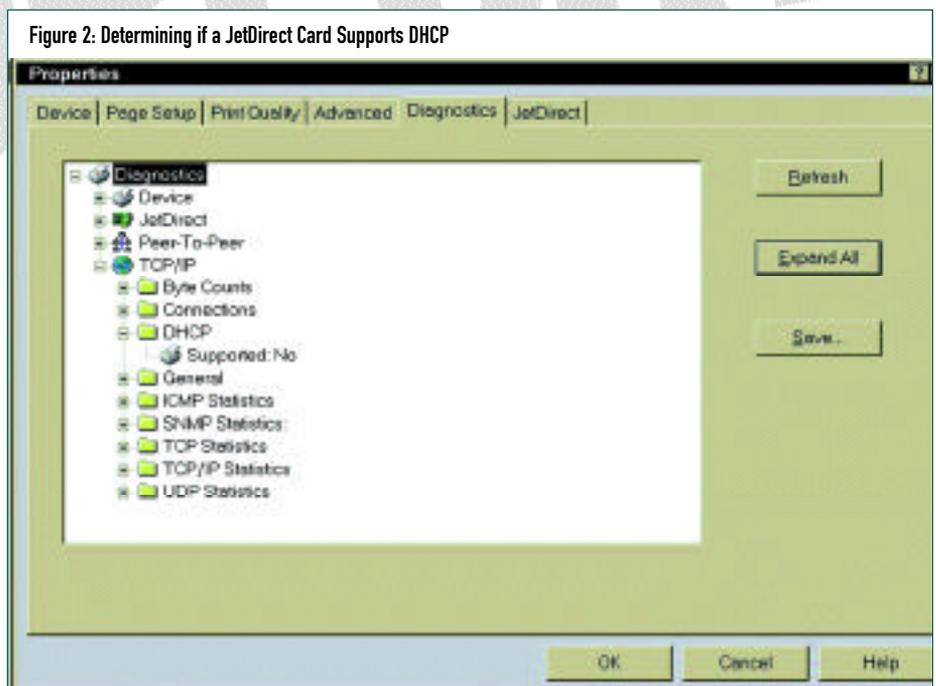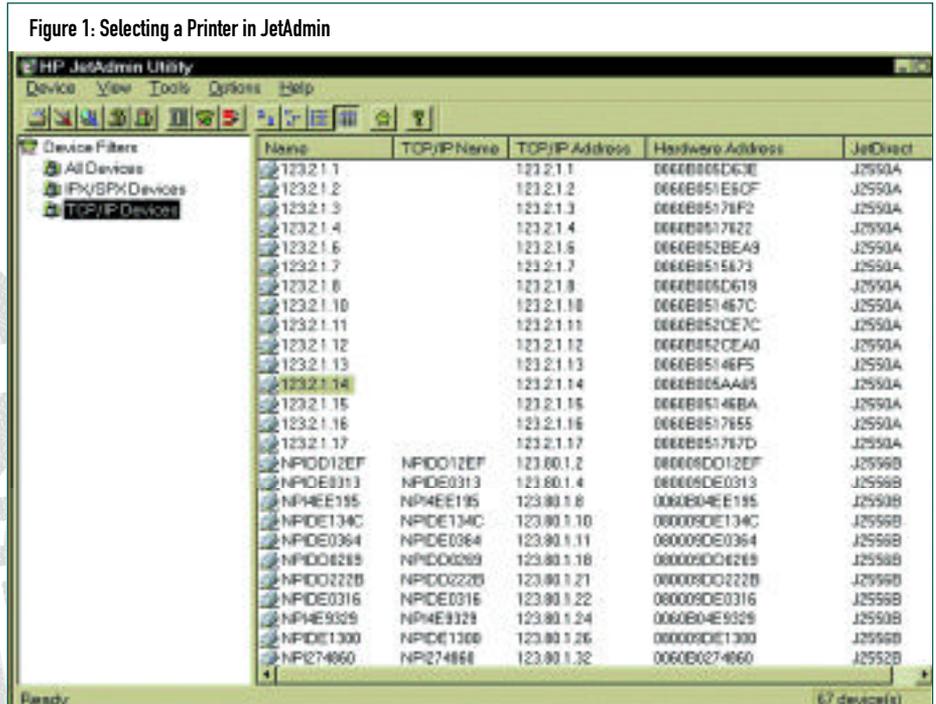
If the card does not support DHCP, select "No" for the BOOTP menu item. Obviously, it is then necessary to enter an IP address and subnet mask from the printer control panel.

If the card does not support DHCP and you mistakenly select "Yes" for the BOOTP menu item, the printer will not display an error message. After being configured in this manner, the printer will try unsuccessfully

to acquire an IP address each time it is turned on. A printer self-test page (also called a configuration page) printed immediately after turning the printer on will show a TCP/IP status of 54 and will state that the printer is trying to acquire an IP address. In general, a TCP/IP status of 54 should be interpreted as a failure to obtain an IP address, and you need to begin troubleshooting the problem. Possible causes, in addition to selecting "Yes" for the BOOTP menu item when the card does not support DHCP, include the following:

◆ the DHCP server is down
◆ the DHCP service is not running
◆ the DHCP scope has been deactivated
◆ the printer's physical link to the network has been broken (check at the patch panel, perhaps the patch cable was unplugged)

In each case, after a time-out period, the printer will cease trying to acquire an address from a DHCP server and will use the factory default address of 192.0.0.192. At this point, for numerous reasons, the

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Figure 1: Selecting a Printer in JetAdmin

Figure 2: Determining if a JetDirect Card Supports DHCP

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printer will not function. For example, assume the printer is attached to a class A network with network number 123. In this case, while the printer is still on the same physical network, it is now on a different logical network (192.0.0) and direct communication between equipment with different network numbers is not possible. In any event, it is illogical that cards that do not support DHCP (such as the J2550A) allow you to select "Yes" for the BOOTP menu item... but they do!

Determining If a JetDirect Card Supports DHCP

Since even JetDirect cards that do not support DHCP can mistakenly be configured as if they do, you will need to determine whether or not a card installed in a printer supports DHCP using the following procedures.

1. Print a self-test page from the printer control panel. Besides indicating IP address information as previously discussed, this page contains considerable information including protocols enabled, printer host name and MAC address. (The MAC address is the hardware address and is titled "LAN HW ADDRESS" on the self-test page.)

2. Next, if JetAdmin is not installed on your PC, install it from the CD-ROM supplied with the JetDirect Card. Run JetAdmin.

3. Under "Device Filters," select "TCP/IP Devices." JetAdmin will then display a list of printers containing TCP/IP enabled JetDirect Cards as shown in Figure 1.

4. From the displayed list of printers click on the printer host name (as specified on the self-test page). You can also identify the printer by its IP address or MAC address.

5. Now click on Device > Properties > Diagnostics > TCP/IP and DHCP. Below DHCP a little printer icon will appear followed by "Supported:". This will be followed by "Yes" if the card supports DHCP or by "No" if it does not (see Figure 2).

In Figure 1 note the differences in attributes between the J2550A cards, which do not support DHCP, and the J2556B or J2550B cards, which do. The cards supporting

DHCP received their IP addresses from a DHCP server with a scope of 123.80.1.1 to 123.80.254.254. The J2550A cards have static, manually assigned IP addresses starting with 123.2.1.1. All of the static manually assigned addresses are external to the DHCP scope. In addition, the J2550A cards do not have a default host name (TCP/IP name).

What If JetAdmin Does Not Display the Printer?

JetAdmin may not display all of the printers on the network for a number of reasons. Firstly, if the device is new, it will not appear until it has been configured. To view a list of MAC addresses for unconfigured devices, click "Device" and "New." To configure the device, click its MAC address and the "Configure" button. Proceed to configure the device in accordance with the displayed instructions.

A second reason derives from the design of JetAdmin. The first time you run JetAdmin after installation, it searches the subnet for networked HP devices. It then displays discovered devices in a list. When you exit JetAdmin, the list of discovered devices is written to a file named hpcolant.dat. On subsequent startups of JetAdmin, a dynamic search of the network is not performed. Instead, JetAdmin reads and displays the list stored in hpcolant.dat. JetAdmin does not inform you that the list is not current. In order to see a current list of devices you must press the F5 key or click "View and Refresh," which initiates an actual search. On each exit, JetAdmin writes the current list of devices (which will not be current unless you refresh the list) to hpcolant.dat. Consider the case where a printer was turned off at the time of the last refresh. Obviously, it will not appear in subsequent JetAdmin sessions until a refresh is performed while the printer is on. On the other side of the coin, you may see printers that are not turned on (at least until you do a refresh).

A third reason derives from the default broadcast method JetAdmin uses to discover devices on the subnet. Using a broadcast is quick, but is not guaranteed to find all devices. If the device you are looking for is not displayed in the list, press the F5 key or click on "View and Refresh" to perform an additional broadcast. In most cases, a few additional broadcasts will locate the device... but not always.

A fourth instance is the case in which two (or more) printers have been connected to the network with the same IP address. If you select "Display TCP/IP Devices," the

printers with the same IP address will not be visible. An effective way to check for this condition is to have IPX/SPX (Novell) enabled on all printers (as noted earlier, enabled is the default setting.) Install NWLink IPX/SPX on your computer. In JetAdmin under Device Filters, you can then select IPX/SPX Devices to see the printers that were not visible under TCP/IP due to duplicate IP addresses.

Using Telnet With Networked HP Printers

Why use Telnet at all? Isn't JetAdmin a better choice? Sure, you could use JetAdmin. On the other hand, there are cases where knowing how to use Telnet could be a big help. For example, let's suppose you have recently installed DHCP. You want to set all the cards that are capable of doing so to use DHCP. You run JetAdmin, but even after numerous refreshes not all printers are displayed in the list. But you know all the currently assigned printer static IP addresses so you can use Telnet to connect to each printer in turn. While connected to a printer, you can then enter the command to enable DHCP. Repeat this procedure for each printer to complete the job.

Actual implementation of this process for a single printer would involve the following steps:

1. Telnet to a printer by entering the following at the command prompt or in the Open field under Run under Start:

`telnet ip_address`

For example, enter:

`telnet 123.80.1.2`

2. Wait a few seconds, and then hit the Enter key a couple of times. You should see a response from the printer like that shown in Figure 3. As instructed in the figure, again press the Enter key twice. You will then get a single ">" prompt. At this point you have established a Telnet session with the printer.

3. Display card help/configuration screen(s). Depending on the card, you will have either one or two display options at this point. On an older card like the J2550A, you can enter a "?". This will cause a combination Help and Configuration screen to be displayed. On newer cards, you have two options: display the Help

screen or display the Configuration screen. Enter a "?" to see the Help screen (see Figure 4) or enter a "/" to see the Configuration screen (see Figure 5). The Help screen displays the printer parameters you can change via Telnet; it also shows the command syntax for changing a parameter. For either type of card proceed to enter a "?" to display the available parameters and the command syntax.

4. Exit or enable DHCP. At this point there are two possibilities: Either you have connected to a card that supports DHCP or you have not. If the card does not support DHCP, there will not be a DHCP parameter. For this case enter "exit" to terminate the Telnet session. Obviously this is a second method to determine whether or not a JetDirect Card supports DHCP. If the card supports DHCP, "dhcp-config" will be included in the list of parameters. Following the Help

screen instructions you would enter the following to enable the use of DHCP:

```
dhcp-config:1
```

5. Save the configuration and exit. Assuming you did not terminate the Telnet session in Step 3, save the new configuration and terminate the Telnet session by entering "quit." To exit without saving any changes enter "exit." As noted earlier, this procedure should be repeated for each printer. Also note that you can use Telnet to connect to and configure most network devices. These devices include bridges, switches, routers and UNIX hosts as well as network print servers.

Correcting the Problem of Multiple Printers With the Same IP Address

As noted previously, in a large enterprise it is not completely unusual to find printers with duplicate IP addresses. You can correct this problem from the printer control

panel, or you can use HP JetAdmin or a combination of HP JetAdmin and Telnet to correct the problem from a computer on the network.

Since we just discussed Telnet, let's look at using it in combination with JetAdmin to solve this problem. For an example, let's assume that numerous printers are connected to the network via J2550A JetDirect Cards that have no DHCP capability. Historically the network was Novell-based and used only the IPX/SPX protocol. As noted above, all protocols are enabled on this card by default. When the printers were installed and configured for IPX/SPX, TCP/IP was not disabled, and the printers were not assigned an IP address manually. Because of this, each printer has the factory default address of 192.0.0.192. Due to a new Web page project, TCP/IP is now being used and the network address is class A address 123. Let's further assume that you are the new network administrator; that the old administrator told you the IP addresses needed to be changed, and because of rapid growth he did not have time to record the location of all of the printers.

1. Determine the MAC address: Use JetAdmin to determine the MAC address of each of the printers by viewing IPX/SPX devices while displaying both the IP address and the MAC address. You should see a list of printers with IP address 192.0.0.192.

2. Configure the computer: There are a couple of options for this step. One is to install a second network interface card (NIC) in your computer. Here we assume the first NIC has already been assigned a class A address with the network part of the address equal to 123. Assign the second NIC the address 192.0.0.200 and a subnet mask of 255.255.255.0.

   Alternatively, assign multiple addresses to the single NIC. To do this under Windows NT, go to My Computer > Control Panel > Network > Protocols > TCP/IP > Properties > IP Address > Advanced, and set an additional IP address and subnet mask (e.g., 192.0.0.200 and 255.255.255.0).

3. Place an entry in the ARP cache: On your computer, enter the following command
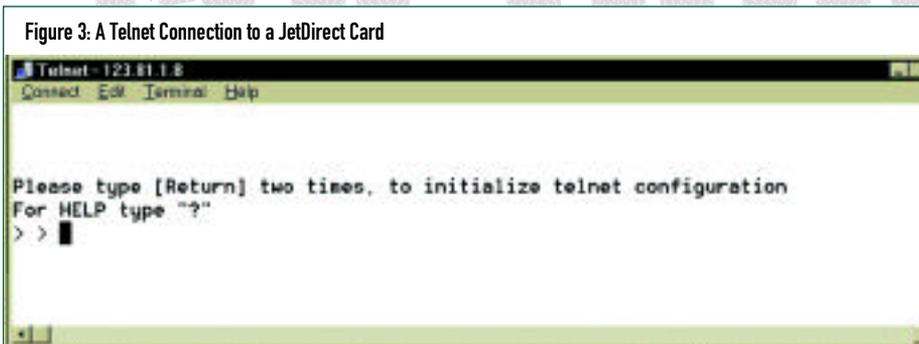
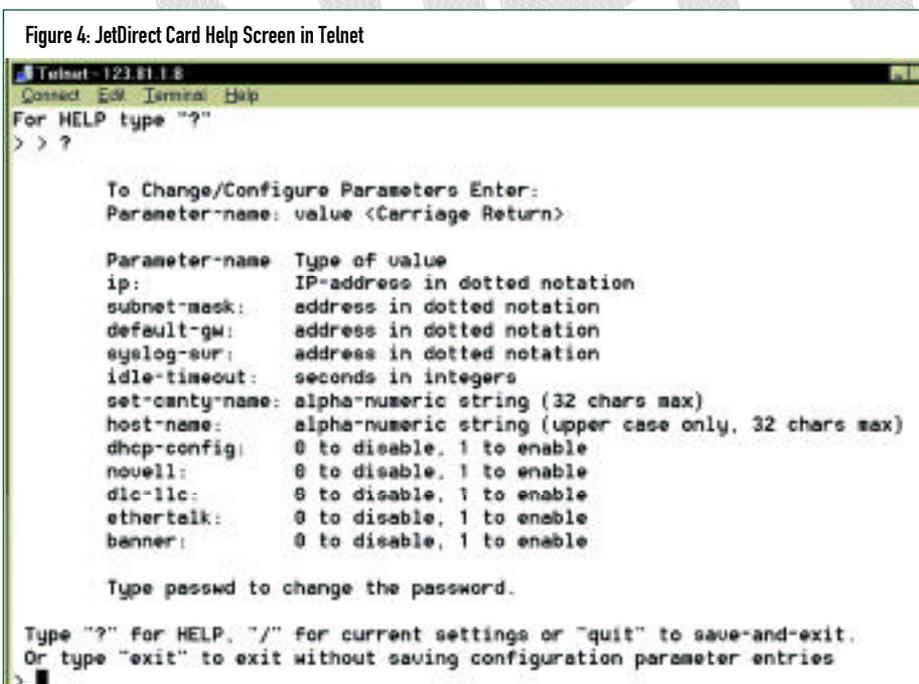**Figure 3: A Telnet Connection to a JetDirect Card**

Figure 4: JetDirect Card Help Screen in Telnet

(substitute the actual MAC address for mac_address) in order to temporarily associate an IP address with a MAC address (LAN HW ADDRESS on a HP self-test page, as noted before):

```
arp -s 192.0.0.192 mac_address
```

Using an actual MAC address the command would look as follows:

```
arp -s 192.0.0.192 00-60-b0-28-8e-37
```

Note that the dashes are mandatory.

We use the above command to assure we will connect to the printer. If we were to skip this step and simply try to connect via Telnet to an IP address of 192.0.0.192, in most cases, the connect would fail. Telnet would use ARP to try to resolve the IP address to a MAC address. The ARP would be unsuccessful due to the multiplicity of 192.0.0.192 addresses. Note that ARP works by first checking the local ARP cache to see if it contains the specified IP address and an associated MAC address. If an entry is found, the MAC address in the cache is used, otherwise ARP does a broadcast in an attempt to resolve the IP address. By using the aforementioned command, we manually place an entry in the ARP cache and avoid the broadcast and associated multiple responses.

4. Telnet to the printer and assign an IP address: Now Telnet to 192.0.0.192. As instructed previously, wait a few seconds and then hit the Enter key a couple of times. When you receive

a response from the printer, press the Enter key two more times and then enter a "?" or a "/" to see current printer settings. To change the IP address enter the following (substitute the new IP address for new_ip_address):

Network printer problems are a major consumer of support resources. The most effective way of reducing printer problems is to assure, as much as possible, that your organization maintains a homogeneous computing environment.

```
ip:new_ip_address
```

For example, if the new address was 123.2.1.18, enter:

```
ip:123.2.1.18
```

Set the subnet mask of 255.0.0.0 using the following command:

```
subnet-mask:255.0.0.0
```

5. Now, enter "quit" to save and exit.

Passwords on JetDirect Cards

You can save yourself some administration headaches by using JetAdmin to apply a configuration password to an HP printer containing a JetDirect Card. This password prevents other HP JetAdmin users from modifying the printer configuration. If the password is lost or forgotten, you can remove the password by doing a printer cold reset.

On a LaserJet 5Si printer, for example, you perform a cold reset by holding the On Line key down while turning the printer off then back on. (For a successful reset you may have to power off and on several times in succession while holding the key down.) Follow any directions displayed in the printer control panel. Consult your HP printer documentation for the cold reset procedure for other printers.

ADDITIONAL TIPS & TRICKS

Is the Printer Really Ready?

Note that an HP printer containing a JetDirect Card will display "Ready"as long as at least one network protocol is functioning correctly. Take the case where IPX/SPX (Novell on the printer self-test page) and TCP/IP are enabled. Assume that the card is set to use BOOTP and that for some reason the card is not able to obtain an IP address. While you might expect the printer display panel to show an error condition, it will not. Instead, it will display "Ready" because the IPX/SPX is functioning.

If your network uses only one network protocol, one work-around is to enable only one network protocol on the printer. In the previous example, if TCP/IP were the only enabled protocol on the printer, an error message would have been displayed on the printer control panel. At least it would have displayed for a while. As noted previously, if the printer can't acquire an IP address within a certain period of time, it will use the factory default of 192.0.0.192. The moral is, do not rely on the printer display panel. Always print a self-test page, which will show the status of each protocol.

Dealing With Dynamic Addresses

HP documentation notes the inability of an HP JetDirect Port to deal with an IP address change on a JetDirect card. Obviously if you are using DHCP to provide IP addresses, it is possible that the IP address assigned to a JetDirect Card may change. Due to this inability to deal with dynamic addresses,

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Figure 5: JetDirect Card Configuration Screen in Telnet


```
Telnet - 123.81.1.8
Connect  Edit  Terminal  Help
> /

   ===JetDirect Telnet Configuration===
        Present Config : DHCP
        MAC Address    : 00:60:b0:4e:93:2b

        IP Address     : 123.81.1.8
        Subnet Mask    : 255.0.0.0
        Default Gateway : 123.80.1.158
        Syslog Server  : 0.0.0.0
        Idle Timeout   : 90 Seconds
        Set Canty Name : Not Specified
        Host Name      : NP14E932B

        DHCP Config    : Enabled
        Passwd         : Disabled
        Novell         : Disabled
        DLC/LLC        : Enabled
        Ethertalk      : Disabled
        Banner page    : Enabled
>
```

HP documentation recommends the use of unlimited DHCP leases or the use of reserved leases. However, the use of unlimited leases defeats many of the advantages of DHCP and should never be used.

Actually, under Windows NT 4.0 you have another option. If you configure a port as a JetDirect Port, specify the host name (from the printer self-test page) rather than an IP address, and you are using WINS as well as DHCP, then you will not have a problem if the printer IP address changes.

On the other hand, if you are using Windows NT 4.0, you do not even need to use a JetDirect port. Use an LPR port instead. This requires only the installation of the Microsoft TCP/IP Printing service under Control Panel, Network, Services. When configuring an LPR port, specify the host name (from the printer self-test page), not the IP address. Assuming you are using WINS as well as DHCP, the host name will be dynamically resolved and printer IP address changes will not be a problem.

Note that the use of Windows NT 4.0 LPR ports, instead of JetDirect ports, eliminates the need to install JetAdmin on each machine where you intend to create a printer. Instead, install JetAdmin on a single machine for use as a printer management and configuration tool.

Under Windows 95 there is no LPR port capability, so you do need to install and use JetAdmin. In this case, the HP documentation is correct, and an IP address change will render the printer inoperable. A reasonable work-around is to specify a reserved IP address for the printer in DHCP.

When All Else Fails…

In some instances, a printer with a DHCP-capable JetDirect Card has been unable to obtain an IP address from an available DHCP server. This error is typically encountered after users have made undocumented changes to the printer configuration from the control panel. The error persists even after the printer is reconfigured from the control panel or via Telnet. In this case the TCP/IP status on the self-test page is 54 and the IP address is 0.0.0.0. Each time the problem has been encountered, it has been successfully corrected by doing a cold reset of the printer.

CONCLUSION

Network printer problems are a major consumer of support resources. The most effective way of reducing printer problems is to assure, as much as possible, that your organization maintains a homogeneous computing environment. On the other hand, it is probably safe to say, given the short life cycles of computing equipment and operating system versions, that very few computer professionals work in such an environment. Given this fact, and the likelihood that you will encounter printer problems, I hope the information provided here will be of some assistance. *ts*

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