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Applications Note

Setting Up Linux® PXE on Server and Client Systems

1 Prerequisites

The example in this document was performed on a PXE server running RHEL5.2 64-bit with DHCP, TFTP, and NFS servers running on the same system.

The PXE automated install using kickstart (configuration file on the PXE server) loads the RHEL5.2 64-bit operating system (OS) onto the PXE client system.

For other Linux distributions or OS versions, the setup may be different.

The applications/services listed in this applications note must be installed. DHCP, TFTP, and the NFS server may reside on different systems; but in this example, all these services are running on the same system.

1.1 PXE Server Side Requirements

PXE server side requirements are listed in Table 1-1.

Table 1-1. PXE Server Side Requirements

Applications	Required/Optional
dhcp server	Required
tftp-server	Required
nfs server	Required
Red Hat® 5.2 x86_64 Install DVD	Required
tftp (client)	Optional

The applications in Table 1-1 can be installed from the appropriate packages with the Package Manager under Red Hat or by searching on the web for the appropriate packages for each Linux distro.

1.2 Validated Components

The components in Table 1-2 have been validated for use with Linux PXE.

Table 1-2. Validated Components for Linux PXE

QLogic Driver	4.0.305
QLogic Firmware	4.0.305

Table 1-2. Validated Components for Linux PXE (Continued)

DHCP server	V3.0.5-Red Hat (inbox)
NFS server	Server nfs v3 (inbox)
TFTP server	Default from RHEL5u2 (in-box)

1.3 Overview

Here is a high-level overview of the steps required to set up Linux PXE on server and client systems. These steps are explained in detail in the following sections.

1. Set up the PXE server with the QLogic driver and configure a specific interface address known to PXE clients.
2. Configure the DHCP service to be enabled and to start when the system powers up.
3. Customize the `initird.img` file with the latest QLogic driver, and modify the `modules.alias` file to remove instances of the inbox kernel GPL driver and include information for the QLogic commercial GPL driver.
4. Configure the `xinetd` and `tftp` services, and then prepare a Linux pre-install kickstart configuration file.
5. Configure NFS and the Linux install ISO image onto a PXE server, and then create a customized Linux install kickstart configuration to automate the process for a network installation.

2 Set Up the PXE Server with the QLogic Driver

Install the QLogic driver, and then configure the `nx_nic` interface for the DHCP server to start at boot time.

1. Go to the QLogic Web site (www.qlogic.com) to download the latest driver package.
2. From a server running RHEL5u2 x86_64 OS, follow the instructions in the *Linux Driver Installation and Configuration* section in the *QLE3xxx Series Intelligent Ethernet Adapters Users Guide* (part number NE0154601-00) to unload the driver package and create the driver file used in the subsequent steps.

   The nx_nic.ko driver is located in the following directory:
   `/lib/modules/2.6.18-92.el5/updates/drivers/net`
3. Configure the QLogic interface to have a static IP address at startup and when the system reboots. To have the PXE server operate at startup with DHCP, NFS, and TFTP servers running:
   a. Enable the network interface when the system boots up.
   b. Configure the network interface using either Red Hat's `neat` utility or by changing the network configuration file as follows.

      Change the appropriate `ifcfg-eth[n]` script file that references the QLogic Intelligent Ethernet adapter on your system from the directory `/etc/sysconfig/network-scripts`.

The following example is from a working system; Items in **bold** have been customized for this setup.

```
# NetXen Incorporated NX3031 Multifunction 1/10 Gigabit Server Adapter
DEVICE=eth2
BOOTPROTO=none
BROADCAST=192.168.30.255
HWADDR=00:0e:1e:00:7c:c8
IPADDR=192.168.30.2
NETMASK=255.255.255.0
NETWORK=192.168.30.0
ONBOOT=yes
TYPE=Ethernet
USERCTL=no
IPV6INIT=no
PEERDNS=yes
```

3 Configure the DHCP Service

A sample of an `/etc/dhcpd.conf` file can be found at `/usr/share/doc/dhcp-3.0.5/dhcpd.conf.sample`. This file can be copied to `/etc/dhcpd.conf`.

Here is an example of a working `/etc/dhcpd.conf` file. Items in **bold** have been customized for this setup.

```
ddns-update-style interim;
subnet 192.168.30.0 netmask 255.255.255.0 {
range 192.168.30.200 192.168.30.254;
default-lease-time 3600;
max-lease-time 4800;
option routers 192.168.0.1;
option domain-name-servers 192.168.0.1;
option subnet-mask 255.255.255.0;
option domain-name "apps.net";
option time-offset -8;
next-server  192.168.30.2;
filename           "pxelinux.0";
}

host apps {
hardware ethernet 00:0e:1e:00:7c:c8;
fixed-address 192.168.30.202;
filename "pxelinux.0";
}
```

1. Ensure that the DHCP service is running on the QLogic's Intelligent Ethernet adapter interface. If there are multiple NICs in the DHCP server system; for example, if there are two onboard NIC ports and the QLogic Intelligent Ethernet adapter, then expect the third interface to be the QLogic interface (eth2).

   QLogic recommends editing or creating a file named dhcpd under the /etc/sysconfig directory that contains the following entry and the interface [*n*] that will be the port to operate the DHCP service.

   ```
   DHCPDARGS=eth[n]
   ```

2. Setup DHCP service to start on each boot, and then run the following command from the Linux prompt:

   ```
   $ chkconfig --level 345 dhcpd on
   ```

4 Customize the initrd.img file with the Latest QLogic driver

1. Insert the RHEL5u2 x86_64 DVD into the DVD drive of the PXE server to copy the installation files needed to start the OS installation sequence.
2. From the Linux install CD/DVD (first CD), access the isolinux directory:
   a. Copy the initrd.img file from the isolinux directory to the /tmp directory.
   b. Create a working directory and type the following commands to expand the initrd image file, and extract the compressed modules file to remove the inbox kernel GPL version of the QLogic driver:
      i. **mkdir /tmp/test_initrd**
      ii. **cd /tmp/test_initrd**
      iii. **gunzip -c ../RHEL5u2_x64_initrd.img | cpio -idmv**
      iv. **cd modules/**
      v. **mkdir module_cgz**
      vi. **cd module_cgz/**
      vii. **zcat ../modules.cgz | cpio -idvm**
      viii. **cd 2.6.18-53.el5/**
      ix. **cd x86_64/**
      x. **rm netxen_nic.ko**
   c. Copy the nx_nic.ko located in /lib/modules/2.6.18-92.el5/updates/drivers/net/ to the current working directory by typing the following command:

      ```
      cp /lib/modules/2.6.18-92.el5/updates/drivers/net ./
      ```

   d. Modify the modules.alias file as follows:
      i. Remove and replace these entries:

      ```
      alias pci:v00004040d00000025sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000024sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000005sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000004sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000003sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000002sv*sd*bc*sc*i* netxen_nic
      alias pci:v00004040d00000001sv*sd*bc*sc*i* netxen_nic
      ```

ii. With the following entries:

```
alias pci:v00004040d00000100sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000025sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000024sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000005sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000004sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000002sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000001sv*sd*bc*sc*i* nx_nic
alias pci:v00004040d00000003sv*sd*bc*sc*i* nx_nic
```

e. Type the following commands to recompress the `modules.cgz` file and repack the `initrd.img` file to a new name:

i. **`cd ../..`**

ii. **`find 2.6.18-53.el5 -type f -print | cpio -o -H crc 2>/dev/null | gzip -c -9 > ./modules.cgz`**

iii. **`cp –f modules.cgz ../`**

iv. **`cd ..`**

v. **`rm -rf module_cgz`**

vi. **`cd ..`**

vii. **`find . | cpio --quiet -c -o > ../initrd_RHEL5u2_x86_64-4.0.305.img`**

viii. **`cd ..`**

ix. **`gzip -9 initrd_RHEL5u2_x86_64-4.0.305.img`**

f. Copy `initrd_RHEL5u2_x86_64-4.0.305.img.gz` to the `/tftpboot` directory for use in the next section.

5 Configure the `xinetd` and `tftp` Services

1. Ensure that `tftp` is enabled from the configuration file. From the file `/etc/xinetd.d/tftp`, change **disable=yes** to **disable=no**, if required.
2. Start the tftp server by typing:

   `$ service xinetd restart`
3. Prepare the PXE boot files on the PXE server.
   a. Create an `/tftpboot` directory on the PXE server.
   b. Copy the `vmlinuz` files from `isolinux` directory to the `/tftpboot` directory on the PXE server. (From every Linux install CD/DVD, there is an `isolinux` directory.)
   c. Create a soft link for the `initrd_RHEL5u2_x86_64-4.0.305.img.gz` to be `initrd.img` by typing the command:

      `ln –s RHEL5u2_x86_64-4.0.305.img.gz initrd.img`
   d. From the PXE server, copy the `pxelinux.0` file from the `/usr/lib/syslinux` directory to the `/tftpboot` directory.

e. Configure the pxelinux.cfg directory:

i. Create a directory /tftpboot/pxelinux.cfg.

ii. Create at least 9 zero-byte size files by using the touch command, for example:

```
$ touch C0A81EC8
```

The zero-size files correspond to the hexadecimal values of the IP address to be assigned to the PXE client. In this example, C0A81EC9 is equivalent to 192.168.30.200.
The 01:00:0e:1e:00:7c:c8 file is the MAC address of the PXE client's Intelligent Ethernet adapter, and the "01" is added in the front to represent a hardware type of Ethernet.

iii. Here is an example of the files required in the pxelinux.cfg directory:

```
[root@cust02 pxelinux.cfg]# ls -l
-rw-r--r-- 1 root root   0 May  6 14:26 01-00-0e-1e-00-7c-c8
-rw-r--r-- 1 root root   0 May  5 12:15 C
-rw-r--r-- 1 root root   0 May  5 12:15 C0
-rw-r--r-- 1 root root   0 May  5 12:15 C0A
-rw-r--r-- 1 root root   0 May  5 12:15 C0A8
-rw-r--r-- 1 root root   0 May  5 12:19 C0A81
-rw-r--r-- 1 root root   0 May  5 12:18 C0A81E
-rw-r--r-- 1 root root   0 May  5 12:18 C0A81EC
-rw-r--r-- 1 root root   0 May  5 12:18 C0A81EC8
```

f. Create a file named default under the /tftpboot/pxelinux.cfg directory. This file determines which files from the /tftpboot directory on the PXE server will be used for booting by the PXE client.

In the following example, the ksdevice may differ on each system, depending on how many Intelligent Ethernet adapters are populated. When booting the PXE client using this method for the first time with initrd_RHEL5u2_x86_64-4.0.305.img.gz, press CTRL, ALT, F3. A window opens that shows the order in which the network drivers are being installed. This information helps determine which eth<*n*> to use.

If this is hard to decipher, then try increasing the eth<*n*> starting from n=0 to (<*maximum number of ports/adapters on the PXE client system*> minus 1).

Here is an example default file from which you can perform a kickstart boot:

```
# Install RHEL5.2 x86_64  via kickstart file
default ks
prompt 1
timeout 20
...
label ks
kernel vmlinuz
append initrd=initrd.img ramdisk_size=9216 ksdevice=eth1 ip=dhcp
ks=nfs:192.168.30.2:/var/ftp/pub/kickstart/RHEL5u2_x86_64-ks.cfg
```

g. Setup the xinetd service to start on the OS or when the host boots by typing:

```
$ chkconfig --level 345 xinetd on
```

h. Restart the dhcpd and xinetd services by typing:

```
$ service dhcpd restart
$ service xinetd restart
```

6 Configure the NFS and Linux ISO Image on the PXE Server

1. Add the following line to `/etc/exports` on the PXE server:

   `/var/ftp/pub  *(ro,insecure,sync,all_squash)`

2. Enable NFS on the PXE server upon boot by typing the following commands:

   a. **`$ chkconfig --level 345 portmap on`**

   b. **`$ chkconfig --level 345 nfslock on`**

   c. **`$ chkconfig --level 345 nfs on`**

3. Restart the NFS services to ensure they are running correctly by typing the following commands:

   a. **`$ service portmap restart`**

   b. **`$ service nfslock restart`**

   c. **`$ service nfs restart`**

4. Insert the Red Hat 5.2 Install DVD and create a directory to store the ISO by typing:

   a. **`mkdir –p /var/ftp/pub/rhel5u2x64`**

   b. **`cd /var/ftp/pub/rhel5u2x64`**

   c. **`dd if=/dev/cdrom of=RHEL5u2-x86_64-dvd1.iso`**

   This may take a while, as the file will be over 3GB.

5. Type the following commands to create a kickstart directory that will contain the actual kickstart file with the installation details used when performing the Red Hat install.

   a. **`mkdir –p /var/ftp/pub/kickstart`**

   b. **`cd /var/ftp/pub/kickstart`**

   c. **`vi RHEL5u2_x86_64-ks.cfg`**

   A tool under Linux called `system-config-kickstart` can help create a working kickstart file. The most important detail is the root password that will be created and can be used when installing on each system.

   The customization of the NFS server IP address, network configuration, and disk configuration settings will probably be required. After the installation completes, a reboot will not happen automatically. Manual interaction is required unless the line `#reboot` is changed to `reboot`.

   Here is an example `RHEL5u2_x86_64-ks.cfg` file. Items in **bold** have been customized for this setup.

```
# System authorization information
auth  --useshadow  --enablemd5
# System bootloader configuration
bootloader --location=mbr
# Partition clearing information
clearpart --all --initlabel
# Use text mode install
text
# Firewall configuration
```

```
firewall --disabled
# Run the Setup Agent on first boot
firstboot --disable
# System keyboard
keyboard us
# System language
lang en_US
# Installation logging level
logging --level=info
# Use NFS installation media
nfs --server=192.168.30.2 --dir=/var/ftp/pub/rhel5u2x64
# To skip installation key entry
key --skip
# Network information
network --bootproto=static --device=eth0 --gateway=10.1.7.252 --ip=10.1.0.181
--nameserver=10.1.1.48 --netmask=255.255.248.0 --onboot=on
network --bootproto=static --device=eth1 --ip=192.168.30.81 --netmask=255.255.255.0
--onboot=on
# Reboot after installation
#reboot
#Root password
rootpw --iscrypted <use your own encrypted password here>
# SELinux configuration
selinux --disabled
# System timezone
timezone  America/Tijuana
# Install OS instead of upgrade
install
# X Window System configuration information
xconfig  --defaultdesktop=GNOME --depth=8 --resolution=1024x768
# Disk partitioning information
part /boot --bytes-per-inode=4096 --fstype="ext3" --size=100
part swap --bytes-per-inode=4096 --fstype="swap" --size=4096
part / --bytes-per-inode=4096 --fstype="ext3" --grow --size=1
%packages --resolvedeps
@ Base
@ Development Tools
@ Legacy Software Development
@ admin-tools
@ gnome-desktop
@ system-tools
```

7 Configure the PXE Client System

1. Ensure that the PXE client system has a QLogic Intelligent Ethernet adapter installed with driver version 4.0.305 and the corresponding firmware version loaded.
2. Load and enable the PXE `zrom` image for the QLogic Intelligent Ethernet adapter through the `nxflash` utility by typing:

   `$ ./nxflash -i eth[n] --pxe-on`

Once the PXE server is up and running and the PXE client has been configured and rebooted, you should see the Linux OS installing onto your client system.

Contact QLogic if you have any further questions about PXE support.

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Changes
Initial release

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