

# **Using PXE with UEFI on PowerEdge Servers with SUSE Linux Enterprise Server 11**

**Stuart Hayes**

**Dell | Enterprise Operating Systems**

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## Introduction

All of Dell's 11G (and later) PowerEdge servers support booting in both legacy BIOS mode and in UEFI mode. This document explains how to set up a PXE server to support Dell PowerEdge servers as UEFI clients, and how to boot these clients. While many of the details in this article are specific to SUSE Linux Enterprise Server (SLES) 11, the information may be useful to users of other linux distributions.

This document primarily addresses the differences between BIOS and UEFI systems as they affect setting up and booting to a PXE. For more complete instructions on setting up and using a PXE server with SLES 11 on Dell PowerEdge servers using legacy BIOS mode, see <http://www.delltechcenter.com/page/PXE+Server+on+SLES+11> (“PXE SERVER ON SLES 11”).

Note that the system on which the PXE server is running does not need to support UEFI to provide files to boot UEFI PXE clients.

## Setup

There are two parts to setting up a PXE server on a SLES 11 system: configuration of the DHCP server, and setup of the TFTP server.

### Configuring the DHCP server to support only UEFI systems

If you only intend to PXE boot UEFI systems (and not legacy BIOS systems), setup is quite simple, and almost identical to the setup for PXE booting legacy BIOS systems.

The primary difference is in the bootloader file that is provided to the clients. In legacy BIOS mode, a PXE-specific bootloader such as *pxelinux* is used. For booting UEFI systems, a UEFI bootloader such as *elilo* (the same bootloader used for booting off of a disk) is used. (The UEFI firmware provides a layer of abstraction, so the bootloader doesn't need to know the type of media from which it is booting.)

So, to change an existing PXE server to support booting UEFI systems instead of BIOS systems, only the “filename” parameter in the `dhcpd.conf` file needs to change. Just edit the `dhcpd.conf` file (usually `/etc/dhcpd.conf`), and edit the “filename” parameter to point to the UEFI bootloader.

For PXE booting BIOS systems, the bootloader file is typically named “`pxelinux.0`” (as it is in the previously-mentioned “PXE SERVER ON SLES 11” article).

For UEFI systems, if you are using the *elilo* bootloader that is included with SLES 11, the bootloader is called “`elilo.efi`” (found at `/usr/lib64/efi/elilo.efi` on a system running SLES 11 with the *elilo* RPM installed), though the same file is often named “`bootx64.efi`” where it is actually

provided as the boot file. Note that the configuration file for elilo must be in the same directory as the binary, and, unless your PXE server provides different bootloader config files to different clients), should be named “elilo.conf” so that elilo can find it. See elilo documentation (“elilo” and “elilo.conf” man pages) for more information.

Note that it is not required that the bootloader is named “bootx64.efi” in this application. This name comes from the UEFI specification, which specifies that the bootloader be in a certain path and have that name for booting to removable media.

## Configuring the DHCP server for booting both UEFI and BIOS systems

If both UEFI and legacy BIOS clients exist on the subnet with the PXE server, it becomes a little more complex to setup the DHCP server, because it must provide a different bootloader to each PXE client depending on whether the system is using BIOS or UEFI to boot.

One way that this could be accomplished is by gathering the MAC address of each client, and putting these systems in groups in your dhcpd.conf file. Then, a different bootloader could be specified in each group. Here’s part of a dhcpd.conf file that could do this:

```
group {
    # UEFI clients
    filename "uefi/bootx64.efi";
    next-server mytftpserver;
    host ncd1 { hardware ethernet 0:c0:c3:49:2b:57; }
    host ncd4 { hardware ethernet 0:c0:c3:80:fc:32; }
    host ncd8 { hardware ethernet 0:c0:c3:22:46:81; }
}
group {
    # BIOS clients
    filename "bios/pxelinux.0";
    next-server mytftpserver;
    host ncd2 { hardware ethernet 0:c0:c3:88:2d:81; }
    host ncd3 { hardware ethernet 0:c0:c3:00:14:11; }
}
```

*Partial dhcpd.conf to manually specify which bootloader is provided to clients*

However, in compliance with the UEFI specification, Dell PowerEdge 11G servers do send the “client system architecture” tag as part of the discover packet. The DHCP server can use this byte to dynamically determine whether the client is using UEFI or BIOS.

Using this tag, the DHCP server could specify the right bootloader automatically, just by putting something like this in the dhcpd.conf file:

```

if option pxe-system-type = 00:07 {
    # UEFI client
    filename "uefi/bootx64.efi";
} else {
    # BIOS client
    filename "bios/pxelinux.0";
}

```

*Partial dhcpd.conf to automatically provide different bootloader to UEFI & BIOS clients*

See table 162 in the UEFI Specification Version 2.1 (<http://www.uefi.org>) for all client system architecture tags and more details.

Unfortunately, while the code to support this tag is in the source code for the dhcp packages that are included with SLES 11, it is not compiled into the binary packages as of SLES 11 SP1, though it may be in future releases. (You can see if your version of the DHCP server supports this just by trying to start the dhcpd service with that option in the dhcpd.conf file—it will fail to start, and /var/log/messages will contain a message telling you that you are using an unknown option if it isn't supported.)

Fortunately, it is not too difficult to compile new dhcp & dhcp-server RPMs which include support for this tag, using these steps:

1. Install the dhcp source package RPM (dhcp-3.1.3.ESV-0.3.38.src.rpm in SLES 11 SP1), and all of the dependencies for this RPM. (This has to be done manually with “rpm -ivh dhcp...rpm”—YaST/Software Management doesn't provide a way to install .src.rpms.)

Note that rpm won't check dependencies for a .src.rpm. You can see the dependencies with “rpm -q --requires -p dhcp-3.1.3.ESV-0.3.38.src.rpm”, and then you can manually install each of them using YaST/Software Management. You may also need the SLES 11 SDK (Software Development Kit) DVDs or .iso images for some of the required RPMs.

2. Install gcc if it isn't already installed (using YaST/Software Management).
3. Open a text editor and create file “/usr/src/packages/SOURCES/pxe-system-type.patch” with the contents shown in the box:

```

--- common/tables.c.orig      2010-10-12 14:46:42.000000000 -0400
+++ common/tables.c          2010-10-12 15:17:23.000000000 -0400
@@ -187,5 +187,5 @@
     { "bcms-controller-address", "Ia", &dhcp_universe, 89, 1 },
+    { "pxe-system-type", "S",          &dhcp_universe, 93, 1 },
   #if 0
     /* Not defined by RFC yet */
-    { "pxe-system-type", "S",          &dhcp_universe, 93, 1 },
     { "pxe-interface-id", "BBB",      &dhcp_universe, 94, 1 },

```

*Patch to add pxe-system-type option to dhcp source*

4. Open the spec file (/usr/src/packages/SPECS/dhcp.spec) with a text editor, change the version number (look for “Version:” or “Release:”—consider adding “pst” to the end of the “Release:” line), add the line “Patch80: pxe-system-type.patch” after the last existing “PatchXX” line, and add the line “%patch80 -p0” after the last existing “%patchXX” line.

5. Build the new RPM with the command “`rpmbuild -ba /usr/src/packages/dhcp.c`”. The new RPMs will be in `/usr/src/packages/RPMS`.

Once you generate and install the new `dhcp` and `dhcp-server` RPMs, you can make use of the “`pxe-system-type`” option in your `dhcpd.conf` file.

## Setup of the TFTP server

Setup of the TFTP server for UEFI PXE boot is no different than it is for BIOS boot, other than the bootloader & bootloader configuration files that are required. The kernel and `initrd` files are the same.

If you are setting up a PXE server to allow installation of SLES 11 onto other systems, you can copy the bootloader (“`bootx64.efi`”), bootloader configuration file (“`elilo.conf`”), kernel (“`linux`”), and `initrd` from the SLES 11 (or SLES 11 SP1) x86-64 DVD 1. If you have the `.iso` file for DVD 1 in the current directory, the files can be extracted with the following commands. (If you have the actual DVD, just use the path where the DVD is mounted in place of “`m1`”.)

```
mkdir m1
mkdir m2
mount -o loop SLES_11_x86-64_DVD_1.iso m1
mount -o loop m1/boot/x86_64/efi m2
cp m2/efi/boot/* /mytftpserver_root/my_uefi_pxe_directory
umount m2 && rmdir m2
umount m1; rmdir m1
```

*Commands to get SLES 11 boot files from DVD*

## Booting the UEFI PXE client

To boot a Dell PowerEdge UEFI client using the PXE server, just hit “`F12`” during boot, or hit “`F11`” to go into the UEFI boot manager, and boot to the appropriate network adapter.