



PXE Modes of Operation

White Paper

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PXE Modes of Operation

Altiris® Deployment Solution™ 6.8 has enhanced the Pre-boot Execution Environment (PXE) modes of operation. The modes are split between automatic or interactive. The automatic mode comes in two flavors: Standard Mode, which is the default, and Forced Mode, which must be configured in conjunction with a DHCP Server. The Interactive Mode is used when other third-party PXE Servers are installed and will be used in conjunction with the installed Deployment Solution PXE Server.

Standard Mode

This mode of operation is the default mode when Deployment Solution 6.8 is installed. The PXE Components that are installed by default will provide all of the PXE features necessary to manage the standard environment utilized by most networks. Besides the three 32-bit operating system types (DOS, Linux, and WinPE) that were available in Deployment Solution 6.5, we have added the 64-bit versions of Linux and WinPE. Intel's x86 (32-bit) CPU platform, which has been the standard for many years, is being used by default on the new 64-bit EM64T or AMD processors. Altiris has added both the Intel and AMD versions of x64 (64-bit) CPU platform detection to the PXE Components. Now, the Altiris PXE Components can manage the major 64-bit computer platforms by providing pre-boot images native to the 64-bit platforms. The IA64 Itanium 64-bit CPU platform is also available. Part of the management suite of the PXE Components is the ability to display the PXE menu lists that are dynamically generated with the available operating system (DOS, Linux, and WinPE) for each processor type. The full enhanced feature set of the PXE Components are described elsewhere.

Forced Mode

For very complex network environments this mode might provide a solution that will reduce the management of the PXE operations. This mode is required if you have the following:

- A separate DHCP Server on one VLAN or equivalent
- A Master PXE Server on a different VLAN or equivalent
- Other PXE Servers on another WAN, VLAN or equivalent

As the PXE booting client contacts the DHCP Server it is told to ask the Master PXE Server to download the special pre-boot image. This pre-boot image, when executed on the PXE booting client, will then look for the best PXE Server from the supplied list of PXE Servers available. This selection is based on the PXE booting client's IP address. Under normal PXE booting, the first PXE Server that responds is the one that the PXE booting client will use to configure and download pre-boot images to the booting client. By using the forced mode the network administrator can force a download from a supplied list of PXE Servers.

This mode only requires configuration changes on the DHCP Server. This mode is designed to force the download of an image from a selected PXE Server. After the selected downloaded image is received the client will then select from the supplied list of PXE Servers that has the closest match to its IP address.

To configure the forced mode

Note: These steps and the information provided are for the Windows DHCP Server. If you use a different DHCP Server you will have to determine the methods used to insert these options into your selected DHCP Server.

The following information and configuration is not for the squeamish; you must be able to think in HEX numbers. We will be adding 4 options to the DHCP Server.

Option 1:

This DHCP option will be 60; field type is a string equal to 'PXECient'. This is a standard return string that tells the PXE booting client that the received packet from the DHCP Server is also acting as a PXE Server. The PXE Server is not located on the same system as the DHCP Server.

Option 2:

This DHCP option will be 66; field type is a string equal to '192.168.1.102'. This is the string form of the IP address of the Master PXE Server that will be used to download the special pre-boot image file. The string form of the IP address shown here is only an example. Please provide your Master PXE Server IP address in string form.

Option 3:

This DHCP option will be 67; field type is a string equal to 'BStrap\X86pc\BStrap.0'. This is the special Altiris pre-booting image file and path. This file can be located on any system within the network that provides TFTP file access. The path shown here is the location of the required file located on the Altiris PXE Server. If you are using the Altiris PXE Server then use the path shown above; otherwise, provide the necessary path based on your selected location.

Option 4:

This DHCP option will be 43; field type is HEX numbers. This is the tricky one and it includes a number of sub options located within DHCP option 43.

List of binary HEX bytes: 06 01 0B 08 0F AA AA 03 C0 A8 02 C8 C0 A8 03 68 C0 A8 01 66

This is a continuous list of HEX bytes no carriage return or line feed. This string of HEX bytes must be edited by the user in the following ways:

- The eighth byte is the number of PXE Server IP addresses that are on the list. In the above example the number is 03 and is underlined to indicate its location. This means that the bytes after the eighth byte are the list of PXE Server IP addresses in HEX. Change this number to the number of PXE Servers that will be on the list. If you have 4 then the number will be changed to 04. If you have 10 then the number will be changed to 0A. Remember, use all HEX numbers.
- The ninth and beyond is the list of PXE Server IP addresses in blocks of 4 bytes. The ninth through twelfth bytes (C0 A8 02 C8), when converted and a dot is placed between each byte, makes the IP address of 192.168.2.200. The next group of bytes 13 – 16 (C0 A8 03 68), when converted and a dot is placed between each byte, makes the IP address 192.168.3.104. The last group of bytes 17 – 20 (C0 A8 01 66), when converted and a dot is placed between each byte, makes the IP address 192.168.1.102. You will need to take each PXE Server IP address that you want on your list and convert them to HEX numbers that can be inserted into the HEX binary list for option 43.
- The fifth byte (also underlined to indicate its location) must be modified if you have a list of PXE Server IP addresses greater or less than 3. This is the length of HEX bytes following the fifth byte. In the list of HEX bites above, the fifth byte is 0F. If you count the number of bytes starting on the sixth byte going to the end you will find that there are 15 bytes, this is equivalent to 0F HEX bytes. Modify this number to include your list of PXE Servers.
- The sixth and seventh bytes are special Altiris numbers that cannot be changed.
- The first 3 bytes are special protocol numbers that cannot be changed.
- You should now have a list of continuous HEX bytes that represents option 43. You must add a single HEX byte at the end to terminate. Add 00.

After all of the options are entered the DHCP Server Option list will look like this, as specified in the Window DHCP Server:

Option Name	Vendor	Value	Class
043 Vendor Specific Info	Standard	06 01 0B 08 0F AA AA	None
060 Class-Identifier	Standard	PXEClient	None
066 Boot Server Host Name	Standard	192.168.1.102	None
067 Bootfile Name	Standard	BStrap\X86pc\BStrap.0	None

Note: Option 43 is only shown in part. It should be the same as was constructed above.

Now, to make this a little easier for Windows DHCP Server users, you can make a batch file that used the Windows Netsh.exe utility. Below is a batch file and associated script file that will add the options to the Windows DHCP Server without having to manually enter each value. Build the following two files: DHCPOptionSet.bat and DHCPOptionValues.scp.

```
Batch file: DHCPOptionsSet.bat
netsh -f DHCPOptionValues.scp
```

```
Script file: DHCPOptionValues.scp
dhcp server set optionvalue 43 BINARY 6010B080FAAAA03C0A802C8C0A80368C0A8016600
dhcp server set optionvalue 60 STRING PXEClient
dhcp server set optionvalue 66 STRING 192.168.1.102
dhcp server set optionvalue 67 STRING BStrap\X86pc\BStrap.0
```

Note: Make sure that on the first entry that a space is after the word BINARY and the list of HEX bytes follow without a carriage return, as shown below.

```
dhcp server set optionvalue 43 BINARY 6010B080FAAAA03C0A802C8C0A80368C0A8016600
```

Run the batch file and the options should be set. Verify that they are correct by viewing the DHCP options on the Windows DHCP Server. When the next PXE client starts, this new mode will be used.

Interactive Mode

In this mode as the name suggests will require an operator to be present when the PXE menu is displayed to make the first selection. This mode is a configuration change to the DHCP Server only and works in conjunction with the Forced Mode described above. A PXE menu is created to allow other third-party PXE Server technologies to be selected. The following example describes a PXE booting client that will receive a menu from the DHCP Server that contains only two selections:

- Altiris Booting

By selecting Altiris Booting, the selected Master PXE Server will be contacted and the client will be given the Altiris pre-boot download image. For details, see the Forced Mode section and configuration detailed above under Force Mode.

- Boot Next

By selecting the Boot Next option the client will start the operating system that is resident on the client. Other third-party menu entries can be added. Consult with your third-party vendor for details on what needs to be added.

To configure the interactive mode

1. To add options 60, 66, 67, and 43, follow the instruction in the Force Mode section.
2. The DHCP option 43 configuration created under Force Mode will have to be modified. All of the same issues apply as in the Forced Mode section.

DHCP option 43 List of binary HEX bytes:

```
06 01 07 08 16 BB BB 01 C0 A8 01 66 AA AA 03 C0 A8 02 C8 C0 A8 03 68 C0 A8 01 66 09 1B BB BB
0C 41 6C 74 69 72 69 73 20 42 6F 6F 74 00 00 09 42 6F 6F 74 20 4E 65 78 74 0A 24 FF 50 72 65 73
73 20 5B 46 38 5D 20 74 6F 20 53 65 6C 65 63 74 20 61 20 62 6F 6F 74 20 6F 70 74 69 6F 6E 3A 00
```

The list of binary HEX bytes above contain all of the necessary information for the DHCP Server to act as a PXE Server. It includes the menu prompt and individual menu items and timeout values. It also includes the Altiris special value to be included with other third-party vendors. The above list of HEX bytes will produce the following on the PXE booting client.

Press [F8] to select a boot option:

→ Altiris Boot

Boot Next

Other third-party menu items could be added as necessary.

3. Now we will edit the Force Mode list of binary HEX bytes to make it display the menu as shown above in the previous step. The list of binary HEX bytes shown above will be used to describe what will be added or edited to create the require DHCP option 43. We will start with the first HEX byte and add or modify as needed.

Same: 06 01

Change: from 0B to 07

Same: 08

Change: from 0F to 16 // this is the length of all of the following bytes in this sub option

Insert Add: BB BB 01

Insert Add: C0 A8 01 66 // Master PXE Server IP address converted to HEX

Same: AA AA 03 C0 A8 02 C8 C0 A8 03 68 C0 A8 01 66 // list of PXE Servers (end of length)

Add: 09 // list of menu items

Add: 1B // length of all menu items in bytes used

Add: BB BB // special Altiris numbers

Add: 0C // length in bytes of this ASCII string

Add: 41 6C 74 69 72 69 73 20 42 6F 6F 74 // ASCII string to be displayed

Add: 00 00 // exit PXE and boot the resident OS

Add: 09 // length in bytes of this ASCII string

Add: 42 6F 6F 74 20 4E 65 78 74 // ASCII string to be displayed

Add: 0A // prompt

Add: 24 // length of prompt in bytes

Add: FF // time out value

Add: 50 72 65 73 73 20 5B 46 38 5D 20 74 6F 20 53 65 6C 65 63 74 20
61 20 62 6F 6F 74 20 6F 70 74 69 6F 6E 3A // ASCII prompt

Add: 00 // don't forget to add the last byte

After you add all of the options, the DHCP Server Option list will look like this, as specified in the Window DHCP Server:

Option Name	Vendor	Value	Class
043 Vendor Specific Info	Standard	06 01 07 08 16 BB BB ...	None
060 Class-Identifier	Standard	PXEClient	None
066 Boot Server Host Name	Standard	192.168.1.102	None
067 Bootfile Name	Standard	BStrap\X86pc\BStrap.0	None

Note: Option 43 is only shown in part. It should be the same as was constructed above.

Now to make this a little easier for Windows DHCP users you can make a batch file that uses the Windows Netsh.exe utility. Below is a batch file and associated script file that will add the options to the Windows DHCP Server without having to hand enter each value. Build the follow two files, DHCPOptionSet.bat and DHCPOptionValues.scp.

```
Batch file: DHCPOptionsSet.bat
netsh -f DHCPOptionValues.scp
```

```
Script file: DHCPOptionValues.scp
dhcp server set optionvalue 43 BINARY
0601070816BBBB01C0A80166AAAA03C0A802C8C0A80368C0A80166091BBBBB0C416C746972697320426F6
F74000009426F6F74204E6578740A24FF5072657373205B46385D20746F2053656C656374206120626F6F
74206F7074696F6E3A00
dhcp server set optionvalue 60 STRING PXEclient
dhcp server set optionvalue 66 STRING 192.168.1.102
dhcp server set optionvalue 67 STRING BStrap\X86pc\BStrap.0
```

Note: Make sure that on the first entry that a space is after the word BINARY and the list of HEX bytes follow without a carriage return or line feed.

4. Run the batch file and the options should be set. Verify that they are correct by viewing the DHCP options on the Windows DHCP Server. When the next PXE client starts, this new mode will be used, as specified in the Window DHCP Server