CONFIGURATION NOTE

USING VENDOR SPECIFIC DHCP OPTION 43 TO DISCOVER A WLAN CONTROLLER—MICROSOFT WINDOWS DHCP SERVER

Cisco customers deploying the Cisco lightweight architecture often use vendor specific DHCP Option 43 to instruct APs on which controller to join. This document describes how to configure the vendor specific DHCP option in the Microsoft Windows 2000 and Microsoft Windows 2003 DHCP Server.

REVISION HISTORY

Revision	Date	Originator	Comments
1.0	09/13/2005	Jake Woodhams	Initial document draft based on Pat Martinez's training material and Akita beta test plan
1.1	12/1/2005	Mark Mateus	1000 series AP revisions based on 3.2 code
1.2	01/09/2006	Jake Woodhams	Updated description of vendor specific options to clarify how DHCP works better. Miscellaneous grammatical corrections.

UNDERSTANDING VENDOR SPECIFIC DHCP OPTIONS

RFC 2132 defines two DHCP Options—Option 60 and Option 43—that are relevant to using vendor specific options. DHCP Option 60 is the "Vendor Class Identifier" (VCI). The VCI is a text string that uniquely identifies a type of vendor device. Table 1 lists the VCIs used by Cisco access points.

Table 1: Cisco Access Point Vendor Class Identifiers

Access Point	Vendor Class Identifier (VCI)
Cisco 1000 Series	Airespace.AP1200
Cisco Aironet 1130 Series	Cisco AP c1130
Cisco Aironet 1240 Series	Cisco AP c1240
Cisco Aironet 1200 Series	Cisco AP c1200

Option 60 is included in the initial DHCP DISCOVER that is broadcast by a DHCP client in search of an address. Figure 1 shows a decoded DHCP DISCOVER packet send by a Cisco Aironet 1240 Series access point that includes the VCI:

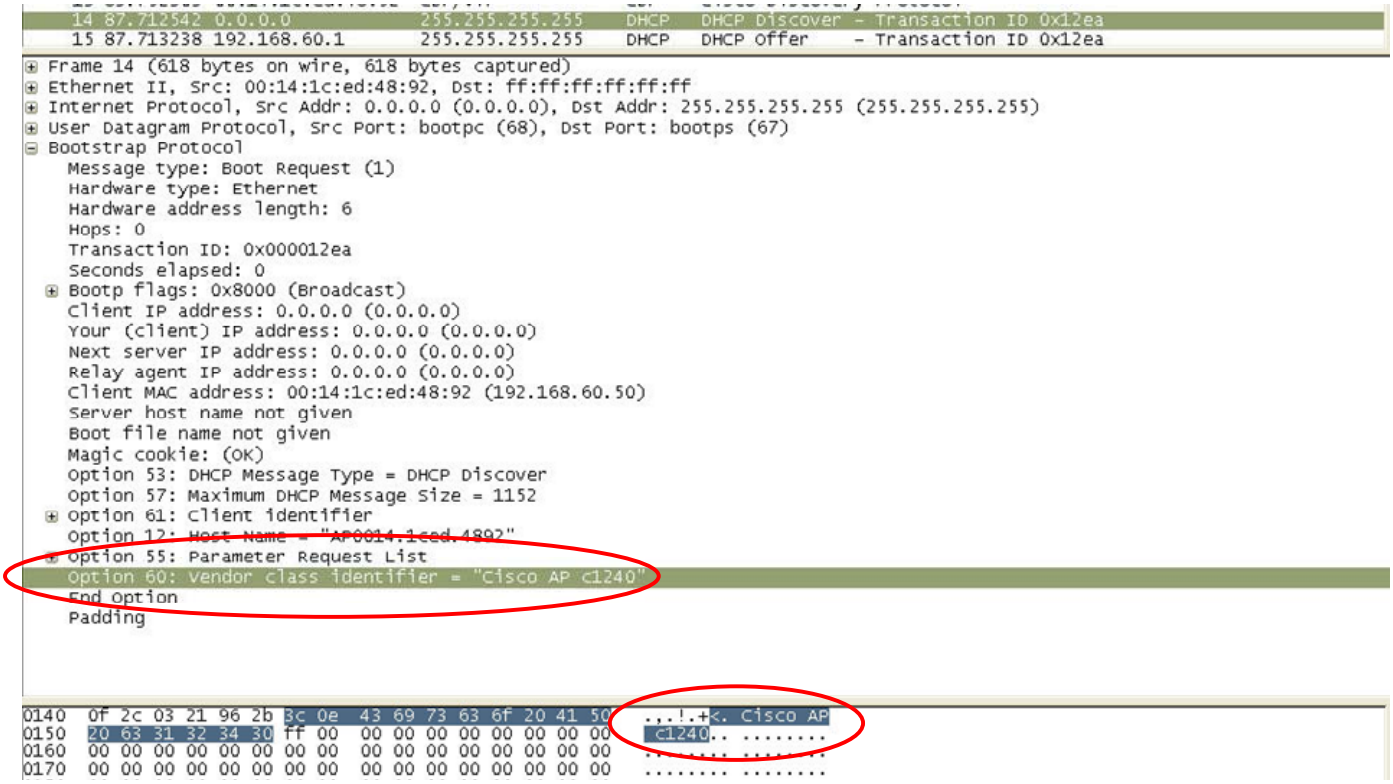

Figure 1: DHCP Option 60 Decode

On the DHCP Server, vendor specific information is mapped to VCI text strings. When the DHCP server sees a recognizable VCI in a DHCP DISCOVER from a DHCP client, it returns the mapped (to the VCI) vendor specific information in its DHCP OFFER to the client as DHCP Option 43. Figure 2 shows a decoded DHCP OFFER to a Cisco Aironet 1240 Series access point that includes Option 43 values:

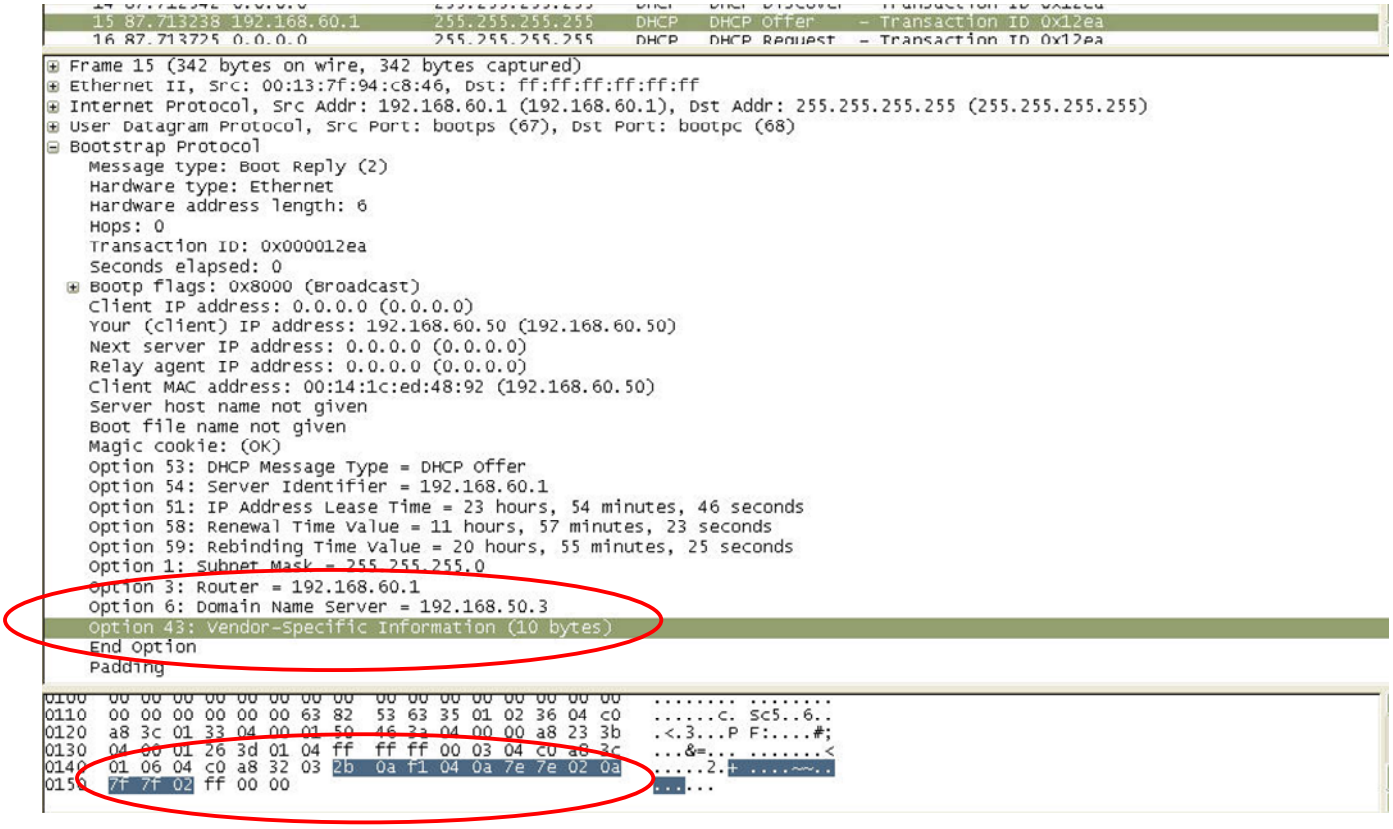

Figure 2: DHCP Option 43 Decode

To facilitate AP discovery of WLAN controllers using DHCP Option 43, the DHCP Server should be programmed to return one or more WLAN controller management interface IP addresses based on the AP's VCI. Typically, this involves programming the DHCP Server to recognize the VCI for each access point type and then defining the vendor specific information that is returned in Option 43 on a per scope or super-scope basis for each VCI.

RFC 2132 defines the format that DHCP Servers should return vendor specific information as DHCP Option 43. The RFC allows for vendors to define encapsulated vendor-specific "sub-option" codes between 0 and 255 exclusive. The sub-options are all included in the DHCP Offer as type-length-value (TLV) blocks embedded within Option 43. The definition of the sub-option codes and their corresponding message format is left to the vendors.

When programming DHCP Servers to offer WLAN Controller IP addresses as Option 43 for Cisco 1000 series APs, the sub-option TLV block is defined as follows:

Type: 0x66 (decimal 102)

Length: The length of the ASCII string in the Value field. The length is a count of the characters in ASCII string in the value field. Length should include the commas if there are more than one controller specified, but not a zero-terminator.

Value: A non-zero terminated ASCII string that is a comma-separated list of controllers. No spaces should be embedded in the list.

When programming DHCP Servers to offer WLAN Controller IP addresses as Option 43 for Cisco Aironet 1130, 1200, and/or 1240 series access points, the sub-option TLV block is defined as follows:

Type: 0xf1 (decimal 241)

Length: Number of controller IP addresses * 4

Value: List of WLC management interfaces (typically translated to hexadecimal values)

The semantics of DHCP Server configuration vary per DHCP Server vendor. This document is specific instructions to the Cisco IOS DHCP Server. For other DHCP Server products, consult the vendor documentation for instructions on configuring vendor specific options.

Software Requirements

Cisco 1000 series APs require version 3.2 or later code to be pre-loaded on the AP in order to use the Vendor Class Identifier feature of DHCP (Option 60). If code earlier than 3.2 is loaded on the AP, then an alternate controller discovery method may be necessary. Suggested alternate methods for AP discovery of the Wireless LAN Controller (WLC) are:

1. Placing AP in same subnet/VLAN as the WLC management interface (priming the AP)
2. Mapping the host name CISCO-LWAPP-CONTROLLER to the IP address of the WLC management interface in DNS
3. Over the Air Provisioning (OTAP) from a neighboring AP
4. Raw DHCP Option 43 (without specifying a VCI)

Consult the Cisco product documentation for more details on these AP discovery strategies.

There are no software limitations on Cisco Aironet 1130, 1200, and 1240 lightweight access points.

CONFIGURING VENDOR SPECIFIC DHCP OPTIONS (OPTION 43) IN THE CISCO IOS DHCP SERVER

This section describes the configurations necessary on the Microsoft DHCP Server to use DHCP Option 43 for WLAN Controller discovery.

Configuring Vendor Specific DHCP Options for Cisco 1000 Series APs

In this section, we'll take a look at how the Windows DHCP Server is used to configured to return vendor specific information to Cisco 1000 APs. Key information you'll need to know are:

- Vendor Class Identifier (VCI)
- Option 43 sub-option code
- Management IP address(es) of WLAN controller(s)

From Table 1, the VCI for a Cisco 1000 Series AP will always be "Airespace.AP1200". Also, as stated in the previous section, the Option 43 sub-option code for the Cisco 1000 Series access points is type 102 (0x66).

The example configurations are done using the Windows MMC Console utility. You can also use the DHCP Server Utility. The steps are virtually identical.

The first step is to create a new vendor class to program the DHCP Server to recognize the VCI "Airespace.AP1200". In the MMC console, right click on the DHCP server icon and choose **Define Vendor Classes.** This is shown in Figure 3:

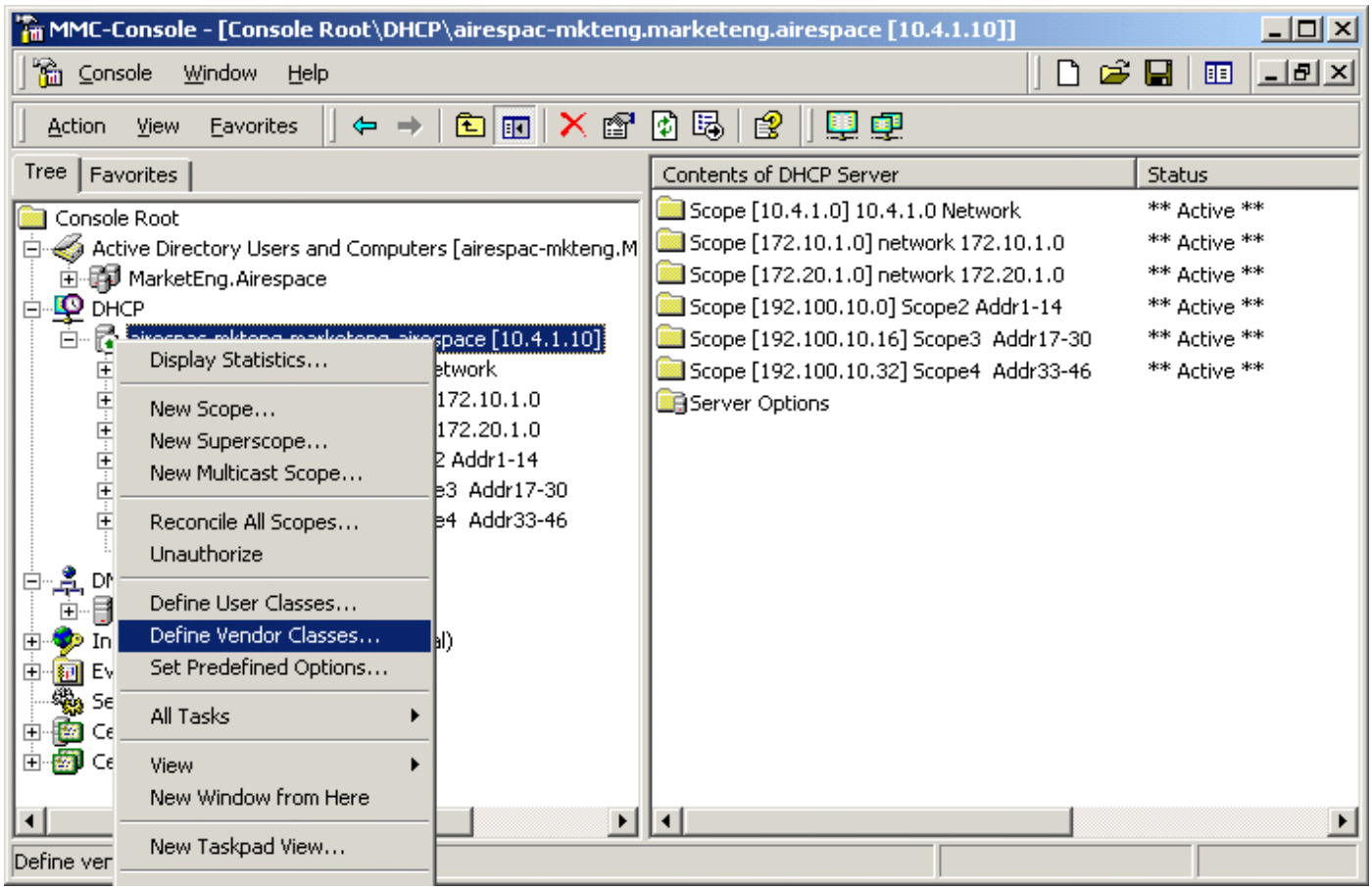

Figure 3: Defining a Vendor Class

Now, define the new Vendor Class. Select "**Add"** to create the new class. The procedure is shown in Figure 4:

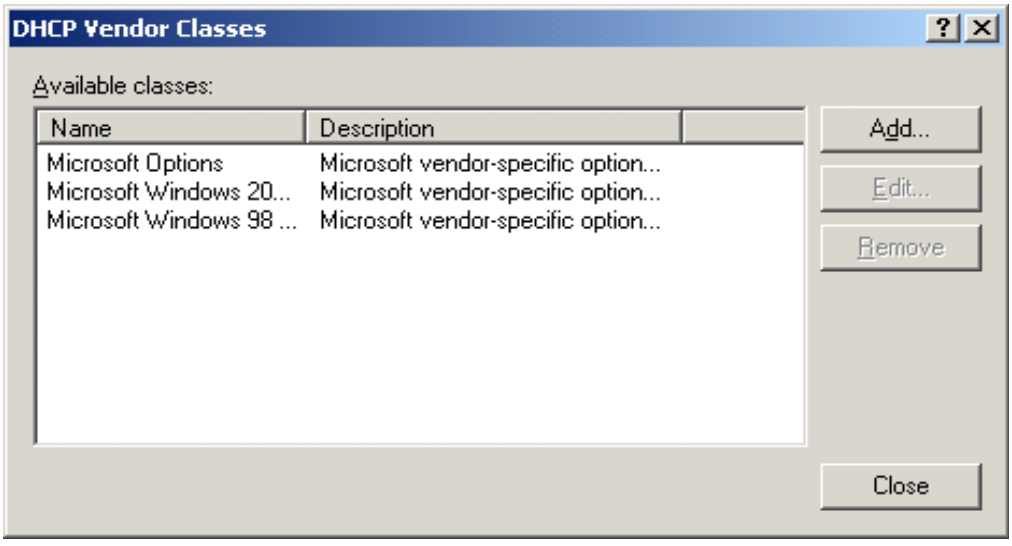

Figure 4: Defining a Vendor Class

Enter a value for the **"Display Name."** In Figure 111, you can see that the value "**Airespace"** is entered for the Display Name. You should also add a short description of the vendor class in the **"Description Field"**. Add the Vendor Class Identifier string by clicking on the ASCII field and typing in the appropriate value, in this case "**Airespace.AP1200"**. Click on **OK** when finished. This is shown in Figure 5:

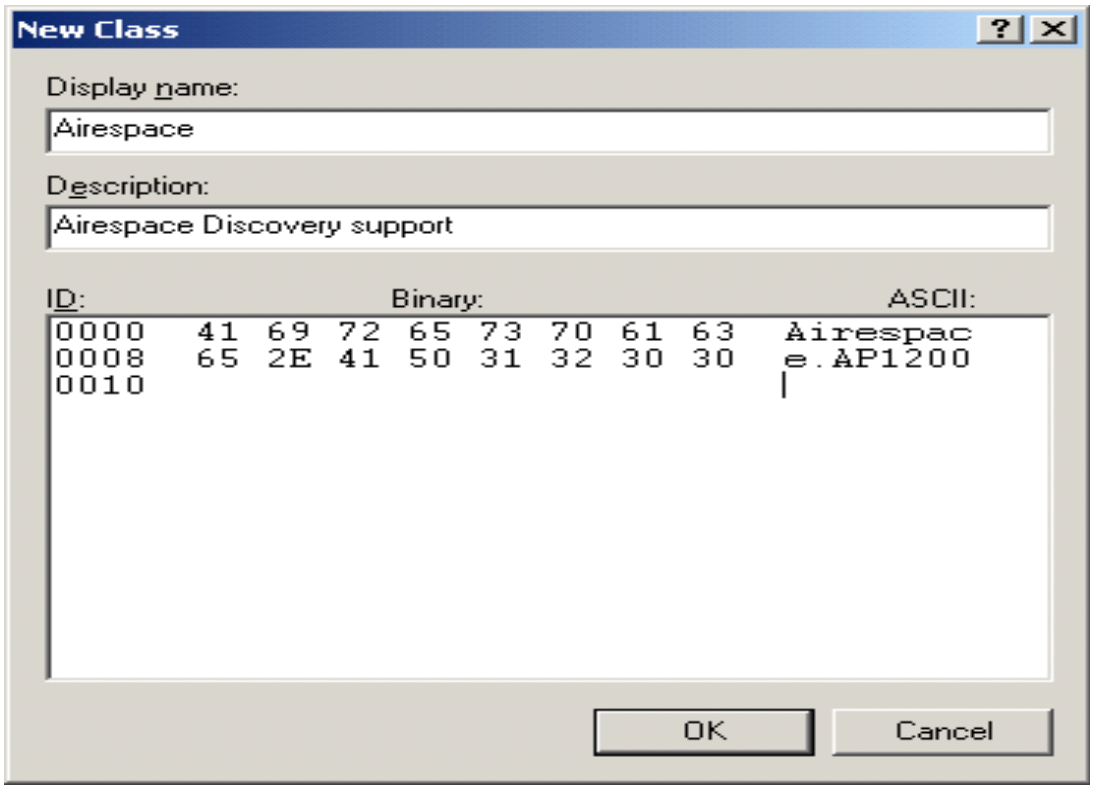

Figure 5: Defining a Vendor Class

You should now see that the new class has been created (see Figure 6). Now click on the **CLOSE** button.

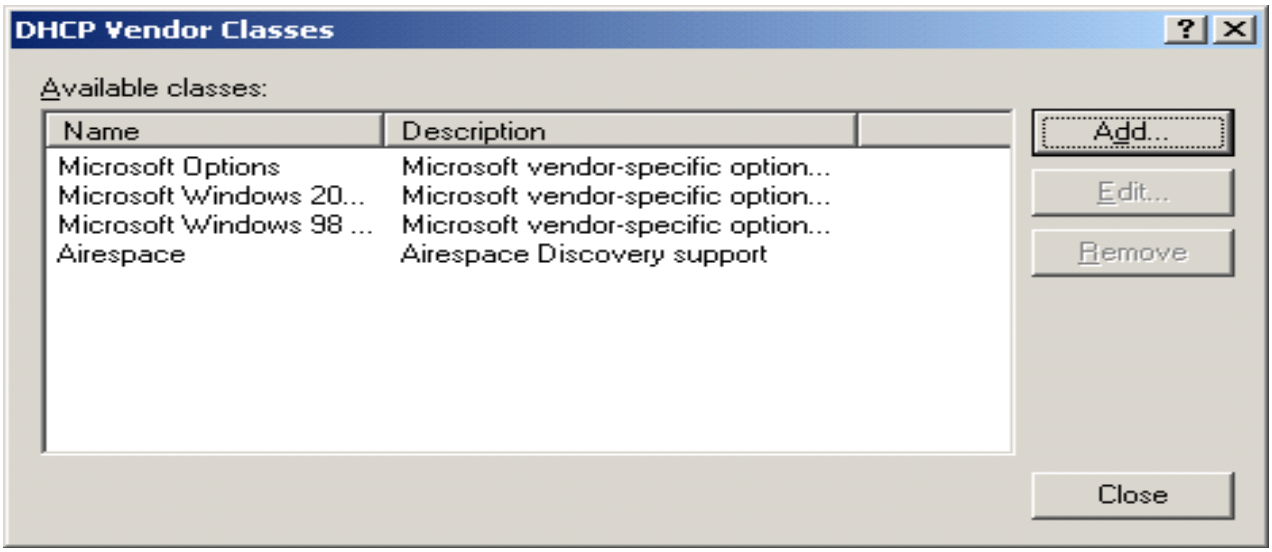

Figure 6: DHCP Vendor Classes Including the Newly Added “Airespace” Class

The next step is to add an entry for the WLAN controller sub-option in the “Predefined Options” for the newly created Vendor Class. This will be where you define the sub-option code type and the data format that will be used to deliver the vendor specific information (Option 43) to the AP’s. To create a Predefined Option, right click on the server icon and choose **Select Predefined Options** from the list of menu items presented. This is shown in Figure 7:

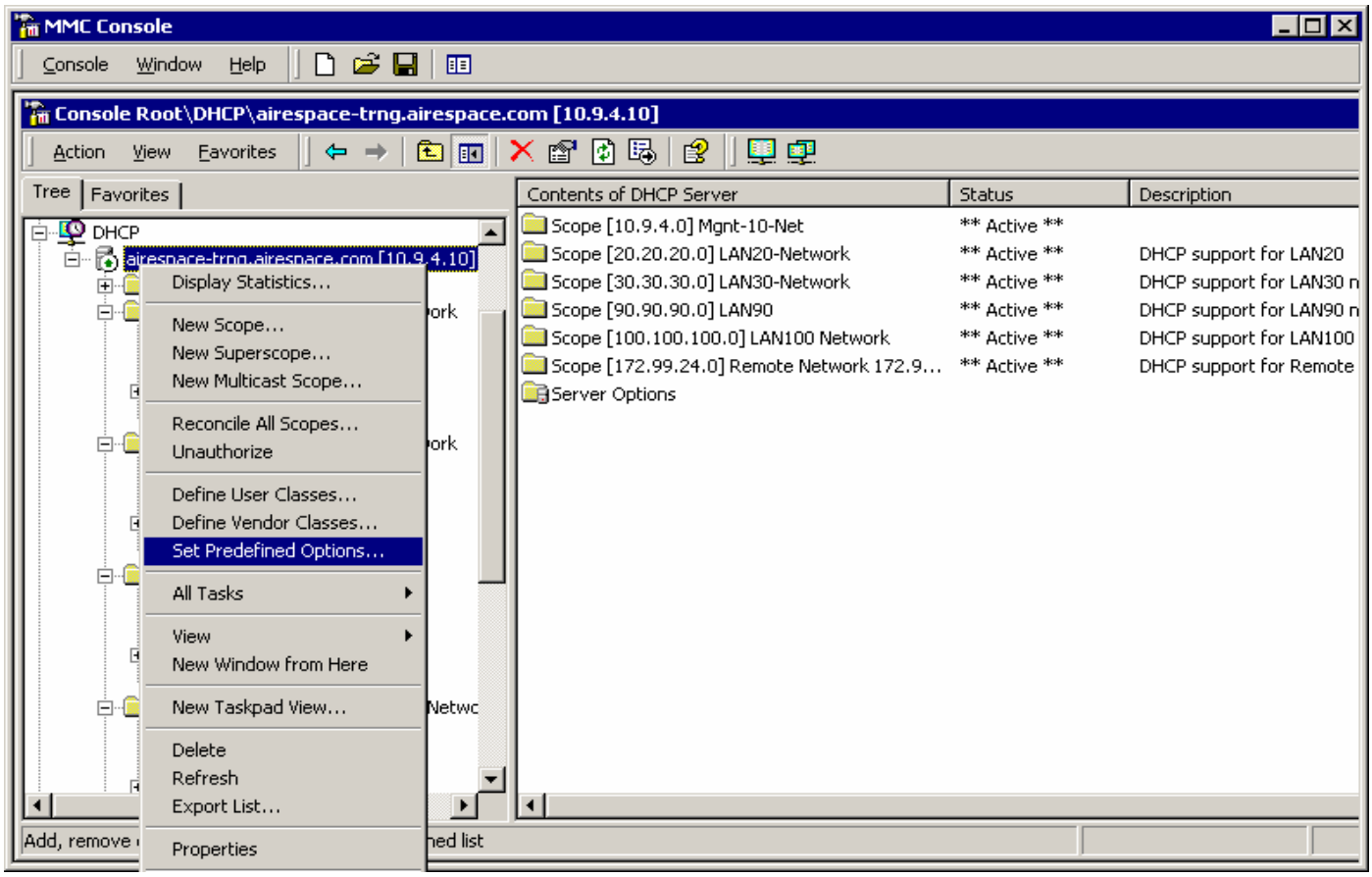

Figure 7: Adding a Predefined Option

A new window opens where you will set the Option class to the value you previously configured for the vendor class. In our example, we are using vendor class name "**Airespace".** Click on the **Add** button to define the option code. This is shown in Figure 8:

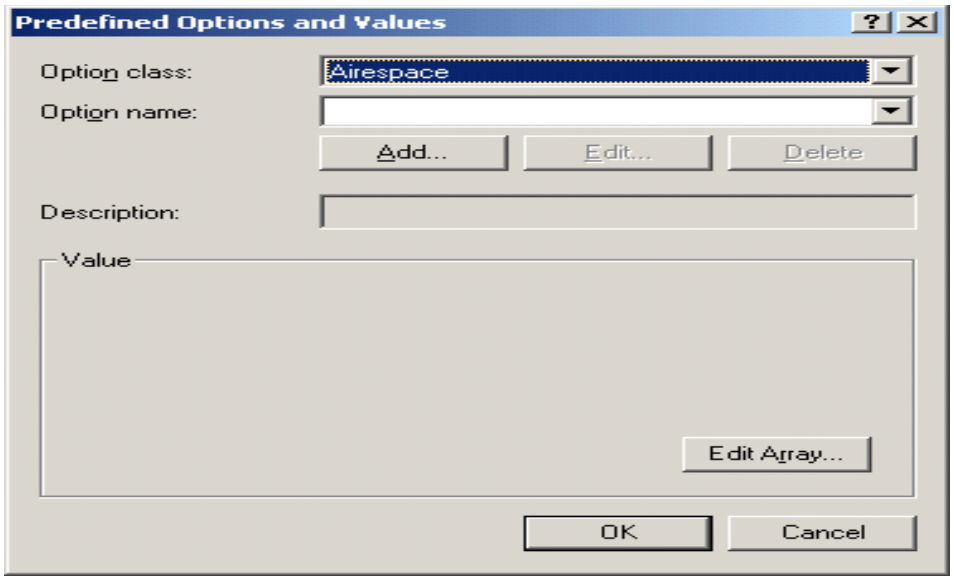

Figure 9: Adding a Predefined Option

An **Option Type** box will pop-up. In the **Name** field, enter a descriptive string value—for example, "Airespace IP provision". Select "Binary" as the **Data Type.** In the **Code** field, enter the sub-option value 102. Enter a **Description,** if desired. Click on the **OK** button. This is shown in Figure 10:

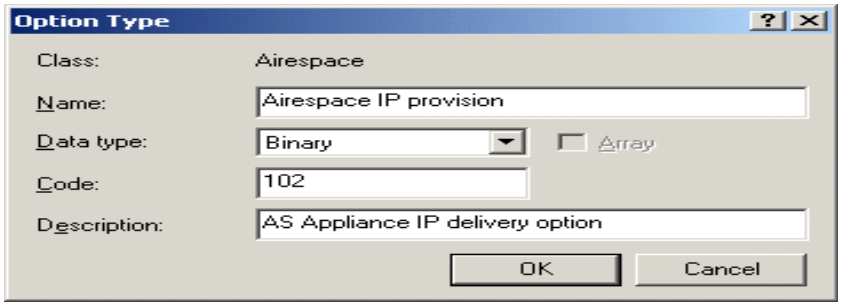

Figure 10: Defining the Predefined Option

You should see the new Predefined Option that is associated with the Airespace class (see Figure 11). Now click **OK** at the bottom of the **Predefined Options and Values** box. This is shown in Figure 11:

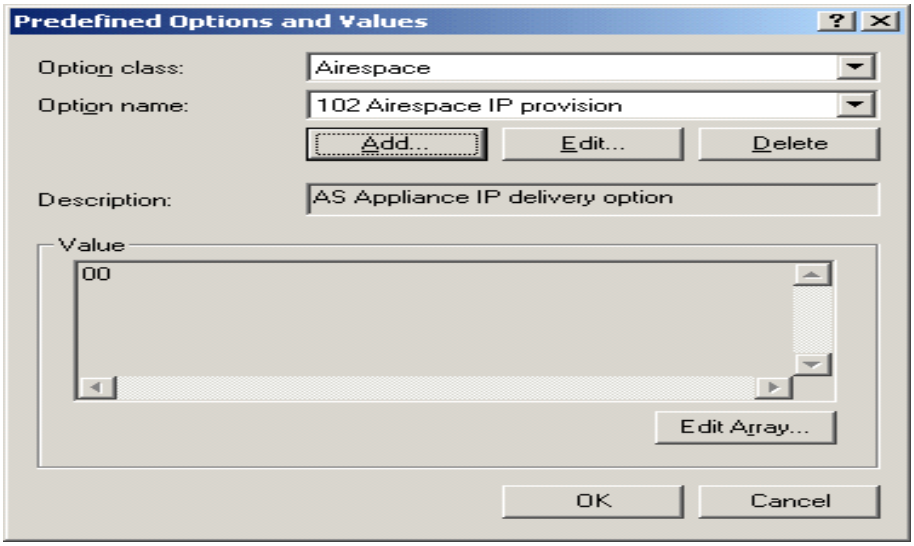

Figure 11: Predefined Option Defined for Vendor Class

This completes the creation of the Vendor class and sub-option type needed to support controller discovery.

Next, you use the vendor class and pre-defined option to support controller auto discovery by defining the appropriate value for the DHCP scope the APs will use. Navigate to the appropriate DHCP scope for the APs. Right-click the **"Scope Options"** folder under the DHCP scope and select **"Configure Options."** This is shown in Figure 12:

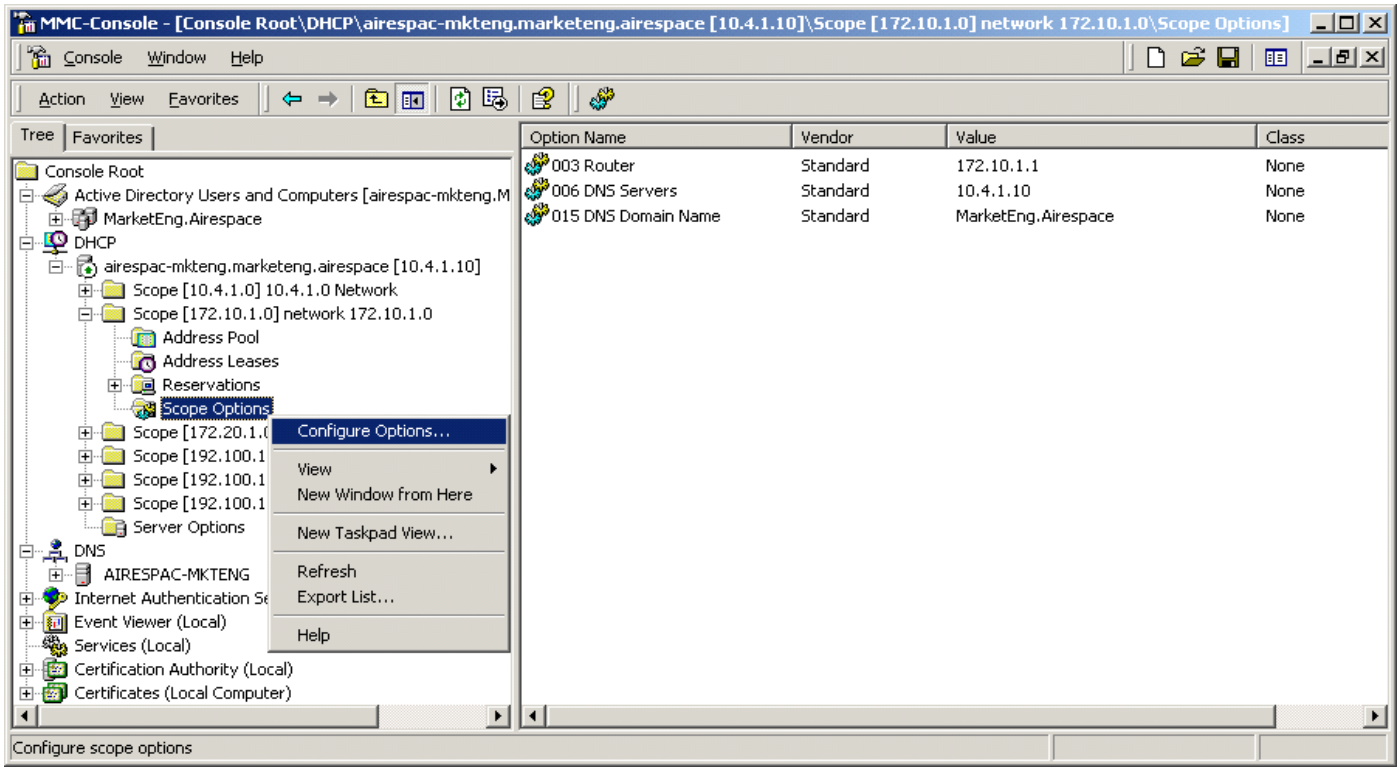

Figure 12: Configuring Vendor Specific Information per DHCP Scope

The **Scope Options** box will appear. Change to the **Advanced** tab. Select the Vendor Class that you are going to use—in this case "**Airespace**". See Figure 13:

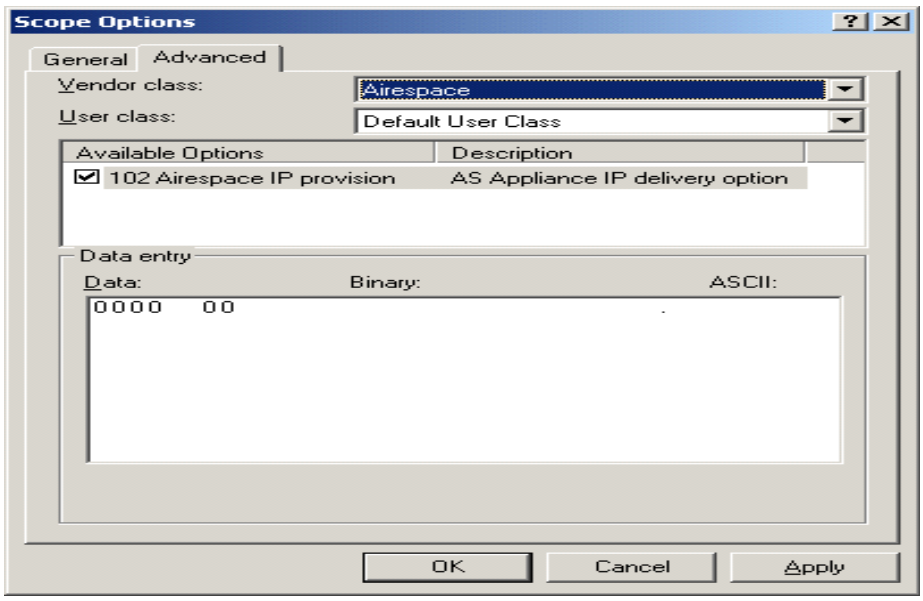

Figure 13: Selecting the Vendor Class and Sub-Option

Select the predefined 102 sub-option that you will assign to this scope. In the Data Entry area, enter the controller management IP address(es) that you are going to return to the APs in the **ASCII** section. This is a comma delimited list. Also note that there is a period (.) found in the initial empty Data Entry area. Make sure you remove this period from the list of IP addresses that will be added in the data entry area. See Figure 14:

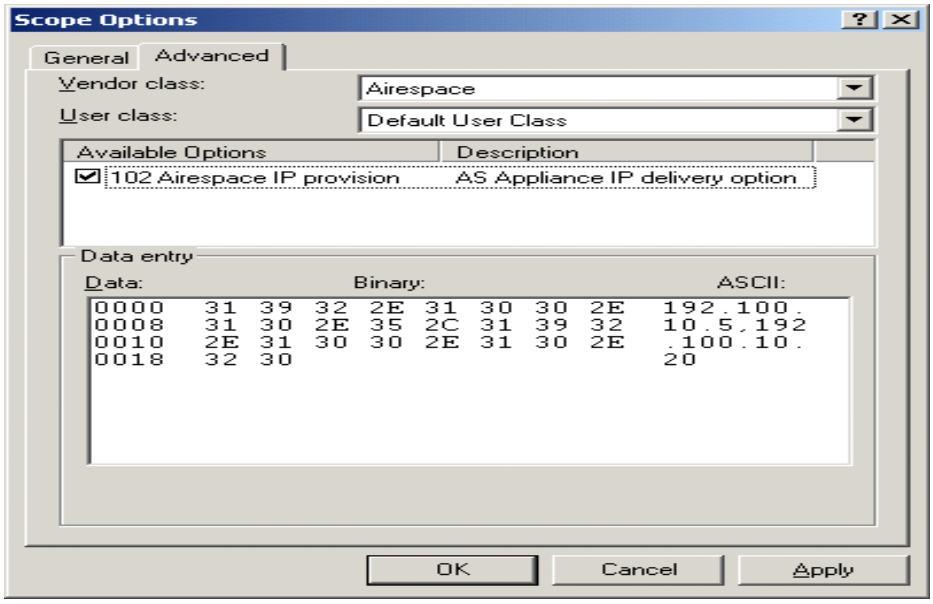

Figure 14: Entering WLAN Controller IP Address Values

When finished, your results should look similar to what's shown in Figure 15. Repeat these steps for each DHCP scope.

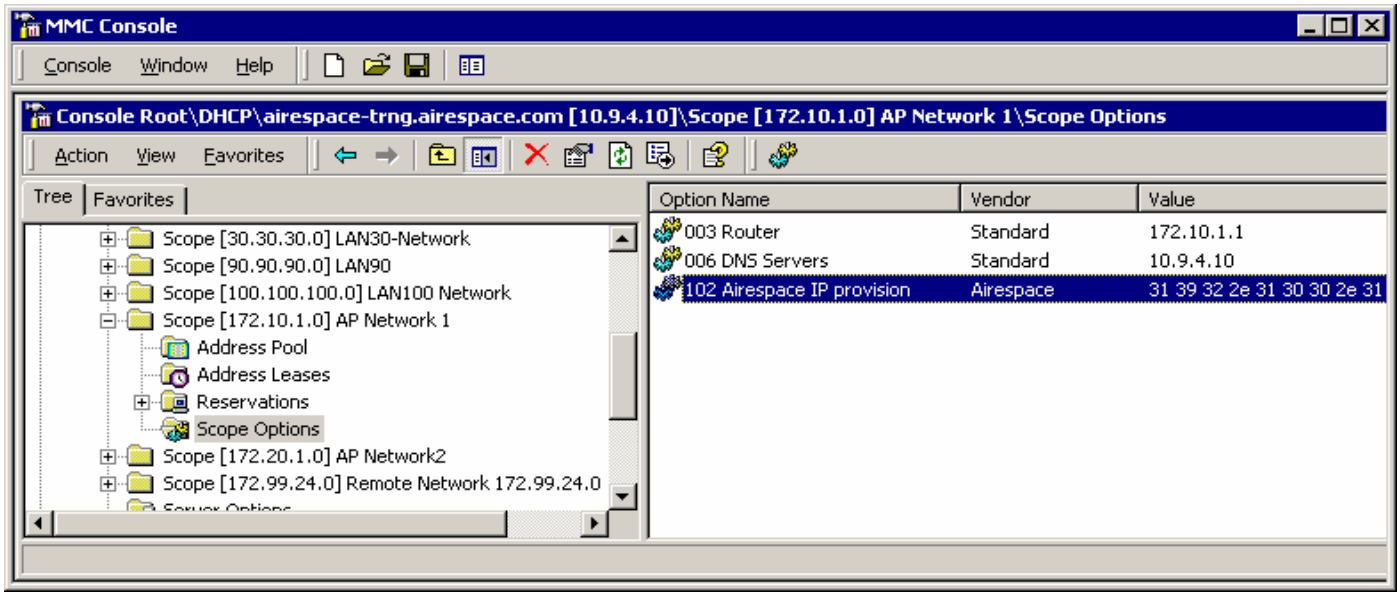

Figure 15: Vendor Specific Information for Cisco 1000 Defined for a DHCP Scope

Configuring Vendor Specific DHCP Options for Lightweight Cisco Aironet Series APs (1130, 1240, and 1200 series)
In this section, we'll take a look at how the Windows DHCP Server is used to configured to return vendor specific information to lightweight Cisco Aironet Series APs. Key information you'll need to know are:

- Vendor Class Identifier (VCI)

- Option 43 sub-option code
- Management IP address(es) of WLAN controller(s)

From Table 1, the VCI for a lightweight Cisco Aironet Series access point is specific to each model type. To support more than one AP model, a Vendor Class needs to be created for each model type. The Option 43 sub-option code for Cisco Aironet Series access points is type 241 (0xf1).

To configure these options in the Windows DHCP Server, open the DHCP Server Administration Tool or MMC console. Right-click the mouse on the DHCP root and then select **Define Vendor Classes** (see Figure 16):

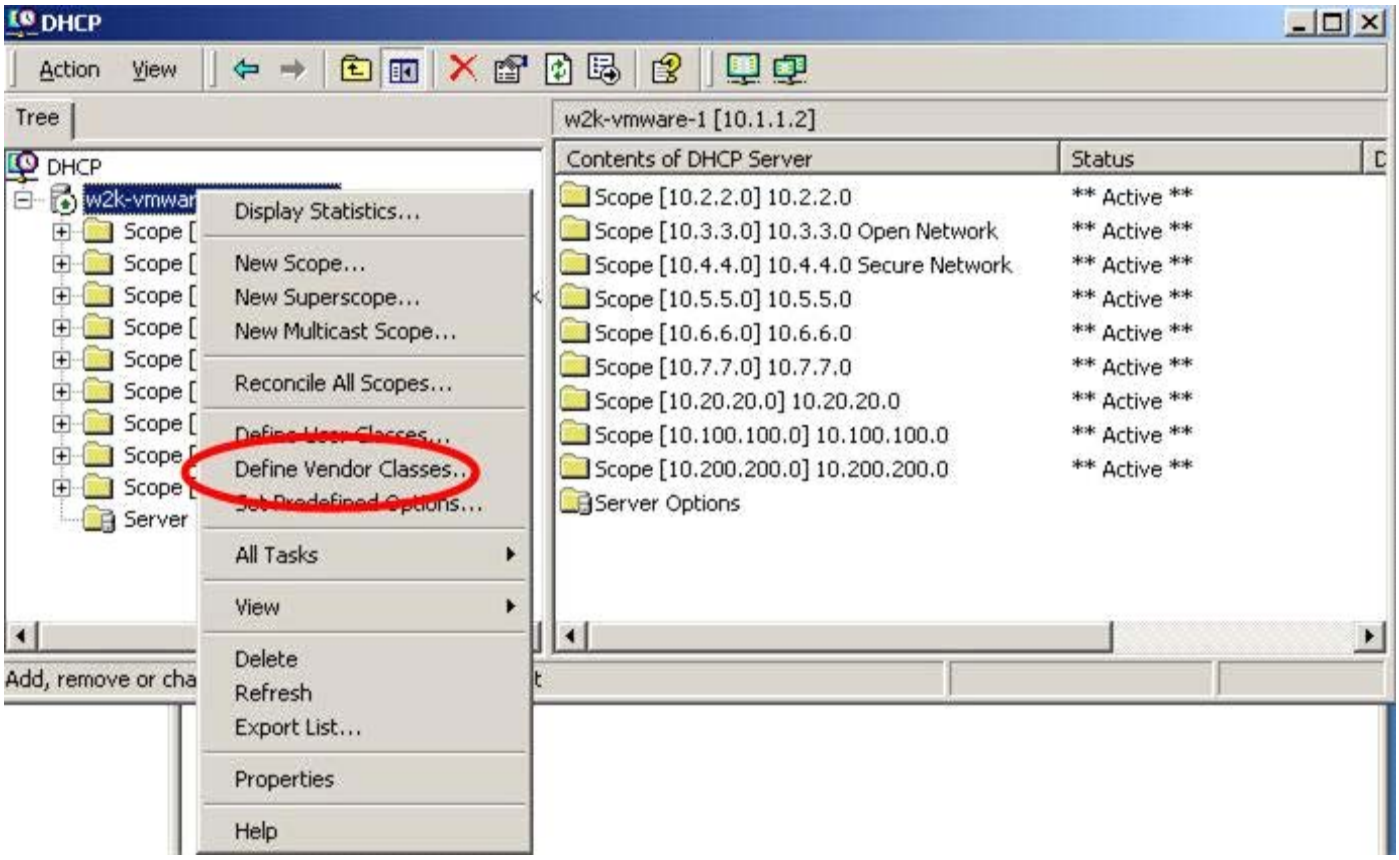

Figure 16: Defining the Vendor Class

The **DHCP Vendor Classes** utility will pop-up. Select the **Add** button (see Figure 17):

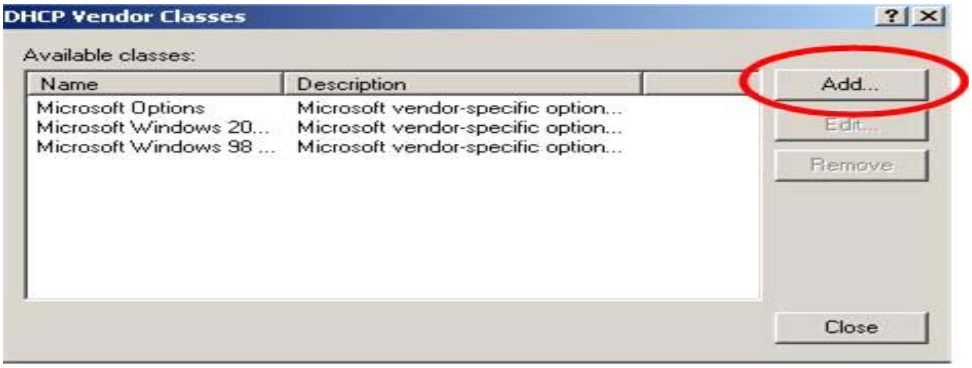

Figure 17: Defining the Vendor Class

A **New Class** configuration box will pop-up. Enter a value for the **Display Name** field—for example, Cisco Aironet 1130 AP—and an appropriate description. Click on the ASCII Section and enter the appropriate string value for the Vendor Class Identifier (see Table 1). Click **OK** to complete the task (see Figure 18) and then click **CLOSE** on the **DHCP Vendor Classes** window (see Figure 18).

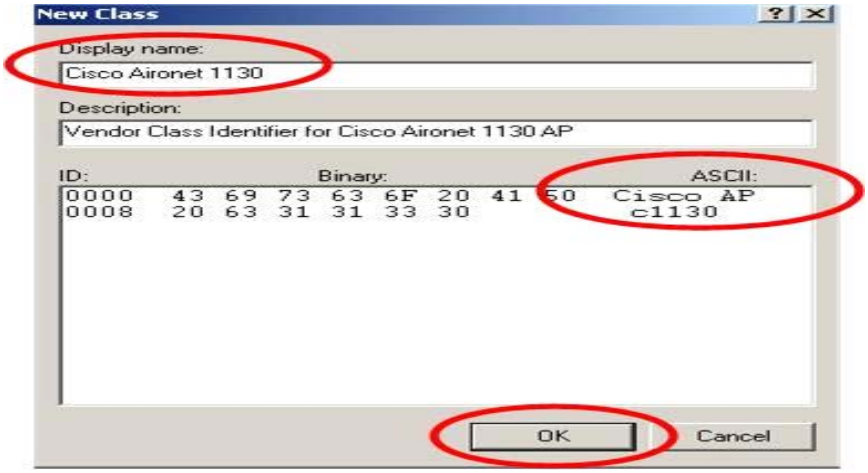

Figure 18: Defining the Vendor Class

The next step is to add an entry for the WLAN controller sub-type as a pre-defined option must be configured for the Vendor Class. Right-click on the DHCP Server Root and then select **Set Predefined Options** (see Figure 19):

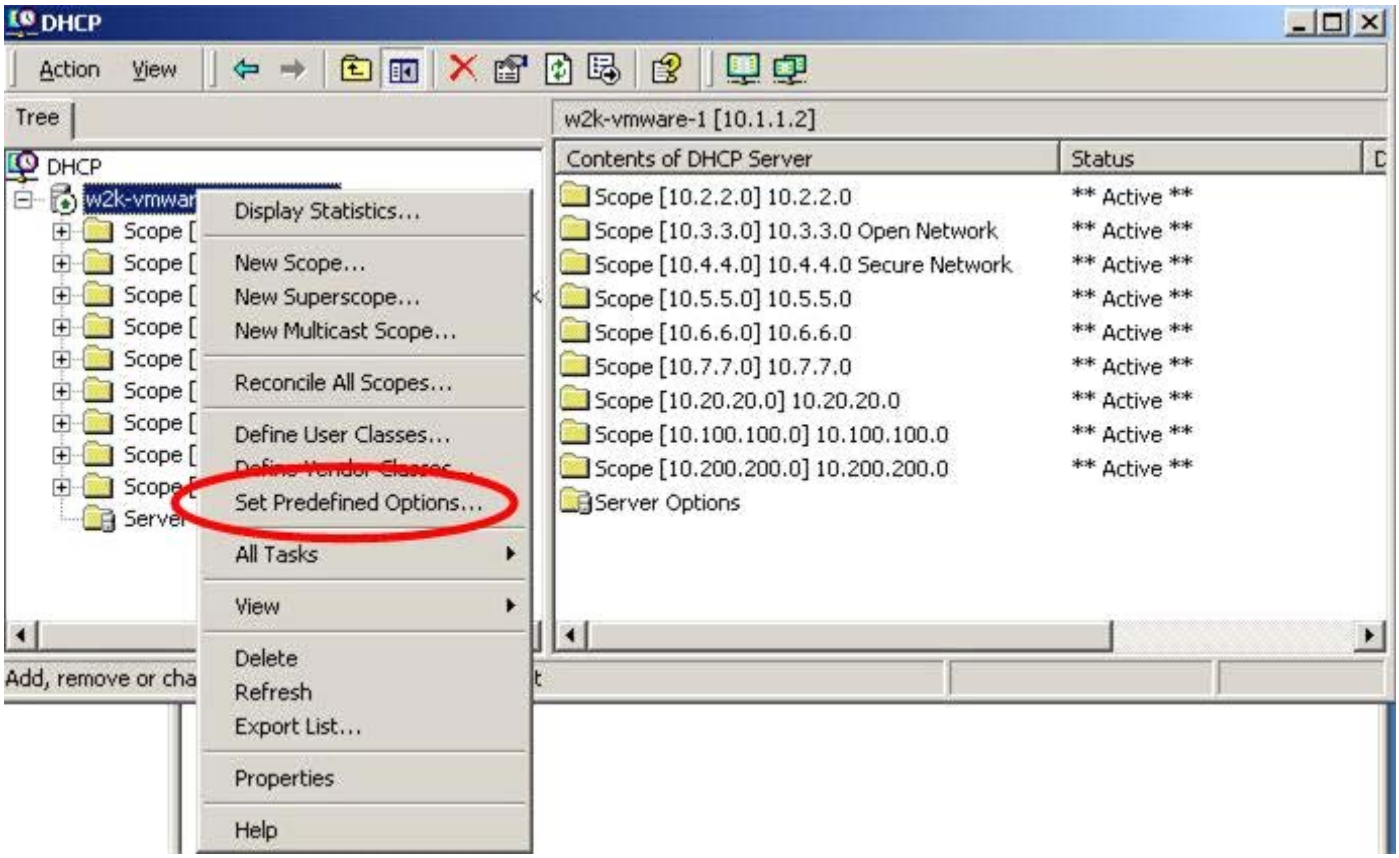

Figure 1 Adding a Pre-defined Option

Select the newly created Vendor Option Class in the **Option Class** field, and then select the **Add** button (see Figure 20):

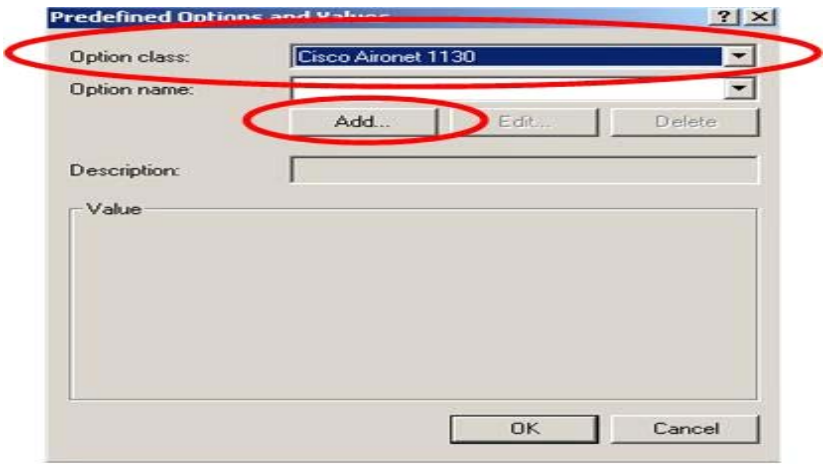

Figure 20: Adding a Pre-defined Option

The **Option Type** box will appear (see Figure 21). In the **Name** field, enter a string value—for example, Option 43. Select the "IP Address" as the **Data Type.** Click the **Array** check-box. In the **Code** field, enter the sub-option code value 241 (0xf1). Enter a **Description** if desired. Click on the **OK** button (see Figure 21):

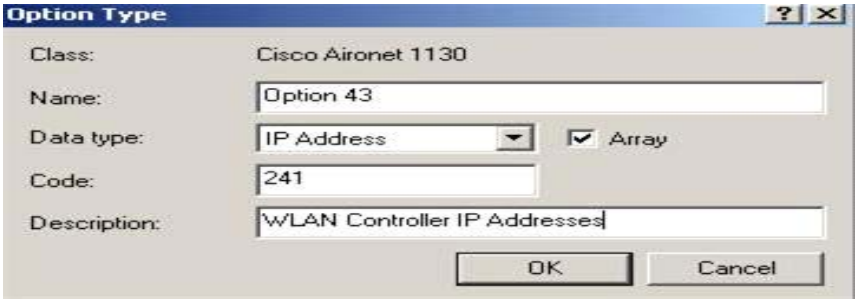

Figure 21: Defining a Sub-Option

The Vendor Class and sub-option are now programmed into the DHCP Server. Now the vendor specific information must be defined for the AP DHCP scope. Select the appropriate DHCP scope. Right-click the mouse on the **Scope Options** and select **Configure Options** (see Figure 22).

Select the **Advanced Tab** (see Figure 22). Select the Vendor Class previously defined. Click the check-box for the value 241, and then enter each WLC management interface IP address. When finished, click on the **OK** button.

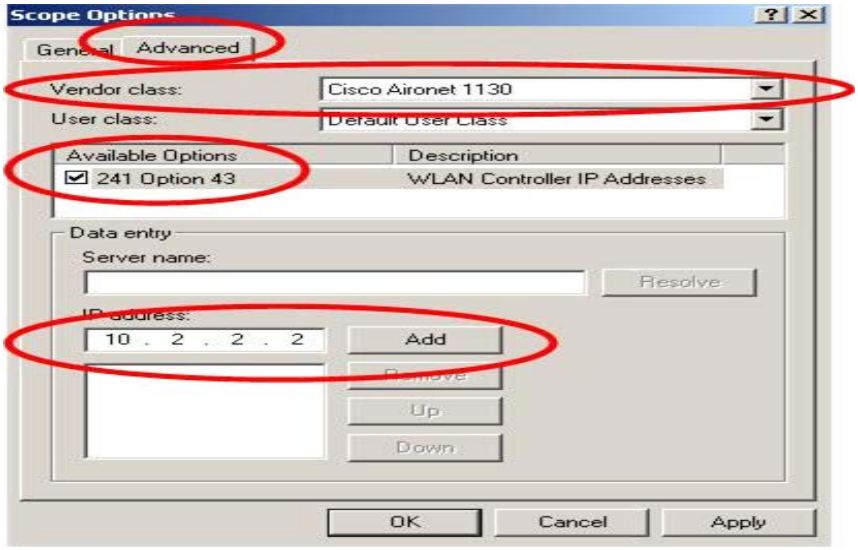

Figure 22: Defining the Vendor Specific Information

A Vendor Class and sub-options must be defined for each type of lightweight Cisco Aironet AP Vendor specific information must also be defined for each vendor class in each DHCP scope.

the Cisco Web site at www.cisco.com/go/offices.