



Avaya Solution and Interoperability Test Lab

Configuring Avaya IP Telephones using DHCP to Facilitate Failover Registration between Avaya IP Office and Avaya Communication Manager - Issue 1.0

Abstract

These Application Notes describe how to configure Avaya 4600 Series IP Telephones using a Microsoft DHCP (Dynamic Host Configuration Protocol) Server so that in the event of a network failure, the telephones originally registered to an Avaya IP Office can register to Avaya Communication Manager.

1. Introduction

These Application Notes describe how to configure a Microsoft DHCP (Dynamic Host Configuration Protocol) Server to provide alternate call server addresses to Avaya 4600 Series IP Telephones. If a failure occurs causing the IP telephone to lose its registration to the primary call server, the telephone can register with the next call server specified by the DHCP Server in the site-specific option 176 string. Avaya IP telephones use the site-specific option 176 string as one of the methods to receive parameters from the DHCP server.

The network configuration diagram (**Figure 1**) shown below was used for these Application Notes.

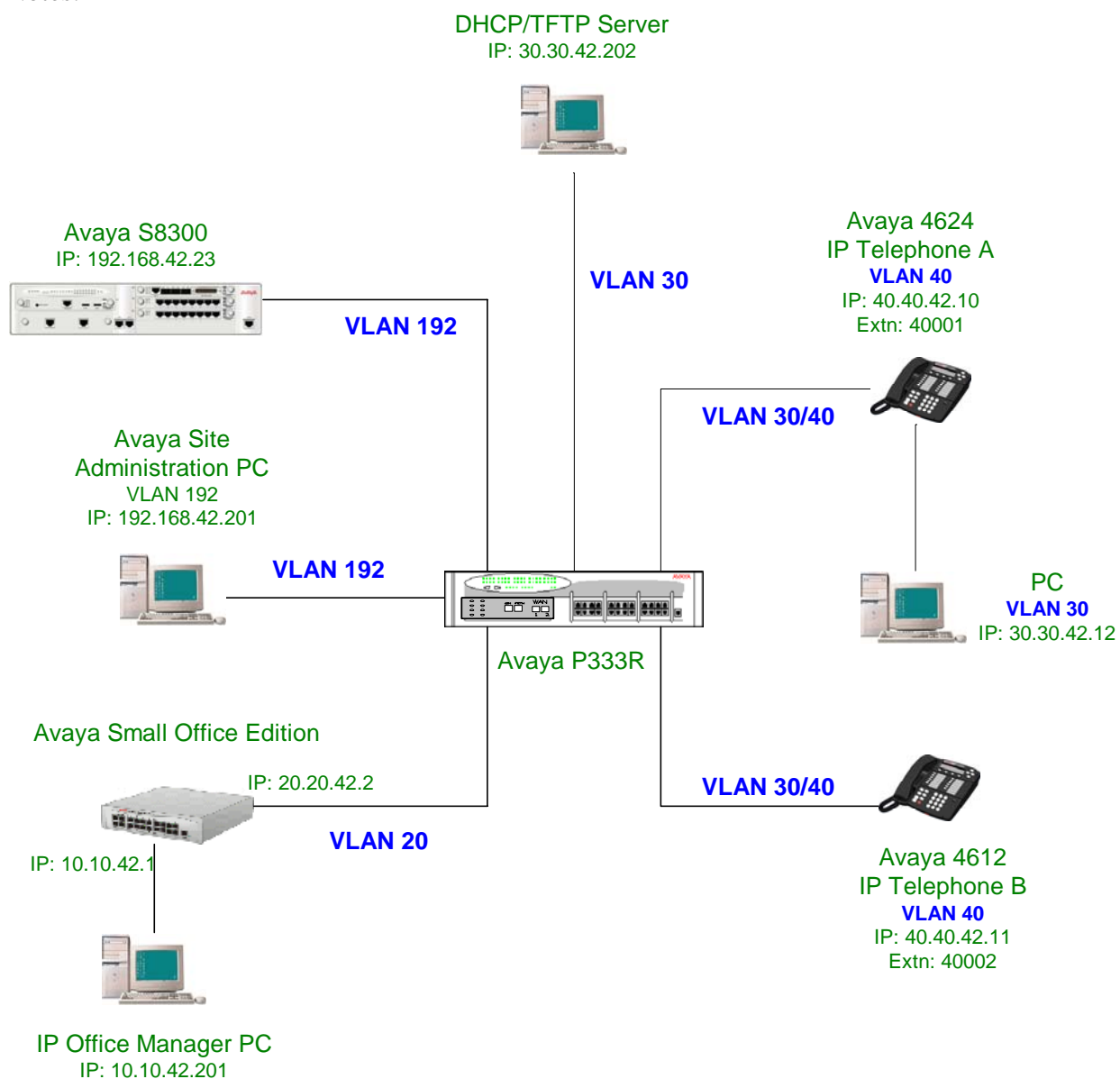


Figure 1 - Network Configuration Diagram

In **Figure 1**, a Microsoft DHCP Server was used by the IP telephones to register with each call server (i.e., IP Office or Avaya Communication Manager). Two separate VLANs (Virtual Local Area Network), one for data (VLAN 30) and another for voice (VLAN 40) were used. The following scopes were defined on the DHCP Server for each VLAN:

```
Scope [30.30.42.0] Data VLAN
  Address Pool:
    Start Address: 30.30.42.10
    End Address: 30.30.42.20
    Subnet mask: 255.255.255.0
Option 003 Router: 30.30.42.1
Option 176 Avaya Option: L2Q=1,L2QVLAN=40

Scope [40.40.42.0] Voice VLAN
  Address Pool:
    Start Address: 40.40.42.10
    End Address: 40.40.42.20
    Subnet mask: 255.255.255.0
Option 003 Router: 40.40.42.1
Option 176 Avaya Option:
MCIPADD=10.10.42.1,192.168.42.23,MCPORT=1719,TFTPSRVR=30.30.42.202
```

Table 1 below describes the relationship between the options on the IP telephone and the options specified on the DHCP scope:

IP Telephone Option	DHCP Scope Parameter	Description
Phone	Address pool range	IP address assigned to the telephone from the address pool of the scope
CallSv	MCIPADD	IP address(es) of call server(s)
CallSvPort	MCPORT	UDP port used for registration
Router	Option 003 Router	IP address of router
Mask	Subnet mask	Subnet mask
FileSv	TFTPSRVR	IP address(es) of TFTP server(s)
802.1Q	L2Q	802.1Q tagging on (1) or off (0)
VLAN ID	L2QVLAN	802.1Q VLAN ID

Table 1– Relationship between IP telephone options and DHCP scope options

The IP telephones were connected to ports on the P333R, which were assigned to native VLAN 30 (data VLAN) and statically bound to VLAN 40 (voice VLAN). DHCP relay was enabled on the P333R and the IP address of the DHCP Server was specified for the VLAN 40 interface in order to allow DHCP discovery broadcasts to be forwarded to the DHCP Server located on VLAN 30.

Two DHCP requests will be made by the IP telephone after it is reset to factory defaults and rebooted. The first DHCP request will result in the assignment of an IP address from the native VLAN 30 scope. The site-specific option 176 string for the VLAN 30 scope will turn 802.1Q tagging on (L2Q=1) and set the 802.1Q VLAN ID of the telephone to 40 (L2QVLAN=40). The IP telephone will then release the IP address from the VLAN 30 scope and request another IP address from the VLAN 40 scope. The IP telephone will retrieve the IP addresses of the call servers (MCIPADD parameter), UDP port used for registration (MCPORT parameter), and the IP address of the TFTP server (TFTPSRVR parameter) from the site-specific option 176 string for the VLAN 40 scope. The IP telephone then retains the Voice VLAN information so that communication with the DHCP server after subsequent resets need not begin on the data VLAN.

The PC connected to the IP telephone will ignore the parameters to turn 802.1Q tagging on and setting the 802.1Q VLAN ID to 40 and continue using the IP address assigned from the VLAN 30 scope.

Table 2 below lists the IP address, VLAN ID, and physical connection of each device.

Device	IP Address	VLAN	Physical Connection
Avaya S8300 Media Server	192.168.42.23	192	P333R-Port 3
Avaya Site Administration PC	192.168.42.201	192	P333R-Port 2
Avaya IP Office Small Office Edition – LAN1 port	10.10.42.1	None assigned	Small Office Edition LAN1 interface address
Avaya IP Office Small Office Edition - LAN2 port	20.20.42.2	20	P333R-Port 4
IP Office Manager PC	10.10.42.201	None assigned	Small Office Edition LAN1 port
Avaya 4624 IP Telephone A	40.40.42.10	40	P333R-Port 5
Avaya 4612 IP Telephone B	40.40.42.11	40	P333R-Port 6
PC connected to IP Telephone A	30.30.42.12	30	IP Telephone A
DHCP/TFTP Server	30.30.42.202	30	P333R-Port 1

Table 2 - Network Configuration

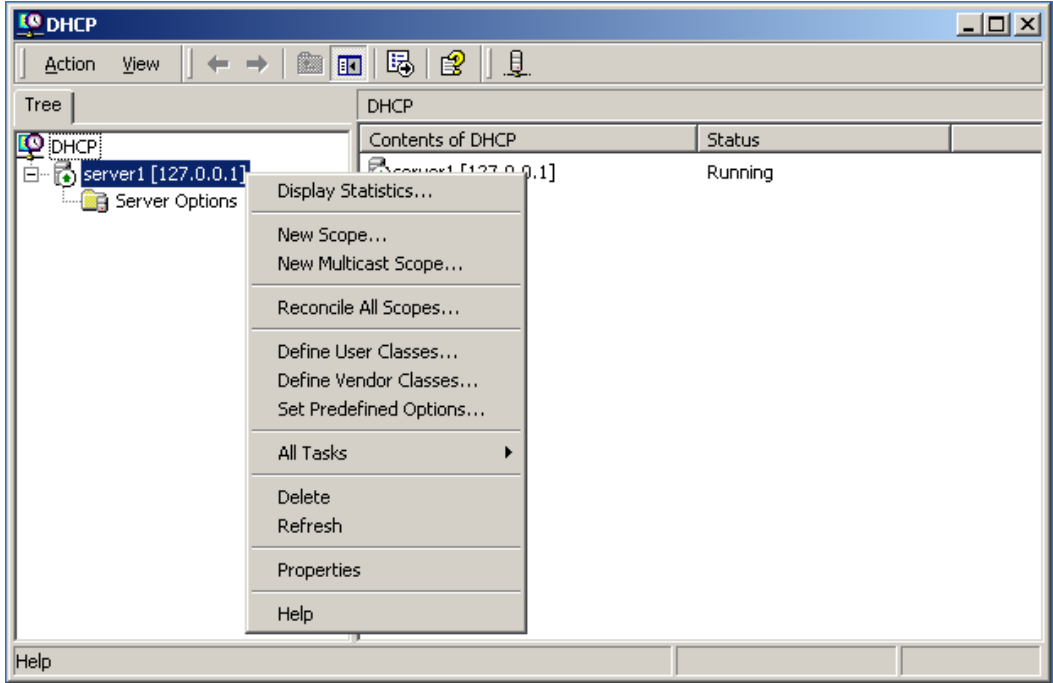
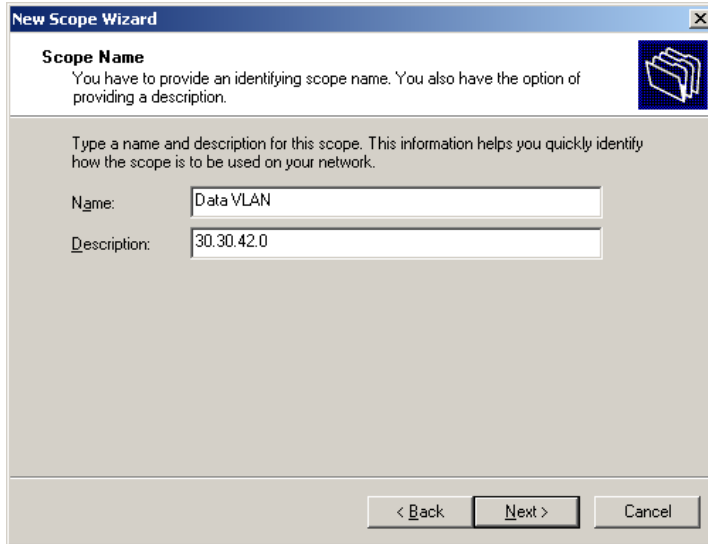
2. Equipment and Software Validated

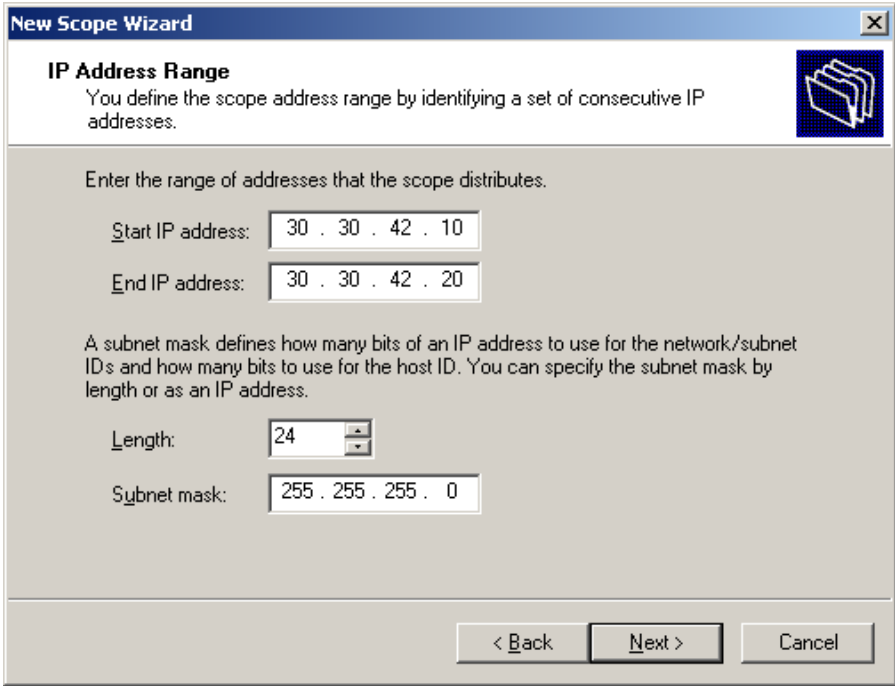
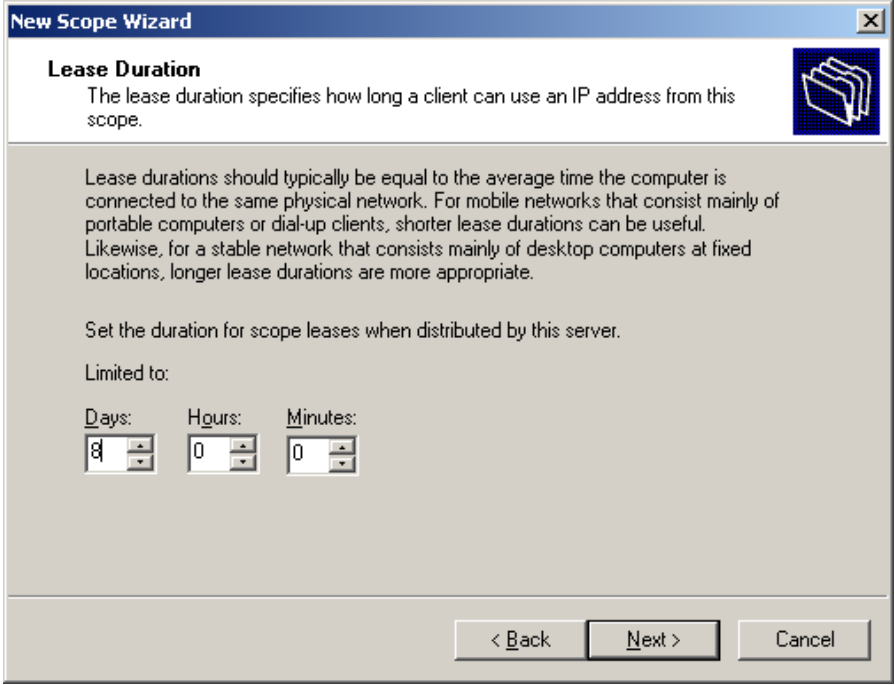
The following hardware and software versions were used for this configuration:

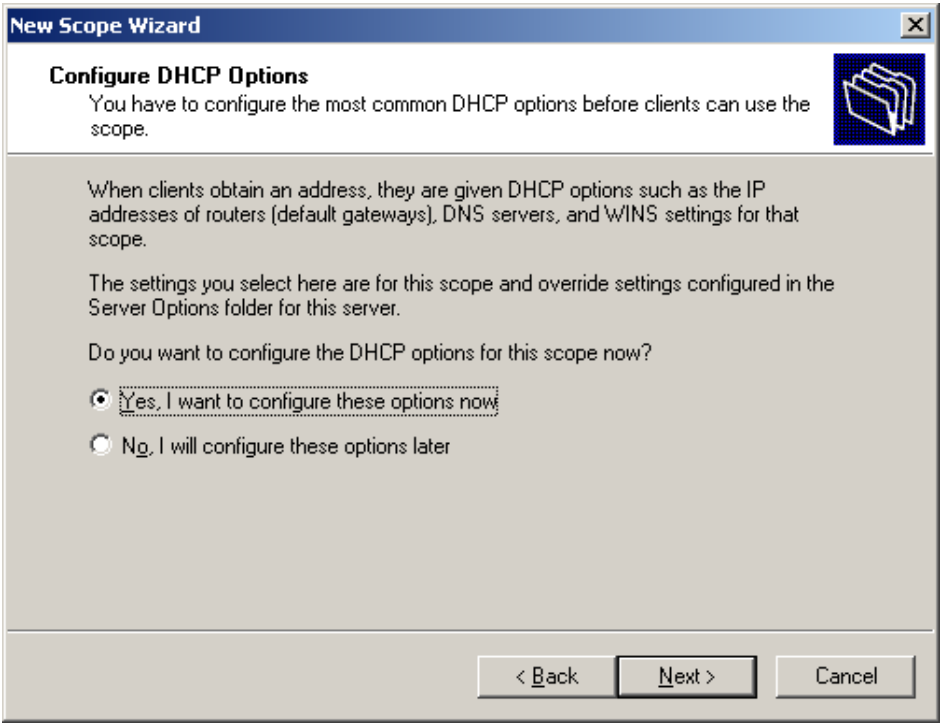
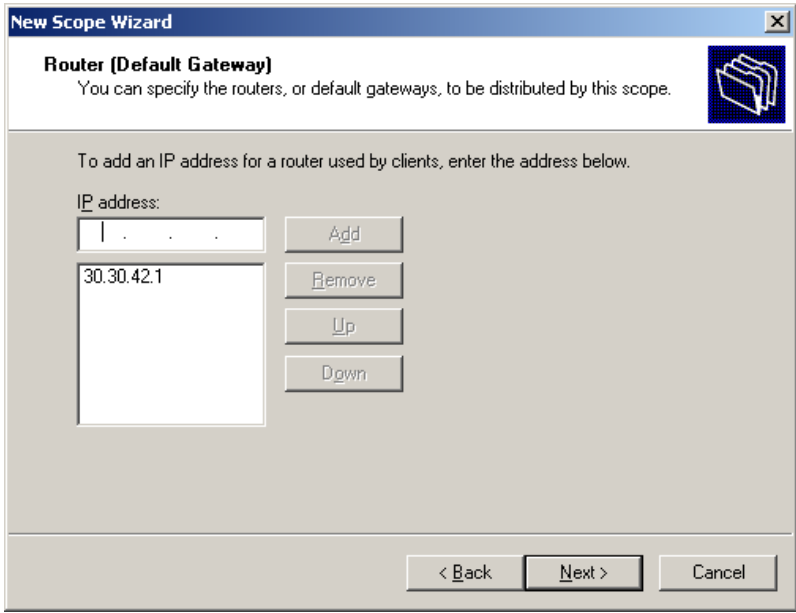
Equipment	Version
Avaya IP Office Small Office Edition	2.0 (16)
Avaya S8300 Media Server	Communication Manager 2.0 (R012x.00.0.219.0)
Avaya G700 Media Gateway	21.20.1
Avaya P333R Multilayer Switch	4.0.9
Avaya 4624 IP Telephone	1.8.1 *
Avaya 4612 IP Telephone	1.8.1 *
Avaya TFTP Server 2000	3.6.1
Microsoft DHCP Server	Windows 2000 Server Service Pack 4

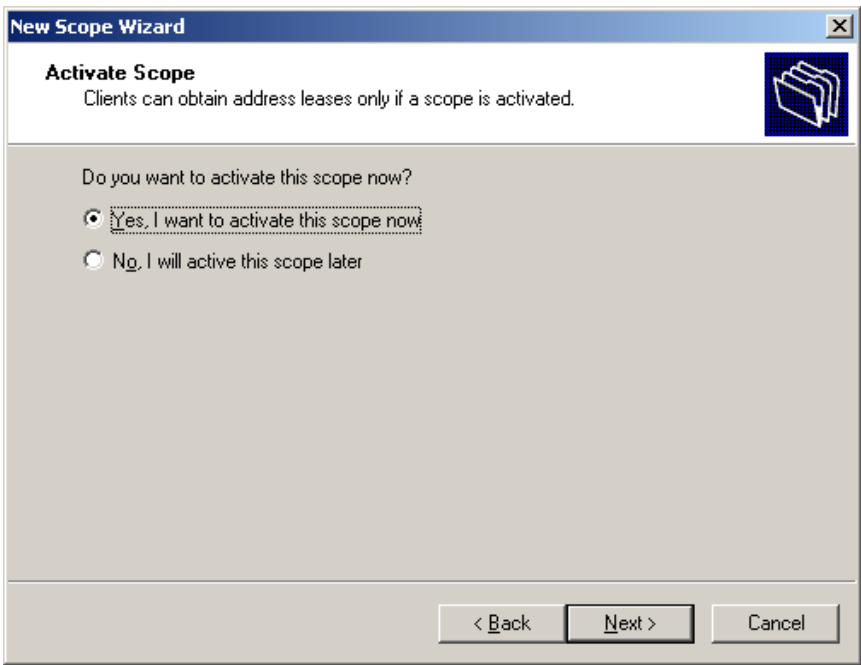
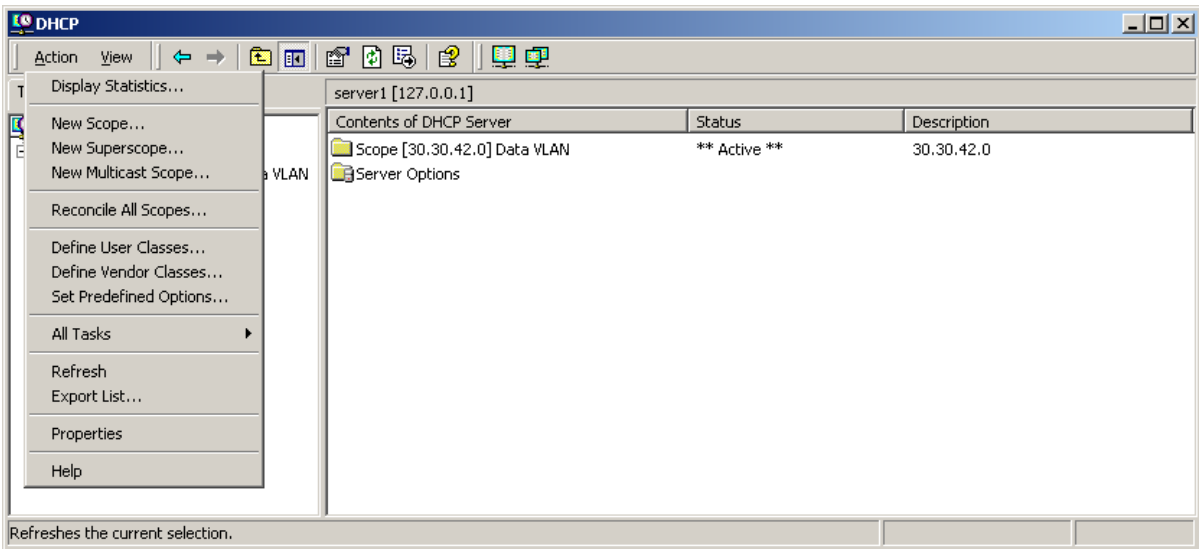
* Later versions of IP telephones may behave differently when registering with Avaya Communication Manager. When the IP telephone obtains its gatekeeper list from the DHCP server and first registers with IP Office, the IP telephone retains the gatekeeper entry for Avaya Communication Manager. If the link to IP Office is lost and the IP telephone registers to Avaya Communication Manager, Communication Manager may send the IP telephone an alternate gatekeeper list. This alternate gatekeeper list takes precedence over DHCP-served gatekeeper addresses. When the IP telephone registers to Communication Manager, Communication Manager can provide the IP Office address as an alternate gatekeeper, in the same fashion as Communication Manager provides the address of local survivable processors (i.e., via the network region configuration). Alternatively, the IP telephones can be reset to force the IP Telephone to retrieve the gatekeeper list from the DHCP server, and attempt to register with the first gatekeeper in the list (e.g., IP Office).

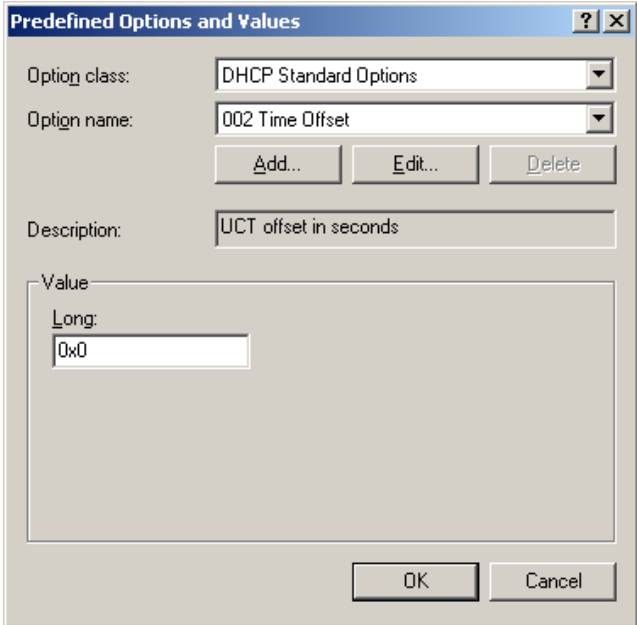
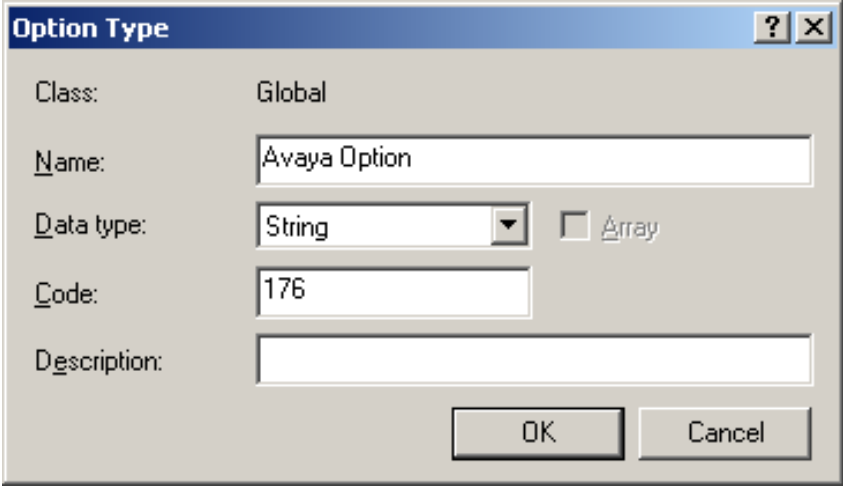
3. Configuring the Microsoft DHCP Server

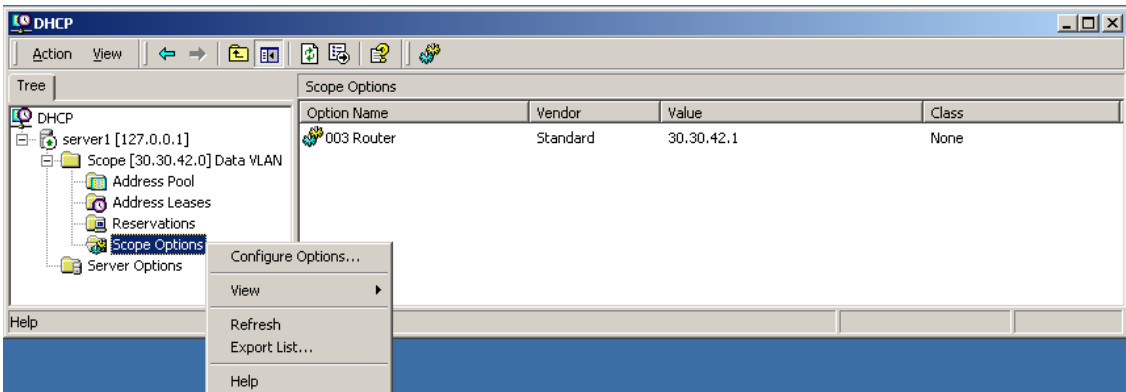
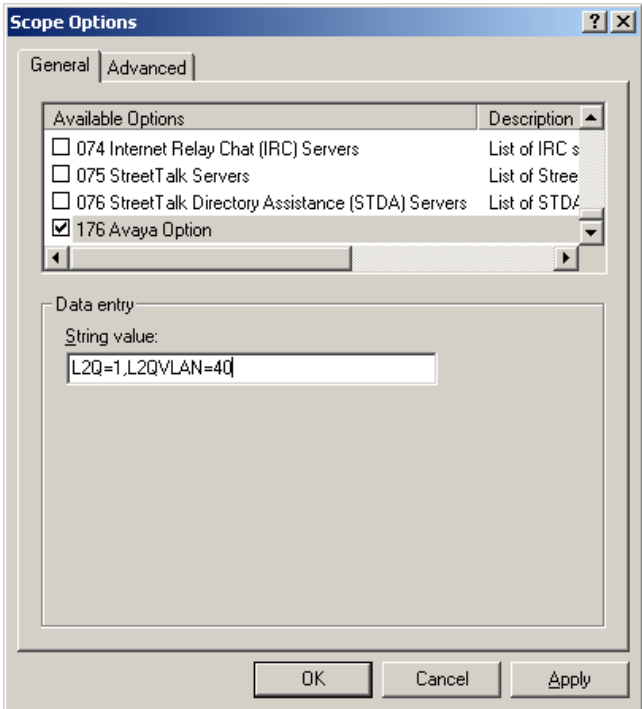
Step	Description
1.	<p>Define the scope for the Data VLAN on the Microsoft DHCP Server by clicking Start → Programs → Administrative Tools → DHCP. Expand the Tree view on the left side of the DHCP window by clicking on the “+” to the left of the server icon. Right-click the server icon and select the New Scope... menu option. The New Scope Wizard will be presented.</p>  <p>The screenshot shows the DHCP console window. On the left, the 'Tree' view is expanded, showing 'server1 [127.0.0.1]' with a '+' icon next to it. A right-click context menu is open over the server icon, with 'New Scope...' selected. The main pane shows the 'Contents of DHCP' table with one entry: 'server1 [127.0.0.1]' with status 'Running'.</p>
2.	<p>Enter Data VLAN for the <i>Name</i> and 30.30.42.0 as the <i>Description</i> for the new scope. Click Next to continue.</p>  <p>The screenshot shows the 'New Scope Wizard' dialog box. The 'Scope Name' section states: 'You have to provide an identifying scope name. You also have the option of providing a description.' Below this, it says: 'Type a name and description for this scope. This information helps you quickly identify how the scope is to be used on your network.' There are two input fields: 'Name:' with the text 'Data VLAN' and 'Description:' with the text '30.30.42.0'. At the bottom, there are three buttons: '< Back', 'Next >', and 'Cancel'.</p>

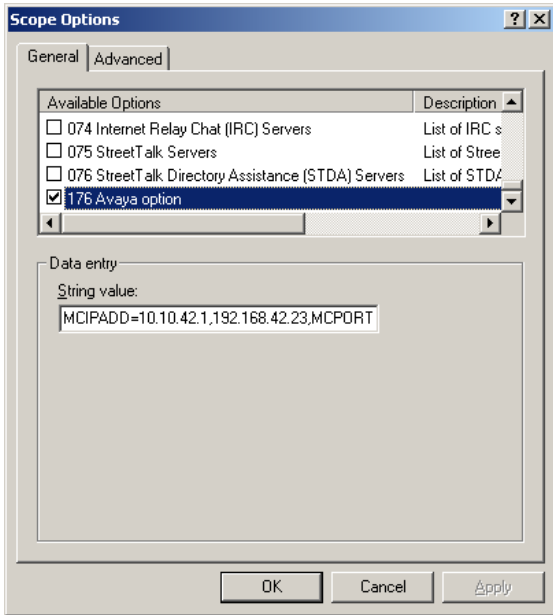
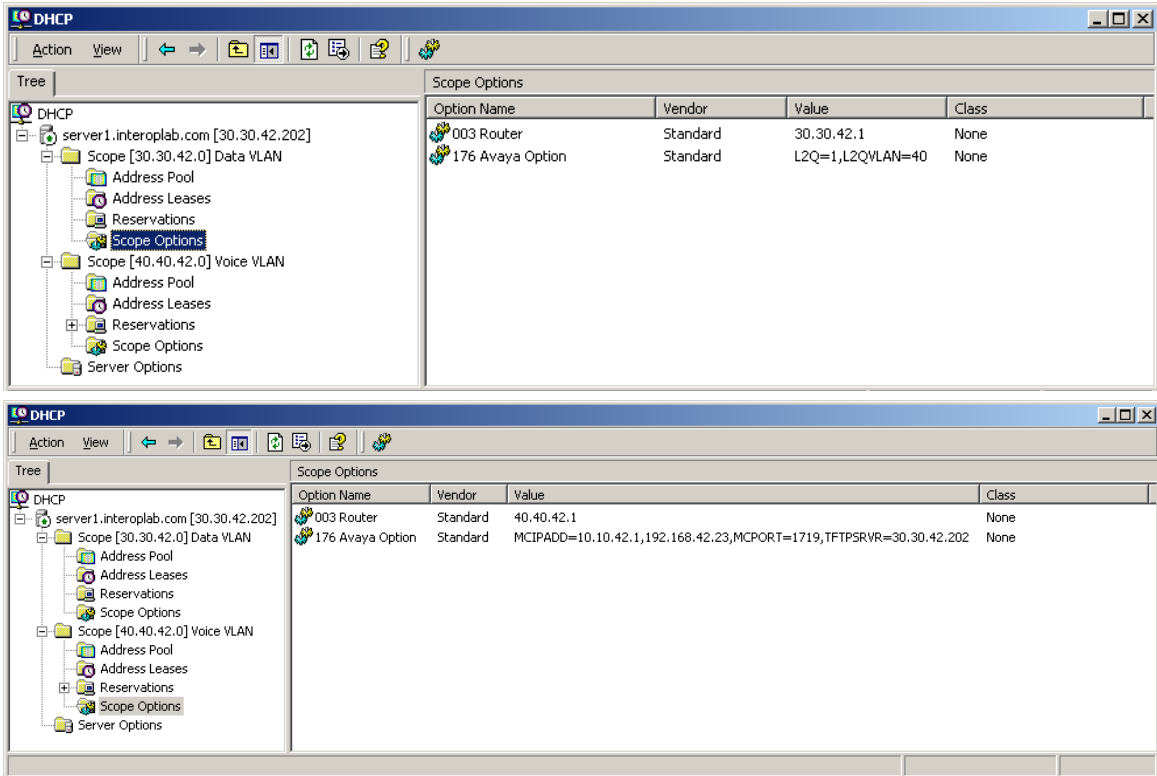
Step	Description
3.	<p>Define the address pool for the scope by entering the appropriate <i>Start and End IP address</i> and the <i>Subnet mask</i> (as a length or an IP address). Click Next to continue.</p>  <p>New Scope Wizard</p> <p>IP Address Range You define the scope address range by identifying a set of consecutive IP addresses.</p> <p>Enter the range of addresses that the scope distributes.</p> <p>Start IP address: 30 . 30 . 42 . 10</p> <p>End IP address: 30 . 30 . 42 . 20</p> <p>A subnet mask defines how many bits of an IP address to use for the network/subnet IDs and how many bits to use for the host ID. You can specify the subnet mask by length or as an IP address.</p> <p>Length: 24</p> <p>Subnet mask: 255 . 255 . 255 . 0</p> <p>< Back Next > Cancel</p>
4.	<p>Click Next to bypass the entering of IP addresses to be excluded from the address pool. Click Next to accept the default lease expiration of 8 days.</p>  <p>New Scope Wizard</p> <p>Lease Duration The lease duration specifies how long a client can use an IP address from this scope.</p> <p>Lease durations should typically be equal to the average time the computer is connected to the same physical network. For mobile networks that consist mainly of portable computers or dial-up clients, shorter lease durations can be useful. Likewise, for a stable network that consists mainly of desktop computers at fixed locations, longer lease durations are more appropriate.</p> <p>Set the duration for scope leases when distributed by this server.</p> <p>Limited to:</p> <p>Days: 8 Hours: 0 Minutes: 0</p> <p>< Back Next > Cancel</p>

Step	Description
5.	<p>Select the Yes option to configure the DHCP options for the scope. Click Next to continue.</p> 
6.	<p>Specify the default gateway (Option 003) for this scope by entering the IP address of the router and clicking Add. Click Next to continue. Click Next to bypass specifying a domain name and DNS servers. Click Next to bypass specifying WINS servers.</p> 

Step	Description
7.	<p>Select the Yes option to activate the scope. Click Next to continue. Click Finish to close the New Scope Wizard.</p> 
8.	<p>Select the server under the Tree view and click the Action menu option in the DHCP window and select the Set Predefined Options... menu option. The status of the scope should be listed as ** Active ** as shown below.</p> 

Step	Description
9.	<p>Click Add to create a new option.</p> 
10.	<p>Create a new site-specific option 176 string with Avaya Option as the <i>Name</i>, String as the <i>Data type</i>, and assign it a <i>Code</i> of 176. Click OK.</p> 

Step	Description								
11.	<p>Expand the Scope Options by clicking on the “+” symbol to the left of the scope under the Tree view. Right-click Scope Options and select the Configure Options... menu item.</p>  <p>The screenshot shows the DHCP console interface. On the left, the 'Tree' view displays a hierarchy: 'DHCP' > 'server1 [127.0.0.1]' > 'Scope [30.30.42.0] Data VLAN'. The 'Scope Options' folder is expanded, and a right-click context menu is open, with 'Configure Options...' selected. The main pane shows a table of Scope Options:</p> <table><thead><tr><th>Option Name</th><th>Vendor</th><th>Value</th><th>Class</th></tr></thead><tbody><tr><td>003 Router</td><td>Standard</td><td>30.30.42.1</td><td>None</td></tr></tbody></table>	Option Name	Vendor	Value	Class	003 Router	Standard	30.30.42.1	None
Option Name	Vendor	Value	Class						
003 Router	Standard	30.30.42.1	None						
12.	<p>Scroll down and check the 176 Avaya Option box. Enter the <i>String value</i> shown to turn 802.1Q tagging on (L2Q=1) and to set the 802.1Q VLAN ID to 40 (L2QVLAN=40).</p>  <p>The screenshot shows the 'Scope Options' dialog box with the 'Advanced' tab selected. Under 'Available Options', the '176 Avaya Option' is checked. The 'Data entry' section shows the 'String value' field containing 'L2Q=1,L2QVLAN=40'.</p>								

Step	Description																								
13.	<p>Repeat Steps 1-12 to define the Voice VLAN. For Step 12 for the Voice VLAN, enter the appropriate <i>String value</i> to set the IP addresses of the call servers (MCIPADD parameter), UDP port used for registration (MCPORT parameter), and the IP address of the TFTP server (TFTPSRVR parameter) in the option 176 string.</p> <div></div> <p>The scope options can be displayed by clicking each one under the Tree view.</p> <div></div> <table><tr><th>Option Name</th><th>Vendor</th><th>Value</th><th>Class</th></tr><tr><td>003 Router</td><td>Standard</td><td>30.30.42.1</td><td>None</td></tr><tr><td>176 Avaya Option</td><td>Standard</td><td>L2Q=1,L2QVLAN=40</td><td>None</td></tr></table> <table><tr><th>Option Name</th><th>Vendor</th><th>Value</th><th>Class</th></tr><tr><td>003 Router</td><td>Standard</td><td>40.40.42.1</td><td>None</td></tr><tr><td>176 Avaya Option</td><td>Standard</td><td>MCIPADD=10.10.42.1,192.168.42.23,MCPORT=1719,TFTPSRVR=30.30.42.202</td><td>None</td></tr></table>	Option Name	Vendor	Value	Class	003 Router	Standard	30.30.42.1	None	176 Avaya Option	Standard	L2Q=1,L2QVLAN=40	None	Option Name	Vendor	Value	Class	003 Router	Standard	40.40.42.1	None	176 Avaya Option	Standard	MCIPADD=10.10.42.1,192.168.42.23,MCPORT=1719,TFTPSRVR=30.30.42.202	None
Option Name	Vendor	Value	Class																						
003 Router	Standard	30.30.42.1	None																						
176 Avaya Option	Standard	L2Q=1,L2QVLAN=40	None																						
Option Name	Vendor	Value	Class																						
003 Router	Standard	40.40.42.1	None																						
176 Avaya Option	Standard	MCIPADD=10.10.42.1,192.168.42.23,MCPORT=1719,TFTPSRVR=30.30.42.202	None																						

The following configuration was entered via the System Administration Terminal (SAT).

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WCH 7/21/2004 Use pursuant to Company Instructions. IPO-DHCP.doc

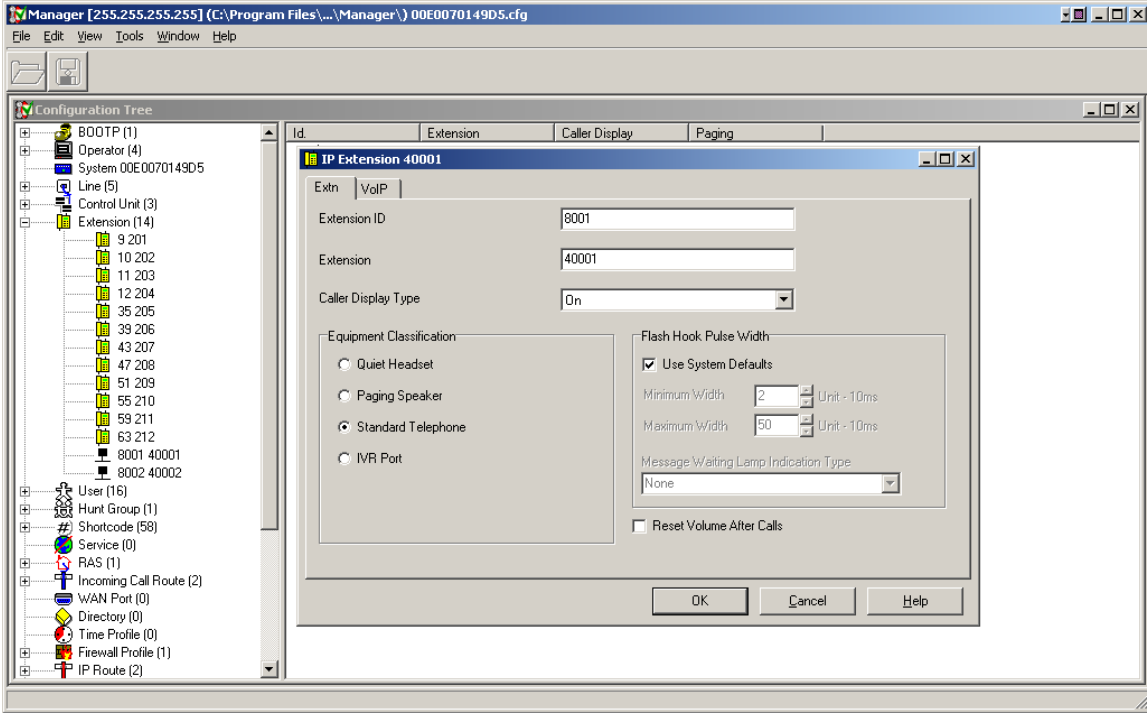
5. Configuring the Avaya P333R

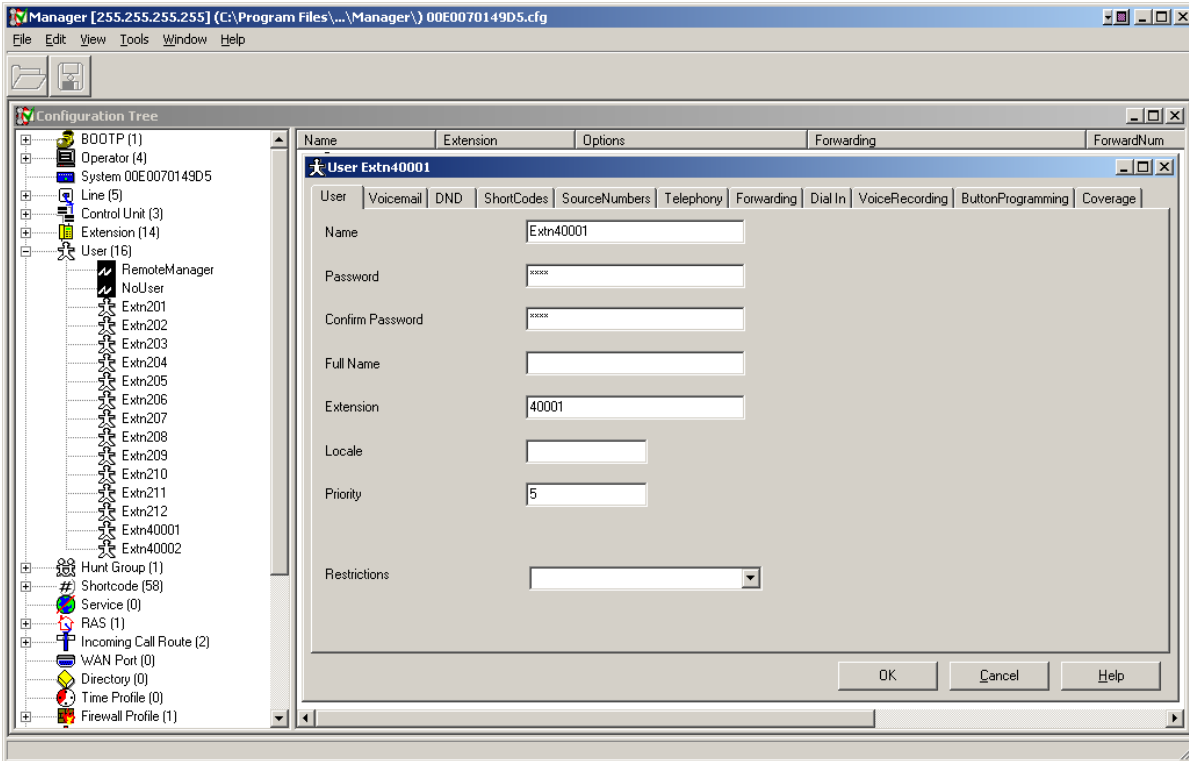
Step	Description
1.	<p>Create the VLANs listed in Table 2 for Layer 2 using the set vlan command.</p> <pre>P330-1# set vlan 20 name VLAN20 P330-1# set vlan 30 name VLAN30 P330-1# set vlan 40 name VLAN40 P330-1# set vlan 192 name VLAN192</pre> <p>Verify each VLAN was created using the show vlan command.</p> <pre>P330-1# show vlan VLAN ID Vlan-name ----- 1 V1 20 VLAN20 30 VLAN30 40 VLAN40 192 VLAN192 Total number of VLANs: 5</pre>
2.	<p>Assign the appropriate native VLAN to each port on the P333R using the set port vlan command.</p> <pre>P330-1(super)# set port vlan 30 1/1 P330-1(super)# set port vlan 192 1/2 P330-1(super)# set port vlan 192 1/3 P330-1(super)# set port vlan 20 1/4 P330-1(super)# set port vlan 30 1/5 P330-1(super)# set port vlan 30 1/6</pre> <p>Verify the native VLAN assignment (<i>Vlan</i> column) using the show port command.</p> <pre>P330-1# show port Port Name Status Vlan Level Neg Dup. Spd. Type ----- 1/1 NO NAME connected 30 0 enable full 100M 10/100Base-Tx 1/2 NO NAME connected 192 0 enable full 100M 10/100Base-Tx 1/3 NO NAME connected 192 0 enable full 100M 10/100Base-Tx 1/4 NO NAME connected 20 0 enable full 100M 10/100Base-Tx 1/5 NO NAME connected 30 0 enable half 100M 10/100Base-Tx 1/6 NO NAME connected 30 0 enable half 100M 10/100Base-Tx</pre>

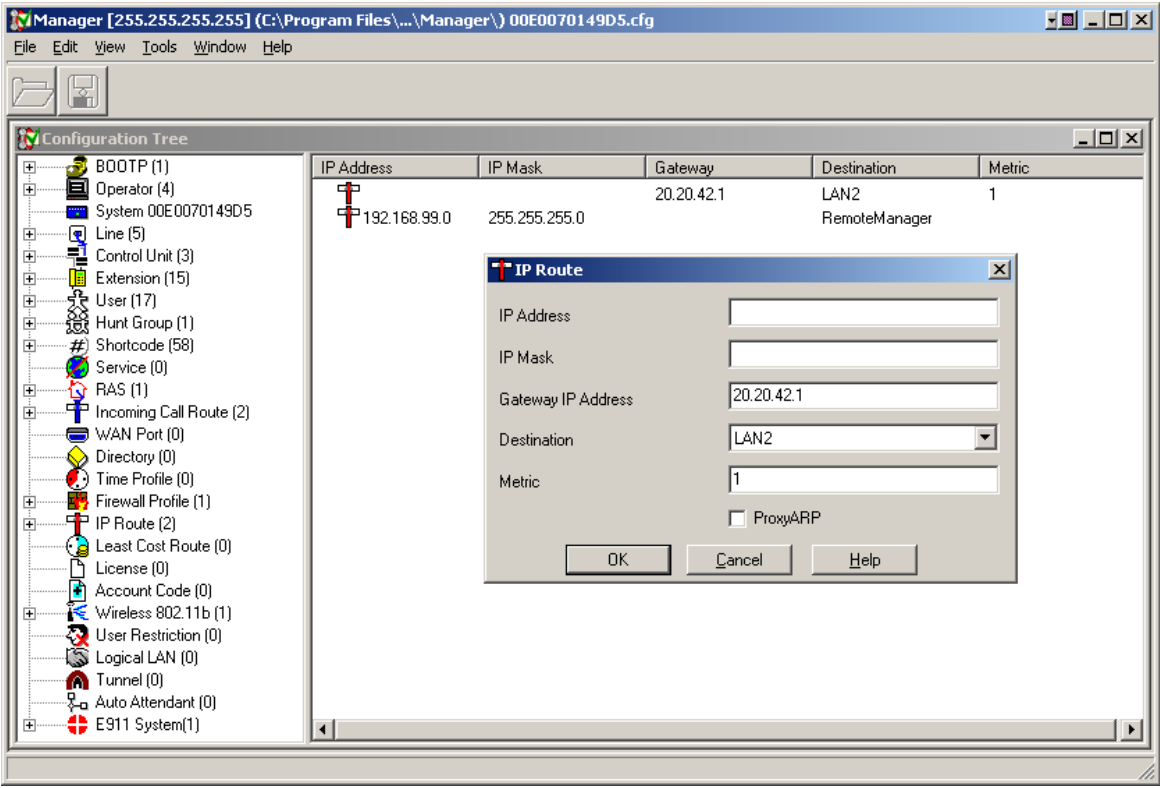
Step	Description
3.	<p>Use the set port static-vlan command to statically bind the ports connecting the IP telephones to the Voice VLAN 40.</p> <pre>P330-1# set port static-vlan 1/5 40 P330-1# set port static-vlan 1/6 40</pre> <p>Verify that the ports for the IP telephones were statically bound to Voice VLAN 40 (<i>Vlans allowed on trunk</i> column) using the show trunk command.</p> <pre>P330-1# show trunk 1/5 Port Mode Binding mode Native vlan Vlans allowed on trunk ----- 1/5 off statically bound 30 30 40 P330-1# show trunk 1/6 Port Mode Binding mode Native vlan Vlans allowed on trunk ----- 1/6 off statically bound 30 30 40</pre>
4.	<p>Create each VLAN on Layer 3 using the set vlan command. For consistency, the same names were used from Step 1 of this section.</p> <pre>P330-1(super)# session router Router-1(super)# config Router-1(configure)# set vlan 20 name VLAN20 Router-1(configure)# set vlan 30 name VLAN30 Router-1(configure)# set vlan 40 name VLAN40 Router-1(configure)# set vlan 192 name VLAN192</pre>
5.	<p>Enable DHCP relay on the P333R using the ip bootp-dhcp relay command to allow DHCP discovery broadcasts to be forwarded.</p> <pre>Router-1(configure)# ip bootp-dhcp relay</pre>

6.	<p>Create an interface for each VLAN using the interface command. Associate each interface with the appropriate VLAN using the ip vlan name command. Assign an IP address for each interface using the ip address command. The IP address of the DHCP Server was specified for the VLAN 40 interface using the ip bootp-dhcp server command in order to allow DHCP discovery broadcasts to be forwarded to the DHCP Server located on VLAN 30.</p> <pre> Router-1(configure)# interface vlan20 Router-1(config-if:vlan20)# ip vlan name VLAN20 Router-1(config-if:vlan20)# ip address 20.20.42.1 255.255.255.0 Router-1(config-if:vlan20)# exit Router-1(configure)# interface vlan30 Router-1(config-if:vlan30)# ip vlan name VLAN30 Router-1(config-if:vlan30)# ip address 30.30.42.1 255.255.255.0 Router-1(config-if:vlan30)# exit Router-1(configure)# interface vlan40 Router-1(config-if:vlan40)# ip vlan name VLAN40 Router-1(config-if:vlan40)# ip address 40.40.42.1 255.255.255.0 Router-1(config-if:vlan40)# ip bootp-dhcp server 30.30.42.202 Router-1(config-if:vlan40)# exit Router-1(configure)# interface vlan192 Router-1(config-if:vlan192)# ip vlan name VLAN192 Router-1(config-if:vlan192)# ip address 192.168.42.1 255.255.255.0 Router-1(config-if:vlan192)# exit </pre>
7.	<p>Add a static route for the Avaya IP Office Small Office Edition using the ip route command.</p> <pre> Router-1(configure)# ip route 10.10.42.0 255.255.255.0 20.20.42.2 1 Router-1(configure)# exit Router-1# </pre>

6. Configuring the Avaya IP Office Small Office Edition

Step	Description
1.	<p>Define the same extensions on the Avaya IP Office Small Office Edition to match the ones on Avaya Communication Manager to support failover registration. In the Manager window, double-click on Extension under the Configuration Tree. Right-click in the Extension window and click on New to add an <i>Extension</i> for 40001 and enter a unique <i>Extension ID</i> (e.g., 8001). Repeat this to add an <i>Extension</i> for 40002 with a unique <i>Extension ID</i> (e.g., 8002).</p> 

Step	Description
2.	<p>Add a user for each extension created in Step 1 of this section. In the Manager window, double-click on User under the Configuration Tree. Right-click in the User window and click on New to add a user for <i>Extension 40001</i> with a <i>Name</i> of Extn40001. Repeat this for <i>Extension 40002</i> with a <i>Name</i> of Extn40002. Ensure that the <i>Password</i> on the User form for each extension matches the <i>Security Code</i> defined on Avaya Communication Manager for each station (Step 1 of Section 4).</p> 

Step	Description
3.	<p>Add a default route for the Avaya IP Office Small Office Edition.</p> 

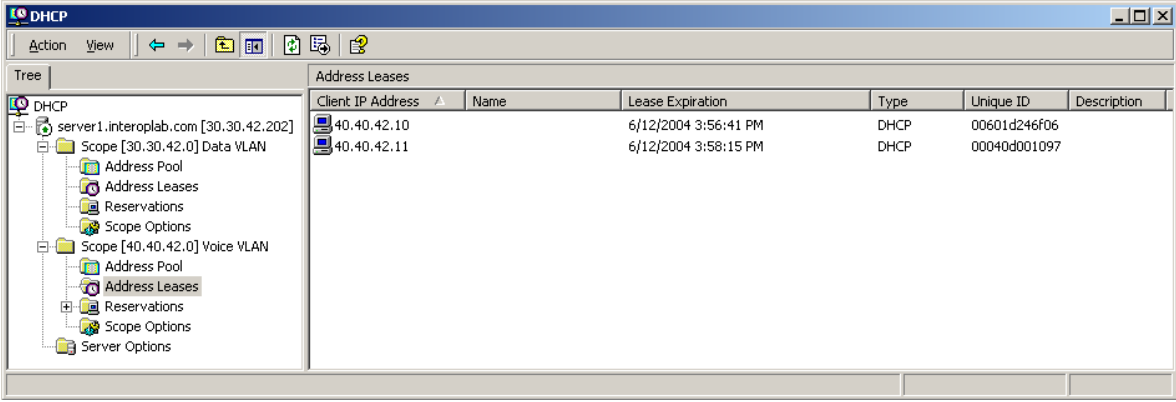
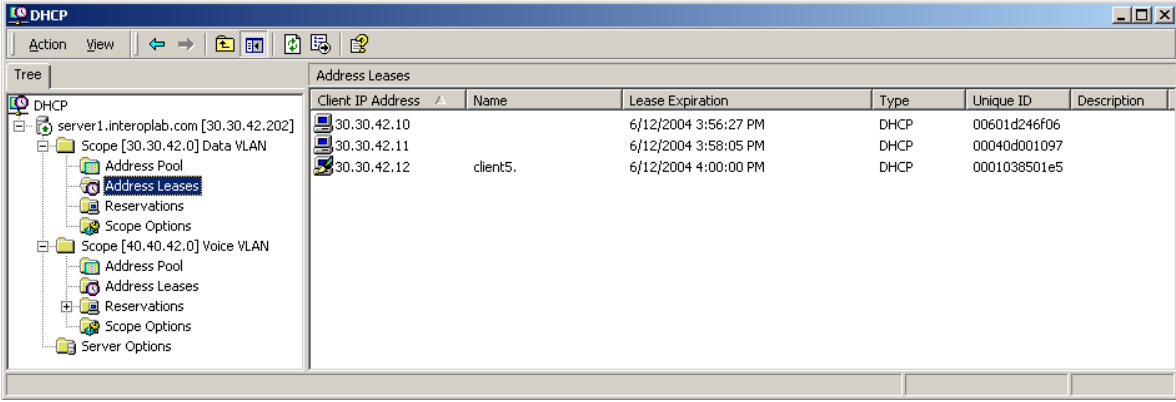
7. Reset the Avaya IP Telephones

The Avaya IP telephones need to be reset in order to request parameters from the DHCP server.

Step	Description
1.	Reset the Avaya 4600 Series IP telephones by pressing the MUTE button followed by the key sequence 73738# (RESET#) with the telephones on-hook and idle.
2.	Press the “#” key when prompted to “Reset Values?”. Enter the extension and password for the telephones when prompted.

8. Verification Steps

Step	Description
1.	Ensure that there is network connectivity to both the Avaya IP Office Small Office Edition and Avaya S8300/G700.
2.	Verify that the IP telephones were able to obtain an IP address and the scope options from the DHCP Server by pressing the MUTE button followed by the key sequence 2337# (ADDR#) while the phones are on-hook and idle, and pressing the “#” key to step through the telephone options listed in Table 1 .
3.	<p>Verify that the PC connected to the IP telephone is able to obtain an IP address from the DHCP Server. The example shown below is from a Windows 2000 PC.</p> <pre>C:\>ipconfig Ethernet adapter Local Area Connection: Connection-specific DNS Suffix . : IP Address. : 30.30.42.12 Subnet Mask : 255.255.255.0 Default Gateway : 30.30.42.1</pre>

Step	Description
4.	<p>Verify on the DHCP Server that the IP telephones were assigned IP addresses from the VLAN 40 (Voice VLAN) scope.</p>  <p>The PC attached to the IP telephone (e.g., client5) shown in Figure 1 is assigned an IP address from the VLAN 30 (Data VLAN) scope.</p> 

Step	Description
5.	<p>Using the IP Office SysMonitor log, verify that the IP telephones register to the Avaya IP Office Small Office Edition. The registration messages will only appear if the trace options for RAS Send and RAS Receive boxes are checked under the H.323 tab for the SysMonitor log filter. Following is an example of the registration messages for extension 40001.</p> <pre> 115377mS RasRx: v=IFace=LAN1, Src=40.40.42.10:49300, Dst=10.10.42.1:1719 peb=0 RasMessage = gatekeeperRequest 115378mS PRN: Recv: GatekeeperRequest 115380mS RasTx: v=Src=10.10.42.1:1719, Dst=40.40.42.10:49300 peb=0 RasMessage = gatekeeperConfirm 115458mS RasRx: v=IFace=LAN1, Src=40.40.42.10:49300, Dst=10.10.42.1:1719 peb=0 RasMessage = registrationRequest 115459mS PRN: Recv: RegistrationRequest reply addr 28282a0a 115460mS PRN: RasServer::OnRRQ --- CallSigProtocol is H323AnnexL_P. Go for IP4600 R2 115461mS PRN: GK: Adding new endpoint 00E0070149D5_40c0c21118c22774 115462mS PRN: User 40001, 28282a0a allowed, bchan 0.0, EI 00E0070149D5_40c0c21118c22774 115462mS PRN: Using IP_Phone 1.80 115464mS RasTx: v=Src=10.10.42.1:1719, Dst=40.40.42.10:49300 peb=0 RasMessage = registrationConfirm </pre>
6.	Disconnect the Ethernet cable from the Avaya IP Office Small Office Edition to the P333R to simulate a network failure. As a result, the IP telephones will now register with Avaya Communication Manager.
7.	<p>Verify the IP telephones register to Avaya Communication Manager using the list registered-ip-stations command.</p> <pre> list registered-ip-stations REGISTERED IP STATIONS Station Set Product Prod Station Net Orig Gatekeeper Ext Type ID Rel IP Address Rgn Port IP Address 40001 4624 IP_Phone 1.800 40.40.42.10 1 192.168.42.23 40002 4612 IP_Phone 1.800 40.40.42.11 1 192.168.42.23 </pre>
8.	Place calls between IP Telephones A and B.

9. Conclusion

These Application Notes described how the Avaya 4600 Series IP Telephones can be configured to register to an alternate call server in the event of a network failure using the site-specific option 176 string specified on a Microsoft DHCP Server. The steps provided do not address all possible configuration scenarios.

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