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Configuring DHCP and TFTP Servers On Avaya G350 and G250 Media Gateways for Avaya IP 4600 Series Telephones - Issue 1.0

Abstract

These Application Notes describe how to configure the DHCP and TFTP servers on Avaya G350 and G250 Media Gateways for Avaya 4600 Series IP Telephones. The Avaya IP Telephones rely on the DHCP and TFTP servers for configuration and firmware upgrade. By configuring these servers on the Media Gateway, external DHCP and TFTP servers are not needed. The DHCP and TFTP Servers configured on the Avaya G350 and G250 Media Gateways can also work with other DHCP and TFTP clients.

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1. Introduction

The Avaya G350 and G250 Media Gateways can be configured as DHCP and TFTP servers for Avaya IP Telephones. When an Avaya 4600 Series IP Telephone is powered up with factory defaults or is reset to the default values by pressing **MUTE 73738#** (**RESET#**), the telephone will function as a DHCP client and sends a DHCP request. After the IP Telephone gets its IP address and the IP address of a TFTP server from the DHCP server, the IP telephone will function as a TFTP client by requesting files from the TFTP server. If the TFTP server has a different version than the IP telephone, the IP telephone will be upgraded by requesting telephone firmware from the TFTP server. The related IP telephone firmware must be placed on the TFTP server for upgrades.

Figure 1 shows the network diagram used in these Application Notes. The DHCP and TFTP servers are configured on the G350 and G250 Media Gateways. Different types of Avaya 4600 Series IP Telephones have been verified. The DHCP and TFTP Servers on the Avaya G350 and G250 Media Gateways can also work with other DHCP and TFTP clients such as Microsoft Windows NT/2000/2003/XP, Red Hat Linux and Sun Solaris. The Avaya H323/SIP VoIP infrastructure shown in **Figure 1** included an Avaya S8500 Media Server with a G650 Media Gateway, an Avaya Converged Communications Server and a configuration HTTP Server.
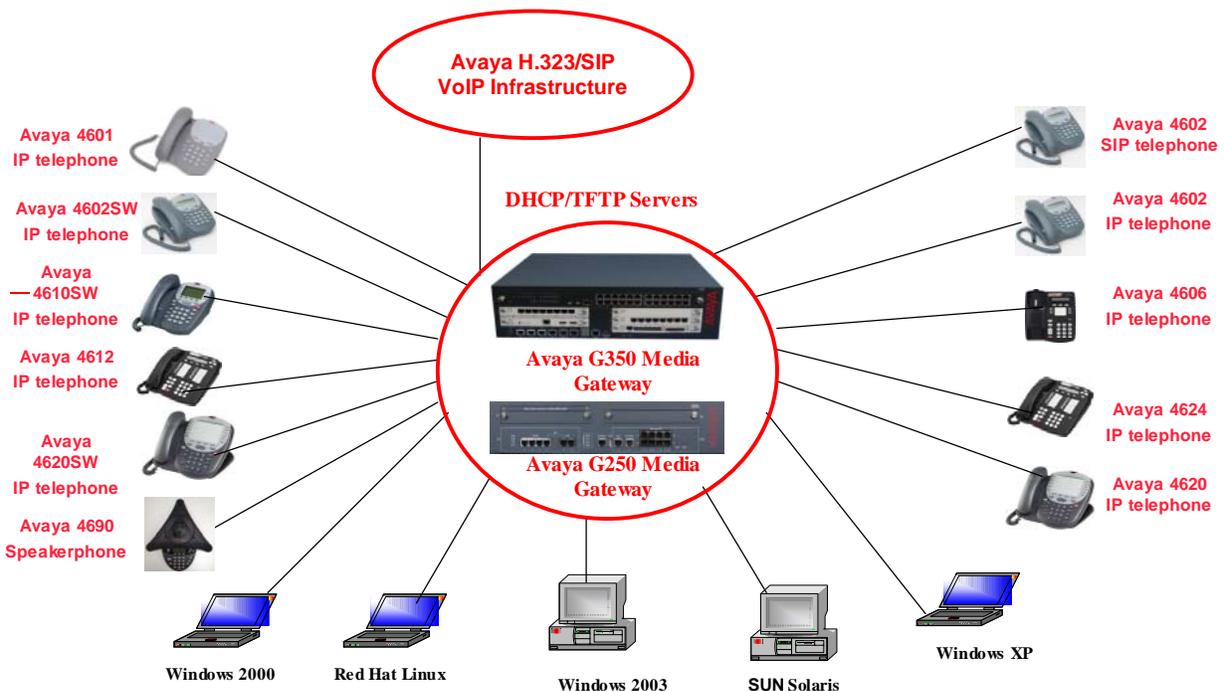

Figure 1: DHCP And TFTP Servers Configuration On G350 and G250 Media Gateways

2. Equipment and Software Validated

The following equipment and software were used for the sample configuration provided.
All of the telephones listed are H.323 telephones unless otherwise specified.

Network Component	Software Version
Avaya G250 Media Gateway	24.6.0
Avaya G350 Media Gateway	23.15.0
Avaya 4601 IP Telephone	1.8.2
Avaya 4602SW SIP Telephone	1.1
Avaya 4602 IP Telephone	1.8.2
Avaya 4602SW IP Telephone	1.8.2
Avaya 4606 IP Telephone	1.8.3
Avaya 4612 Gen-2 IP Telephone	1.8.3
Avaya 4624 Gen-2 IP Telephone	1.8.3
Avaya 4610SW IP Telephone	2.1.3
Avaya 4620 IP Telephone	2.1.3
Avaya 4620SW IP Telephone	2.1.3
Avaya 4690 IP Speakerphone	1.7.7
DHCP/TFTP Clients:	
Microsoft Windows 2000 Professional	5.00.2195
Microsoft Windows XP	Version 2002
Microsoft Windows NT Server	4.00.1381
Microsoft Windows NT Workstation	4.00.1381
Microsoft Windows 2003 Server	Enterprise Edition
Red Hat Linux	Release 9
Sun Solaris	9.1.5

Table 1 - Network Components And Software Versions

3. Configuring DHCP Servers on the G350 and G250 Media Gateways

When a DHCP server is enabled on the Media Gateway, the DHCP server will run on the PMI (Primary Management Interface) interface. Therefore, the PMI interface must be active.

Configurations in Sections 3.1 and 3.2 are based on the following requirements:

- Two VLANs are created on each Media Gateway. All the ports are configured with a native and static VLAN. A static VLAN is configured for the IP telephones and a native VLAN is configured for the other end stations (for example, the attached PC).

- Two DHCP pools are created on each switch. One IP pool is for the data VLAN and the other is for the voice VLAN.

- Option 176 is created for both VLANs. Avaya H.323 IP Telephones use option 176 to obtain their VoIP parameters.

- For Avaya SIP Telephones, option 172 is configured with the IP address of a configuration HTTP server. The IP addresses of the proxy server and registration server are configured in the configuration HTTP server. Configuration of the HTTP server is not covered in these Application Notes.

3.1. Configuring DHCP Server on the G350 Media Gateway

Create VLANs 200 and 201. VLAN 201 is configured for IP telephones, and VLAN 200 is for the other stations. Configure the native VLAN to 200 and static-vlan to 201 for each port.

The following screen shows the configuration. Note that interface "vlan 200" is configured as a PMI interface. The DHCP server will be bound to 192.168.200.1 when it is enabled.

```
set vlan 200 name "data-vlan"
set vlan 201 name "voice-vlan"
set port vlan 200 6/1-24
set port static-vlan 6/1-24 201

interface Vlan 200
 ip address 192.168.200.1   255.255.255.0
 pmi
 exit

interface Vlan 201
 ip address 192.168.201.1   255.255.255.0
 exit
```

The command **ip dhcp-server** is used to enable the DHCP server. By enabling **ip dhcp ping packets**, the Media Gateway will send a ping packet to an IP address before leasing it to a client. A successful ping means the IP address is in use on the network and the DHCP server will not offer it to the client. Instead, the Media Gateway will ping another IP address. If the ping fails and times out (default time out value is 500 ms), the IP address is not in use on the network, the DHCP server will offer it to the client. The command **ip dhcp ping timeout <milliseconds>** can be used to change the time out value. The following screen shows the configuration.

```
ip dhcp-server
ip dhcp ping packets
```

Use the command **ip dhcp pool <index>** to create a DHCP pool. The following shows the options supported on the Media Gateway. The default lease time is 8 days and subnet mask matches the configured network class.

```
G350-001(super)# ip dhcp pool 1
G350-001(super-DHCP 1)# ?
bootfile                      Set the boot file name
client-identifier             Set the client identifier for manual IP address
                              lease
default-router                Set the default router IP addresses (option 3)
dns-server                    Configure the DNS server IP addresses (option 6)
domain-name                   Set the domain-name (option 15)
end-ip-addr                   Set the end IP address of the DHCP pool range
lease                         Set the lease time of the allocated IP address
name                          Set the DHCP pool name
next-server                   Set the next server IP address
no                            No, use 'no help' for more info
option                        Set the DHCP option
server-name                   Set the server name
show                          Show, use 'show help' for more info
start-ip-addr                 Set the start IP address of the DHCP pool range
subnet-mask                   Set the DHCP pool subnet mask (option 1)
vendor-specific-option        Set the vendor-specific option
Universal commands:-
?, exit, help, prompt-length, retstatus, tree.
```

The following screen shows the DHCP pool configuration used in these Application Notes. IP DHCP pool 1 is configured on the network 192.168.200.0/24 with the IP address range from 192.168.200.100 to 192.168.200.200. The default router is configured to 192.168.200.1. IP DHCP pool 2 is configured on the network 192.168.201.0/24 with the IP address range from 192.168.201.100 to 192.168.201.200. The default router is configured to 192.168.201.1.
The command **ip dhcp activate pool <index>** is used to activate a pool**.**

```
ip dhcp pool 1
 name "DHCP Pool for PC"
 start-ip-addr 192.168.200.100
 end-ip-addr 192.168.200.200
 default-router 192.168.200.1
 dns-server 192.168.1.11
 domain-name "interop.avaya.com"
 option 176
  value ascii "L2Q=1,L2QVLAN=201"
 exit
exit
ip dhcp activate pool 1

ip dhcp pool 2
 start-ip-addr 192.168.201.100
 end-ip-addr 192.168.201.200
 default-router 192.168.201.1
option 172
  value ascii "configHttpSrvr=10.1.1.103"
 exit
 option 176
  value ascii "MCIPADD=192.168.88.22,TFTPDIR=/phonedir/,TFTPSRVR=192.168.200.1"
 exit
exit
ip dhcp activate pool 2
```

By default, Avaya 4600 Series H.323 IP Telephones obtain VoIP parameters from site-specific Option 176 configured on the DHCP server. Option 176 must be configured as type ASCII (string). Valid parameters must be configured under Option 176. Please refer to reference [1] in Section 7 for detailed information.

In the sample configuration, when an Avaya IP Telephone is reset, it will initially send an untagged DHCP request. The Media Gateway is configured with both native VLAN 200 and static VLAN 201 for the port connected to the IP telephone. The untagged DHCP request will be associated with the native VLAN on the port. The Media Gateway's IP interface on that VLAN has IP address 192.168.200.1. This IP interface is also the PMI interface on which the DHCP server runs. The DHCP server associates this request with the 192.168.200.0 scope (IP DHCP pool 1) and returns a reply with Option 176 string, instructing the IP telephone to enable 802.1Q tagging with VLAN ID 201. The IP telephone receiving this reply will release the supplied IP address and issue a new DHCP request with VLAN ID 201. This request will be associated with the static VLAN on the port. The router interface of this VLAN has IP address 192.168.201.1 and will relay the DHCP request to the DHCP server with this address as the source. The DHCP server associates this address with scope 192.168.201.0 and replies with an IP address from that scope as well as several parameters in the Option 176 string. **MCIPADD=192.168.88.22** in Option 176 configures the IP address of Avaya Call Server, the IP telephone will register to this IP address. **TFTPSRVR=192.168.200.1** in option 176 configures the TFTP server to the PMI interface of the Media Gateway (See Section 4). The IP telephone will use the TFTP server for firmware upgrades. For version 23.15.0 of the G350 Media Gateway, **TFTPDIR** must be configured to **/phonedir/**. See Section 4 for detailed TFTP server configuration.

By default, Avaya 4602/2602SW SIP Telephones obtain VoIP parameters from site-specific Option 172 configured on the DHCP server. Option 172 must be configured as type ASCII (string). A configuration HTTP server is configured to 10.1.1.103 in the example. A SIP configuration file must be configured on the HTTP server. Please refer to reference [2] for detailed information.

When a computer issues a DHCP request, it will receive an IP address in the DHCP response. The computer will ignore the Options 176 and 172 strings and will not issue a second DHCP request

3.2. Configuring DHCP Server on the G250 Media Gateway

The Avaya G250 and G350 Media Gateways use the same DHCP server configuration. The following shows the DHCP server configuration on the G250 Media Gateway. VLAN 101 is configured for IP telephones, and VLAN 100 is for the other stations. For version 24.6.0 of the G250 Media Gateway, **TFTPDIR** does not need to be configured in Option 176. Since the PMI is configured on VLAN 100, the DHCP server runs on 192.168.100.1.

```
ip dhcp-server
ip dhcp ping packets
ip dhcp pool 1
 start-ip-addr 192.168.100.100
 end-ip-addr 192.168.100.200
 default-router 192.168.100.1
 domain-name "interop.avaya.com"
 option 176
  value ascii "L2Q=1,L2QVLAN=101"
 exit
exit
ip dhcp activate pool 1
ip dhcp pool 2
 start-ip-addr 192.168.101.100
 end-ip-addr 192.168.101.200
 default-router 192.168.101.1
 domain-name "interop.avaya.com"
option 172
  value ascii "configHttpSrvr=10.1.1.103"
 option 176
  value ascii "MCIPADD=192.168.88.22,TFTPSRVR=192.168.100.1"
exit
exit
ip dhcp activate pool 2
ip tftp-server
set vlan 100 name "data-vlan"
set vlan 101 name "voice-vlan"
set port static-vlan 10/3-10 101
set port vlan 101 10/3-10
!
interface Vlan 1
 icc-vlan
 exit
!
interface Vlan 100
 ip address 192.168.100.1   255.255.255.0
 pmi
 exit
!
interface Vlan 101
 ip address 192.168.101.1   255.255.255.0
 exit
!
…
```

4. Configuring TFTP Servers on the G350 and G250 Media Gateways

When a TFTP server is enabled, the TFTP server will run on the PMI (Primary Management Interface) interface. Therefore, the PMI interface must be always up, and cannot be shut down.

If the TFTP server on the Media Gateway is used for the Avaya IP Telephones, the TFTP server Option 176 must be configured to the PMI interface, as shown in Sections 3.1 and 3.2.

IP telephones files must be downloaded to the TFTP server on the Media Gateway from an external TFTP server. The Media Gateway functions as a TFTP client for the download operation. The phone scripts are saved in NVRAM, and the phone images are saved in RAM. After the reset of the Media Gateway, the phone scripts will be kept. However, the phone images will be lost. The IP telephones after upgrades only need the phone scripts and do not need the phone images.

For version 23.15.0 of the G350 Media Gateway, **TFTPDIR** must be configured to **/phonedir/** for Option 176. For version 24.6.0 of the G250 Media Gateway, **TFTPDIR** does not need to be configured.

4.1. Configuring TFTP Server On the G350 Media Gateway

Use the command **ip tftp-server** to enable the TFTP server on the PMI interface.

```
G350-001(super)# ip tftp-server
Done!
```

Download the phone firmware to an external TFTP server. For version 23.15.0, the G350 Media Gateway supports two phone scripts (phone-scriptA and phone-scriptB) and four phone images (phone-imageA, phone-imageB, phone-imageC and phone-imageD).

Use the command **copy tftp phone-scriptA(B) <filename> <ip>** to download the phone script files. 46xxupgrade.scr and 46xxsettings.txt (or 46xxsettings.scr) are two script files used by the 4600 Series IP Telephones. The options in the 46xxsettings file can be administered to add useful functionality to the Avaya IP Telephones. The 46xxupgrade.scr file is used for the upgrade.

The following screen shows how to download these scripts into the Media Gateway. Use the command **erase phone-scriptA(B)** to erase the existing phone scripts. Use the command **show download phone-image-file status** to show the download status. 192.168.89.5 is the IP address of an external TFTP server.

```
G350-001(super)# erase phone-scriptA
Beginning erase operation .... Done!
G350-001(super)# erase phone-scriptb
Beginning erase operation .... Done!
```

```
G350-001(super)# copy tftp phone-scriptA 46xxupgrade.scr 192.168.89.5
Confirmation - do you want to continue (Y/N)? y

Beginning download operation ...
This operation may take up to 20 seconds.
Please refrain from any other operation during this time.
For more information , use 'show download phone-script-file status' command

G350-001(super)# show download phone-script-file status
Module #10
===========
Module          : 10
Source file     : 46xxupgrade.scr
Destination file : phone-ScriptA
Host            : 192.168.89.5
Running state   : Idle
Failure display : (null)
Last warning    : No-warning
Bytes Downloaded : 4088
```

```
G350-001(super)# copy tftp phone-scriptB 46xxsettings.txt 192.168.89.5
Confirmation - do you want to continue (Y/N)? y

Beginning download operation ...
This operation may take up to 20 seconds.
Please refrain from any other operation during this time.
For more information , use 'show download phone-script-file status' command

G350-001(super)# show download phone-script-file status
Module #10
===========
Module          : 10
Source file     : 46xxsettings.txt
Destination file : phone-ScriptB
Host            : 192.168.89.5
Running state   : Idle
Failure display : (null)
Last warning    : No-warning
```

Based on the types of the IP telephones used, download the appropriate phones images. The image names for each type of IP telephone can be found in the **46xxreadme** file. For example, a20d01b2_1_3.bin and b20d01b2_1_3.bin are the phone images for release 2.1.13 of the 4620SW IP Telephones. The following screen shows how to download these images to the Media Gateway. Use the command **show download phone-image-file status** to show the download status.

```
G350-001(super)# copy tftp phone-imageA a20d01b2_1_3.bin 192.168.89.5
Confirmation - do you want to continue (Y/N)? y
Beginning download operation ...
This operation may take up to 20 seconds.
Please refrain from any other operation during this time.
For more information , use 'show download phone-image-file status' command

G350-001(super)# show download phone-image-file status
Module #10
===========
Module          : 10
Source file     : a20d01b2_1_3.bin
Destination file : phone-ImageA
Host            : 192.168.89.5
Running state   : Idle
Failure display : (null)
Last warning    : No-warning
Bytes Downloaded : 1943386
```

```
G350-001(super)# copy tftp phone-imageB b20d01b2_1_3.bin 192.168.89.5
Confirmation - do you want to continue (Y/N)? y

Beginning download operation ...
This operation may take up to 20 seconds.
Please refrain from any other operation during this time.
For more information , use 'show download phone-image-file status' command

G350-001(super)# show download phone-image-file status
Module #10
===========
Module          : 10
Source file     : b20d01b2_1_3.bin
Destination file : phone-ImageB
Host            : 192.168.89.5
Running state   : Idle
Failure display : (null)
Last warning    : No-warning
Bytes Downloaded : 2833387
```

4.2. Configuring TFTP Server on the G250 Media Gateway

The G250 and G350 Media Gateways use the same configuration for the TFTP server, refer to Section 4.1 for the detailed TFTP server configuration. For version 24.6.0, the G250 supports four phone scripts and six phone images as shown in the following screen.

```
G250-???(super)# copy tftp ?
Copy tftp commands:
-------------------------------------------------------------------------
copy tftp SW_imageA          Download a File (using tftp) to Bank A
copy tftp SW_imageB          Download a File (using tftp) to Bank B
copy tftp auth-file          Download an authentication file (using tftp)
copy tftp license-file       Download file (using tftp) to license
copy tftp phone-imageA       Download a file (using tftp) to phone image bank A
copy tftp phone-imageB       Download a file (using tftp) to phone image bank B
copy tftp phone-imageC       Download a file (using tftp) to phone image bank C
copy tftp phone-imageD       Download a file (using tftp) to phone image bank D
copy tftp phone-imageE       Download a file (using tftp) to phone image bank E
copy tftp phone-imageF       Download a file (using tftp) to phone image bank F
copy tftp phone-scriptA      Download a file (using tftp) to phone script bank A
copy tftp phone-scriptB      Download a file (using tftp) to Phone Script Bank B
copy tftp phone-scriptC      Download a file (using tftp) to Phone Script Bank C
copy tftp phone-scriptD      Download a file (using tftp) to Phone Script Bank D
copy tftp startup-config     Download a file (using tftp) to startup configuration
```

5. Verification Steps

The DHCP and TFTP servers run on the PMI interface. The PMI interface must be active. Use the command **show pmi** to display the primary management interface.

```
G350-001(super)# show pmi
Active PMI    : interface Vlan 200                        (192.168.200.1)
Configured PMI : interface Vlan 200                       (192.168.200.1)
```

Use the command **show ip interface** to verify that the PMI is up.

```
G350-001(super)# show ip interface vlan 200
Showing 1 Interfaces
Vlan 200 is up
 Internet address is 192.168.200.1  , subnet mask is 255.255.255.0
 Broadcast address is 192.168.200.255
 Directed broadcast forwarding is disabled
 Proxy ARP is disabled
 OSPF is enabled
 Primary management IP interface
```

5.1. Verification Steps For the DHCP Sever

Use the command **show ip dhcp-serve**r to verify the DHCP server status. The following screen shows that the DHCP server is enabled, ping packet (used for conflict detection) is enabled and the ping time out is 500 ms.

```
G350-001(super)# show ip dhcp-server
Mode:                      Enable
Ping Packets:              Enable
Ping Timeout:              500 ms
```

Use the command **show ip dhcp-pool <index>** to show the pool configuration.

```
G350-001(super)# show ip dhcp-pool 2
Index          Name
-------        ------------------
2              DHCP pool #2
Mode:          Active
Start IP Address Range: 192.168.201.100
End IP Address Range:   192.168.201.200
Lease Time:             8 days 0 hours 0 minutes 0 seconds
BootFile:               N/A
Next-Server:            N/A
Client-Identifier:      N/A
Server-Name:            N/A
DHCP options
Option Num              1              Name      subnet-mask
Value                   255.255.255.0

Option Num              3              Name      default-router
Value                   192.168.201.1
Option Num              176            Name      Option #176
Value              MCIPADD=192.168.88.22,TFTPDIR=/phonedir/,TFTPSRVR=192.168.200.1
```

Use the command **show ip dhcp-server bindings** to view client-binding information. A leased IP address is associated with a client's MAC address. The expired IP addresses can be offered to another DHCP client when all the other IP addresses have been used. The expired IP addresses in the following screen correspond to the released IP addresses on the native VLAN from the IP telephones.

```
G350-001(super)# show ip dhcp-server bindings
IP Address        Lease Expiration    Type       Client-Identifier
                  (D:H:M:S)
---------------   ------------------  ---------  ----------------------------
192.168.200.100   Expired             Automatic  01:00:04:0d:4b:d8:5d
192.168.200.101   Expired             Automatic  01:00:09:6e:02:68:d2
192.168.200.102   Expired             Automatic  01:00:04:0d:4b:76:9c
192.168.201.100   7:23:59:35          Automatic  01:00:04:0d:4b:76:9c
192.168.201.101   7:23:56:10          Automatic  01:00:04:0d:4b:d8:5d
192.168.201.102   7:23:57:20          Automatic  01:00:09:6e:02:68:d2
```

Use the command **show ip dhcp-server statistics** to view the DHCP statistics information.

```
G350-001(super)# show ip dhcp-server statistics
Counter               Value
--------------        ----------
BOOTP Requests        0
DHCP  Discover        12
DHCP  Requests        11
DHCP  Declines        0
DHCP  Releases        8
DHCP  Informs         0

BOOTP Replies         0
DHCP  Offers          12
DHCP  Acks            11
DHCP  Nacks           0
```

5.2. Verification Steps For the TFTP Sever

Verify that the TFTP server is enabled on the Media Gateway using the command **show protocol**.

```
G350-001(super)# show protocol
  Protocols          Status
------------       --------
SSH                  ON
TELNET-CLIENT        OFF
SNMPv1               ON
SNMPv3               ON
TELNET               ON
HTTP                 ON
recovery-password    ON
ftp-client           ON
DHCP                 ON
TFTP                 ON
```

Use the command **show ip tftp-server files** to show all the files in the TFTP server.

```
G350-001(super)# show ip tftp-server files
            File                        Bank          Location       Size
(Bytes)
--------------------------------  ---------------  -------------  ----------
46xxupgrade.scr                   phone-ScriptA    Nv-Ram         4088
46xxsettings.txt                  phone-ScriptB    Nv-Ram         12896
a20d01b2_1_3.bin                  phone-ImageA     Ram            1943386
b20d01b2_1_3.bin                  phone-ImageB     Ram            2833387

Nv-Ram:
Total bytes used:                 16984
Total bytes free:                 114088
Total bytes capacity(fixed)       131072

Ram:
Total bytes used:                 4793757
Total bytes free:                 14211683
Total bytes capacity (Allocated)  19005440
Total bytes capacity (Configured) 19005440
```

5.3. Verification Steps For Avaya IP Telephones

Connect Avaya 4600 IP Telephones to the Media Gateway. Verify that the IP telephone can obtain their IP addresses from the DHCP server. Use the command **show ip dhcp-server bindings** to verify that the telephones received their IP addresses from the DHCP server on the voice VLAN. Verify that the IP telephones can obtain the 46xxupgrade.scr and 46xxsettings.txt files from the TFTP server, and then upgrade if the telephones have different versions from the TFTP server. Press **MUTE 2337#** (**ADDR#**) or **MUTE 8439** (**VIEW#**) on the IP telephone to verify the configurations. Verify that the IP telephone can register to the Avaya Communication Server successfully.

6. Conclusion

The DHCP and TFTP servers configured on the G350 and G250 Media Gateways can be used for Avaya 4600 Series IP Telephones, and other DHCP and TFTP clients successfully. The TFTP server on the G350 and G250 media Gateways does not support the upgrade of the Avaya 4630/4630SW IP Telephone. Since the DHCP and TFTP servers run on the PMI, the PMI must not be shut down.

7. References

[1] *4600 Series IP Telephone R2.1 LAN Administrator's Guide*, Issue 2.2, Document ID 555-233-507.

[2] *4602 SIP Telephone R1.2 Administrator's Guide*, Issue 1.2, Document ID 16-3000037.

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