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Avaya Solution & Interoperability Test Lab

Application Notes for Configuring BroadSoft BroadWorks with Avaya SIP Enablement Services and Avaya Communication Manager – Issue 1.0

Abstract

These Application Notes describe the procedures for configuring BroadSoft BroadWorks with Avaya SIP Enablement Services (SES) and Avaya Communication Manager.

BroadSoft BroadWorks is a SIP application server offering a wide variety of applications to fixed-line and wireless service providers including Hosted PBX, Mobile PBX, Business Trunking, IP Centrex and Residential Broadband. For the purposes of the compliance test, BroadWorks was configured as a Hosted IP PBX. The compliance testing focused on SIP interoperability between BroadWorks and the Avaya SIP infrastructure.

Information in these Application Notes has been obtained through DevConnect compliance testing and additional technical discussions. Testing was conducted via the DevConnect Program at the Avaya Solution and Interoperability Test Lab.

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BroadWorks-SES

1. Introduction

These Application Notes describe the procedures for configuring BroadSoft BroadWorks with Avaya SIP Enablement Services (SES) and Avaya Communication Manager.

BroadSoft BroadWorks is a SIP application server offering a wide variety of applications to fixed-line and wireless service providers including Hosted PBX, Mobile PBX, Business Trunking, IP Centrex and Residential Broadband. For the purposes of the compliance test, BroadWorks was configured as a Hosted IP PBX. The compliance testing focused on SIP interoperability between BroadWorks and the Avaya SIP infrastructure.

1.1. Configuration

Figure 1 illustrates the test configuration. The test configuration shows two locations with different SIP domains connected across the Internet. Location 1 has an Avaya SES which controls the SIP domain avremote.com. Also, located at location 1 is Avaya Communication Manager running on an Avaya S8500B Server with an Avaya G650 Media Gateway. Endpoints include both SIP and non-SIP endpoints. Avaya Communication Manager serves as the HTTP server used by IP endpoints that require the download of a configuration file. The Avaya SES is the license server for the Avaya one-X™ Desktop Edition.

Location 2 has a BroadWorks application server which performs SIP proxy and registrar functions for SIP domain as.iop1.broadworks.net. Endpoints include two Avaya 9600 Series IP Telephones with SIP firmware that register directly to BroadWorks. In a real customer configuration, location 2 represents a second enterprise location or a SIP service provider. No PSTN access or non-SIP endpoints were used at Location 2 since this would require additional third-party equipment which is outside the scope of these Application Notes. Communication between the two locations is via a SIP trunk between BroadWorks and Avaya SES.
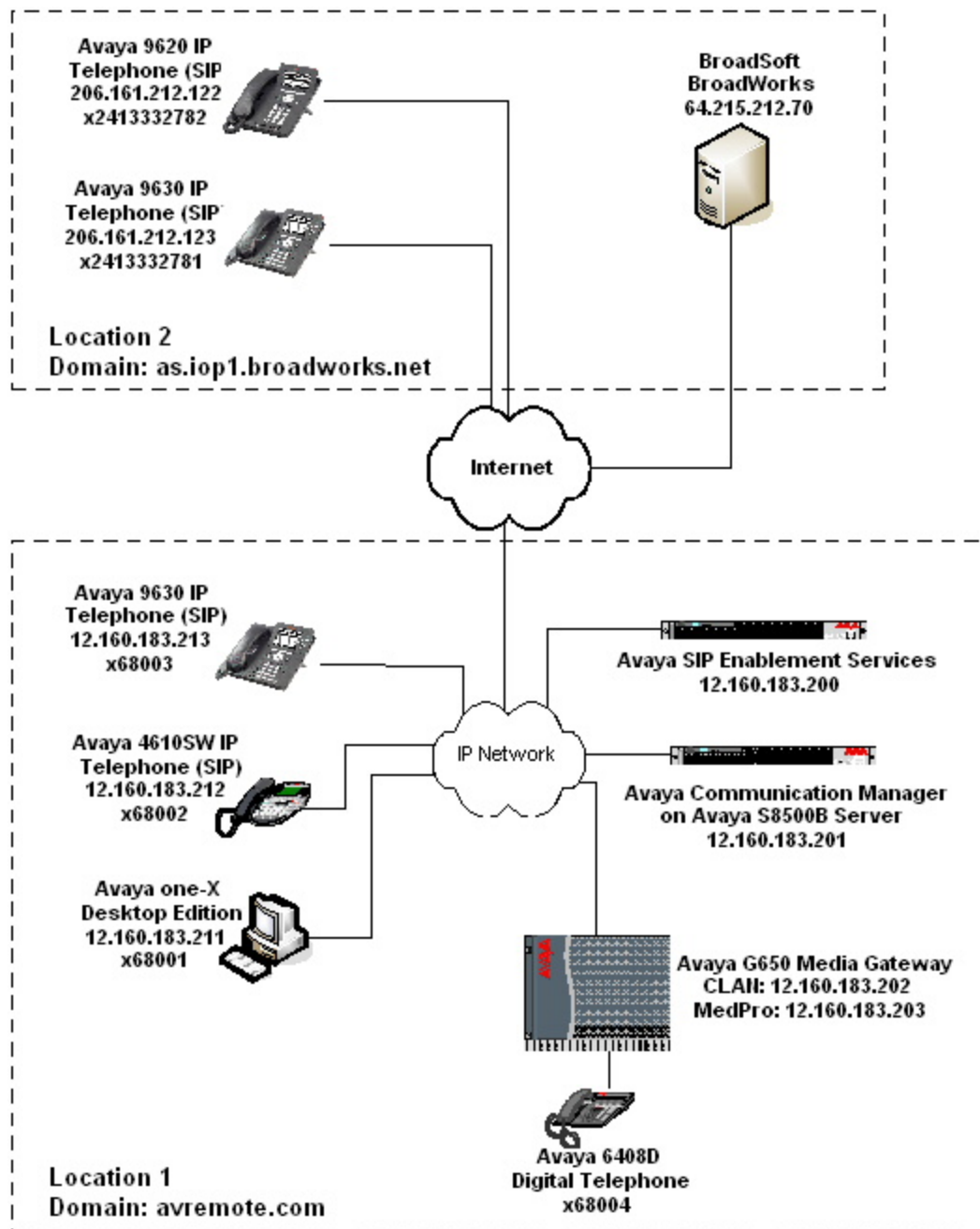
Figure 1: BroadWorks Test Configuration

2. Equipment and Software Validated

The following equipment and software/firmware were used for the sample configuration provided:

Equipment	Software/Firmware
Avaya Communication Manager on Avaya S8500B Server	4.0.1 (R014x.00.1.731.2)

Avaya G650 Media Gateway
   IPSI (TN2312BP)
   CLAN (TN799DP)
   MedPro (TN2302AP)
	
	HW26 FW36
	HW13 FW21
	HW21 FW110

Avaya SIP Enablement Services on Avaya S8500B Server	4.0 (SES-4.0.0.0-033.6)
Avaya 4610SW IP Telephone	SIP version 2.2.2
Avaya 9620 IP Telephone Avaya 9630 IP Telephone	Avaya one-X Deskphone SIP 1.0 Service Pack 1
Avaya one-X Desktop Edition	2.1 SP1 (Build 70) (Windows XP Professional)
Avaya 6408D Digital Telephone	-
BroadSoft BroadWorks	14.SP2

Table 1: Equipment Used

3. Configure Avaya Communication Manager

This section describes the Avaya Communication Manager configuration. It assumes the procedures necessary to support SIP have been performed as described in [3]. It also assumes that an off-PBX station (OPS) has been configured on Avaya Communication Manager for each SIP endpoint in the configuration as described in [3] and [4].

This section is divided into two parts. **Section 3.1** will summarize some of the user-defined parameters used in the installation procedures that are important to understanding the solution as a whole. It will not attempt to show the installation procedures in their entirety. It will also describe any deviations from the standard procedures, if any.

Section 3.2 will describe procedures beyond the initial SIP installation procedures that are necessary for interoperating with BroadWorks.

The configuration of Avaya Communication Manager was performed using the System Access Terminal (SAT). After the completion of the configuration, perform a **save translation** command to make the changes permanent.

3.1. Summary of Initial SIP Installation

This section summarizes the applicable user-defined parameters used during the SIP installation procedures.

Step	Description
1.	**IP network region** The Avaya Media Gateway components (CLAN and Medpro), Avaya SES and SIP endpoints were located in a single IP network region (IP network region 1) using the parameters described below. Use the **display ip-network-region** command to view these settings. The example below shows the values used for the compliance test. ▪ **Authoritative Domain**: *avremote.com* This field was configured to match the domain name configured on Avaya SES. This name will appear in the "From" header of SIP messages originating from this IP region. ▪ **Name**: *Main* Any descriptive name may be used. ▪ **Intra-region IP-IP Direct Audio**: *yes* **Inter-region IP-IP Direct Audio**: *yes* IP-IP direct audio (media shuffling) was enabled to allow audio traffic to be sent directly between IP endpoints without using media resources in the Avaya Media Gateway. Shuffling can be further restricted at the trunk level on the **Signaling Group** form. ▪ **Codec Set**: *1* The codec set contains the set of codecs available for calls within this IP network region. This includes SIP calls since all necessary components are within the same region.

```
display ip-network-region 1                                    Page   1 of  19
                             IP NETWORK REGION
  Region: 1
Location:              Authoritative Domain: avremote.com
    Name: Main
MEDIA PARAMETERS                      Intra-region IP-IP Direct Audio: yes
      Codec Set: 1                    Inter-region IP-IP Direct Audio: yes
   UDP Port Min: 2048                              IP Audio Hairpinning? n
   UDP Port Max: 3329
DIFFSERV/TOS PARAMETERS                       RTCP Reporting Enabled? y
 Call Control PHB Value: 46        RTCP MONITOR SERVER PARAMETERS
       Audio PHB Value: 46          Use Default Server Parameters? y
       Video PHB Value: 26
802.1P/Q PARAMETERS
 Call Control 802.1p Priority: 6
       Audio 802.1p Priority: 6
       Video 802.1p Priority: 5     AUDIO RESOURCE RESERVATION PARAMETERS
H.323 IP ENDPOINTS                                    RSVP Enabled? n
  H.323 Link Bounce Recovery? y
 Idle Traffic Interval (sec): 20
   Keep-Alive Interval (sec): 5
             Keep-Alive Count: 5
```

Step	Description

2.	**Codecs**
	IP codec set 1 was used for the compliance test. Multiple codecs were listed in priority order to allow the codec used by a specific call to be negotiated during call establishment. The list includes the codecs the enterprise wishes to support within the normal trade-off of bandwidth versus voice quality. The example below shows the values used in the compliance test. It should be noted that when testing the use of G.729, G.711MU was removed from the list.
	
	<pre>display ip-codec-set 1 Page 1 of 2
	
	                     IP Codec Set
	
	    Codec Set: 1
	
	    Audio Silence Frames Packet
	    Codec Suppression Per Pkt Size(ms)
	 1: G.711MU n 2 20
	 2: G.729A n 2 20
	 3:</pre>

Step	Description

3.	**Signaling Group**
	
	For the compliance test, signaling group 1 was used for the signaling group associated with the SIP trunk group between Avaya Communication Manager and Avaya SES. Signaling group 1 was configured using the parameters highlighted below. All other fields were set as described in [3].
	
	▪ **Near-end Node Name**: *clan1* This node name maps to the IP address of the CLAN in the Avaya G650 Media Gateway. Node names are defined using the **change node-names ip** command.
	▪ **Far-end Node Name**: *ses* This node name maps to the IP address of Avaya SES.
	▪ **Far-end Network Region**: *1* This defines the IP network region which contains Avaya SES.
	▪ **Far-end Domain**: blank This domain will default to the domain specified in the IP network region form in **Step 1.** This domain is sent in the "To" header of SIP messages of calls using this signaling group.
	
	<pre>display signaling-group 1
	                             SIGNALING GROUP
	
	 Group Number: 1 Group Type: sip
	                       Transport Method: tls
	
	  Near-end Node Name: clan1 Far-end Node Name: ses
	 Near-end Listen Port: 5061 Far-end Listen Port: 5061
	                                  Far-end Network Region: 1
	       Far-end Domain:
	
	                                  Bypass If IP Threshold Exceeded? n
	
	       DTMF over IP: rtp-payload Direct IP-IP Audio Connections? y
	                                          IP Audio Hairpinning? n
	 Enable Layer 3 Test? n
	 Session Establishment Timer(min): 3</pre>

Step	Description

4.	**Trunk Group**
	For the compliance test, trunk group 1 was used for the SIP trunk group between Avaya Communication Manager and Avaya SES. Trunk group 1 was configured using the parameters highlighted below. All other fields were set as described in [3].
	▪ **Signaling Group**: *1* This field is set to the signaling group shown in the previous step.
	▪ **Number of Members:** *10* This field represents the number of trunks in the SIP trunk group. It determines how many simultaneous SIP calls can be supported by the configuration. Each SIP call between two SIP endpoints (whether internal or external) requires two SIP trunks for the duration of the call. Thus, a call from a SIP telephone to another SIP telephone will use two SIP trunks. A call between a non-SIP telephone and a SIP telephone will only use one trunk.
	
	<pre>display trunk-group 1 Page 1 of 21
	                            TRUNK GROUP
	
	Group Number: 1 Group Type: sip CDR Reports: y
	  Group Name: SES COR: 1 TN: 1 TAC: 101
	   Direction: two-way Outgoing Display? n
	 Dial Access? n Night Service:
	Queue Length: 0
	Service Type: tie Auth Code? n
	
	                                                   Signaling Group: 1
	                                                Number of Members: 10</pre>

5.	**Trunk Group – continued**
	On **Page 3**:
	▪ Verify the **Numbering Format** field is set to *public*. This field specifies the format of the calling party number sent to the far-end.
	▪ The default values may be retained for the other fields.
	
	<pre>display trunk-group 1 Page 3 of 21
	TRUNK FEATURES
	        ACA Assignment? n Measured: none
	                                                       Maintenance Tests? y
	
	                        Numbering Format: public
	                                             UUI Treatment: service-provider
	
	                                             Replace Unavailable Numbers? n
	
	  Show ANSWERED BY on Display? y</pre>

Step	Description

6.	**Public Unknown Numbering**
	Use the **change public-unknown-numbering 0** command to define the calling party number to be sent to the far-end. Add an entry for the trunk group defined in **Step 4**. In the example shown below, all calls originating from a 5-digit extension beginning with 68 and routed across trunk group 1 will be sent as a 5 digit calling number. This calling party number will be sent to the far-end in the SIP "From" header.
	
	<pre>change public-unknown-numbering 0 Page 1 of 2
	                    NUMBERING - PUBLIC/UNKNOWN FORMAT
	                                        Total
	Ext Ext Trk CPN CPN
	Len Code Grp(s) Prefix Len
	                                                 Total Administered: 2
	 5 68 1 5 Maximum Entries: 9999</pre>

3.2. Configure SIP Trunk and Routing to BroadWorks

To communicate to BroadWorks, a second SIP trunk with the appropriate call routing must be configured on Avaya Communication Manager. This SIP trunk will be used to route SIP calls to Avaya SES that are destined to the BroadWorks SIP domain.

Step	Description

1.	**Signaling Group**
	For the compliance test, signaling group 2 was used for the signaling group associated with the SIP trunk group defined for BroadWorks calls (see **Step 2**). Signaling group 2 was configured using the same parameters as signaling group 1 in **Section 3.1** with the exception of the far-end domain. The **Far-end Domain** field is set to the domain of the BroadWorks server, *as.iop1.broadworks.net*.
	
	<pre>display signaling-group 2
	                             SIGNALING GROUP
	
	  Group Number: 2 Group Type: sip
	                        Transport Method: tls
	
	   Near-end Node Name: clan1 Far-end Node Name: ses
	 Near-end Listen Port: 5061 Far-end Listen Port: 5061
	                                    Far-end Network Region: 1
	        Far-end Domain: as.iop1.broadworks.net
	
	                                        Bypass If IP Threshold Exceeded? n
	
	         DTMF over IP: rtp-payload Direct IP-IP Audio Connections? y
	                                               IP Audio Hairpinning? n
	 Enable Layer 3 Test? n
	 Session Establishment Timer(min): 3</pre>

2.	**Trunk Group**
	For the compliance test, trunk group 2 was used for the SIP trunk group defined for BroadWorks calls. Trunk group 2 was configured using the same parameters as trunk group 1 in **Section 3.1** except the **Signaling Group** field is set to 2. This includes the settings on **Page 3** of the trunk group form (not shown).
	
	<pre>display trunk-group 2 Page 1 of 21
	                           TRUNK GROUP
	
	Group Number: 2 Group Type: sip CDR Reports: y
	  Group Name: Trk2 COR: 1 TN: 1 TAC: 102
	   Direction: two-way Outgoing Display? n
	 Dial Access? n Night Service:
	Queue Length: 0
	Service Type: tie Auth Code? n
	
	                                        Signaling Group: 2
	                                      Number of Members: 10</pre>

Step	Description

3.	**Public Unknown Numbering**
	Use the **change public-unknown-numbering 0** command to define the calling party number to be sent to the far-end. Add a new entry for the trunk group defined in **Step 2**. In the example shown below, all calls originating from a 5-digit extension beginning with 68 and routed across trunk group 2 will be sent as an 11 digit calling number with prefix 173245. This calling party number will be sent to the far-end in the SIP "From" header.
	
	<pre>change public-unknown-numbering 0 Page 1 of 2
	                  NUMBERING - PUBLIC/UNKNOWN FORMAT
	                                            Total
	Ext Ext Trk CPN CPN
	Len Code Grp(s) Prefix Len
	                                                  Total Administered: 2
	 5 68 2 173245 11 Maximum Entries: 9999
	 5 68 1 5</pre>

4.	**Automatic Route Selection**
	Automatic Route Selection (ARS) was used to route calls to BroadWorks. In the compliance test, numbers that begin with 1241333 were used for testing.
	
	The **change ars analysis *n*** command was used to add an entry in the ARS Digit Analysis Table for the dialed string beginning with ***n***. In the example shown, numbers that begin with 1241333 and 11 digits long use route pattern 990. Route pattern 990 routes calls to the SIP trunk defined for BroadWorks calls.
	
	<pre>display ars analysis 124 Page 1 of 2
	                     ARS DIGIT ANALYSIS TABLE
	                       Location: all Percent Full: 1
	
	        Dialed Total Route Call Node ANI
	        String Min Max Pattern Type Num Reqd
	     124 11 11 deny fnpa n
	     1241333 11 11 990 fnpa n
	     125 11 11 deny fnpa n</pre>

Step	Description

5.	**Route Pattern**
	For the compliance test, route pattern 990 was used for calls destined for BroadWorks. Route pattern 990 was configured using the parameters highlighted below.
	▪ **Pattern Name**: Any descriptive name.
	▪ **Grp No**: *2* This field is set to the trunk group number defined in **Step 2**.
	▪ **FRL**: *0* This field is the Facility Restriction Level of the trunk. It must be set to an appropriate level to allow authorized users to access the trunk. The level of 0 is the least restrictive.
	
	<pre>display route-pattern 990 Page 1 of 3
	                  Pattern Number: 990 Pattern Name: Compliance
	                           SCCAN? n Secure SIP? n
	    Grp FRL NPA Pfx Hop Toll No. Inserted DCS/ IXC
	    No Mrk Lmt List Del Digits QSIG
	                         Dgts Intw
	 1: 2 0 n user
	 2: n user
	 3: n user
	 4: n user
	 5: n user
	 6: n user
	
	     BCC VALUE TSC CA-TSC ITC BCIE Service/Feature PARM No. Numbering LAR
	     0 1 2 M 4 W Request Dgts Format
	                                                          Subaddress
	 1: y y y y y n n rest none
	 2: y y y y y n n rest none
	 3: y y y y y n n rest none
	 4: y y y y y n n rest none
	 5: y y y y y n n rest none
	 6: y y y y y n n rest none</pre>

6.	**Incoming Call Treatment**
	The **change inc-call-handling-trmt trunk-group** *n* command was used to map an incoming number to a destination endpoint, where *n* is the trunk group number connected to BroadWorks. The compliance test used trunk group 2 to connect to BroadWorks. The example below shows any incoming 10-digit numbers will have the first 5 digits deleted, leaving the 5 digit extension of the destination station to be routed by Avaya Communication Manager.
	
	<pre>change inc-call-handling-trmt trunk-group 2 Page 1 of 30
	                    INCOMING CALL HANDLING TREATMENT
	    Service/ Called Called Del Insert
	    Feature Len Number
	    tie 10 5</pre>

4. Configure Avaya SIP Enablement Services

This section covers the configuration of Avaya SES. Avaya SES is configured via an Internet browser using the administration web interface. It is assumed that the Avaya SES software and the license file have already been installed on the server. During the software installation, an installation script is run from the Linux shell of the server to specify the IP network properties of the server along with other parameters. In addition, it is assumed that the setup screens of the administration web interface have been used to initially configure Avaya SES. For additional information on these installation tasks, refer to [5].
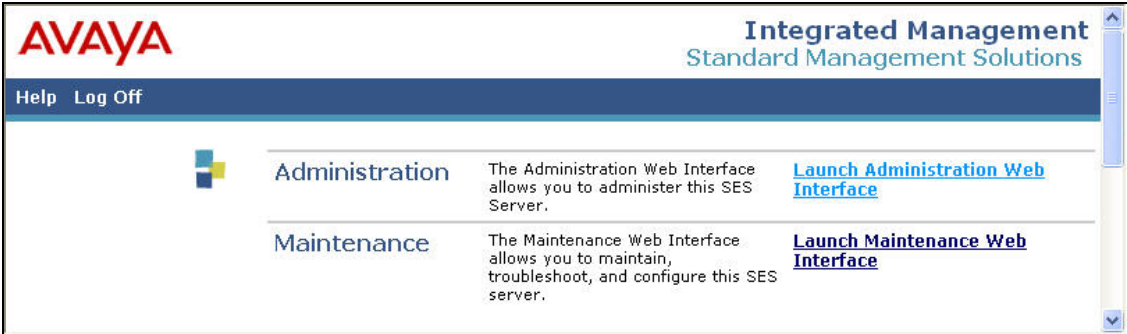
Each SIP endpoint used in the compliance test that registers with Avaya SES requires that a user and media server extension be created on Avaya SES. This configuration is not directly related to the interoperability of BroadWorks so it is not included here. These procedures are covered in [5].

This section is divided into two parts. **Section 4.1** will summarize some of the user-defined parameters used in the installation procedures that are important to understanding the solution as a whole. It will not attempt to show the installation procedures in their entirety. It will also describe any deviations from the standard procedures, if any.

Section 4.2 will describe procedures beyond the initial SIP installation procedures that are necessary for interoperating with BroadWorks.

4.1. Summarize Initial Configuration Parameters

This section summarizes the applicable user-defined parameters used during the SIP installation procedures.
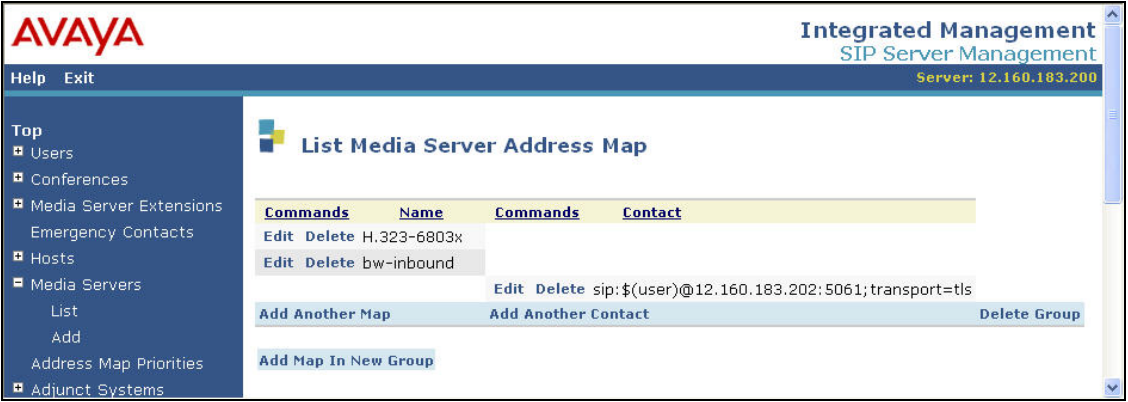
Step	Description
1.	**Login** Access the Avaya SES administration web interface by entering http://*<ip-addr>*/admin as the URL in an Internet browser, where *<ip-addr>* is the IP address of the Avaya SES server. Log in with the appropriate credentials and then select the **Launch Administration Web Interface** link from the main page as shown below.

Step	Description
2.	**Top Page** The Avaya SES **Top** page will be displayed as shown below. If any changes are made within Avaya SES, an **Update** link appears in the menu options at the top of the page. It is necessary to click this link to commit the pending changes to the database.
3.	**Initial Configuration Parameters** As part of the Avaya SES installation and initial configuration procedures, the following parameters were defined. Although these procedures are out of the scope of these Application Notes, the values used in the compliance test are shown below for reference. After each parameter is a brief description of how to view the value from the Avaya SES administration home page shown in the previous step. - SIP Domain: ***avremote.com*** (To view, navigate to **Server Configuration→System Parameters**) - Host (SES IP address): ***12.160.183.200*** (To view, navigate to **Host→List**; click **Edit**) - Host Type: ***home/edge*** (To view, navigate to **Host→List**; click **Edit**) - Media Server (Avaya Communication Manager) Interface Name: ***cmremote1*** (To view, navigate to **Media Server→List**; click **Edit**) - SIP Trunk IP Address (CLAN IP address): ***12.160.183.202*** (To view, navigate to **Media Server→List**; click **Edit**)
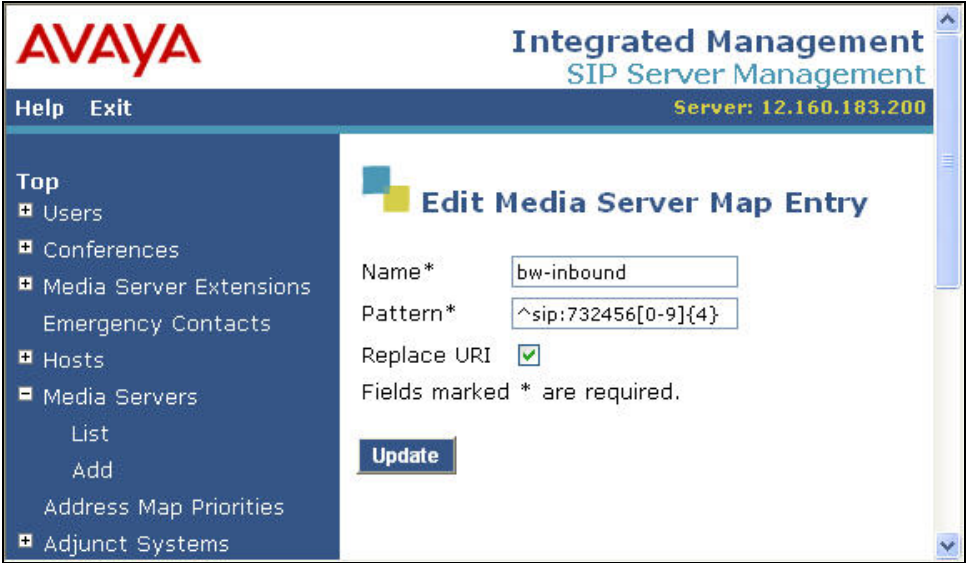
4.2. BroadWorks Specific Configuration

This section describes additional Avaya SES configuration necessary for interoperating with BroadWorks.

Step	Description
1.	**Trusted Host** The IP address of BroadWorks must be configured as a trusted host in Avaya SES so that SIP messages from BroadWorks are not challenged by Avaya SES. To add a trusted host, navigate to **Trusted Hosts → Add** from the left pane of the Avaya SES window. The **Add Trusted Host** screen will appear. Enter the parameters as described below: • **IP Address**: The IP address of BroadWorks. • **Host**: The IP address of Avaya SES. • **Comment**: Any descriptive comment.

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BroadWorks-SES

Step	Description
2.	**Media Server Address Map** A media server address map is needed to route calls from location 2 to a non-SIP phone at location 1. This is because neither the caller nor the called party is a registered user on Avaya SES with a media server extension assigned to it. Thus, Avaya SES does not know to route this call to Avaya Communication Manager. Thus to accomplish this task, a media server address map is created. To configure a media server address map: • Navigate to **Media Server→List** in the left pane. In the **List Media Servers** window that appears (not shown), click on the **Map** link next to the host name of Avaya Communication Manager. • The **List Media Server Address Map** window will appear as shown below. If no other maps exist, click **Add Map In New Group**. If adding another map for the same media server, click **Add Another Map**. In either case, a window similar to the one shown in **Step 3** will appear, for entering the map data. The example below shows the media server address map, named ***bw-inbound***, after it was created. To view or edit the contents of the map, click the **Edit** link next to the map name (see **Step 3**). After configuring the map, the initial **Contact** information is populated automatically and directs the calls to the IP address of Avaya Communication Manager (***12.160.183.202***) using port ***5061*** and ***TLS*** as the transport protocol. The user portion in the original request URI is substituted for ***$(user)***. For the compliance test, the **Contact** field for the media server address map is displayed as: `sip:$(user)@12.160.183.202:5061;transport=tls`

Step	Description
3.	**Media Server Address Map – continued** The content of the media server address map is described below. • **Name**: Contains any descriptive name • **Pattern**: Contains an expression to define the matching criteria for calls to be routed from location 2 to the local Avaya Communication Manager. The example below shows the expression used in the compliance test. This expression will match any URI that begins with *sip:732456* followed by any digit between *0-9* for the next *4* digits. Additional information on the syntax used for address map patterns can be found in [5]. • **Replace URI**: Check the box. If any changes are made, click **Update**. **AVAYA** **Integrated Management** SIP Server Management Help Exit Server: 12.160.183.200 **Top** ⊞ Users ⊞ Conferences ⊞ Media Server Extensions Emergency Contacts ⊞ Hosts ⊟ Media Servers List Add Address Map Priorities ⊞ Adjunct Systems **Edit Media Server Map Entry** Name* bw-inbound Pattern* ^sip:732456[0-9]{4} Replace URI ☑ Fields marked * are required. **Update**

5. Configure the Avaya SIP Telephones

The SIP telephones at location 1 will use Avaya SES as the registrar and SIP proxy. The SIP telephones at location 2 will use BroadWorks as the registrar and SIP proxy.
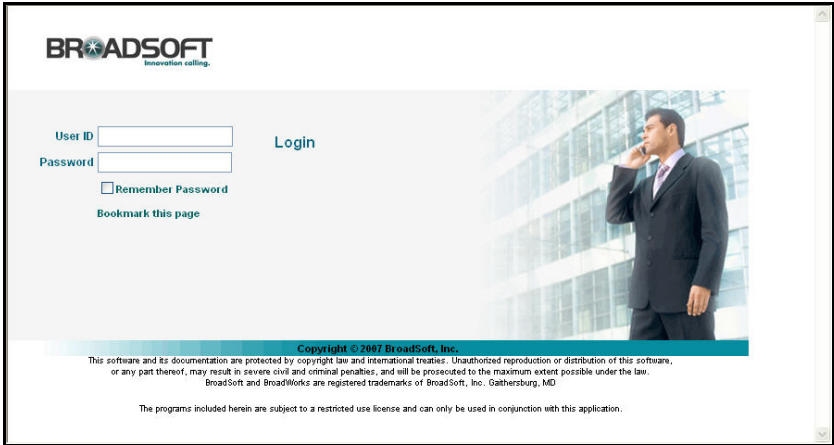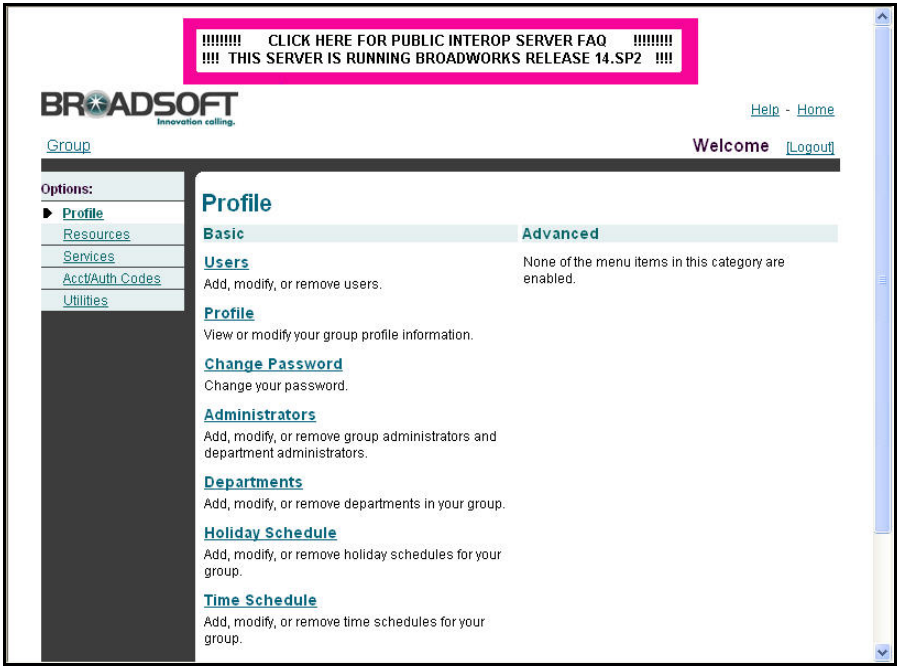
The table below shows an example of the SIP telephone network settings for both locations. For the endpoints at location 1, some of these values may be obtained from the download of the endpoint's configuration file. For endpoints at location 2, all values are entered manually at the endpoint.
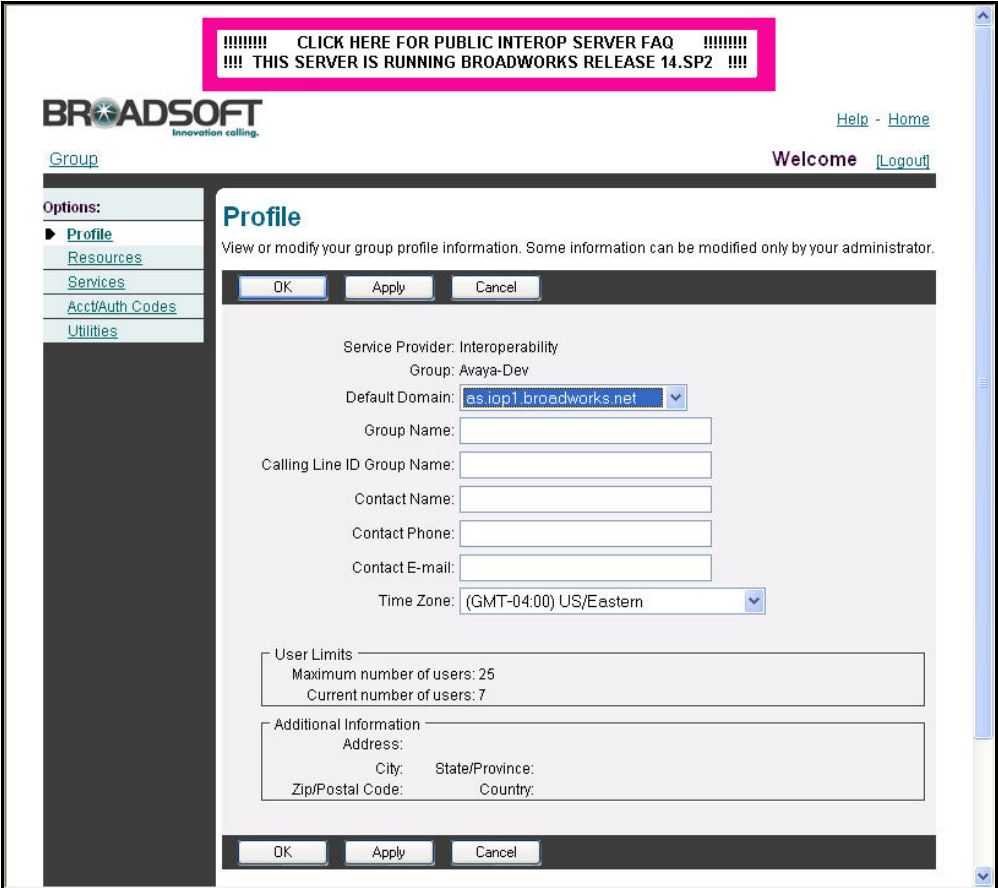
	Location 1 Avaya 4600 Series IP Telephone	Location 1 Avaya 9600 Series IP Telephone	Location 2 Avaya 9600 Series IP Telephone
Extension	68002	68003	241 333-2781
IP Address (no DHCP)	12.160.183.212	12.160.183.213	206.161.212.122
Subnet Mask	255.255.255.224	255.255.255.224	255.255.255.224
Router	12.160.183.193	12.160.183.193	206.161.212.97
File Server	12.160.183.201	12.160.183.201	N/A
DNS Server	12.127.16.67	12.127.16.67	12.160.179.100
SIP Mode	Not Configurable	Proxied	Proxied
SIP Domain	avremote.com	avremote.com	as.iop1.broadworks.net
Avaya Environment	Not Applicable	Yes	No
Transport Type	Not Configurable (UDP)	TLS	UDP
Call Server or SIP Proxy Server	12.160.183.200	12.160.183.200	64.215.212.70
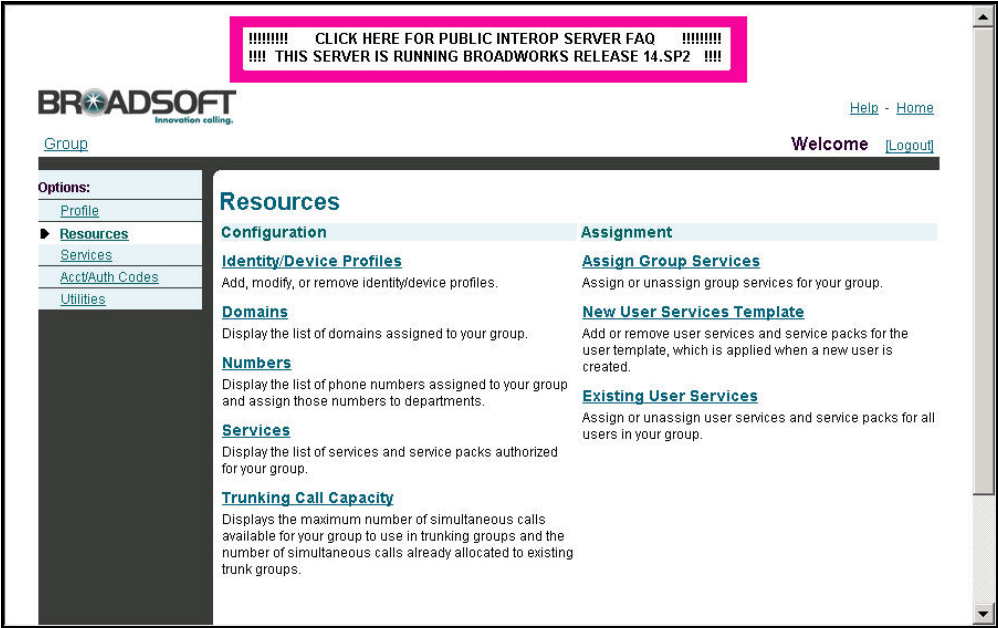
Table 2: Telephone Network Settings
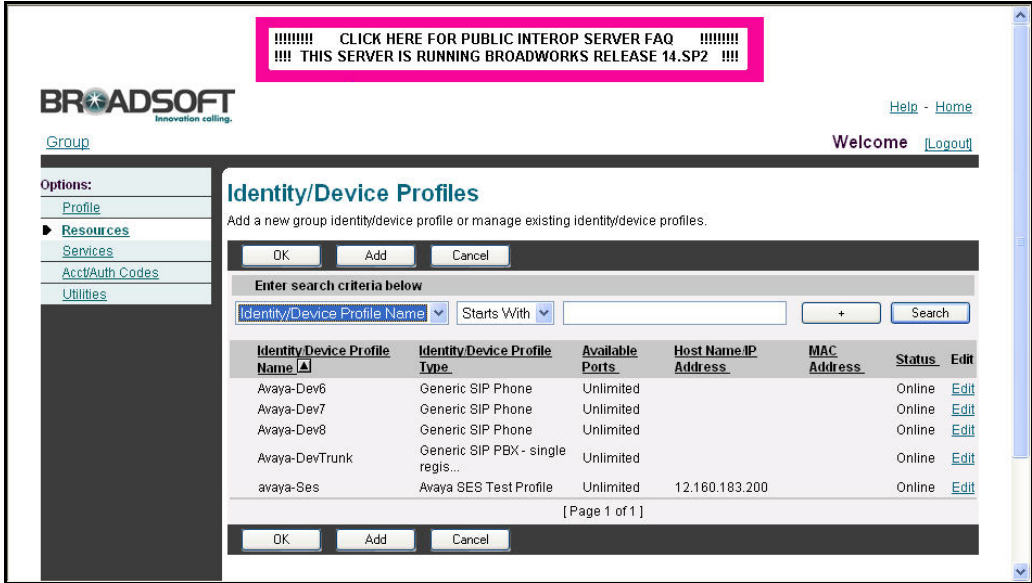
6. Configure BroadSoft BroadWorks
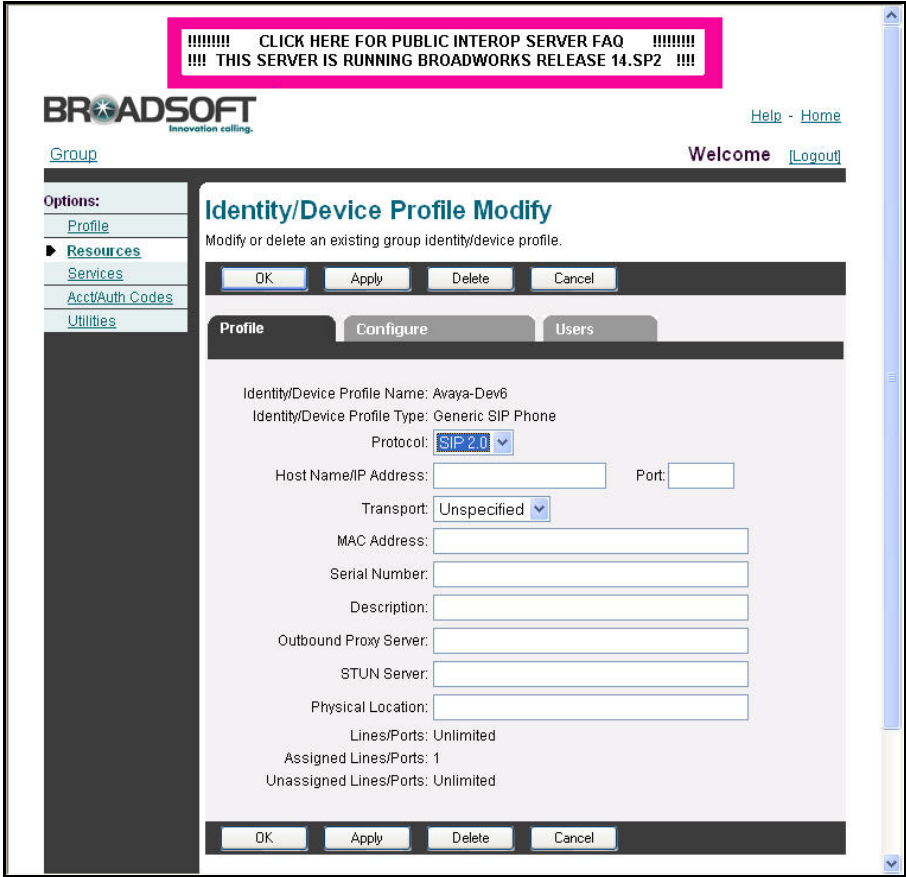
This section describes the configuration of BroadWorks.
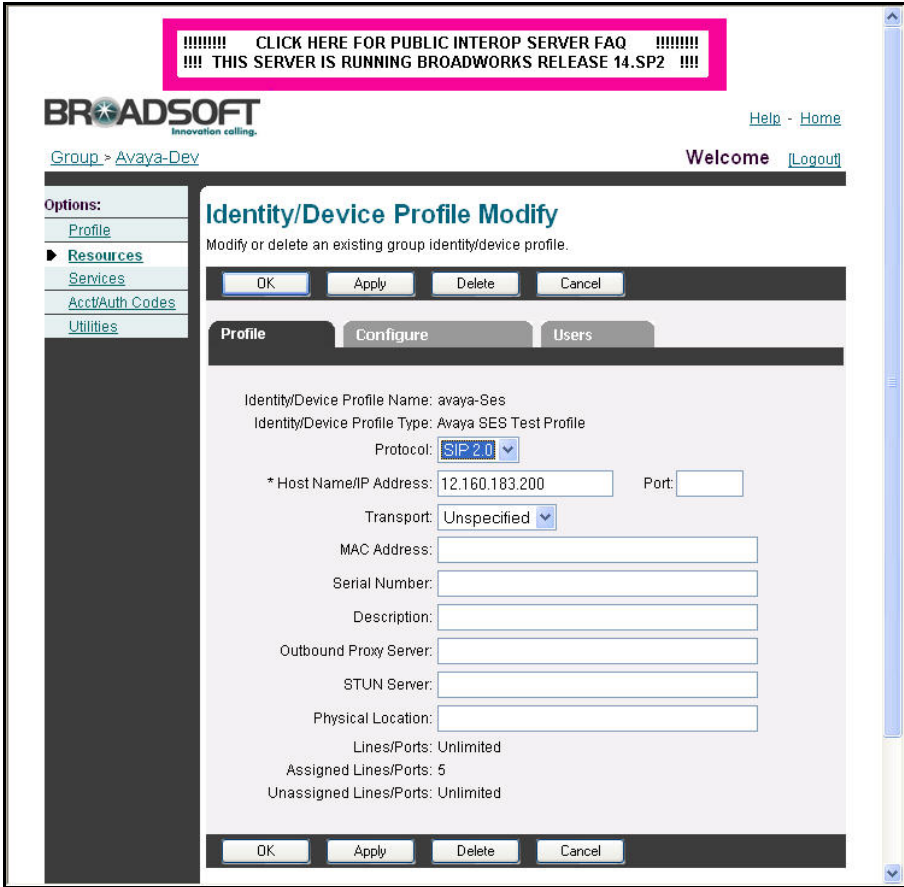
Step	Description
1.	**Login** Access the BroadWorks web page by entering *as.iop1.broadworks.net* in the URL field of an Internet browser. Log in with the appropriate credentials.
2.	**Main Page** The BroadWorks main page appears as shown below.

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BroadWorks-SES

Step	Description
3.	**Group** The applications and functionality provided by BroadWorks is separated by groups. A group, **Avaya-Dev**, was created for the compliance test to contain all the resources, users, and service definitions needed for the test. To view the profile for this group, select **Profile** from the left pane of the main page. The SIP domain for BroadWorks, *as.iop1.broadworks.net*, is defined in the **Default Domain** field.

Step	Description
4.	**Resources** Identity/Device Profiles must be created for each resource used by the compliance test. This includes each of the local SIP phones and the Avaya SES. To view the identity/device profiles created for testing, select the **Resources** link in the left pane followed by selecting the **Identity/Profile** link in the right pane.

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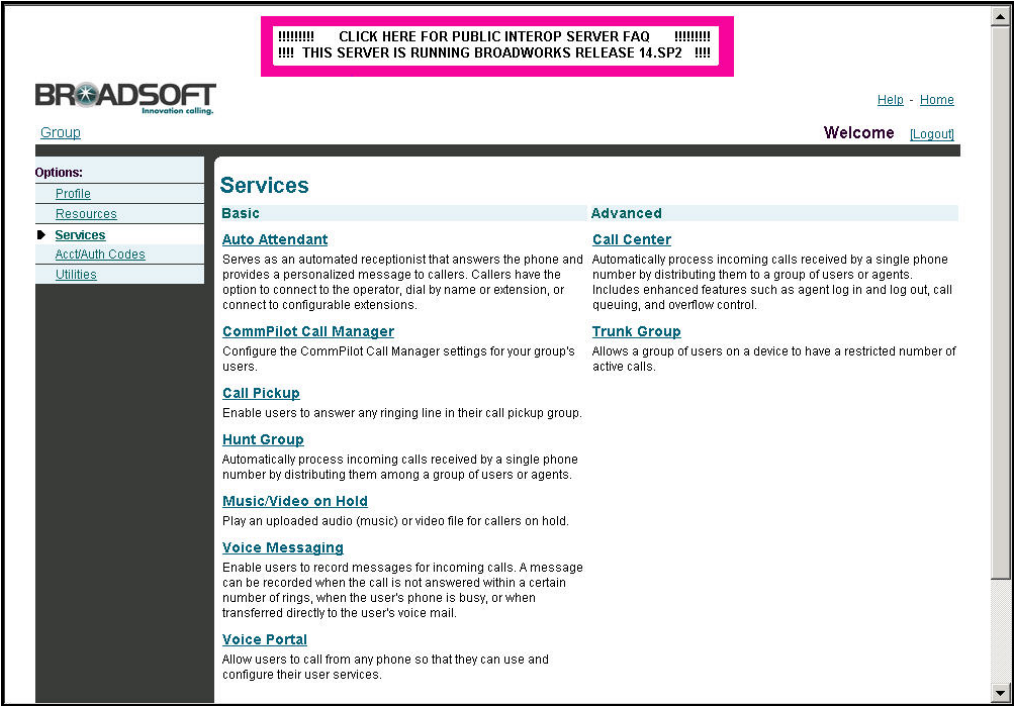BroadWorks-SES

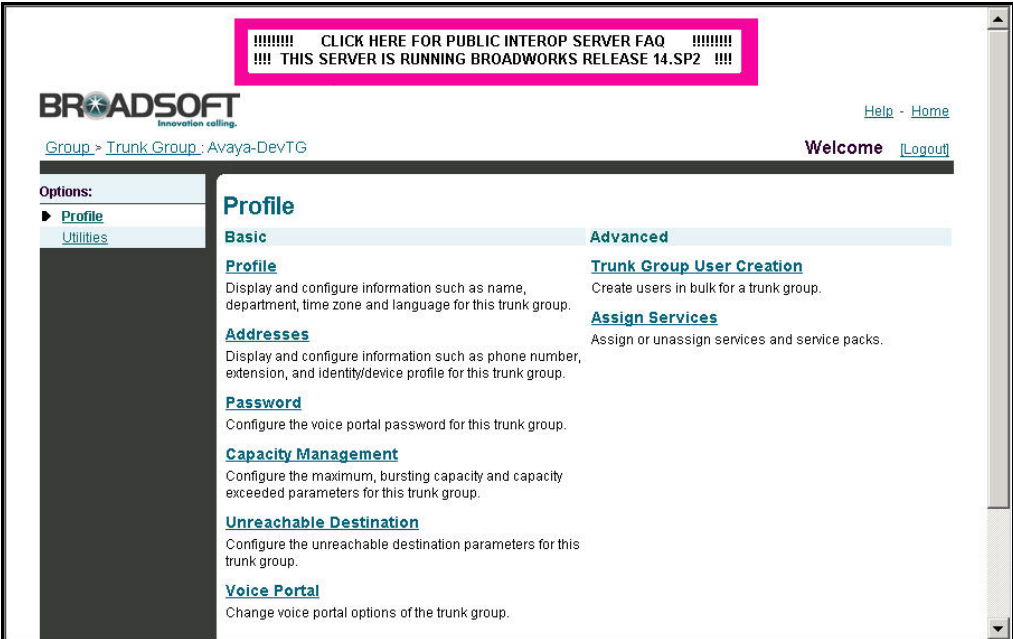| Step	Description
5.	**Identity/Device Profile** The **Identity/Device Profiles** page will appear similar to that shown below but without a list of existing profiles. To view a list of existing profiles, select the **Search** button in the right pane. The resulting view is shown below. To view any profile, select the **Edit** link next to that profile. The profile named **Avaya-DevTrunk** was not used as part of the testing. It was replaced with the profile named **avaya-Ses**. Also, only two SIP phones were used on the BroadWorks for the compliance test, even though three profiles were created.

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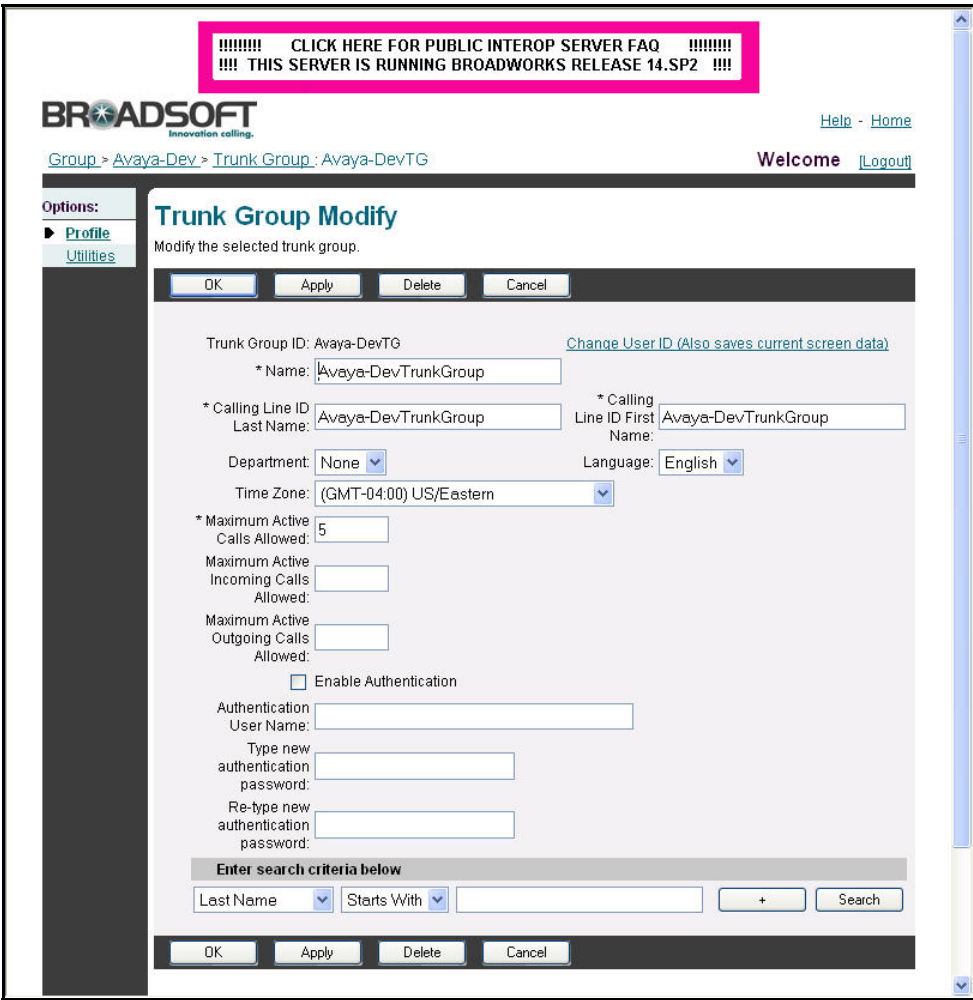| Step	Description
6.	**Generic SIP Phone Device Profile** For each SIP phone registered to BroadWorks, a separate profile was created with a separate name and the **Identity/Device Profile Type** set to *Generic SIP Phone*. Below is the profile named Avaya-Dev6 which is associated with one of the SIP phones registered with BroadWorks.

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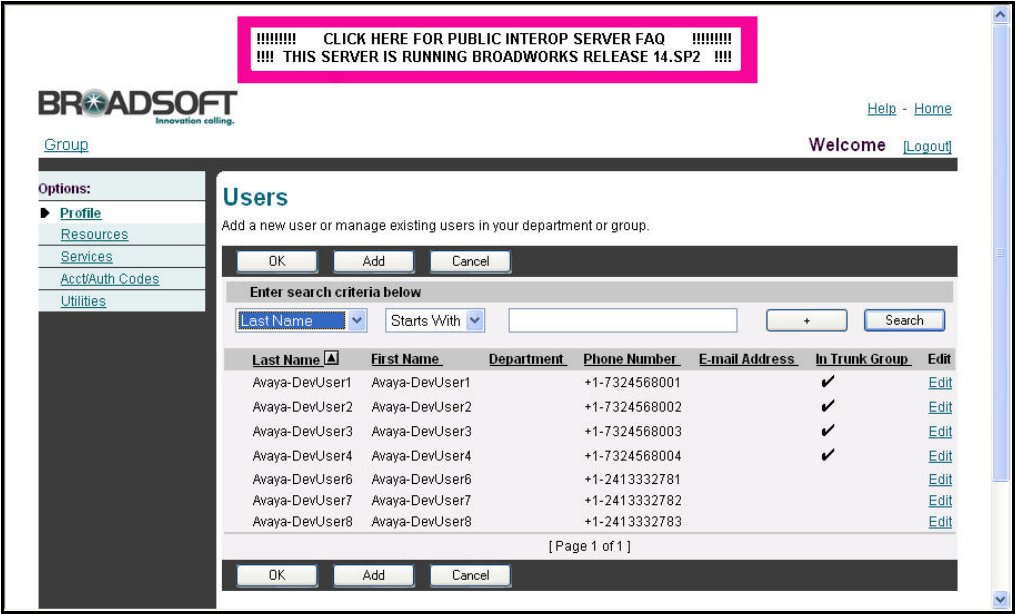| Step	Description
7.	**Avaya SES Test Profile** For the SES, a separate **Identity/Device Profile Type** was used called *Avaya SES Test Profile*. The **Host Name/IP Address** field was set to the IP address of Avaya SES. The properties of this profile type are shown in **Step 8**. This profile allows the BroadWorks to use the Avaya SES IP address in the SIP "To" header for calls destined for the Avaya SES. This is necessary for interoperability in the configuration shown in **Figure 1**.
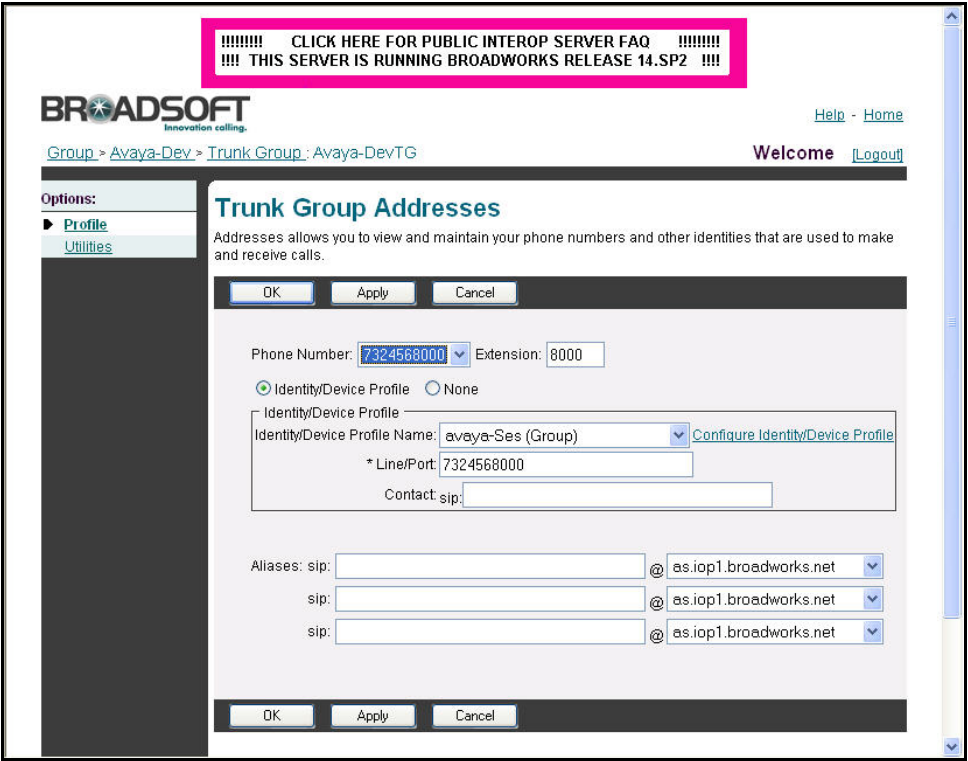
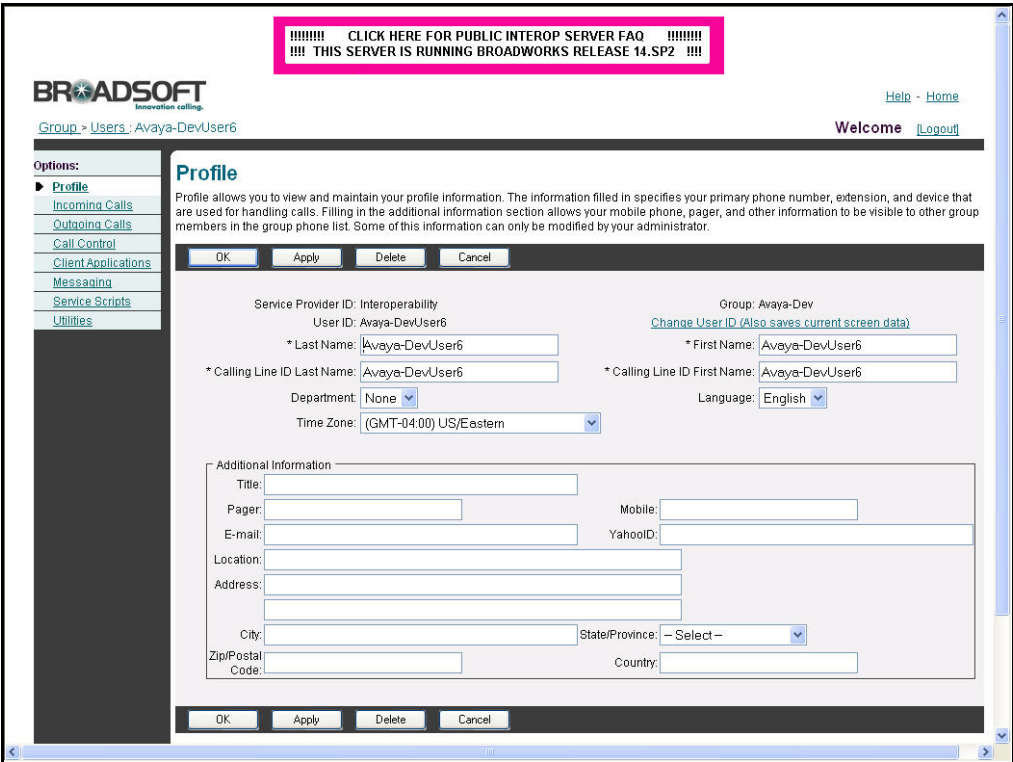| Step	Description
8.	**Avaya SES Profile Type** Creating or modifying **Identity/Device Profile Types** requires System or Service Provider provisioning-level access. To access the profile type settings, log in with the appropriate credentials and select the **Resources** link in the left pane, followed by **Identity/Device Profile Type** in the right pane. Select the **Edit** link next to the profile type of interest and the page shown below will be displayed. The Avaya SES Profile Type was created with the parameters of a BroadWorks PBX Classification Type-E PBX. This profile type is a device addressing profile, which means the Avaya SES IP address is expected in the SIP "From" header for calls originating from the Avaya SES. Similarly, the Avaya SES IP address is expected in the SIP "To" header in calls terminating on the Avaya SES. Please refer to [6] for a full explanation on this topic and the settings used below.

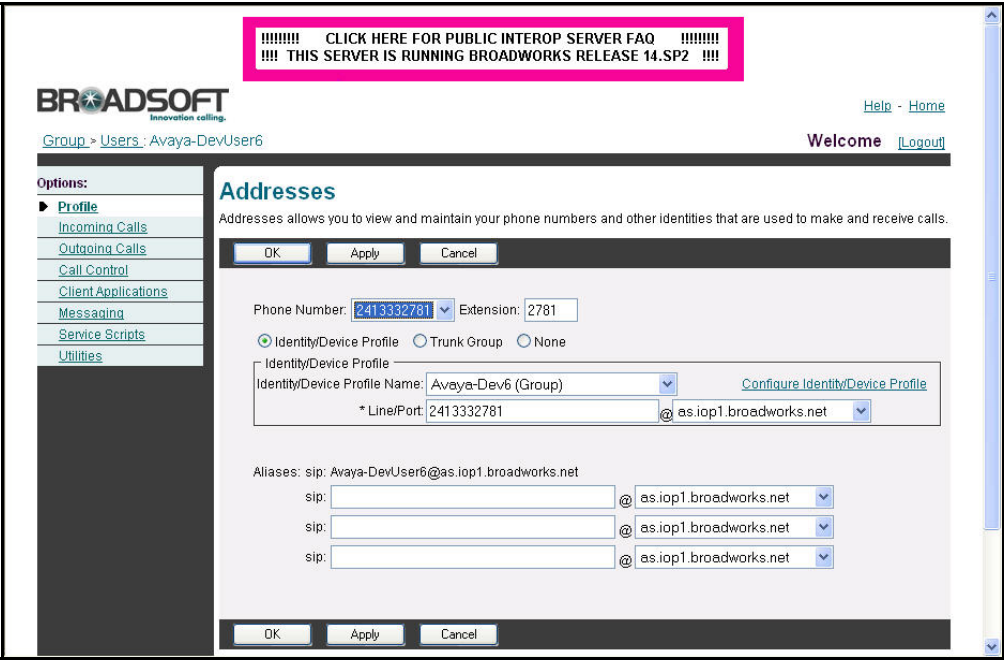| Step	Description
9.	**Services** A trunk group was created to access Avaya SES. To view the trunk groups created for the compliance test, select **Services** from the left pane, then select **Trunk Group** from the right pane. A list of trunk groups will appear. In the case of the compliance test, a single trunk appears in the list. Select the **Edit** link next to the trunk.

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Step	Description
10.	**Trunk Group** The trunk group menu options appear as shown below. To view the profile settings for the trunk group, select the **Profile** link in the right pane.

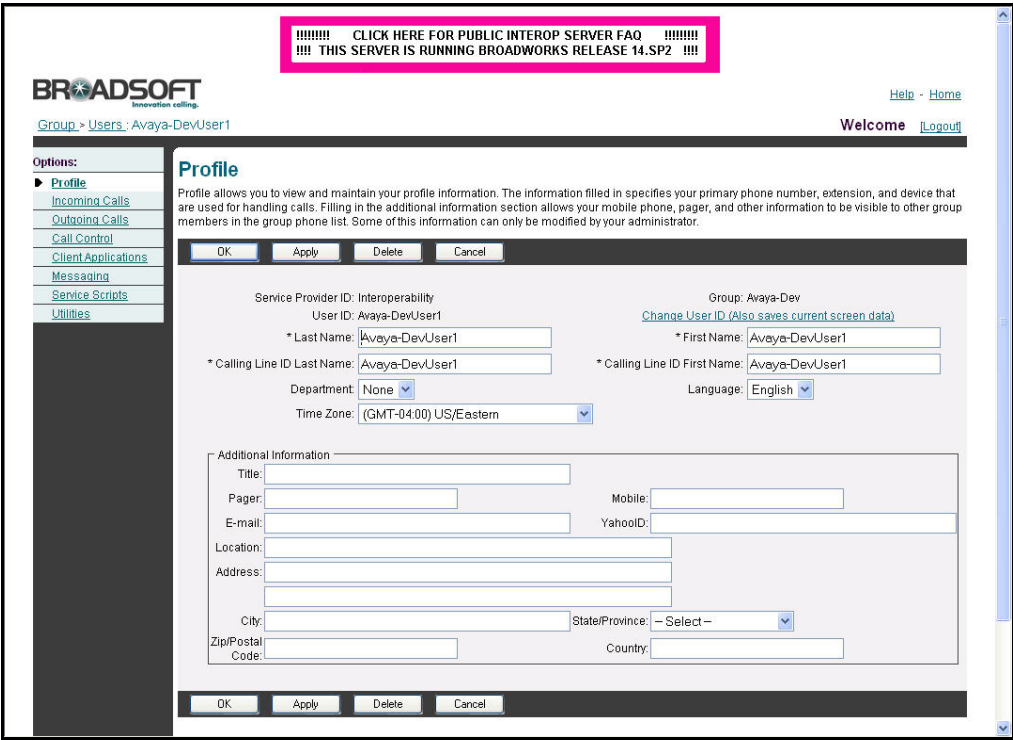| Step	Description
11.	**Trunk Group Profile** The trunk group was created with the name *Avaya-DevTrunkGroup*. This same name was used in the **Calling Line ID Last Name** and **Calling Line ID First Name** fields.

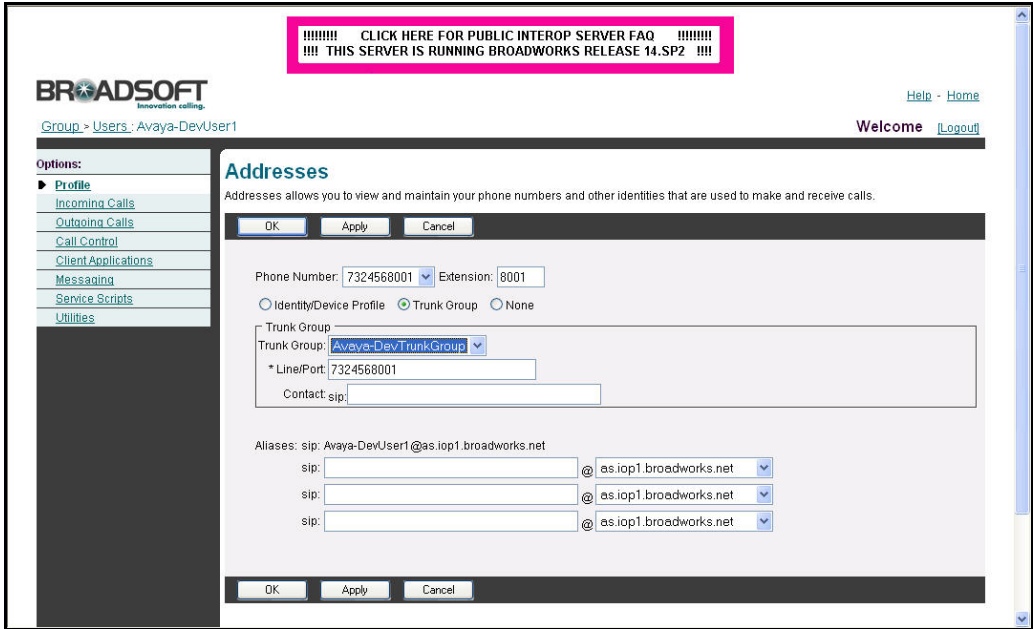| Step	Description
12.	**Trunk Group Address** The trunk address settings can be viewed by selecting the **Addresses** link in the window shown in **Step 10**. The trunk address settings are configured with the following parameters: ■ **Phone Number**: This is a number that can be used as a general access number for the far-end PBX (Avaya Communication Manager) such as an auto attendant. It was not used as part of the compliance test. ■ **Identity/Device Profile** radio button: selected ■ **Identity/Device Profile Name**: Set to the Avaya SES profile defined in **Step 7**. ■ **Line/Port**: Same as the **Phone Number** field.

Step	Description
13.	**Users** Users must be created for each endpoint used in the test. This includes local endpoints and those connected to the far-end PBX. To view the list of users, select the **User** link in the right pane of the window in **Step 2**. The **Users** page will appear similar to that shown below but without a list of existing users. To view a list of existing users, select the **Search** button in the right pane. The resulting view is shown below. To view any user profile, select the **Edit** link next to that user followed by the **Profile** link in the subsequent window (not shown). Only two SIP phones were used on the BroadWorks for the compliance test (see **Figure 1**), even though additional profiles are shown.

Step	Description
14.	**Local User** The settings for one of the local users are shown below. All local users have similar settings. The **User ID** given to the user below was *Avaya-DevUser6*. The same name was used for the **Last Name, First Name**, **Calling Line ID Last Name** and **Calling Line ID First Name** fields. The **Group** field is set to *Avaya-Dev* which was shown in **Step 3**.

Step	Description
15.	**Local User Address** To view the user address settings, select the **Edit** link in the window in **Step 13**, followed by the **Address** link in the subsequent window (not shown). The following window appears. The user address settings are configured with the following parameters: ▪ **Phone Number**: This is the phone number associated with the user. ▪ **Identity/Device Profile** radio button: selected ▪ **Identity/Device Profile Name**: Set to the **Avaya-Dev6** profile for this user shown in **Step 6**. ▪ **Line/Port**: This is set to the *Phone Number@as.iop1.broadworks.net*.

Step	Description
16.	**Avaya SES User** The settings for one of the Avaya SES users are shown below. All Avaya SES users have similar settings. The **User ID** given to the user below was *Avaya-DevUser1*. The same name was used for the **Last Name, First Name**, **Calling Line ID Last Name** and **Calling Line ID First Name** fields. The **Group** field is set to *Avaya-Dev* which was shown in **Step 3**.

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Step	Description
17.	**Avaya SES User Address** To view the user address settings, select the **Edit** link in the window in **Step 13**, followed by the **Address** link in the subsequent window (not shown). The following window appears. The user address settings are configured with the following parameters: ▪ **Phone Number**: This is the phone number associated with the user. ▪ **Trunk Group** radio button: selected ▪ **Trunk Group**: Set to the trunk group profile for the Avaya SES defined in **Step 10**. ▪ **Line/Port**: This is set to the same as the **Phone Number** field.

7. Interoperability Compliance Testing

This section describes the compliance testing used to verify the interoperability of BroadSoft BroadWorks with Avaya SIP Enablement Services and Avaya Communication Manager. This section covers the general test approach and the test results.

7.1. General Test Approach

The general test approach was to make calls to/from BroadWorks using various codec settings and exercising common PBX features.

7.2. Test Results

BroadWorks passed compliance testing. The following features and functionality were verified. Any observations related to these tests are listed at the end of this section.
   ▪ Successful registrations of the endpoints at each location.
   ▪ Calls between SIP endpoints at location 1 and BroadWorks endpoints.

- Calls between non-SIP endpoints at location 1 and BroadWorks endpoints.
- Calls using various SIP telephone types including the Avaya 4600 Series IP Telephones (with SIP firmware), Avaya 9600 Series IP Telephones (with SIP firmware) and the Avaya one-X Desktop Edition (SIP Softphone).
- G.711MU and G.729A codec support
- Proper recognition of DTMF transmissions.
- PBX features including Hold, Transfer, Call Waiting, Call Forwarding and Conference.
- Extended telephony features using Avaya Communication Manager Feature Name Extensions (FNE) such as Call Park, Call Pickup, and Automatic Redial. For more information on FNEs, please refer to [4].
- Proper system recovery after a loss of IP connection to BroadWorks.

The following observations were made during compliance testing:
- To support the BroadWorks redundancy model, SIP phones that register to BroadWorks must support DNS Naming Authority Pointer (NAPTR) or Service (SRV) lookups of the FQDN contact supplied by BroadWorks. DNS Address (A) record lookups are not sufficient, unless it can be ensured that the DNS server returns fixed order A records. The phones at location 2 in **Figure 1** only supported DNS A lookups and the initial DNS server did not return fixed order A records, so a second DNS server was configured to return a single address for the BroadWorks Application Server FQDN. Without this change, intermittent dropped calls occurred with the SIP phones at location 2.
- BroadWorks does not support the History-Info header for call forwarding purposes. This affects call scenarios not shown in **Figure 1**. This affects scenarios where BroadWorks provides PSTN access for the endpoints connected behind Avaya SES (endpoints at location 1). Specifically, call forwarding will fail in the following scenario. An endpoint connected behind the Avaya SES is forwarded to a PSTN number (via the BroadWorks server). Any incoming PSTN call from BroadWorks destined to this endpoint with call forwarding enabled will not be properly forwarded back to the PSTN via the BroadWorks server.

8. Verification Steps
The following steps may be used to verify the configuration:
- From the Avaya Communication Manager SAT, use the **status signaling-group** command to verify that the SIP signaling group is in-service.
- From the Avaya Communication Manager SAT, use the **status trunk-group** command to verify that the SIP trunk group is in-service.
- From the Avaya SES web administration interface, verify that all endpoints are registered with Avaya SES. To view, navigate to **Users→Registered Users**.
- Verify that calls can be made between SIP endpoints registered with Avaya SES and BroadWorks endpoints.
- Verify that calls can be made between non-SIP endpoints connected to Avaya Communication Manager and BroadWorks endpoints.

9. Support
For technical support on BroadWorks, contact BroadSoft via the **Services and Support** link at www.broadsoft.com.

10. Conclusion

BroadSoft BroadWorks passed compliance testing. These Application Notes describe the procedures required to configure BroadSoft BroadWorks to interoperate with Avaya SIP Enablement Services and Avaya Communication Manager as shown in **Figure 1**.

11. Additional References

[1] *Feature Description and Implementation For Avaya Communication Manager*, Doc # 555-245-205, Issue 5.0, February 2007.

[2] *Administrator Guide for Avaya Communication Manager*, Doc # 03-300509, Issue 3.1, February 2007.

[3] *SIP support in Avaya Communication Manager Running on the Avaya S8300, S8400, S8500 Series and S8700 Series Media Server,* Doc # 555-245-206, Issue 6.1, March 2007.

[4] *Avaya Extension to Cellular and Off-PBX Station (OPS) Installation and Administration Guide Release 3.0*, version 6.0, Doc # 210-100-500, Issue 9, June 2005

[5] *Installing and Administering SIP Enablement Services,* Doc# 03-600768, Issue 4, May 2007.

[6] *BroadSoft BroadWorks Business Trunking Configuration Guide, Release 14.0,*Version 1.

[7] *BroadSoft BroadWorks SIP Business Trunking Interworking Guide, Release 14.0*, Version 4.

[8] *BroadSoft BroadWorks Application Server Service Provider Web Interface Administration Guide – Part 1, Release 14.0*, Version 4.

[9] *BroadSoft BroadWorks Application Server Group Web Interface Administration Guide – Part 2, Release 14.0*, Version 4.

Product documentation for Avaya products may be found at http://support.avaya.com.

Product documentation for BroadWorks can be obtained from BroadSoft.

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