Aruba Instant 6.5.1.0-4.3.1.0

aruba

a Hewlett Packard
Enterprise company

User Guide

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Contents

Chapter 1
About this Guide

This User Guide describes the features supported by Aruba Instant and provides detailed instructions for setting up and configuring the Instant network.

Intended Audience

This guide is intended for administrators who configure and use IAPs.

Related Documents

In addition to this document, the Instant product documentation includes the following:

- *Aruba Instant Access Point Installation Guides*
- *Aruba Instant Quick Start Guide*
- *Aruba Instant CLI Reference Guide*
- *Aruba Instant MIB Reference Guide*
- *Aruba Instant Syslog Messages Reference Guide*
- *Aruba Instant Release Notes*

Conventions

The following conventions are used throughout this manual to emphasize important concepts:

Table 1: *Typographical Conventions*

Style Type	Description
Italics	This style is used to emphasize important terms and to mark the titles of books.
`System items`	This fixed-width font depicts the following: - Sample screen output - System prompts - Filenames, software devices, and specific commands when mentioned in the text.
`Commands`	In the command examples, this style depicts the keywords that must be typed exactly as shown.

Table 1: *Typographical Conventions*

Style Type	Description
<Arguments>	In the command examples, italicized text within angle brackets represents items that you should replace with information appropriate to your specific situation. For example: `# send <text message>` In this example, you would type "send" at the system prompt exactly as shown, followed by the text of the message you wish to send. Do not type the angle brackets.
`[Optional]`	Command examples enclosed in square brackets are optional. Do not type the square brackets.
`{Item A | Item B}`	In the command examples, items within curly brackets and separated by a vertical bar represent the available choices. Enter only one choice. Do not type the curly brackets or bars.

The following informational icons are used throughout this guide:

NOTE

Indicates helpful suggestions, pertinent information, and important things to remember.

CAUTION

Indicates a risk of damage to your hardware or loss of data.

WARNING

Indicates a risk of personal injury or death.

Contacting Support

Table 2: *Support Information*

Main Site	arubanetworks.com
Support Site	support.arubanetworks.com
Airheads Social Forums and Knowledge Base	community.arubanetworks.com
North American Telephone	1-800-943-4526 (Toll Free) 1-408-754-1200
International Telephone	arubanetworks.com/support-services/contact-support/

Software Licensing Site	licensing.arubanetworks.com
End-of-life Information	arubanetworks.com/support-services/end-of-life/
Security Incident Response Team (SIRT)	Site: arubanetworks.com/support-services/security-bulletins/ Email: sirt@arubanetworks.com

This chapter provides the following information:

- Instant Overview on page 12
- What is New in this Release on page 15

Instant Overview

Instant virtualizes Aruba Mobility Controller capabilities on 802.1--capable access points (APs), creating a feature-rich enterprise-grade wireless LAN (WLAN) that combines affordability and configuration simplicity.

Instant is a simple, easy to deploy turnkey WLAN solution consisting of one or more IAPs. An Ethernet port with routable connectivity to the Internet or a self-enclosed network is used for deploying an Instant Wireless Network. An Instant Access Point (IAP) can be installed at a single site or deployed across multiple geographically dispersed locations. Designed specifically for easy deployment and proactive management of networks, Instant is ideal for small customers or remote locations without requiring any on-site IT administrator.

Instant consists of an IAP and a Virtual Controller (VC). The VC resides within one of the IAPs. In an Instant deployment scenario, only the first IAP needs to be configured. After the first IAP is configured, the other IAPs inherit all the required configuration information from the VC. Instant continually monitors the network to determine the IAP that should function as a VC at any time, and the VC will move from one IAP to another as necessary without impacting network performance.

Supported IAP Platforms

The following table provides a list of IAP platforms that support Instant software:

Table 3: *Supported IAP Platforms*

IAP Platform	Minimum Required Instant Software Version
IAP-207	Instant 6.5.1.0-4.3.1.0 or later
IAP-304/305	Instant 6.5.1.0-4.3.1.0 or later
IAP-334/335	Instant 6.5.0.0-4.3.0.0 or later
IAP-314/315	Instant 6.5.0.0-4.3.0.0 or later
IAP-324/325	Instant 6.4.4.3-4.2.2.0 or later
IAP-205H IAP-228 IAP-277	Instant 6.4.3.1-4.2.0.0 or later
IAP-204/205 IAP-214/215	Instant 6.4.2.0-4.1.1.0 or later

Table 3: *Supported IAP Platforms*

IAP Platform	Minimum Required Instant Software Version
IAP-103 IAP-274/275	Instant 6.4.0.2-4.1.0.0 or later
IAP-114/115 IAP-224/225	Instant 6.3.1.1-4.0.0.0 or later
RAP-155/155P	Instant 6.2.1.0-3.3.0.0 or later
RAP-108/109	Instant 6.2.0.0-3.2.0.0 or later

NOTE

Each IAP model has a minimum required Instant software version as shown in Table 3. When a new IAP is added into an existing cluster, it can join the cluster only if the existing cluster is running at least the minimum required version of that IAP. If the existing cluster is running a version prior to the minimum required version of the new IAP, new IAP will not come up and may reboot with the reason **Image sync fail**. To recover from this condition, upgrade the existing cluster to at least the minimum required version of the new IAP first, and add the new IAP.

NOTE

Aruba recommends that networks with more than 128 IAPs be designed as multiple, smaller VC networks with Layer-3 mobility enabled between these networks.

Aruba IAPs are available in the following variants:

- US (United States)
- JP (Japan)
- IL (Israel)
- RW

The following table provides the variants supported for each IAP platform:

Table 4: *Supported IAP Variants*

IAP Model (Reg Domain)	IAP-###-US (US only)	IAP-###-JP (Japan only)	IAP-###-IL (Israel only)	IAP-###-RW (Rest of the World except US/JP/IL)
IAP-334/335	Yes	Yes	Yes	Yes
IAP-314/315	Yes	Yes	Yes	Yes
IAP-324/325	Yes	Yes	Yes	Yes

Table 4: *Supported IAP Variants*

IAP Model (Reg Domain)	IAP-###-US (US only)	IAP-###-JP (Japan only)	IAP-###-IL (Israel only)	IAP-###-RW (Rest of the World except US/JP/IL)
IAP-277	Yes	Yes	No	Yes
IAP-274/275	Yes	Yes	Yes	Yes
IAP-228	Yes	Yes	No	Yes
IAP-224/225	Yes	Yes	Yes	Yes
IAP-214/215	Yes	Yes	Yes	Yes
IAP-205H	Yes	Yes	Yes	Yes
IAP-204/205	Yes	Yes	Yes	Yes
RAP155/155P	Yes	Yes	Yes	No
IAP-114/115	Yes	Yes	Yes	Yes
RAP-108/109	Yes	Yes	Yes	No
IAP-103	Yes	Yes	Yes	Yes

For information on regulatory domains and the list of countries supported by the IAP-###-RW type, see the **Specifying Country Code** section in Logging in to the Instant UI on page 21

Instant UI

The Instant User Interface (UI) provides a standard web-based interface that allows you to configure and monitor a Wi-Fi network. Instant is accessible through a standard web browser from a remote management console or workstation and can be launched using the following browsers:

- Microsoft Internet Explorer 11 or earlier
- Apple Safari 6.0 or later
- Google Chrome 23.0.1271.95 or later
- Mozilla Firefox 17.0 or later

If the Instant UI is launched through an unsupported browser, a warning message is displayed along with a list of recommended browsers. However, the users are allowed to log in using the **Continue login** link on the **Login** page.

NOTE

To view the Instant UI, ensure that JavaScript is enabled on the web browser.

The Instant UI logs out automatically if the window is inactive for 15 minutes.

Instant CLI

The Instant Command Line Interface (CLI) is a text-based interface that is accessible through a Secure Shell (SSH) session.

SSH access requires that you configure an IP address and a default gateway on the IAP and connect the IAP to your network. This is typically performed when the Instant network on an IAP is set up.

What is New in this Release

The following features are introduced in Instant 6.5.1.0-4.3.1.0:

Table 5: *New Features*

Feature	Description
Cluster Security	Support for cluster security is introduced to secure control plane messages between IAPs. Additionally, DTLS is used with cluster security for extended security facilities. Cluster security also provides the option of logging and debugging by organizing the logs into modules which are later used for debugging.
Support for RFC5997	Starting from Instant 6.5.1.0-4.3.1.0, you can configure the RFC5997 feature on the IAP to send a status request query to the RADIUS server each time there is an authentication or accounting request timeout. This helps determine if the server is actually down before marking the server as unavailable.
Clarity Live	Instant now supports inline monitoring through Clarity Live to identify client connectivity issues and send the data to AirWave for analysis. It helps in isolating the root cause of the connectivity issues experienced by receiving regular statistics and updates generated by the events.
Client Match for Access Points in a Zone	Starting from Instant 6.5.1.0-4.3.1.0, the decision to move a client from a home IAP to a target IAP will be made at the SSID level instead of the radio level, by adding the SSID name to the client match radio database. Client Match will check if the same SSID (zone specific SSID on Home IAP) is available on the target IAP before it moves the client.
Changing the IAP Installation Mode	Instant now allows users to change the installation type of the IAPs from indoor to outdoor or vice-versa.

Support for New IAP Devices

Instant 6.5.1.0-4.3.1.0 release introduces support for the following new IAP devices. These new devices do not interoperate with Instant versions lower than Instant 6.5.0.0-4.3.0.0. If these IAPs are placed into a cluster running older Instant versions prior to Instant 6.5.1.0-4.3.1.0, the devices will reboot with the **Image Sync Fail** reason. To resolve this issue, upgrade the existing cluster to minimum Instant 6.5.1.0-4.3.1.0 release, and then add the new IAP devices.

Table 6: *New Hardware Platforms*

Feature	Description
IAP-304/305	The IAP-300 Series (IAP-304/305) wireless access points are equipped with one 10/100/1000Base-T auto-sensing MDI/MDX Ethernet port. This port supports wired-network connectivity, in addition to Power over Ethernet (PoE) from IEEE 802.3af and 802.3at compliant power sources. They also have two LEDs that indicate the system and radio status of the device and are equipped with three external antenna connectors.
IAP-207	The IAP-207 Series access points are equipped with one 10/100/1000Base-T (RJ-45) auto-sensing, MDI/MDX Ethernet port ENET0) for wired network connectivity. This port supports IEEE 802.3af Power over Ethernet (PoE), as a standard defined Powered Device (PD) from a Power Sourcing Equipment (PSE) such as a PoE midspan injector or network infrastructure that supports PoE. The 207 Series access points have two LEDs that indicate the system and radio status of the device.

This chapter describes the following procedures:

- Setting up Instant Network on page 17
- Provisioning an IAP on page 18
- Logging in to the Instant UI on page 21
- Accessing the Instant CLI on page 22

Setting up Instant Network

Before installing an IAP:

- Ensure that you have an Ethernet cable of the required length to connect an IAP to the home router.
- Ensure that you have one of the following power sources:
  - IEEE 802.3af/at-compliant Power over Ethernet (PoE) source. The PoE source can be any power source equipment (PSE) switch or a midspan PSE device.
  - IAP power adapter kit.

Perform the following procedures to set up the Instant network:

1. Connecting an IAP on page 17
2. Assigning an IP address to the IAP on page 17

Connecting an IAP

Based on the type of the power source used, perform one of the following steps to connect an IAP to the power source:

- PoE switch—Connect the Ethernet 0 (Enet0) port of the IAP to the appropriate port on the PoE switch.
- PoE midspan—Connect the Enet0 port of the IAP to the appropriate port on the PoE midspan.
- AC to DC power adapter—Connect the 12V DC power jack socket to the AC to DC power adapter.

NOTE

RAP-155P supports PSE for 802.3at-powered device (class 0-4) on one port (E1 or E2), or 802.3af-powered DC IN (Power Socket) on two ports (E1 and E2).

Assigning an IP address to the IAP

The IAP needs an IP address for network connectivity. When you connect an IAP to a network, it receives an IP address from a DHCP server.

To obtain an IP address for an IAP:

1. Ensure that the DHCP service is enabled on the network.
2. Connect the Enet0 port of IAP to a switch or router using an Ethernet cable.
3. Connect the IAP to a power source. The IAP receives an IP address provided by the switch or router.

NOTE

If there is no DHCP service on the network, the IAP can be assigned a static IP address. If a static IP is not assigned, the IAP obtains an IP automatically within the 169.254 subnet.

Assigning a Static IP

To assign a static IP to an IAP:

1. Connect a terminal, PC, or workstation running a terminal emulation program to the **Console** port on the IAP.
2. Turn on the IAP. An autoboot countdown prompt that allows you to interrupt the normal startup process and access **apboot** is displayed.
3. Press **Enter** key before the timer expires. The IAP goes into the **apboot** mode.
4. In the **apboot** mode, execute the following commands to assign a static IP to the IAP.

```
Hit <Enter> to stop autoboot:  0
apboot>
apboot> setenv ipaddr 192.0.2.0
apboot> setenv netmask 255.255.255.0
apboot> setenv gatewayip 192.0.2.2
apboot> save
Saving Environment to Flash...
Un-Protected 1 sectors
.done
Erased 1 sectors
Writing
```

5. Use the **`printenv`** command to view the configuration.

```
apboot> printenv
```

Provisioning an IAP

This section provides the following information:

- Zero Touch Provisioning of IAPs on page 18
- Provisioning IAPs though Aruba Central
- Provisioning IAPs through AirWave

Zero Touch Provisioning of IAPs

Zero Touch Provisioning eliminates the traditional method of deploying and maintaining devices and allows you to provision new devices in your network automatically, without manual intervention. Following are the zero-touch provisioning methods for Instant.

Aruba Activate is a cloud-based service designed to enable more efficient deployment and maintenance of IAPs. Aruba activate is hosted in the cloud and is available at activate.arubanetworks.com. You can register for a free account by using the serial number and MAC address of the device you currently own. For more information on how to setup your device and provision using Aruba Activate, refer to the *Aruba Activate User Guide*.

In order for zero-touch provisioning to be successful, the timezone of the IAP must be in synchronization with the NTP server.

NOTE

To facilitate zero-touch provisioning using the AirWave Management Platform (AMP), Central, or Activate, you must configure the firewall and wired infrastructure to either allow the NTP traffic to pool.ntp.org, or provide alternative NTP servers under DHCP options. For more information on configuring an NTP server, see NTP Server.

In a scenario where the NTP server is unreachable, the connection between the IAP and Activate will fall back to the unsecured status. The NTP client process running in the back end will continuously attempt to reconnect to the NTP server until a secure connection is established. The NTP client process receives a response from the NTP server on successfully establishing a connection and notifies the CLI process which runs a series of checks to ensure the NTP server is reachable.

Connecting to a Provisioning Wi-Fi Network

The IAPs boot with factory default configuration and try to provision automatically. If the automatic provisioning is successful, the Instant SSID will not be available. If AirWave and Activate are not reachable and the automatic provisioning fails, the Instant SSID becomes available and the users can connect to a provisioning network by using the Instant SSID.

To connect to a provisioning Wi-Fi network:

1. Ensure that the client is not connected to any wired network.
2. Connect a wireless-enabled client to a provisioning Wi-Fi network: for example, Instant.
3. If the Windows operating system (OS) is used:
   a. Click the wireless network connection icon in the system tray. The **Wireless Network Connection** window is displayed.
   b. Click the Instant network and then click **Connect**.
4. If the Mac OS system is used:
   a. Click the **AirPort** icon. A list of available Wi-Fi networks is displayed.
   b. Click the **instant** network.

NOTE

The Instant SSIDs are broadcast in 2.4 GHz only.

IAP Cluster

IAPs in the same VLAN automatically find each other and form a single functioning network managed by a VC.

NOTE

Moving an IAP from one cluster to another requires a factory reset of the IAP.

Disabling the Provisioning Wi-Fi Network

The provisioning network is enabled by default. Instant provides the option to disable the provisioning network through the console port. Use this option only when you do not want the default SSID Instant to be broadcast in your network.

To disable the provisioning network:

1. Connect a terminal, PC, or workstation running a terminal emulation program to the **Console** port on the IAP.
2. Configure the terminal or terminal emulation program to use the following communication settings:

Table 7: *Terminal Communication Settings*

Baud Rate	Data Bits	Parity	Stop Bits	Flow Control
9600	8	None	1	None

3. Turn on the IAP. An autoboot countdown prompt that allows you to interrupt the normal startup process and access apboot is displayed.

4. Click **Enter**key before the timer expires. The IAP goes into the apboot mode through console.
5. In the apboot mode, execute the following commands to disable the provisioning network:

```
apboot> factory_reset
apboot> setenv disable_prov_ssid 1
apboot> saveenv
apboot> reset
```

Provisioning IAPs through Central

For provisioning IAPs through Aruba Central, the IAPs must obtain the cloud activation key.

Obtaining Cloud Activation Key

The IAPs obtain the cloud activation key from the Aruba Activate server in the following scenarios:

- During reboot, if the VC has the Central URL stored, it will connect directly to Central using the activation key obtained from the Aruba Activate server. If there is no URL stored, the VC tries to establish a connection with the Activate server every 5 minutes, until a successful SSL connection is established and the activation key is obtained.
- If the IAP VC has a Central URL stored, but fails to establish a connection to Central in three attempts, the VC reconnects to the Activate server to obtain a new activation key.

The cloud activation key obtained from the Activate server is valid for 10 days. To obtain a new activation key, IAPs reconnect to the Activate server after the initially assigned key expires.

Prerequisites for Obtaining the Cloud Activation Key

To ensure that the IAPs obtain the cloud activation key from the Aruba Activate server, perform the following checks:

- The serial number or the MAC address of the IAP is registered in the Activate database.
- The IAP is operational and is able to connect to the Internet.
- IAP has received a DNS server address through DHCP or static configuration.
- IAP is able to configure time zone using a Network Time Proticol (NTP) server.
- The required firewall ports are open. Most of the communication between devices on the remote site and the Central server in the cloud is carried out through HTTPS (TCP 443). However, you may need to configure the following ports:
  - TCP port 443 for configuration and management of devices.
  - TCP port 80 for image upgrade.
  - UDP port 123 for NTP server to configure timezone when factory default IAP comes up.
  - TCP port 2083 for Remote Authentication Dial-In User Service (RADIUS) authentication for guest management. If 2083 port is blocked, the HTTPS protocol is used.

If a cloud activation key is not obtained, perform the following checks:

- If the IAP IP address is assigned from the DHCP server, ensure that the DNS server is configured.
- If the IAP is assigned a static IP address, manually configure the DNS server IP address. For more information, see Specifying a Method for Obtaining IP Address.

Viewing the Cloud Activation Key

If IAP has already obtained the activation key, complete the following steps:

1. Connect to the Instant SSID and type http://instant.arubanetworks.com in the web browser.
2. Log in to the website by using the default username **admin** and the default password **admin**.
3. In the IAP UI, navigate to **Maintenance > About** and copy the cloud activation key.

4. To view the MAC address of the master IAP, click the device name under the Access Point widget. The MAC address will be displayed under the **Info** section of the main window.

You can also check the cloud activation key of an IAP by running the **show about** and **show activate status** commands. For more information on these commands, refer to the *Aruba Instant 6.5.0.0-4.3.0.0 CLI Reference Guide*.

NOTE

If the IAP is deployed in the cluster mode, the slave IAPs do not obtain the activation key. You must use the cloud activation key and MAC address of the master IAP for provisioning through Central.

Provisioning IAPs through AirWave

For information on provisioning IAPs through AirWave, refer to the *AirWave Deployment Guide*.

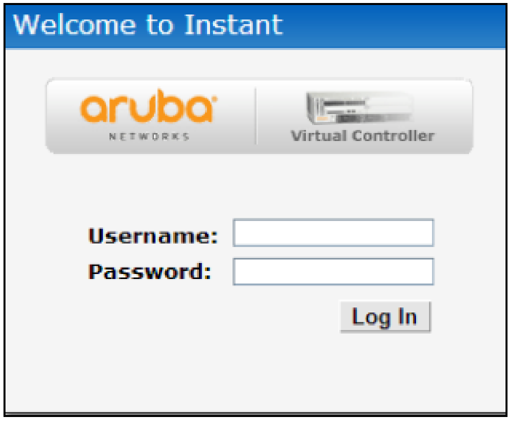
Logging in to the Instant UI

Launch a web browser and enter http://instant.arubanetworks.com. In the login screen, enter the following credentials:

- Username—admin
- Password—admin

The following figure shows the **Login** screen:

Figure 1 *Login Screen*



When you use a provisioning Wi-Fi network to connect to the Internet, all browser requests are directed to the Instant UI. For example, if you enter www.example.com in the address bar, you are directed to the Instant UI. You can change the default login credentials after the first login.

Regulatory Domains

The IEEE 802.11/b/g/n Wi-Fi networks operate in the 2.4 GHz spectrum and IEEE 802.11a/n operates in the 5 GHz spectrum. The spectrum is divided into channels. The 2.4 GHz spectrum is divided into 14 overlapping, staggered 20 MHz wireless carrier channels. These channels are spaced 5 MHz apart. The 5 GHz spectrum is divided into more channels. The channels that can be used in a particular country vary based on the regulations of that country.

The initial Wi-Fi setup requires you to specify the country code for the country in which the Instant operates. This configuration sets the regulatory domain for the radio frequencies that the IAPs use. Within the regulated transmission spectrum, a high-throughput 802.11ac, 802.11a, 802.11b/g, or 802.11n radio setting can be configured. The available 20 MHz, 40 MHz, or 80 MHz channels are dependent on the specified country code.

You cannot change the country code for the IAPs in the restricted regulatory domains such as US, Japan, and Israel for most of the IAP models. For IAP-RW variants, you can select from the list of supported regulatory domains. If the supported country code is not in the list, contact your Aruba Support team to know if the required country code is supported and obtain the software that supports the required country code.

> CAUTION
>
> Improper country code assignments can disrupt wireless transmissions. Most countries impose penalties and sanctions on operators of wireless networks with devices set to improper country codes.

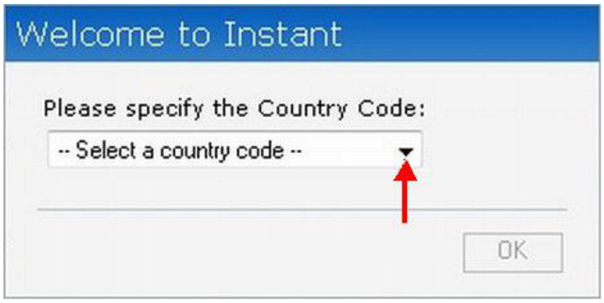
To view the country code information, run the **show country-codes** command.

Specifying Country Code

> NOTE
>
> This procedure is applicable only to the IAP-RW variants. Skip this step if you are installing IAP in the United States, Japan, or Israel.

The **Country Code** window is displayed for the IAP-RW variants when you log in to the IAP UI for the first time. The **Please Specify the Country Code** drop-down list displays only the supported country codes. If the IAP cluster consists of multiple IAP platforms, the country codes supported by the master IAP is displayed for all other IAPs in the cluster. Select a country code from the list and click **OK**. The IAP operates in the selected country code domain.

Figure 2 *Specifying a Country Code*



.

You can also view the list of supported country codes for the IAP-RW variants using the **show country-codes** command.

Accessing the Instant CLI

Instant supports the use of Command Line Interface (CLI) for scripting purposes. When you make configuration changes on a master IAP in the CLI, all associated IAPs in the cluster inherit these changes and subsequently update their configurations. By default, you can access the CLI from the serial port or from an SSH session. You must explicitly enable Telnet access on the IAP to access the CLI through a Telnet session.

For information on enabling SSH and Telnet access to the IAP CLI, see Terminal access on page 63.

Connecting to a CLI Session

On connecting to a CLI session, the system displays its host name followed by the login prompt. Use the administrator credentials to start a CLI session. For example:

```
User: admin
```

If the login is successful, the privileged command mode is enabled and a command prompt is displayed. For example:

```
(Instant AP)#
```

The privileged EXEC mode provides access to **show**, **clear**, **ping**, **traceroute**, and **commit** commands. The configuration commands are available in the config mode. To move from Privileged EXEC mode to the Configuration mode, enter the following command at the command prompt:

```
(Instant AP)# configure terminal
```

The configure terminal command allows you to enter the basic configuration mode and the command prompt is displayed as follows:

```
(Instant AP)(config)#
```

The Instant CLI allows CLI scripting in several other subcommand modes to allow the users to configure individual interfaces, SSIDs, access rules, and security settings.

You can use the question mark (?) to view the commands available in a privileged EXEC mode, configuration mode, or subcommand mode.

NOTE

Although automatic completion is supported for some commands such as **configure terminal**, the complete **exit** and **end** commands must be entered at command prompt.

Applying Configuration Changes

Each command processed by the VC is applied on all the slaves in a cluster. The changes configured in a CLI session are saved in the CLI context. The CLI does not support the configuration data exceeding the 4K buffer size in a CLI session. Therefore, Aruba recommends that you configure fewer changes at a time and apply the changes at regular intervals.

To apply and save the configuration changes at regular intervals, execute the following command in the privileged EXEC mode:

```
(Instant AP)# commit apply
```

To apply the configuration changes to the cluster without saving the configuration, execute the following command in the privileged EXEC mode:

```
(Instant AP)# commit apply no-save
```

To view the changes that are yet to be applied, execute the following command in the privileged EXEC mode:

```
(Instant AP)# show uncommitted-config
```

To revert to the earlier configuration, execute the following command in the privileged EXEC mode.

```
(Instant AP)# commit revert
```

Example:

To apply and view the configuration changes:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# beacon-interval 200
(Instant AP)(RF dot11a Radio Profile)# no legacy-mode
(Instant AP)(RF dot11a Radio Profile)# dot11h
(Instant AP)(RF dot11a Radio Profile)# interference-immunity 3
(Instant AP)(RF dot11a Radio Profile)# csa-count 2
(Instant AP)(RF dot11a Radio Profile)# spectrum-monitor
(Instant AP)(RF dot11a Radio Profile)# end

(Instant AP)# show uncommitted-config
   rf dot11a-radio-profile
   beacon-interval 200
   no legacy-mode
   dot11h
   interference-immunity 3
   csa-count 2
   spectrum-monitor
```

```
(Instant AP)# commit apply
```

Using Sequence-Sensitive Commands

The Instant CLI does not support positioning or precedence of sequence-sensitive commands. Therefore, Aruba recommends that you remove the existing configuration before adding or modifying the configuration details for sequence-sensitive commands. You can either delete an existing profile or remove a specific configuration by using the **no...** commands.

The following table lists the sequence-sensitive commands and the corresponding **no** commands to remove the configuration:

Table 8: *Sequence-Sensitive Commands*

Sequence-Sensitive Command	Corresponding no command
`opendns <username <password>`	`no opendns`
`rule <dest> <mask> <match> <protocol> <start-port> <end-port> {permit | deny | src-nat | dst-nat {<IP-address> <port> | <port>}}[<option1....option9>]`	`no rule <dest> <mask> <match> <protocol> <start-port> <end-port> {permit | deny | src-nat | dst-nat}`
`mgmt-auth-server <auth-profile-name>`	`no mgmt-auth-server <auth-profile-name>`

`set-role <attribute>{{equals| not-equals | starts-with | ends-with | contains} <operator> <role> | value-of}`	`no set-role <attribute>{{equals | not-equals | starts-with | ends-with | contains} <operator>| value-of}`
	`no set-role`

`set-vlan <attribute>{{equals | not-equals | starts-with | ends-with | contains} <operator> <VLAN-ID> | value-of}`	`no set-vlan <attribute>{{equals | not-equals | starts-with | ends-with | contains} <operator> | value-of}`
	`no set-vlan`

`auth-server <name>`	`no auth-server <name>`

Banner and Loginsession Configuration using CLI

Starting from Instant 6.5.0.0-4.3.0.0, the Banner and Loginsession Configuration feature is introduced in the IAP, wherein the text banner can be displayed at the login prompt when users are on a management (Telnet or SSH) session of the CLI, and the management session can remain active even when there is no user activity involved.

The **banner** command defines a text banner to be displayed at the login prompt of a CLI. Instant supports up to 16 lines text, and each line accepts a maximum of 255 characters including spaces.

To configure a banner:

```
(Instant AP)(config)# banner motd <motd_text>
```

Example of a text banner configuration:

```
(Instant AP)(config)# banner motd "######welcome to login instant##########"
(Instant AP)(config)# banner motd "####please start to input admin and password#########"
(Instant AP)(config)# banner motd "###Don't leak the password###"
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To display the banner:

```
(Instant AP)# show banner
```

The **loginsession** command configures the management session (Telnet or SSH) to remain active without any user activity.

To define a timeout interval:

```
(Instant AP) (config) #loginsession timeout <val>
```

<val> can be any number of minutes from 5 to 60, or any number of seconds from 1 to 3600. You can also specify a timeout value of 0 to disable CLI session timeouts. The users must re-login to the IAP after the session times out. The session does not time out when the value is set to 0.

Chapter 4
Automatic Retrieval of Configuration

This chapter provides the following information:

Managed Mode Operations

IAPs support managed mode operations to retrieve the configuration file from a server through the File Transfer Protocol (FTP) or FTP over Secure Sockets Layer (FTPS), and automatically update the IAP configuration.

The server details for retrieving configuration files are stored in the basic configuration of the IAPs. The basic configuration of an IAP includes settings specific to an IAP, for example, host name, static IP, and radio configuration settings. When an IAP boots up, it performs a GET operation to retrieve the configuration (.cfg) file from the associated server using the specified download method.

After the initial configuration is applied to the IAPs, the configuration can be changed at any point. You can configure a polling mechanism to fetch the latest configuration by using an FTP or FTPS client periodically. If the remote configuration is different from the one running on the IAP and if a difference in the configuration file is detected by the IAP, the new configuration is applied. At any given time, IAPs can fetch only one configuration file, which may include the configuration details specific to an IAP. For configuring polling mechanism and downloading configuration files, the users are required to provide credentials (username and password). However, if automatic mode is enabled, the user credentials required to fetch the configuration file are automatically generated. To enable automatic configuration of the IAPs, configure the managed mode command parameters.

Prerequisites

Perform the following checks before configuring the managed mode command parameters:

- Ensure that the IAP is running Instant 6.2.1.0-3.4 or later versions.
- When the IAPs are in the managed mode, ensure that the IAPs are not managed by AirWave.

Configuring Managed Mode Parameters

To enable the automatic configuration, perform the steps described in the following table:

Table 9: *Managed Mode Commands*

Steps	Command
1. Start a CLI session to configure the managed-mode profile for automatic configuration.	`(Instant AP)(config)# managed-mode-profile`

2. Enable automatic configuration
Or
Specify the user credentials.
	`(Instant AP)(managed-mode-profile)# automatic`
	Or
	`(Instant AP)(managed-mode-profile)# username <username>`
	`(Instant AP)(managed-mode-profile)# password <password>`
	NOTE: If the automatic mode is enabled, the user credentials are automatically generated based on IAP MAC address.

3. Specify the configuration file.	`(Instant AP)(managed-mode-profile)# config-filename <file_name>` Filename—Indicates filename in the alphanumeric format. Ensure that configuration file name does not exceed 40 characters.
4. Specify the configuration file download method.	`(Instant AP)(managed-mode-profile)# download-method <ftp|ftps>` You can use either FTP or FTPS for downloading configuration files.
5. Specify the name of the server or the IP address of the server from which the configuration file must be downloaded.	`(Instant AP)(managed-mode-profile)# server <server_name>`

Table 9: *Managed Mode Commands*

Steps	Command
6. Configure the day and time at which the IAPs can poll the configuration files from the server.	`(Instant AP) (managed-mode-profile)# sync-time day <dd> hour <hh> min <mm> window <window>` Based on the expected frequency of configuration changes and maintenance window, you can set the configuration synchronization timeline. - `day <dd>`—Indicates day, for example to configure Sunday as the day, specify 01. To configure the synchronization period as everyday, specifiy 00. - `hour <hh>`—Indicates hour within the range of 0–23. - `min <mm>`—Indicates minutes within the range of 0–59. - `window <hh>`—Defines a window for synchronization of the configuration file. The default value is 3 hours.
7. Configure the time interval in minutes between two retries, after which IAPs can retry downloading the configuration file.	`(Instant AP)(managed-mode-profile)# retry-poll-period <seconds>` **NOTE:** Specify the retry interval in seconds within the range of 5–60 seconds. The default retry interval is 5 seconds.

8. Apply the configuration changes.	`(Instant AP)(managed-mode-profile)# end`
	`(Instant AP)# commit apply`

If you want to apply the configuration immediately and do not want to wait until next configuration retrieval attempt, execute the following command:

```
(Instant AP)# managed-mode-sync-server
```

Example

To configure managed mode profile:

```
(Instant AP)(config)# managed-mode-profile
(Instant AP)(managed-mode-profile)# username <username>
(Instant AP)(managed-mode-profile)# password <password>
(Instant AP)(managed-mode-profile)# config-filename instant.cfg
(Instant AP)(managed-mode-profile)# download-method ftps
(Instant AP)(managed-mode-profile)# sync-time day 00 hour 03 min 30 window 02
(Instant AP)(managed-mode-profile)# retry-poll-period 10
(Instant AP)(managed-mode-profile)# end
(Instant AP)# commit apply
```

Verifying the Configuration

To verify if the automatic configuration functions, perform the following checks:

1. Verify the status of configuration by running the following commands at the command prompt:

```
(Instant AP)# show managed-mode config
(Instant AP)# show managed-mode status
```

2. Verify the status of download by running the following command at the command prompt:

```
(Instant AP)# show managed-mode logs
```

If the configuration settings retrieved in the configuration file are incomplete, IAPs reboot with the earlier configuration.

Chapter 5
Instant User Interface

This chapter describes the following Instant UI elements:

- Login Screen on page 30
- Main Window on page 31

Login Screen

The Instant login page allows you to perform the following tasks:

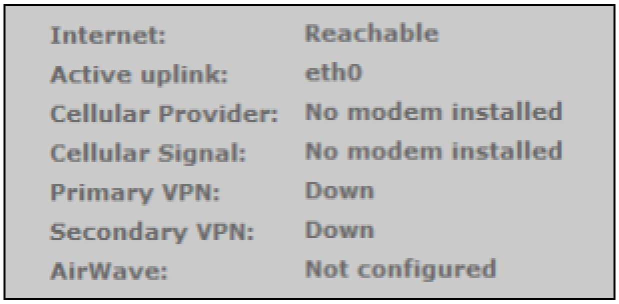
- View Instant Network Connectivity summary
- View the Instant UI in a specific language
- Log in to the Instant UI

Viewing Connectivity Summary

The login page also displays the connectivity status to the Instant network. The users can view a summary that indicates the status of the Internet availability, uplink, cellular modem and signal strength, VPN, and AirWave configuration details before logging in to the Instant UI.

The following figure shows the information displayed in the connectivity summary:

Figure 3 *Connectivity Summary*



Internet:	Reachable
Active uplink:	eth0
Cellular Provider:	No modem installed
Cellular Signal:	No modem installed
Primary VPN:	Down
Secondary VPN:	Down
AirWave:	Not configured

Language

The **Language** drop-down list contains the available languages and allows users to select their preferred language before logging in to the Instant UI. A default language is selected based on the language preferences in the client desktop operating system or browser. If Instant cannot detect the language, then **English** is used as the default language.

You can also select the required language option from the **Languages** drop-down list located on the Instant main window.

Logging into the Instant UI

To log in to the Instant UI, enter the following credentials:

- Username—admin
- Password—admin

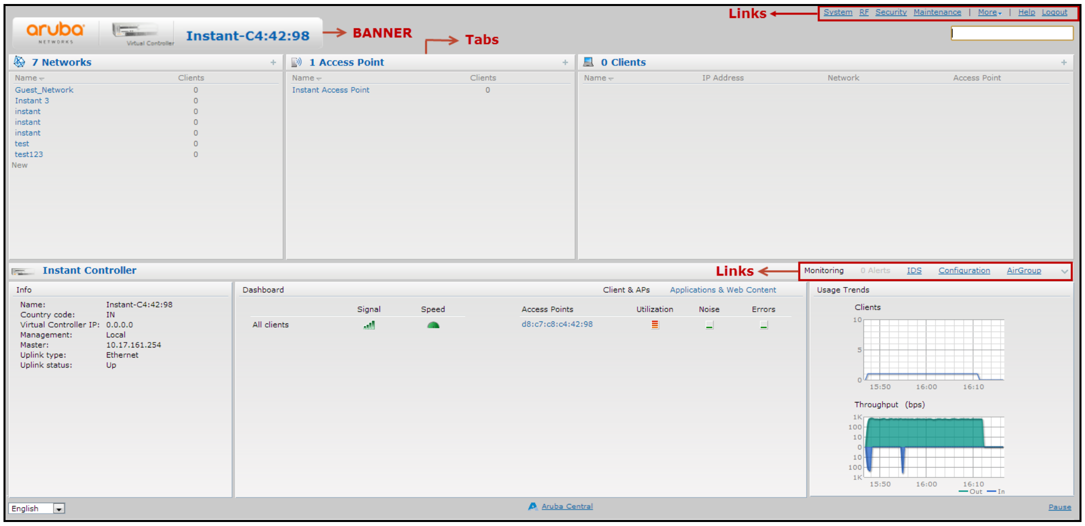
The Instant UI main window is displayed.

When you log in to an IAP with the factory default settings, a popup box displays an option to sign up for the Aruba cloud solution and enable IAP management through Aruba Central. To sign up for a free 90-day trial of Central, click here on the Instant main window.

Main Window

On logging in to Instant, the Instant UI Main Window is displayed. The following figure shows the Instant main window:

Figure 4 *Instant Main Window*



Name	Clients
Guest_Network	0
Instant 3	0
instant	0
instant	0
instant	0
test	0
test123	0
New	

Name	Clients
Instant Access Point	0

Name	IP Address	Network	Access Point

Info

Name:	Instant-C4:42:98
Country code:	IN
Virtual Controller IP:	0.0.0.0
Management:	Local
Master:	10.17.161.254
Uplink type:	Ethernet
Uplink status:	Up

	Signal	Speed	Access Points	Utilization	Noise	Errors
All clients			d8:c7:c8:c4:42:98			

The main window consists of the following elements:

- Banner
- Search Text Box
- Tabs
- Links
- Views

Banner

The banner is a horizontal gray rectangle that appears on the Instant main window. It displays the company name, logo, and the VC's name.

Search Text Box

Administrators can search for an IAP, client, or a network in the **Search** text box. When you type a search text, the search function suggests matching keywords and allows you to automatically complete the search text entry.

Tabs

The Instant main window consists of the following tabs:

- Network Tab—Provides information about the network profiles configured in the Instant network.
- Access Points Tab—Provides information about the IAPs configured in the Instant network.
- Clients Tab—Provides information about the clients in the Instant network.

Each tab appears in a compressed view by default. The number of networks, IAPs, or clients in the network precedes the coresponding tab names. The individual tabs can be expanded or collapsed by clicking the tabs. The list items in each tab can be sorted by clicking the triangle icon next to the heading labels.

Network Tab

This tab displays a list of Wi-Fi networks that are configured in the Instant network. The network names are displayed as links. The expanded view displays the following information about each WLAN SSID:

- **Name**—Name of the network.
- **Clients**—Number of clients that are connected to the network.
- **Type**—Type of network such as Employee, Guest, or Voice.
- **Band**—Band in which the network is broadcast: 2.4 GHz band, 5 GHz band, or both.
- **Authentication Method**—Authentication method required to connect to the network.
- **Key Management**—Authentication key type.
- **IP Assignment**—Source of IP address for the client.
- **Zone**—IAP zone configured on the SSID.

To add a wireless network profile, click the **New** link on the **Network** tab. To edit, click the **edit** link that is displayed on clicking the network name in the **Network** tab. To delete a network, click the **x** link.

For more information on the procedure to add or modify a wireless network, see Wireless Network Profiles on page 80.

Access Points Tab

If the Auto-Join Mode feature is enabled, a list of enabled and active IAPs in the Instant network is displayed on the **Access Points** tab. The IAP names are displayed as links. If the Auto Join Mode feature is disabled, the **New** link is displayed. Click this link to add a new IAP to the network. If an IAP is configured and not active, its MAC Address is displayed in red.

The expanded view of the **Access Points** tab displays the following information about each IAP:

- **Name**—Name of the IAP. If the IAP functions as a master IAP in the network, the asterisk sign "*" is displayed next to the IAP.
- **IP Address**—IP address of the IAP.
- **Mode**—Mode of the IAP.
  - **Access**—In this mode, the IAP serves clients and scans the home channel for spectrum analysis while monitoring channels for rogue IAPs in the background.
  - **Monitor**—In this mode, the IAP acts as a dedicated Air Monitor (AM), scanning all channels for rogue IAPs and clients.
- **Spectrum**—When enabled, the IAP functions as a dedicated full-spectrum RF monitor, scanning all channels to detect interference from neighboring IAPs or non-Wi-Fi devices such as microwaves and cordless phones. When Spectrum is enabled, the IAP does not provide access services to clients.
- **Clients**—Number of clients that are currently associated to the IAP.
- **Type**—Model number of the IAP.
- **Mesh Role**—Role of the IAP as a mesh portal or mesh point.
- **Zone**—IAP zone.
- **Serial number**—Serial number of the device.
- **Channel**—Channel on which the IAP is currently broadcast.
- **Power (dB)**—Maximum transmission Effective Isotropic Radiated Power (EIRP) of the radio.
- **Utilization (%)**—Percentage of time that the channel is utilized.

- **Noise (dBm)**—Noise floor of the channel.

An **edit** link is displayed on clicking the IAP name. For details on editing IAP settings, see Customizing IAP Settings on page 66.

Clients Tab

This tab displays a list of clients that are connected to the Instant network. The client names are displayed as links. The expanded view displays the following information about each client:

- **Name**—Username of the client or guest users if available.
- **IP Address**—IP address of the client.
- **MAC Address**—MAC address of the client.
- **OS**—Operating system that runs on the client.
- **ESSID**—ESSID to which the client is connected.
- **Access Point**—IAP to which the client is connected.
- **Channel**—The client operating channel.
- **Type**—Type of the Wi-Fi client.
- **Role**—Role assigned to the client.
- **Signal**—Current signal strength of the client, as detected by the IAP.
- **Speed (mbps)**—Current speed at which data is transmitted. When the client is associated with an IAP, it constantly negotiates the speed of data transfer. A value of 0 means that the IAP has not heard from the client for some time.

Links

The following links allow you to configure various features for the Instant network:

- New Version Available
- System
- RF
- Security
- Maintenance
- More
- Help
- Logout
- Monitoring
- Client Match
- AppRF
- Spectrum
- Alerts
- IDS
- AirGroup
- Configuration
- AirWave Setup
- Pause/Resume

Each of these links is explained in the subsequent sections.

New Version Available

This link is displayed on the Instant main window only if a new image version is available on the image server and AirWave is not configured. For more information on the **New version available** link and its functions, see Upgrading an IAP on page 354.

System

This link displays the **System** window. The **System** window consists of the following tabs:

> NOTE
>
> Use the **Show/Hide Advanced** option of the **System** window to view or hide the advanced options.

- **General**—Allows you to configure, view, or edit the Name, IP address, NTP Server, and other IAP settings for the VC.
- **Admin**—Allows you to configure administrator credentials for access to the VC Management UI. You can also configure AirWave in this tab. For more information on management interface and AirWave configuration, see Managing IAP Users on page 142 and Managing an IAP from AirWave on page 311, respectively.
- **Uplink**—Allows you to view or configure uplink settings. See Uplink Configuration on page 323 for more information.
- **L3 Mobility**—Allows you to view or configure the Layer-3 mobility settings. See Configuring L3-Mobility on page 344 for more information.
- **Enterprise Domains**—Allows you to view or configure the DNS domain names that are valid in the enterprise network. See Configuring Enterprise Domains on page 195 for more information.
- **Monitoring**—Allows you to view or configure the following details:
  - **Syslog**—Allows you to view or configure Syslog server details for sending syslog messages to the external servers. See Configuring a Syslog Server on page 370 for more information.
  - **TFTP Dump**—Allows you to view or configure a Trivial File Tranfer Protocol (TFTP) dump server for core dump files. See Configuring TFTP Dump Server on page 371 for more information.
  - **SNMP**—Allows you to view or configure Simple Network Management Protocol (SNMP) agent settings. See Configuring SNMP on page 366 for more information.
- **WISPr**—Allows you to view or configure the Wireless ISP-roaming (WISPr) settings. See Configuring WISPr Authentication on page 174 for more information.
- **Proxy**—Allows you to configure HTTP proxy on an IAP. See Configuring HTTP Proxy on an IAP on page 354 for more information.
- **Time Based Services**—Allows you to configure a time profile which can be assigned to the SSID configured on the IAP. See Configuring Time-Based Services on page 220

RF

The **RF** link displays a window for configuring Adaptive Radio Management (ARM) and Radio features.

- **ARM**—Allows you to view or configure channel and power settings for all the IAPs in the network. For information on ARM configuration, see ARM Overview on page 252.
- **Radio**—Allows you to view or configure radio settings for 2.4 GHz and the 5 GHz radio profiles. For information on Radio, see Configuring Radio Settings on page 259.

Security

The **Security** link displays a window with the following tabs:

- **Authentication Servers**—Use this tab to configure an external RADIUS server for a wireless network. For more information, see Configuring an External Server for Authentication on page 155.
- **Users for Internal Server**—Use this tab to populate the system's internal authentication server with users. This list is used by networks for which per-user authorization is specified using the internal authentication server of the VC. For more information on users, see Managing IAP Users on page 142.
- **Roles** —Use this tab to view the roles defined for all the Networks. The Access Rules part allows you to configure permissions for each role. For more information, see Configuring User Roles on page 198 and Configuring ACL Rules for Network Services on page 181.
- **Blacklisting**—Use this tab to blacklist clients. For more information, see Blacklisting Clients on page 175.
- **Firewall Settings**—Use this tab to enable or disable Application Layer Gateway (ALG) supporting address and port translation for various protocols and to configure protection against wired attacks. For more information, see Configuring ALG Protocols on page 187 and Configuring Firewall Settings for Protection from ARP Attacks on page 188
- **Inbound Firewall**—Use this tab to enhance the inbound firewall by allowing the configuration of inbound firewall rules, management subnets, and restricted corporate access through an uplink switch. For more information, see Managing Inbound Traffic on page 190.
- **Walled Garden**—Use this tab to allow or prevent access to a selected list of websites. For more information, see Configuring Walled Garden Access on page 140.
- **External Captive Portal**—Use this tab to configure external captive portal profiles. For more information, see Configuring External Captive Portal for a Guest Network on page 128.
- **Custom Blocked Page URL**—Use this tab to create a list of URLs that can be blocked using an ACL rule. For more information, see Creating Custom Error Page for Web Access Blocked by AppRF Policies on page 197.

Maintenance

The **Maintenance** link displays a window that allows you to maintain the Wi-Fi network. The **Maintenance** window consists of the following tabs:

- **About**—Displays the name of the product, build time, IAP model name, the Instant version, website address of Aruba Networks, and copyright information.
- **Configuration**—Displays the following details:
  - **Current Configuration**—Displays the current configuration details.
  - **Clear Configuration**—Allows you to clear the current configuration details of the network.
  - **Backup Configuration**—Allows you to back up local configuration details. The backed up configuration data is saved in the file named **instant.cfg**.
  - **Restore Configuration**—Allows you to restore the backed up configuration. After restoring the configuration, the IAP must be rebooted for the changes to take effect.
- **Certificates**—Displays information about the certificates installed on the IAP. You can also upload new certificates to the IAP database. For more information, see Uploading Certificates on page 178.
- **Firmware**—Displays the current firmware version and provides various options to upgrade to a new firmware version. For more information, see Upgrading an IAP on page 354.
- **Reboot**—Displays the IAPs in the network and provides an option to reboot the required IAP or all IAPs. For more information, see Upgrading an IAP on page 354.

- **Convert**—Provides an option to convert an IAP to a Mobility Controller managed Remote AP or Campus AP, or to the default VC mode. For more information, see Converting an IAP to a Remote AP and Campus AP on page 358.

More

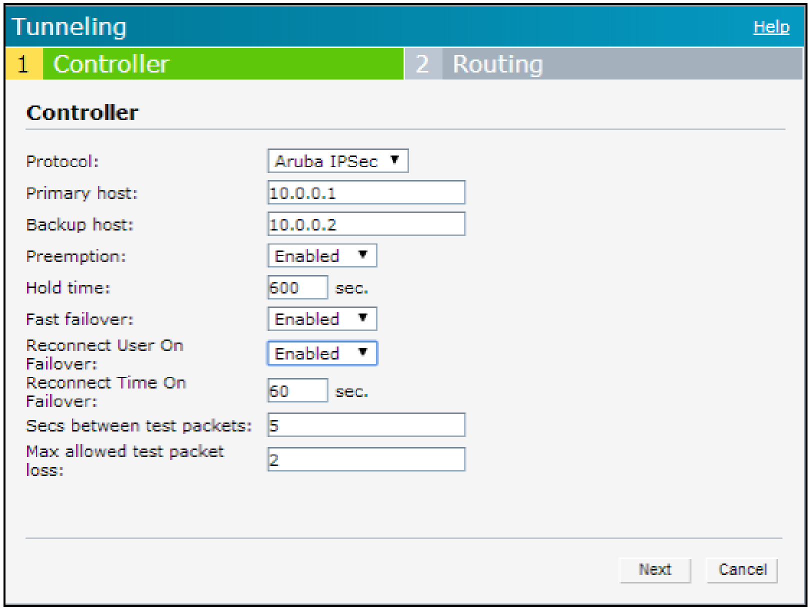
The **More** link allows you to select the following options:

- VPN
- IDS
- Wired
- Services
- DHCP Server
- Support

VPN

The **VPN** window allows you to define communication settings with an Aruba controller or a third party VPN concentrator. See VPN Configuration on page 227 for more information. The following figure shows an example of the IPsec configuration options available in the **VPN** window:

Figure 5 *VPN Window for IPsec Configuration*



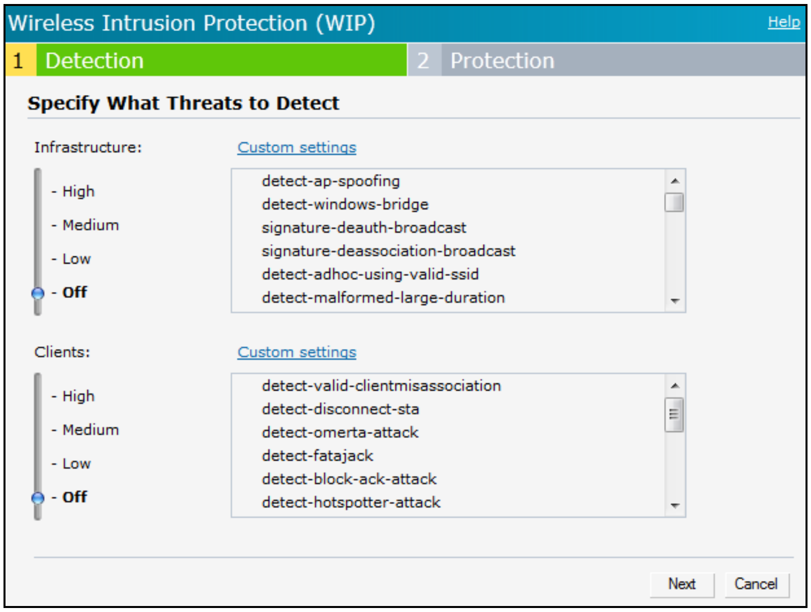
Controller

Protocol:	Aruba IPSec
Primary host:	10.0.0.1
Backup host:	10.0.0.2
Preemption:	Enabled
Hold time:	600 sec.
Fast failover:	Enabled
Reconnect User On Failover:	Enabled
Reconnect Time On Failover:	60 sec.
Secs between test packets:	5
Max allowed test packet loss:	2

IDS

The **IDS** window allows you to configure wireless intrusion detection and protection levels. The following figures show the **IDS** window:

Figure 6 *IDS Window: Intrusion Detection*



Specify What Threats to Detect

Infrastructure:

- High
- Medium
- Low
- **Off**

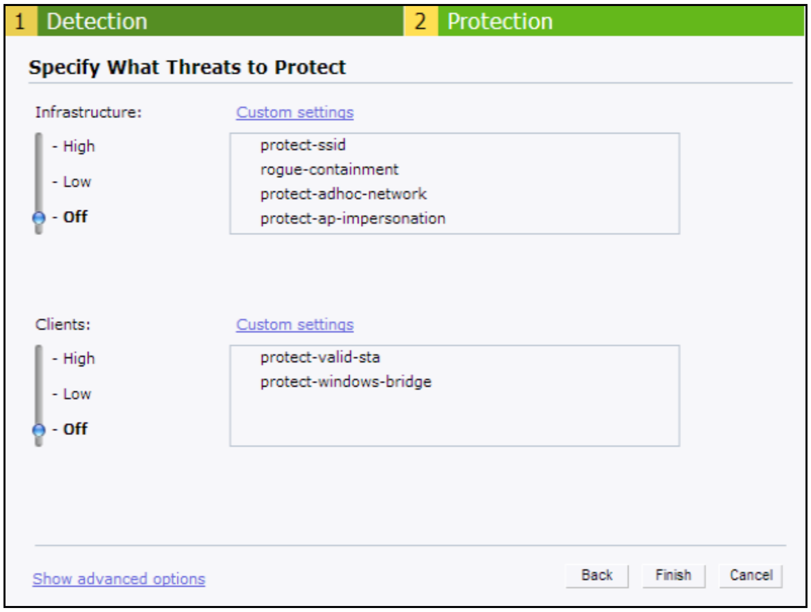
```
detect-ap-spoofing
detect-windows-bridge
signature-deauth-broadcast
signature-deassociation-broadcast
detect-adhoc-using-valid-ssid
detect-malformed-large-duration
```

Clients:

- High
- Medium
- Low
- **Off**

```
detect-valid-clientmisassociation
detect-disconnect-sta
detect-omerta-attack
detect-fatajack
detect-block-ack-attack
detect-hotspotter-attack
```

Figure 7 *IDS Window: Intrusion Protection*



Specify What Threats to Protect

Infrastructure:

- High
- Low
- **Off**

```
protect-ssid
rogue-containment
protect-adhoc-network
protect-ap-impersonation
```

Clients:

- High
- Low
- **Off**

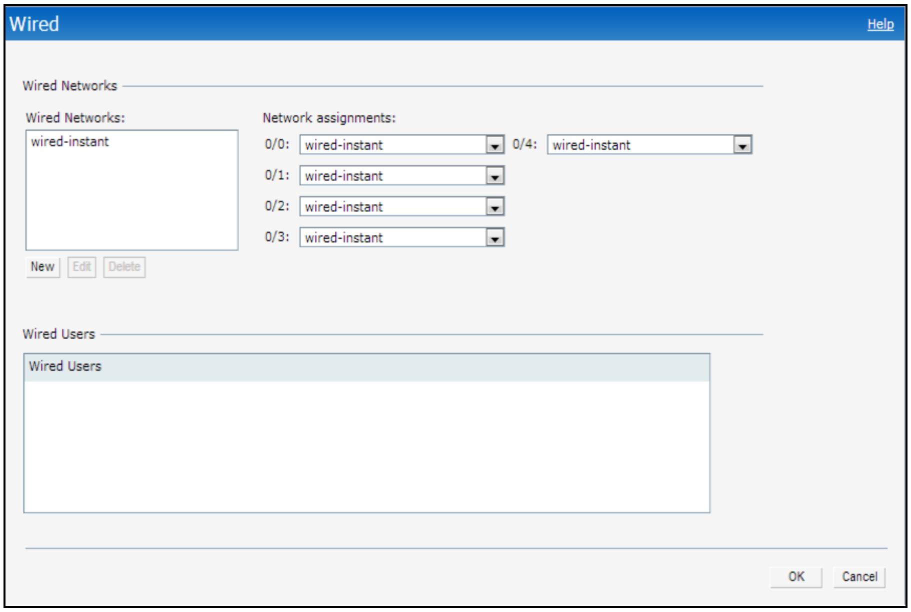
```
protect-valid-sta
protect-windows-bridge
```

For more information on wireless intrusion detection and protection, see Detecting and Classifying Rogue IAPs on page 333.

Wired

The **Wired** window allows you to configure a wired network profile. See Wired Profiles on page 107 for more information. The following figure shows the **Wired** window:

Figure 8 *Wired Window*



Wired Networks: wired-instant

Network assignments:

0/0: wired-instant

0/1: wired-instant

0/2: wired-instant

0/3: wired-instant

0/4: wired-instant

Wired Users

Services

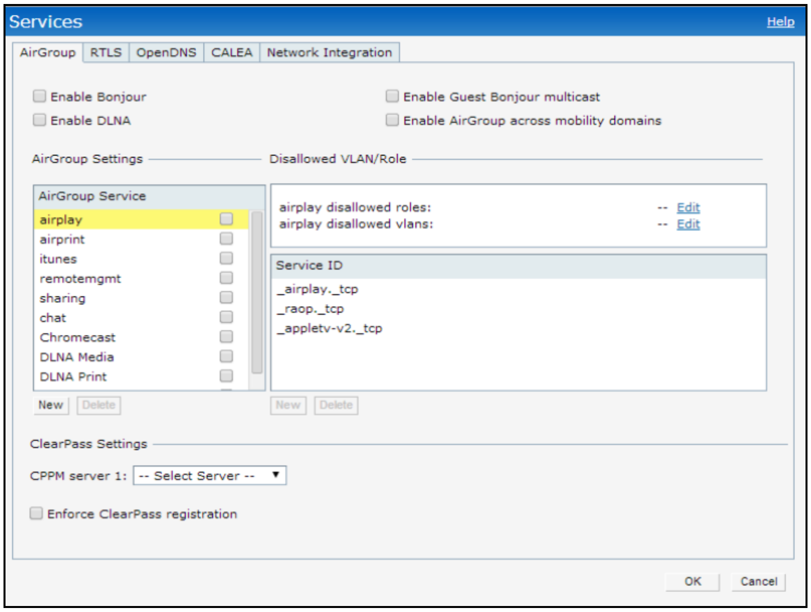
The **Services** window allows you to configure services such as AirGroup, Real Time Location System (RTLS), and OpenDNS. The Services window consists of the following tabs:

- **AirGroup**—Allows you to configure the AirGroup and AirGroup services. For more information, see Configuring AirGroup on page 282.
- **RTLS**—Allows you to integrate AMP or third-party RTLS such as Aeroscout Real Time Location Server with Instant. For more information, see Configuring an IAP for RTLS Support on page 291.

  The RTLS tab also allows you to integrate IAP with the Analytics and Location Engine (ALE). For more information about configuring an IAP for ALE integration, see Configuring an IAP for Analytics and Location Engine Support on page 292.
- **OpenDNS**—Allows you to configure support for OpenDNS business solutions, which require an OpenDNS (www.opendns.com) account. The OpenDNS credentials are used by Instant and AirWave to filter content at the enterprise level. For more information, see Configuring OpenDNS Credentials on page 297.
- **CALEA**—Allows you configure support for Communications Assistance for Law Enforcement Act (CALEA) server integration, thereby ensuring compliance with Lawful Intercept and CALEA specifications. For more information, see CALEA Integration and Lawful Intercept Compliance on page 302.
- **Network Integration**—Allows you to configure an IAP for integration with Palo Alto Networks (PAN) Firewall and XML API server. For more information on IAP integration with PAN, see Integrating an IAP with Palo Alto Networks Firewall on page 297and Integrating an IAP with an XML API Interface on page 299.

The following figure shows the default view of the **Services** window:

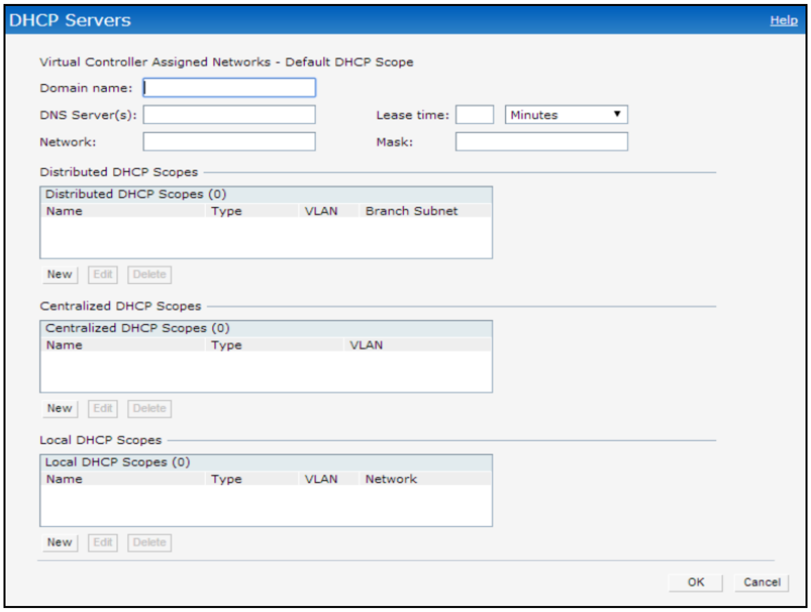
Figure 9 *Services Window: Default View*



DHCP Server

The **DHCP Servers** window allows you to configure various DHCP modes. The following figure shows the options available in the **DHCP Servers** window:

Figure 10 *DHCP Servers Window*



For more information, see DHCP Configuration on page 210.

Support

The **Support** link consists of the following details:

- **Command**—Allows you to select a support command for execution.
- **Target**—Displays a list of IAPs in the network.
- **Run**—Allows you to execute the selected command for a specific IAP or all IAPs and view logs.

- **Auto Run**—Allows you to configure a schedule for automatic execution of a support command for a specific IAP or all IAPs.
- **Filter**—Allows you to filter the contents of a command output.
- **Clear**—Clears the command output that is displayed after a command is executed.
- **Save**—Allows you to save the support command logs as an HTML or text file.

For more information on support commands, see Running Debug Commands on page 372.

Help

The **Help** link allows you to view a short description or definition of the selected terms in the UI windows or the dialog boxes.

To activate the context-sensitive help:

1. Click the **Help** link available above the Search bar on the Instant main window.
2. Click any text or term displayed in green italics to view its description or definition.
3. To disable the help mode, click **Done**.

Logout

The **Logout** link allows you to log out of the Instant UI.

Monitoring

The **Monitoring** link displays the Monitoring pane for the Instant network. Use the down arrow ⌄ located to the right side of these links to compress or expand the Monitoring pane.

The Monitoring pane consists of the following sections:

- Info
- RF Dashboard
- RF Trends
- Usage Trends
- Mobility Trail

Info

The **Info** section displays the configuration information of the VC by default. On selecting the **Network View** tab, the monitoring pane displays configuration information of the selected network. Similarly, in the **Access Point** or the **Client** view, this section displays the configuration information of the selected IAP or the client.

Table 10: *Contents of the Info Section in the Instant Main Window*

Name	Description
Info section in the **Virtual Controller** view	The **Info** section in the **Virtual Controller** view displays the following information: ● **Name**—Displays the VC name. ● **Country Code**—Displays the Country in which the VC is operating. ● **Virtual Controller IP address**—Displays the IP address of the VC. ● **VC DNS**—Displays the DNS IP address configured for the VC. ● **Management**—Indicates if the IAP is managed locally or through AirWave or Aruba Central. ● **Master**—Displays the IP address of the IAP acting as VC. ● **OpenDNS Status**—Displays the OpenDNS status. If the OpenDNS status indicates **Not Connected**, ensure that the network connection is up and appropriate credentials are configured for **OpenDNS**. ● **MAS integration**—Displays the status of the Mobility Access Switch (MAS) integration feature. ● **Uplink type**—Displays the type of uplink configured on the IAP, for example, Ethernet or 3G. ● **Uplink status**—Indicates the uplink status. ● **Blacklisted clients**—Displays the number of blacklisted clients. ● **Internal RADIUS Users**—Displays the number of internal RADIUS users. ● **Internal Guest Users**—Displays the number of internal guest users. ● **Internal User Open Slots**—Displays the available slots for user configuration as supported by the IAP model.
Info section in the **Network** view	The **Info** section in the **Network** view displays the following information: ● **Name**—Displays the name of the network. ● **Status**—Displays the status of the network. ● **Type**—Displays the type of network, for example, Employee, Guest, or Voice. ● **VLAN**—Displays VLAN details. ● **IP Assignment**—Indicates if the IAP clients are assigned IP address from the network that the VC is connected to, or from an internal autogenerated IP scope from the VC. ● **Access**—Indicates the level of access control configured for the network. ● **WMM DSCP**—Displays Wi-Fi Multemedia (WMM) DSCP mapping details. ● **Security level**—Indicates the type of user authentication and data encryption configured for the network. The **info** section for WLAN SSIDs also indicates status of captive portal and CALEA ACLs and provides a link to upload certificates for the internal server. For more information, see Uploading Certificates on page 178.
Info section in the **Access Point** view	The **Info** section in the **Access Point** view displays the following information: ● **Name**—Displays the name of the selected IAP. ● **IP Address**—Displays the IP address of the IAP.

Table 10: *Contents of the Info Section in the Instant Main Window*

Name	Description
	● **Mode**—Displays the mode in which the IAP is configured to operate. ● **Spectrum**—Displays the status of the spectrum monitor. ● **Clients**—Number of clients associated with the IAP. ● **Type**—Displays the model number of the IAP. ● **Zone**—Displays IAP zone details. ● **CPU Utilization**—Displays the CPU utilization in percentage. ● **Memory Free**—Displays the memory availability of the IAP in MB. ● **Serial number**—Displays the serial number of the IAP. ● **MAC**—Displays the MAC address. ● **From Port**—Displays the port from where the slave IAP is learned in hierarchy mode.
Info section in the **Client** view	The **Info** section in the **Client** view displays the following information: ● **Name**—Displays the name of the client. ● **IP Address**—Displays the IP address of the client. ● **MAC Address**—Displays MAC address of the client. ● **OS**—Displays the operating system that is running on the client. ● **ESSID**—Indicates the network to which the client is connected. ● **Access Point**—Indicates the IAP to which the client is connected. ● **Channel**—Indicates the channel that is currently used by the client. ● **Type**—Displays the channel type on which the client is broadcasting. ● **Role**—Displays the role assigned to the client.

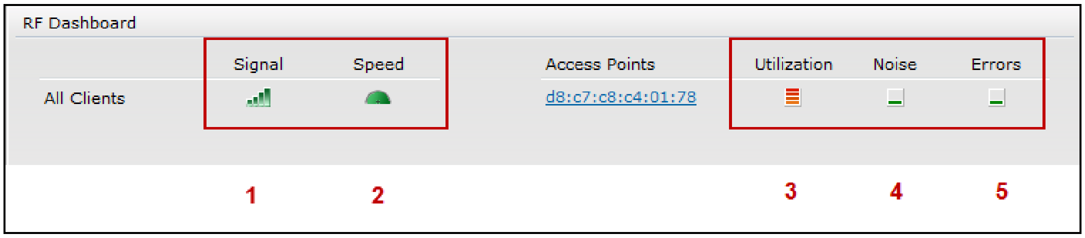
RF Dashboard

The **RF Dashboard** section lists the IAPs that exceed the utilization, noise, or error threshold. It also shows the clients with low speed or signal strength in the network and the RF information for the IAP to which the client is connected.

The IAP names are displayed as links. When an IAP is clicked, the IAP configuration information is displayed in the Info section and the RF Dashboard section is displayed on the Instant main window.

The following figure shows an example of the RF dashboard with Utilization, Band frames, Noise Floor, and Errors details:

Figure 11 *RF Dashboard in the Monitoring Pane*



The following table describes the icons available on the RF Dashboard pane:

Table 11: *RF Dashboard Icons*

Icon number	Name	Description
1	Signal	Displays the signal strength of the client. Signal strength is measured in decibels. Depending on the signal strength of the client, the color of the lines on the Signal icon changes in the following order: ● Green—Signal strength is more than 20 dB. ● Orange—Signal strength is between 15 dB and 20 dB. ● Red—Signal strength is less than 15 dB. To view the signal graph for a client, click the signal icon next to the client in the **Signal** column.
2	Speed	Displays the data transfer speed of the client. Depending on the data transfer speed of the client, the color of the Speed icon changes in the following order: ● Green—Data transfer speed is more than 50% of the maximum speed supported by the client. ● Orange—Data transfer speed is between 25% and 50% of the maximum speed supported by the client. ● Red—Data transfer speed is less than 25% of the maximum speed supported by the client. To view the data transfer speed graph of a client, click the speed icon corresponding to the client name in the **Speed** column.
3	Utilization	Displays the radio utilization rate of the IAPs. Depending on the percentage of utilization, the color of the lines on the Utilization icon changes in the following order: ● Green—Utilization is less than 50%. ● Orange—Utilization is between 50% and 75%. ● Red—Utilization is more than 75%. To view the utilization graph of an IAP, click the Utilization icon next to the IAP in the **Utilization** column.

Table 11: *RF Dashboard Icons*

Icon number	Name	Description
4	Noise	Displays the noise floor details for the IAPs. Noise is measured in decibels/meter. Depending on the noise floor, the color of the lines on the Noise icon changes in the following order: ● Green—Noise floor is more than -87 dBm. ● Orange—Noise floor is between -80 dBm and -87 dBm. ● Red—Noise floor is less than -80 dBm. To view the noise floor graph of an IAP, click the Noise icon next to the IAP in the **Noise** column.
5	Errors	Displays the errors for the IAPs. Depending on the errors, color of the lines on the Errors icon changes in the following order: ● Green—Errors are less than 5000 frames per second. ● Orange—Errors are between 5000 and 10,000 frames per second. ● Red—Errors are more than 10000 frames per second. To view the errors graph of an IAP, click the Errors icon next to the IAP in the **Errors** column.

RF Trends

The **RF Trends** section displays the following graphs for the selected IAP and the client. To view the details on the graphs, click the graphs and hover the mouse on a data point:

Figure 12 *RF Trends for Access Point*

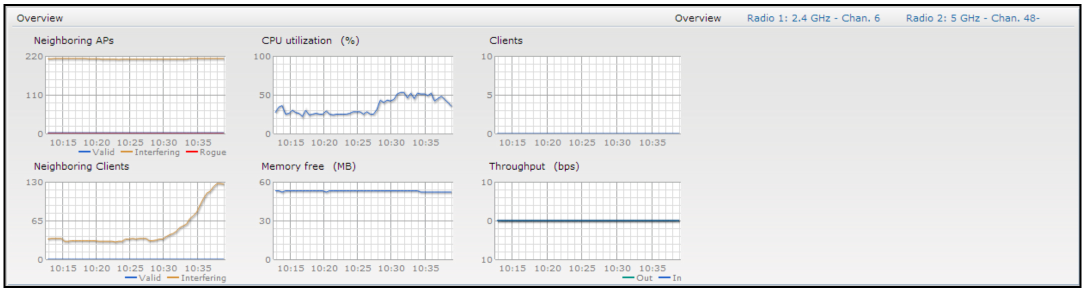
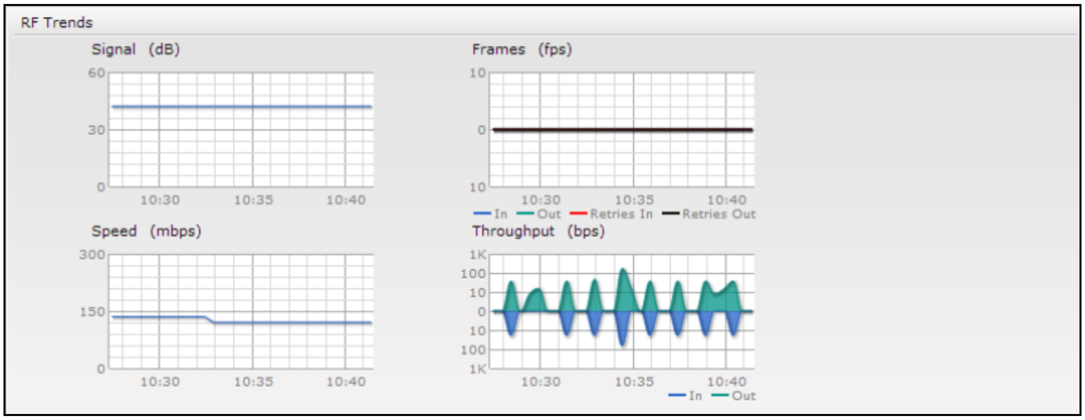


Figure 13 *RF Trends for Clients*



The following table describes the RF trends graphs available in the Client view:

Table 12: *Client View—RF Trends Graphs and Monitoring Procedures*

Graph Name	Description	Monitoring Procedure
Signal	The Signal graph shows the signal strength of the client for the last 15 minutes. It is measured in decibels. To see an enlarged view, click the graph. The enlarged view provides Last, Minimum, Maximum, and Average signal statistics of the client for the last 15 minutes. To see the exact signal strength at a particular time, move the cursor over the graph line.	To monitor the signal strength of the selected client for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Clients** tab, click the IP address of the client for which you want to monitor the signal strength. 3. Study the Signal graph in the RF Trends pane. For example, the graph shows that signal strength for the client is 54.0 dB at 12:23 hours.
Frames	The Frames graph shows the In and Out frame rate per second of the client for the last 15 minutes. It also shows data for the Retry In and Retry Out frames. - Outgoing frames—Outgoing frame traffic is displayed in green. It is shown above the median line. - Incoming frames—Incoming frame traffic is displayed in blue. It is shown below the median line. - Retry Out—Retries for the outgoing frames are displayed above the median line in black . - Retry In—Retries for the incoming frames are displayed below the median line in red. To see an enlarged view, click the graph. The enlarged view provides Last, Minimum, Maximum, and Average statistics for the In, Out, Retries In, and Retries Out frames. To see the exact frames at a particular time, move the cursor over the graph line.	To monitor the In and Out frame rate per second and retry frames for the In and Out traffic, for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Clients** tab, click the IP address of the client for which you want to monitor the frames. 3. Study the Frames graph in the RF Trends pane. For example, the graph shows 4.0 frames per second for the client at 12:27 hours.
Speed	The Speed graph shows the data transfer speed for the client. Data transfer is measured in Mbps. To see an enlarged view, click the graph. The enlarged view shows Last, Minimum, Maximum, and Average statistics of the client for the last 15 minutes.	To monitor the speed for the client for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Clients** tab, click the IP address of the client for which you want to monitor the speed. 3. Study the Speed graph in the RF Trends pane. For example, the graph shows that the data transfer

Table 12: *Client View—RF Trends Graphs and Monitoring Procedures*

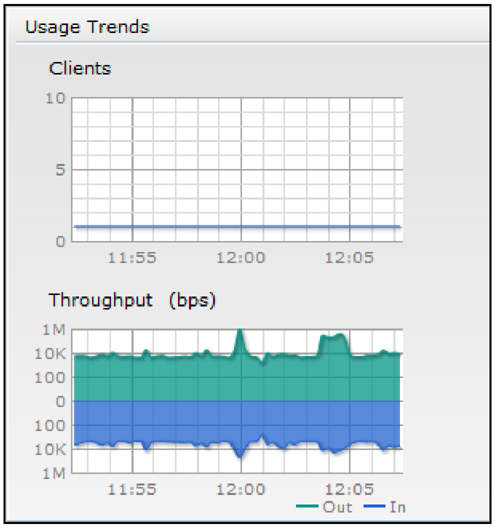
Graph Name	Description	Monitoring Procedure
	To see the exact speed at a particular time, move the cursor over the graph line.	speed at 12:26 hours is 240 Mbps.
Throughput	The Throughput Graph shows the throughput of the selected client for the last 15 minutes. • Outgoing traffic—Throughput for the outgoing traffic is displayed in green. It is shown above the median line. • Incoming traffic—Throughput for the incoming traffic is displayed in blue. It is shown below the median line. To see an enlarged view, click the graph. The enlarged view shows Last, Minimum, Maximum, and Average statistics for the incoming and outgoing traffic throughput of the client for the last 15 minutes. To see the exact throughput at a particular time, move the cursor over the graph line.	To monitor the errors for the client for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. In the **Clients** tab, click the IP address of the client for which you want to monitor the throughput. 3. Study the Throughput graph in the RF Trends pane. For example, the graph shows 1.0 Kbps outgoing traffic throughput for the client at 12:30 hours.

Usage Trends

The **Usage Trends** section displays the following graphs:

- **Clients**—In the default view, the Clients graph displays the number of clients that were associated with the VC in the last 15 minutes. In Network view or the Access Point view, this graph displays the number of clients that were associated with the selected network or IAP in the last 15 minutes.
- **Throughput**—In the default view, the Throughput graph displays the incoming and outgoing throughput traffic for the VC in the last 15 minutes. In the Network view or the Access Point view, this graph displays the incoming and outgoing throughput traffic for the selected network or IAP in the last 15 minutes.

Figure 14 *Usage Trends Graphs in the Default View*



The following table describes the graphs displayed in the Network view:

Table 13: *Network View—Graphs and Monitoring Procedures*

Graph Name	Description	Monitoring Procedure
Clients	The Clients graph shows the number of clients associated with the network for the last 15 minutes. To see an enlarged view, click the graph. ● The enlarged view provides Last, Minimum, Maximum, and Average statistics for the number of clients associated with the VC for the last 15 minutes. ● To see the exact number of clients in the Instant network at a particular time, move the cursor over the graph line.	To check the number of clients associated with the network for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Network** tab, click the network for which you want to check the client association. 3. Study the Clients graph in the **Usage Trends** pane. For example, the graph shows that one client is associated with the selected network at 12:00 hours.
Throughput	The Throughput graph shows the throughput of the selected network for the last 15 minutes. ● Outgoing traffic—Throughput for the outgoing traffic is displayed in green. Outgoing traffic is shown above the median line. ● Incoming traffic—Throughput for the incoming traffic is displayed in blue. Incoming traffic is shown below the median line. To see an enlarged view, click the graph. ● The enlarged view provides Last, Minimum, Maximum, and Average statistics for the incoming and outgoing traffic throughput of the network for the last 15 minutes. To see the exact throughput of the selected network at a particular time, move the cursor over the graph line.	To check the throughput of the selected network for the last 15 minutes, 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Network** tab, click the network for which you want to check the client association. 3. Study the Throughput graph in the **Usage Trends** pane. For example, the graph shows 22.0 Kbps incoming traffic throughput for the selected network at 12:03 hours.

The following table describes the graphs displayed in the Access Point view:

Table 14: *Access Point View—Usage Trends and Monitoring Procedures*

Graph Name	IAP Description	Monitoring Procedure
Neighboring IAPs	The Neighboring IAPs graph shows the number of IAPs detected by the selected IAP: ● Valid IAPs: An IAP that is part of the enterprise providing WLAN service. ● Interfering IAPs: An IAP that is seen in the RF environment but is not connected to the network. ● Rogue IAPs: An unauthorized IAP that is plugged into the wired side of the network. To see the number of different types of neighboring IAPs for the last 15 minutes, move the cursor over the respective graph lines.	To check the neighboring IAPs detected by the IAP for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Access Points** tab, click the IAP for which you want to monitor the client association. 3. Study the Neighboring IAPs graph in the **Overview** section. For example, the graph shows that 148 interfering IAPs are detected by the IAP at 12:04 hours.
CPU Utilization	The CPU Utilization graph displays the utilization of CPU for the selected IAP. To see the CPU utilization of the IAP, move the cursor over the graph line.	To check the CPU utilization of the IAP for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Access Points** tab, click the IAP for which you want to monitor the client association. 3. Study the CPU Utilization graph in the **Overview** pane. For example, the graph shows that the CPU utilization of the IAP is 30% at 12:09 hours.
Neighboring Clients	The Neighboring Clients graph shows the number of clients not connected to the selected IAP, but heard by it. ● Any client that successfully authenticates with a valid IAP and passes encrypted traffic is classified as a valid client. ● Interfering: A client associated to any IAP and is not valid is classified as an interfering client. To see the number of different types of neighboring clients for the last 15 minutes, move the cursor over the respective graph lines.	To check the neighboring clients detected by the IAP for the last 15 minutes, 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Access Points** tab, click the IAP for which you want to monitor the client association. 3. Study the Neighboring Clients graph in the **Overview** pane. For example, the graph shows that 20 interfering clients were detected by the IAP at 12:15 hours.
Memory free (MB)	The Memory free graph displays the memory availability of the IAP in MB. To see the free memory of the IAP, move the cursor over the graph line.	To check the free memory of the IAP for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view.

Table 14: *Access Point View—Usage Trends and Monitoring Procedures*

Graph Name	IAP Description	Monitoring Procedure
		2. On the **Access Points** tab, click the IAP for which you want to monitor the client association. 3. Study the Memory free graph in the **Overview** pane. For example, the graph shows that the free memory of the IAP is 64 MB at 12:13 hours.
Clients	The Clients graph shows the number of clients associated with the selected IAP for the last 15 minutes. To see an enlarged view, click the graph. The enlarged view provides Last, Minimum, Maximum, and Average statistics for the number of clients associated with the IAP for the last 15 minutes. To see the exact number of clients associated with the selected IAP at a particular time, move the cursor over the graph line.	To check the number of clients associated with the IAP for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Access Points** tab, click the IAP for which you want to monitor the client association. 3. Study the Clients graph. For example, the graph shows that six clients are associated with the IAP at 12:11 hours.
Throughput	The Throughput graph shows the throughput for the selected IAP for the last 15 minutes. - Outgoing traffic—Throughput for the outgoing traffic is displayed in green. It is shown above the median line. - Incoming traffic—Throughput for the incoming traffic is displayed in blue. It is shown below the median line. To see an enlarged view, click the graph. - The enlarged view provides Last, Minimum, Maximum, and Average statistics for the incoming and outgoing traffic throughput of the IAP for the last 15 minutes. To see the exact throughput of the selected IAP at a particular time, move the cursor over the graph line.	To check the throughput of the selected IAP for the last 15 minutes: 1. Log in to the Instant UI. The Virtual Controller view is displayed. This is the default view. 2. On the **Access Points** tab, click the IAP for which you want to monitor the throughput. 3. Study the Throughput graph. For example, the graph shows 44.03 Kbps incoming traffic throughput at 12:08 hours.

Mobility Trail

The **Mobility Trail** section displays the following mobility trail information for the selected client:

- **Association Time**—The time at which the selected client was associated with a particular IAP. The Instant UI shows the client and IAP association over the last 15 minutes.
- **Access Point**—The IAP name with which the client was associated.

NOTE

Mobility information about the client is reset each time it roams from one IAP to another.

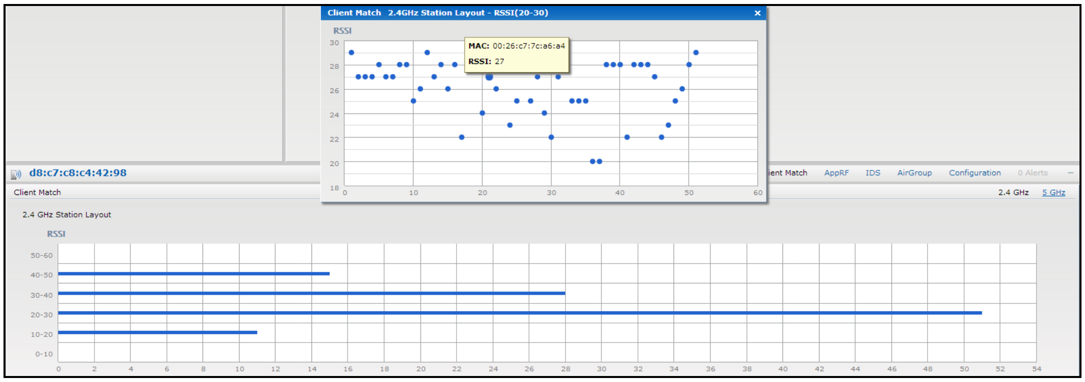
Client Match

If Client Match is enabled, the **Client Match** link provides a graphical representation of radio map view of an IAP and the client distribution on an IAP radio.

On clicking an access point in the **Access Points** tab and the **Client Match** link, a stations map view is displayed and a graph is drawn with real-time data points for the IAPradio. If the IAP supports dual-band, you can toggle between 2.4 GHz and 5 GHz links in the Client Match graph area to view the data. When you hover the mouse on the graph, details such as RSSI, Client Match status, and the client distribution on channels are displayed.

The following figure shows the client distribution details for an IAP radio.

Figure 15 *Client Distribution on IAP Radio*

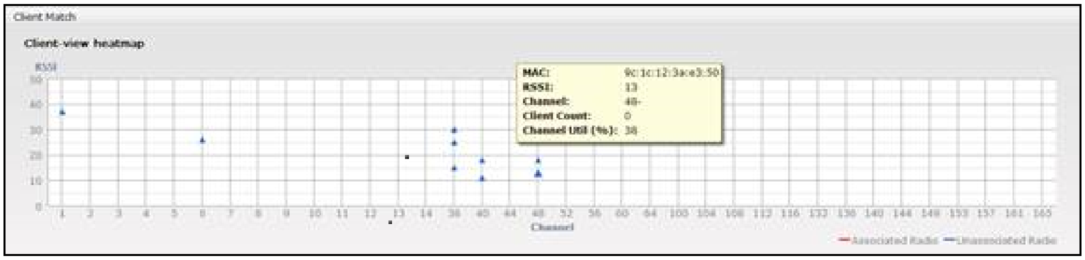


MAC: 00:26:c7:7c:a6:a4
RSSI: 27

On clicking a client in the **Clients** tab and the **Client Match** link, a graph is drawn with real-time data points for an IAP radio map. When you hover the mouse on the graph, details such as RSSI, channel utilization details, and client count on each channel are displayed.

The following figure shows the client view heat map for an IAP radio:

Figure 16 *Channel Availability Map for Clients*



MAC: 9c:1c:12:3a:e3:50
RSSI: 13
Channel: 48-
Client Count: 0
Channel Util (%): 38

AppRF

The **AppRF** link displays the application traffic summary for IAPs and client devices. The **AppRF** link in the activity panel is displayed only if **AppRF visibility** is enabled in the **System** window. For more information on application visibility and AppRF charts, see Application Visibility on page 265.

Spectrum

The spectrum link (in **Access Point** view) displays the spectrum data that is collected by a hybrid IAP or by an IAP that has enabled spectrum monitor. The spectrum data is not reported to the VC.

The spectrum link displays the following:

- **Device list**—The device list display consists of a device summary table and channel information for active non Wi-Fi devices currently seen by a spectrum monitor or a hybrid IAP radio.
- **Channel Utilization and Monitoring**—This chart provides an overview of channel quality across the spectrum. It shows channel utilization information such as channel quality, availability, and utilization

metrics as seen by a spectrum monitor for the 2.4 GHz and 5 GHz radio bands. The first bar for each channel represents the percentage of airtime used by non-Wi-Fi interference and Wi-Fi devices. The second bar indicates the channel quality. A higher percentage value indicates better quality.

- **Channel Details**—When you move your mouse over a channel, the channel details or the summary of the 2.4 GHz and 5 GHz channels as detected by a spectrum monitor are displayed. You can view the aggregate data for each channel seen by the spectrum monitor radio, including the maximum IAP power, interference, and the Signal-to-Noise-plus-Interference Ratio (SNIR). Spectrum monitors display spectrum analysis data seen on all channels in the selected band, and hybrid IAPs display data from the single channel that they are monitoring.

For more information on spectrum monitoring, see Spectrum Monitor on page 346.

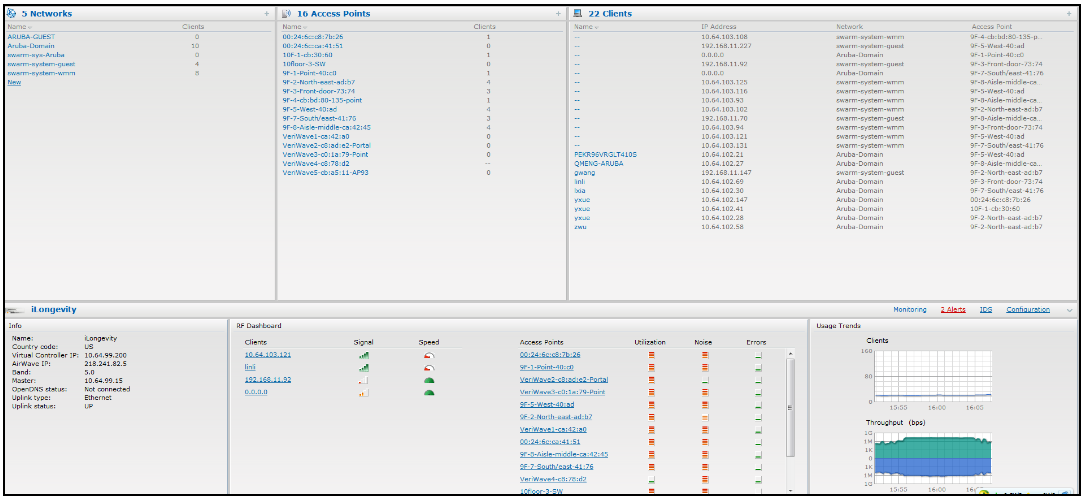
Alerts

Alerts are generated when a user encounters problems while accessing or connecting to a network. The alerts that are generated can be categorized as follows:

- 802.11-related association and authentication failure alerts
- 802.1X-related mode and key mismatch, server, and client time-out failure alerts
- IP-address-related failures—Static IP address or DHCP-related alerts.

The following figure shows the contents of details displayed on clicking the **Alerts** link:

Figure 17 *Alerts Link*



5 Networks

Name	Clients
ARUBA-GUEST	0
Aruba-Domain	10
swarm-sys-Aruba	0
swarm-system-guest	4
swarm-system-wmm	8
New	

16 Access Points

Name	Clients
00:24:6c:c8:7b:26	1
00:24:6c:ca:41:51	0
10F-1-cb:30:60	1
10floor-3-SW	0
9F-1-Point-40:c0	1
9F-2-North-east-ad:b7	4
9F-3-Front-door-73:74	3
9F-4-cb:bd:80-135-point	1
9F-5-West-40:ad	4
9F-7-South/east-41:76	3
9F-8-Aisle-middle-ca:42:45	4
VeriWave1-ca:42:a0	0
VeriWave2-c8:ad:e2-Portal	0
VeriWave3-c0:1a:79-Point	0
VeriWave4-c8:78:d2	--
VeriWave5-cb:a5:11-AP93	0

22 Clients

Name	IP Address	Network	Access Point
--	10.64.103.108	swarm-system-wmm	9F-4-cb:bd:80-135-p...
--	192.168.11.227	swarm-system-guest	9F-5-West-40:ad
--	0.0.0.0	Aruba-Domain	9F-1-Point-40:c0
--	192.168.11.92	swarm-system-guest	9F-3-Front-door-73:74
--	0.0.0.0	Aruba-Domain	9F-7-South/east-41:76
--	10.64.103.125	swarm-system-wmm	9F-8-Aisle-middle-ca...
--	10.64.103.116	swarm-system-wmm	9F-5-West-40:ad
--	10.64.103.93	swarm-system-wmm	9F-8-Aisle-middle-ca...
--	10.64.103.102	swarm-system-wmm	9F-2-North-east-ad:b7
--	192.168.11.70	swarm-system-guest	9F-8-Aisle-middle-ca...
--	10.64.103.94	swarm-system-wmm	9F-3-Front-door-73:74
--	10.64.103.121	swarm-system-wmm	9F-5-West-40:ad
--	10.64.103.131	swarm-system-wmm	9F-7-South/east-41:76
PEKR96VRGLT410S	10.64.102.21	Aruba-Domain	9F-5-West-40:ad
QMENG-ARUBA	10.64.102.27	Aruba-Domain	9F-8-Aisle-middle-ca...
gwang	192.168.11.147	swarm-system-guest	9F-2-North-east-ad:b7
linli	10.64.102.69	Aruba-Domain	9F-3-Front-door-73:74
lxia	10.64.102.30	Aruba-Domain	9F-7-South/east-41:76
yxue	10.64.102.147	Aruba-Domain	00:24:6c:c8:7b:26
yxue	10.64.102.41	Aruba-Domain	10F-1-cb:30:60
yxue	10.64.102.28	Aruba-Domain	9F-2-North-east-ad:b7
zwu	10.64.102.58	Aruba-Domain	9F-2-North-east-ad:b7

iLongevity

Info

Name:	iLongevity
Country code:	US
Virtual Controller IP:	10.64.99.200
AirWave IP:	218.241.82.5
Band:	5.0
Master:	10.64.99.15
OpenDNS status:	Not connected
Uplink type:	Ethernet
Uplink status:	UP

RF Dashboard

Clients	Signal	Speed
10.64.103.121		
linli		
192.168.11.92		
0.0.0.0		

Access Points	Utilization	Noise	Errors
00:24:6c:c8:7b:26			
9F-1-Point-40:c0			
VeriWave2-c8:ad:e2-Portal			
VeriWave3-c0:1a:79-Point			
9F-5-West-40:ad			
9F-2-North-east-ad:b7			
VeriWave1-ca:42:a0			
00:24:6c:ca:41:51			
9F-8-Aisle-middle-ca:42:45			
9F-7-South/east-41:76			
VeriWave4-c8:78:d2			
10floor-3-SW			

Usage Trends

The **Alerts** link displays the following types of alerts:

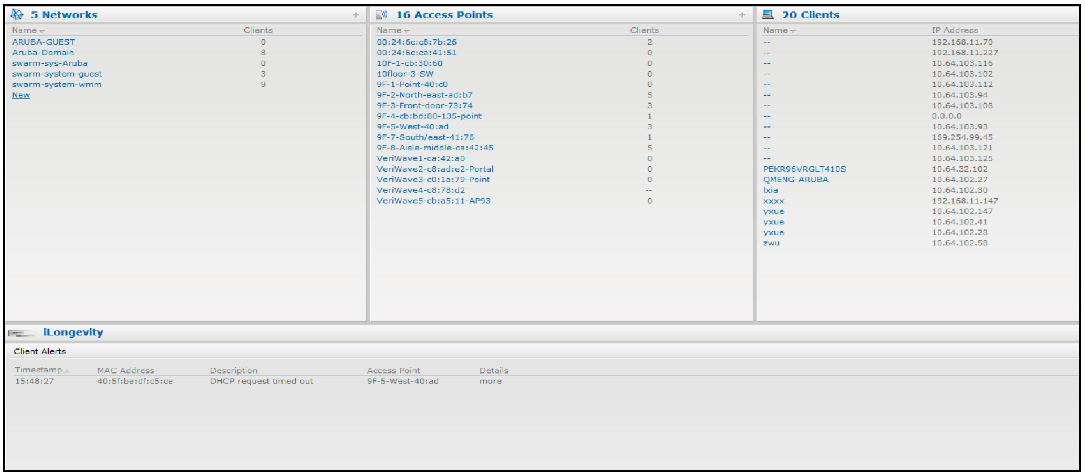
- Client Alerts
- Active Faults
- Fault History

Table 15: *Types of Alerts*

Type of Alert	Description	Information Displayed
Client Alerts	The alert type, **Client Alerts**, occur when clients are connected to the Instant network.	The alert type, **Client Alert** displays the following information: • **Timestamp**—Displays the time at which the client alert was recorded. • **MAC address**—Displays the MAC address of the client that caused the alert. • **Description**—Provides a short description of the alert. • **Access Points**—Displays the IP address of the IAP to which the client is connected. • **Details**—Provides complete details of the alert.
Active Faults	The **Active Faults** alerts occur in the event of a system fault.	The **Active Faults** alerts consists of the following information: • **Time**—Displays the system time when an event occurs. • **Number**—Indicates the number of sequence. • **Description**—Displays the event details.
Fault History	The **Fault History** alerts display the historic system faults.	The **Fault History** alert displays the following information: • **Time**—Displays the system time when an event occurs. • **Number**—Indicates the number of sequence. • **Cleared by**—Displays the module which cleared this fault. • **Description**—Displays the event details.

The following figures show the client alerts, active faults, and fault history:

Figure 18 *Client Alerts*



5 Networks

Name	Clients
ARUBA-GUEST	0
Aruba-Domain	8
swarm-sys-Aruba	0
swarm-system-guest	3
swarm-system-wmm	9
New	

16 Access Points

Name	Clients
00:24:6c:c8:7b:26	2
00:24:6c:ca:41:51	0
10F-1-cb:30:60	0
10floor-3-SW	0
9F-1-Point-40:c0	0
9F-2-North-east-ad:b7	5
9F-3-Front-door-73:74	3
9F-4-cb:bd:80-135-point	1
9F-5-West-40:ad	3
9F-7-South/east-41:76	1
9F-8-Aisle-middle-ca:42:45	5
VeriWave1-ca:42:a0	0
VeriWave2-c8:ad:e2-Portal	0
VeriWave3-c0:1a:79-Point	0
VeriWave4-c8:78:d2	--
VeriWave5-cb:a5:11-AP93	0

20 Clients

Name	IP Address
--	192.168.11.70
--	192.168.11.227
--	10.64.103.116
--	10.64.103.102
--	10.64.103.112
--	10.64.103.94
--	10.64.103.108
--	0.0.0.0
--	10.64.103.93
--	169.254.99.45
--	10.64.103.121
--	10.64.103.125
PEKR96VRGLT410S	10.64.32.102
QMENG-ARUBA	10.64.102.27
Ixia	10.64.102.30
xxxx	192.168.11.147
yxue	10.64.102.147
yxue	10.64.102.41
yxue	10.64.102.28
zwu	10.64.102.58

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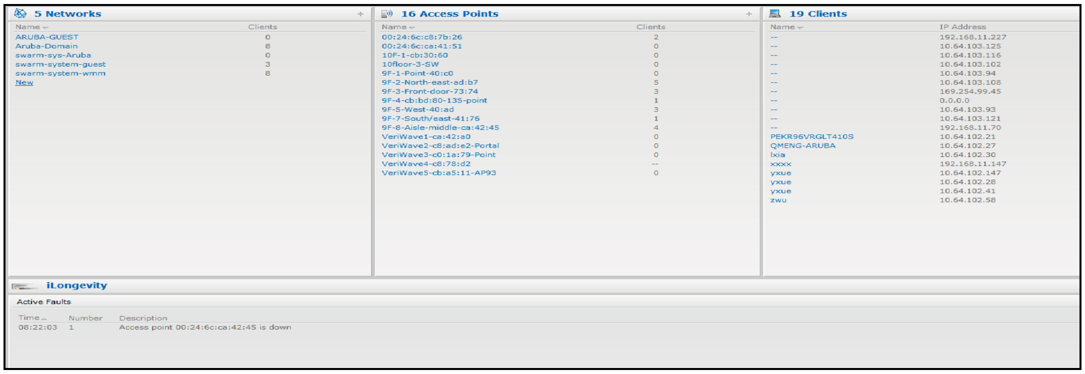
Client Alerts

Timestamp	MAC Address	Description	Access Point	Details
15:48:27	40:5f:be:df:c5:ce	DHCP request timed out	9F-5-West-40:ad	more

Figure 19 *Active Faults*



5 Networks

Name	Clients
ARUBA-GUEST	0
Aruba-Domain	8
swarm-sys-Aruba	0
swarm-system-guest	3
swarm-system-wmm	8
New	

16 Access Points

Name	Clients
00:24:6c:c8:7b:26	2
00:24:6c:ca:41:51	0
10F-1-cb:30:60	0
10floor-3-SW	0
9F-1-Point-40:c0	0
9F-2-North-east-ad:b7	5
9F-3-Front-door-73:74	3
9F-4-cb:bd:80-135-point	1
9F-5-West-40:ad	3
9F-7-South/east-41:76	1
9F-8-Aisle-middle-ca:42:45	4
VeriWave1-ca:42:a0	0
VeriWave2-c8:ad:e2-Portal	0
VeriWave3-c0:1a:79-Point	0
VeriWave4-c8:78:d2	--
VeriWave5-cb:a5:11-AP93	0

19 Clients

Name	IP Address
--	192.168.11.227
--	10.64.103.125
--	10.64.103.116
--	10.64.103.102
--	10.64.103.94
--	10.64.103.108
--	169.254.99.45
--	0.0.0.0
--	10.64.103.93
--	10.64.103.121
--	192.168.11.70
PEKR96VRGLT410S	10.64.102.21
QMENG-ARUBA	10.64.102.27
lxia	10.64.102.30
xxxx	192.168.11.147
yxue	10.64.102.147
yxue	10.64.102.28
yxue	10.64.102.41
zwu	10.64.102.58

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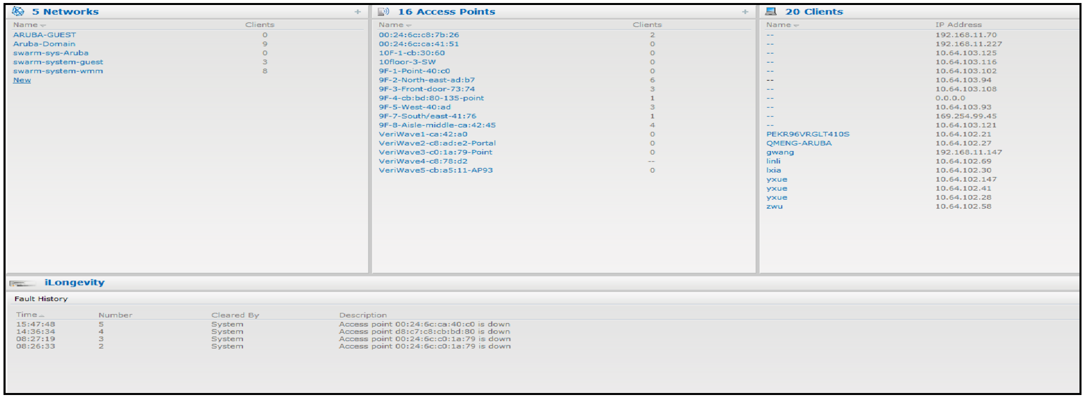
Active Faults

Time	Number	Description
08:22:03	1	Access point 00:24:6c:ca:42:45 is down

Figure 20 *Fault History*



5 Networks

Name	Clients
ARUBA-GUEST	0
Aruba-Domain	9
swarm-sys-Aruba	0
swarm-system-guest	3
swarm-system-wmm	8
New	

16 Access Points

Name	Clients
00:24:6c:c8:7b:26	2
00:24:6c:ca:41:51	0
10F-1-cb:30:60	0
10floor-3-SW	0
9F-1-Point-40:c0	0
9F-2-North-east-ad:b7	6
9F-3-Front-door-73:74	3
9F-4-cb:bd:80-135-point	1
9F-5-West-40:ad	3
9F-7-South/east-41:76	1
9F-8-Aisle-middle-ca:42:45	4
VeriWave1-ca:42:a0	0
VeriWave2-c8:ad:e2-Portal	0
VeriWave3-c0:1a:79-Point	0
VeriWave4-c8:78:d2	--
VeriWave5-cb:a5:11-AP93	0

20 Clients

Name	IP Address
--	192.168.11.70
--	192.168.11.227
--	10.64.103.125
--	10.64.103.116
--	10.64.103.102
--	10.64.103.94
--	10.64.103.108
--	0.0.0.0
--	10.64.103.93
--	169.254.99.45
--	10.64.103.121
PEKR96VRGLT410S	10.64.102.21
QMENG-ARUBA	10.64.102.27
gwang	192.168.11.147
linli	10.64.102.69
lxia	10.64.102.30
yxue	10.64.102.147
yxue	10.64.102.41
yxue	10.64.102.28
zwu	10.64.102.58

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Fault History

Time	Number	Cleared By	Description
15:47:48	5	System	Access point 00:24:6c:ca:40:c0 is down
14:36:34	4	System	Access point d8:c7:c8:cb:bd:80 is down
08:27:19	3	System	Access point 00:24:6c:c0:1a:79 is down
08:26:33	2	System	Access point 00:24:6c:c0:1a:79 is down

The following table displays a list of alerts that are generated in the IAP network:

Table 16: *Alerts List*

Description Code	Description	Details	Corrective Actions
100101	Internal error	The IAP has encountered an internal error for this client.	Contact the Aruba customer support team.
100102	Unknown SSID in association request	The IAP cannot allow this client to associate because the association request received contains an unknown SSID.	Identify the client and check its Wi-Fi driver and manager software.
100103	Mismatched authentication/encryption setting	The IAP cannot allow this client to associate because its authentication or encryption settings do not match AP's configuration.	Ascertain the correct authentication or encryption settings and try to associate again.

Table 16: *Alerts List*

Description Code	Description	Details	Corrective Actions
100104	Unsupported 802.11 rate	The IAP cannot allow this client to associate because it does not support the 802.11 rate requested by this client.	Check the configuration on the IAP to see if the desired rate can be supported; if not, consider replacing the IAP with another model that can support the rate.
100105	Maximum capacity reached on IAP	The IAP has reached maximum capacity and cannot accommodate any more clients.	Consider expanding capacity by installing additional IAPs or balance load by relocating IAPs.
100206	Invalid MAC Address	The IAP cannot authenticate this client because its MAC address is not valid.	This condition may be indicative of a misbehaving client. Try to locate the client device and check its hardware and software.
100307	Client blocked due to repeated authentication failures	The IAP is temporarily blocking the 802.1X authentication request from this client because the credentials provided have been rejected by the RADIUS server too many times.	Identify the client and check its 802.1X credentials.
100308	RADIUS server connection failure	The IAP cannot authenticate this client using 802.1X because the RADIUS server did not respond to the authentication request. If the IAP is using the internal RADIUS server, it is recommend to check the related configuration as well as the installed certificate and passphrase.	If the IAP is using the internal RADIUS server, Aruba recommends checking the related configuration as well as the installed certificate and passphrase. If the IAP is using an external RADIUS server, check if there are any issues with the RADIUS server and try connecting again.
100309	RADIUS server authentication failure	The IAP cannot authenticate this client using 802.1X, because the RADIUS server rejected the authentication credentials (for example, password) provided by the client.	Ascertain the correct authentication credentials and log in again.

Table 16: *Alerts List*

Description Code	Description	Details	Corrective Actions
100410	Integrity check failure in encrypted message	The IAP cannot receive data from this client because the integrity check of the received message (MIC) has failed. Recommend checking the encryption setting on the client and on the IAP.	Check the encryption setting on the client and on the IAP.
100511	DHCP request timed out	This client did not receive a response to its DHCP request in time. Recommend checking the status of the DHCP server in the network.	Check the status of the DHCP server in the network.
101012	Wrong Client VLAN	VLAN mismatch between the IAP and the upstream device. Upstream device can be upstream switch or RADIUS server.	

IDS

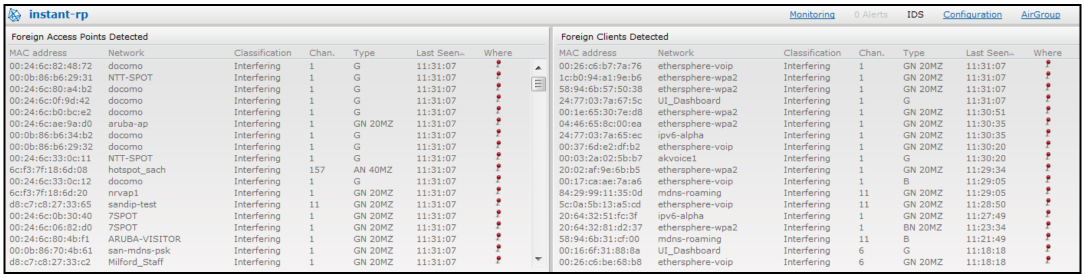
The **IDS** link displays a list of foreign IAPs and foreign clients that are detected in the network. It consists of the following sections:

- **Foreign Access Points Detected**—Lists the IAPs that are not controlled by the VC. The following information is displayed for each foreign IAP:
  - **MAC address**—Displays the MAC address of the foreign IAP.
  - **Network**—Displays the name of the network to which the foreign IAP is connected.
  - **Classification**—Displays the classification of the foreign IAP, for example, Interfering IAP or Rogue IAP.
  - **Channel**—Displays the channel in which the foreign IAP is operating.
  - **Type**—Displays the Wi-Fi type of the foreign IAP.
  - **Last seen**—Displays the time when the foreign IAP was last detected in the network.
  - **Where**—Provides information about the IAP that detected the foreign IAP. Click the push pin icon to view the information.
- **Foreign Clients Detected**— Lists the clients that are not controlled by the VC. The following information is displayed for each foreign client:
  - **MAC address**—Displays the MAC address of the foreign client.
  - **Network**—Displays the name of the network to which the foreign client is connected.
  - **Classification**—Displays the classification of the foreign client: Interfering client.
  - **Channel**—Displays the channel in which the foreign client is operating.
  - **Type**—Displays the Wi-Fi type of the foreign client.
  - **Last seen**—Displays the time when the foreign client was last detected in the network.

- **Where**—Provides information about the IAP that detected the foreign client. Click the Push Pin icon to view the information.

The following figure shows an example for the intrusion detection log:

Figure 21 *Intrusion Detection*



Foreign Access Points Detected

MAC address	Network	Classification	Chan.	Type	Last Seen	Where
00:24:6c:82:48:72	docomo	Interfering	1	G	11:31:07	📍
00:0b:86:b6:29:31	NTT-SPOT	Interfering	1	G	11:31:07	📍
00:24:6c:80:a4:b2	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:0f:9d:42	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:b0:bc:e2	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:ae:9a:d0	aruba-ap	Interfering	1	GN 20MZ	11:31:07	📍
00:0b:86:b6:34:b2	docomo	Interfering	1	G	11:31:07	📍
00:0b:86:b6:29:32	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:33:0c:11	NTT-SPOT	Interfering	1	G	11:31:07	📍
6c:f3:7f:18:6d:08	hotspot_sach	Interfering	157	AN 40MZ	11:31:07	📍
00:24:6c:33:0c:12	docomo	Interfering	1	G	11:31:07	📍
6c:f3:7f:18:6d:20	nrvap1	Interfering	1	GN 20MZ	11:31:07	📍
d8:c7:c8:27:33:65	sandip-test	Interfering	11	GN 20MZ	11:31:07	📍
00:24:6c:0b:30:40	7SPOT	Interfering	1	GN 20MZ	11:31:07	📍
00:24:6c:06:82:d0	7SPOT	Interfering	1	GN 20MZ	11:31:07	📍
00:24:6c:80:4b:f1	ARUBA-VISITOR	Interfering	1	GN 20MZ	11:31:07	📍
00:0b:86:70:4b:61	san-mdns-psk	Interfering	1	GN 20MZ	11:31:07	📍
d8:c7:c8:27:33:c2	Milford_Staff	Interfering	1	GN 20MZ	11:31:07	📍

Foreign Clients Detected

MAC address	Network	Classification	Chan.	Type	Last Seen	Where
00:26:c6:b7:7a:76	ethersphere-voip	Interfering	1	GN 20MZ	11:31:07	📍
1c:b0:94:a1:9e:b6	ethersphere-wpa2	Interfering	1	GN 20MZ	11:31:07	📍
58:94:6b:57:50:38	ethersphere-wpa2	Interfering	1	GN 20MZ	11:31:07	📍
24:77:03:7a:67:5c	UI_Dashboard	Interfering	1	G	11:31:07	📍
00:1e:65:30:7e:d8	ethersphere-wpa2	Interfering	1	GN 20MZ	11:30:51	📍
04:46:65:8c:00:ea	ethersphere-wpa2	Interfering	1	GN 20MZ	11:30:35	📍
24:77:03:7a:65:ec	ipv6-alpha	Interfering	1	GN 20MZ	11:30:35	📍
00:37:6d:e2:df:b2	ethersphere-voip	Interfering	1	GN 20MZ	11:30:20	📍
00:03:2a:02:5b:b7	akvoice1	Interfering	1	G	11:30:20	📍
20:02:af:9e:6b:b5	ethersphere-wpa2	Interfering	1	GN 20MZ	11:29:34	📍
00:17:ca:ae:7a:a6	ethersphere-voip	Interfering	1	B	11:29:05	📍
84:29:99:11:35:0d	mdns-roaming	Interfering	11	GN 20MZ	11:29:05	📍
5c:0a:5b:13:a5:cd	ethersphere-voip	Interfering	11	GN 20MZ	11:28:50	📍
20:64:32:51:fc:3f	ipv6-alpha	Interfering	1	GN 20MZ	11:27:49	📍
20:64:32:81:d2:37	ethersphere-wpa2	Interfering	1	BN 20MZ	11:23:34	📍
58:94:6b:31:cf:00	mdns-roaming	Interfering	11	B	11:21:49	📍
00:16:6f:31:88:8a	UI_Dashboard	Interfering	6	G	11:18:18	📍
00:26:c6:be:68:b8	ethersphere-voip	Interfering	6	GN 20MZ	11:18:18	📍

For more information on the intrusion detection feature, see Intrusion Detection on page 333.

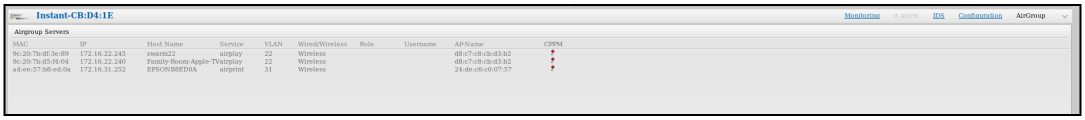
AirGroup

This **AirGroup** link provides an overall view of your AirGroup configuration. Click each parameter to view or edit the settings.

- **MAC**—Displays the MAC address of the AirGroup servers.
- **IP**—Displays the IP address of the AirGroup servers.
- **Host Name**—Displays the machine name or host name of the AirGroup servers.
- **Service**— Displays the type of services such as AirPlay or AirPrint.
- **VLAN**—Displays VLAN details of the AirGroup servers.
- **Wired/Wireless**—Displays if the AirGroup server is connected through a wired or wireless interface.
- **Role**—Displays the user role if the server is connected through 802.1X authentication. If the server is connected through Phase-Shift Keying (PSK) or open authentication, this parameter is blank.
- **Group**—Displays the group.
- **CPPM**—By clicking this, you get details of the registered rules in ClearPass Policy Manager (CPPM) for this server.
- **MDNS Cache**—By clicking this, you receive MDNS record details of a particular server.

The following figure shows the AirGroup server details available on clicking the **AirGroup** link:

Figure 22 *AirGroup Link*



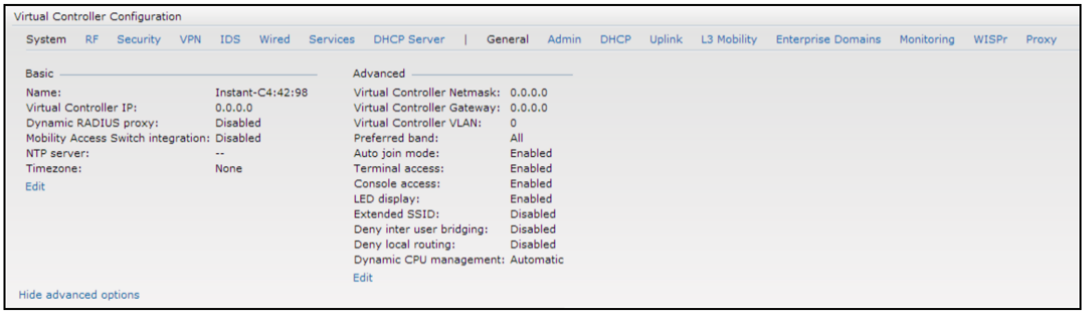
Airgroup Servers

MAC	IP	Host Name	Service	VLAN	Wired/Wireless	Role	Username	AP-Name	CPPM
9c:20:7b:df:3e:89	172.16.22.245	swarm22	airplay	22	Wireless			d8:c7:c8:cb:d3:b2	📍
9c:20:7b:d5:f4:04	172.16.22.240	Family-Room-Apple-TV	airplay	22	Wireless			d8:c7:c8:cb:d3:b2	📍
a4:ee:57:b8:ed:0a	172.16.31.252	EPSONB8ED0A	airprint	31	Wireless			24:de:c6:c0:07:57	📍

Configuration

The **Configuration** link provides an overall view of your VC, IAPs, and WLAN SSID configuration. The following figure shows the VC configuration details displayed on clicking the **Configuration** link.

Figure 23 *Configuration Link*



Basic

Name:	Instant-C4:42:98
Virtual Controller IP:	0.0.0.0
Dynamic RADIUS proxy:	Disabled
Mobility Access Switch integration:	Disabled
NTP server:	--
Timezone:	None

Advanced

Virtual Controller Netmask:	0.0.0.0
Virtual Controller Gateway:	0.0.0.0
Virtual Controller VLAN:	0
Preferred band:	All
Auto join mode:	Enabled
Terminal access:	Enabled
Console access:	Enabled
LED display:	Enabled
Extended SSID:	Disabled
Deny inter user bridging:	Disabled
Deny local routing:	Disabled
Dynamic CPU management:	Automatic

AirWave Setup

AirWave is a solution for managing rapidly changing wireless networks. When enabled, AirWave allows you to manage the Instant network. For more information on AirWave, see Managing an IAP from AirWave on page 311. The AirWave status is displayed below the Virtual Controller section of the Instant main window. If the AirWave status is **Not Set Up**, click the **Set Up Now** link to configure AirWave. The **System > Admin** window is displayed.

Aruba Central

The Instant UI provides a link to launch a support portal for Aruba Central. You can use Central's evaluation accounts through this website and get registered for a free account. You must fill in the registration form available on this page. After you complete this process, an activation link will be sent to your registered ID to get started.

Pause/Resume

The **Pause/Resume** link is located on the Instant main window.

The Instant UI is automatically refreshed every 15 seconds by default. Click the **Pause** link to pause the automatic refreshing of the Instant UI after every 15 seconds. When the automatic refreshing is paused, the **Pause** link changes to **Resume**. Click the **Resume** link to resume automatic refreshing.

Automatic refreshing allows you to get the latest information about the network and network elements. You can use the **Pause** link when you want to analyze or monitor the network or a network element, and therefore do not want the UI to refresh.

Views

Depending on the link or tab that is clicked, Instant displays information about the VC, Wi-Fi networks, IAPs, or the clients in the Info section. The views on the Instant main window are classified as follows:

- **Virtual Controller** view—The VC view is the default view. This view allows you to monitor the Instant network.
- The following Instant UI elements are available in this view:
  - **Tabs**—Networks, Access Points, and Clients. For detailed information on the tabs, see Tabs on page 31.
  - **Links**—Monitoring, Client Alerts, and IDS. The Spectrum link is visible if you have configured the IAP as a spectrum monitor. These links allow you to monitor the Instant network. For more information on these links, see Monitoring on page 40, IDS on page 55, Alerts on page 51, and Spectrum Monitor on page 346.
- **Network** view—The Network view provides information that is necessary to monitor a selected wireless network. All Wi-Fi networks in the Instant network are listed in the **Network** tab. Click the name of the network that you want to monitor.

- Instant Access Point view—The Instant Access Point view provides information that is necessary to monitor a selected IAP. All IAPs in the Instant network are listed in the **Access Points** tab. Click the name of the IAP that you want to monitor.
- **Client** view—The Client view provides information that is necessary to monitor a selected client. In the Client view, all the clients in the Instant network are listed in the **Clients** tab. Click the IP address of the client that you want to monitor.

For more information on the graphs and the views, see Monitoring on page 40.

This chapter consists of the following sections:

- Configuring System Parameters on page 59
- Changing Password on page 65

Configuring System Parameters

This section describes how to configure the system parameters of an IAP.

To configure system parameters:

1. Select **System**.

Table 17: *System Parameters*

Parameter	Description	CLI Configuration
Name	Name of the IAP.	`(Instant AP)# name <name>`
System location	Physical location of the IAP.	`(Instant AP)# (config)# syslocation <location-name>`
Virtual Controller IP	This parameter allows you to specify a single static IP address that can be used to manage a multi-IAP Instant network. This IP address is automatically provisioned on a shadow interface on the IAP that takes the role of a VC. When an IAP becomes a VC, it sends three Address Resolution Protocol (ARP) messages with the static IP address and its MAC address to update the network ARP cache.	`(Instant AP)(config)# virtual-controller-ip <IP-address>`
Allow IPv6 Management	Select the check box to enable IPv6 configuration	
Virtual Controller IPv6	This parameter is used to configure the IPv6 address.	`(Instant AP)(config)# virtual-controller-ipv6 <ipv6 address>`
Uplink switch native VLAN	This parameter notifies the IAP about the native-VLAN of the upstream switch to which the IAP is connected. The parameter stops the IAP from sending out tagged frames to clients connected with the SSID that has the same VLAN as the native VLAN of the upstream switch, to which the IAP is connected. By default, the IAP considers the uplink switch native VLAN value as 1.	`(Instant AP)(config)# enet-vlan <vlan-ID>`

Table 17: *System Parameters*

Parameter	Description	CLI Configuration

Dynamic Proxy	This parameter allows you to enable or disable the dynamic proxy for RADIUS and Terminal Access Controller Access Control System (TACACS) servers.
	- Dynamic RADIUS proxy—When dynamic RADIUS proxy is enabled, the VC network will use the IP address of the VC for communication with external RADIUS servers. Ensure that you set the VC IP address as a Network Access Server (NAS) client in the RADIUS server if Dynamic RADIUS proxy is enabled.
	- Dynamic TACACS proxy—When enabled, the VC network will use the IP address of the VC for communication with external TACACS servers. The IP address is chosen based on one of the following rules:
	If a VPN tunnel exists between the IAP and the TACACS server, then the IP address of the tunnel interface will be used.
	If a VC IP address is configured, the the same will be used by the VC network to communicate with the external TACACS server.
	If a VC IP is not configured, then the IP address of the bridge interface is used.
	NOTE: When dynamic-tacacs-proxy is enabled on the IAP, the TACACS server cannot identify the slave IAP that generates the TACACS traffic as the source IP address is changed.
		To enable dynamic RADIUS proxy:
		`(Instant AP)(config) # dynamic-radius-proxy`
		To enable TACACS proxy:
		`(Instant AP)(config) # dynamic-tacacs-proxy`

MAS Integration	Select **Enabled**/**Disabled** from the **MAS integration** drop-down list to enable or disable the Link Layer Discovery Protocol (LLDP) protocol for Mobility Access Switch integration. With this protocol, IAPs can instruct the Mobility Access Switch to turn off ports where rogue access points are connected, as well as take actions such as increasing PoE priority and automatically configuring VLANs on ports where Instant Access Points are connected.	`(Instant AP)(config) # mas-integration`
NTP Server	This parameter allows you to configure NTP server. To facilitate communication between various elements in a network, time synchronization between the elements and across the network is critical. Time synchronization allows you to: - Trace and track security gaps, monitor network usage, and troubleshoot network issues.	To configure an NTP server: `(Instant AP)(config) # ntp-server <name>`

Table 17: *System Parameters*

Parameter	Description	CLI Configuration
	- Validate certificates. - Map an event on one network element to a corresponding event on another. - Maintain accurate time for billing services and similar tasks. NTP helps obtain the precise time from a server and regulate the local time in each network element. Connectivity to a valid NTP server is required to synchronize the IAP clock to set the correct time. If NTP server is not configured in the IAP network, an IAP reboot may lead to variation in time data. By default, the IAP tries to connect to **pool.ntp.org** to synchronize time. The NTP server can also be provisioned through the DHCP option 42. If the NTP server is configured, it takes precedence over the DHCP option 42 provisioned value. The NTP server provisioned through the DHCP option 42 is used if no server is configured. The default server **pool.ntp.org** is used if no NTP server is configured or provisioned through DHCP option 42. **NOTE:** To facilitate zero-touch provisioning using the AMP, Central, or Activate, you must configure the firewall and wired infrastructure to either allow the NTP traffic to pool.ntp.org, or provide alternative NTP servers under DHCP options.	

Timezone	Timezone in which the IAP must operate. You can also enable daylight saving time (DST) on IAPs if the time zone you selected supports the daylight saving time. When enabled, the DST ensures that the IAPs reflect the seasonal time changes in the region they serve.	To configure timezone:
		`(Instant AP)(config) # clock timezone <name> <hour-offset> <minute-offset>`
		To configure daylight saving time:
		`(Instant AP)(config) # clock summer-time <timezone> recurring <start-week> <start-day> <start-month> <start-hour> <end-week> <end-day> <end-month> <end-hour>`

Preferred Band	The preferred band for the IAP. **NOTE:** Reboot the IAP after modifying the radio profile for changes to take effect.	`(Instant AP)(config) # rf-band <band>`
AppRF Visibility	Select one of the following options from the **AppRF visibility** drop-down list.	`(Instant AP)(config) # dpi`

Table 17: *System Parameters*

Parameter	Description	CLI Configuration
	- **App**—Displays only inbuilt Deep Packet Inspection (DPI) data. - **WebCC**—Displays the DPI data hosted on the cloud. - **All**—Displays both App and WebCC DPI data. - **None**—Does not display any AppRF content.	
URL Visibility	Select **Enabled** or **Disabled** from the **URL visibility** drop-down list.	`(Instant AP)(config) # url-visibility`
Cluster security	Select **Enabled** to ensure that the control plane messages between access points are secured. This option is disabled by default. **NOTE:** The Cluster security setting can be enabled only if the default NTP server or a static NTP server is reachable.	`(Instant AP)(config) # cluster-security`

Virtual Controller network settings	If the VC IP address is in the same subnet as the IAP, ensure that you select **Custom** from the **Virtual Controller network settings** drop-down list and configure the following details:
	- **Virtual Controller Netmask**—Enter subnet mask details.
	- **Virtual Controller Gateway**—Enter a gateway address.
	- **Virtual Controller DNS**—If the DNS IP address is configured for a master IAP, the DNS IP settings are synchronized for all APs in an IAP cluster.
	  - If the DNS IP address is configured for an IAP as part of the per IAP setting (**Edit Access Point > General**), it takes precedence over the VC DNS IP address defined in the **System > General** window.
	  - If the IAPs are not explicitly assigned a DNS IP address, the DNS IP address defined in **System > General** takes precedence.
	  - If the DNS IP address is not defined for IAPs or VC, the DNS address dynamically assigned from the DHCP server is used.
	- **Virtual Controller VLAN**—Ensure that the VLAN defined for the VC is not the same as the native VLAN of the IAP.
	VC VLAN, gateway, and subnet mask details.
		`(Instant AP)(config) # virtual-controller-dnsip <addr>`
		`(Instant AP)(config) # virtual-controller-vlan <vcvlan> <vcmask> <vcgw>`

Table 17: *System Parameters*

Parameter	Description	CLI Configuration

Auto join mode	The Auto-Join feature allows IAPs to automatically discover the VC and join the network. The Auto-Join feature is enabled by default. If the Auto-Join feature is disabled, a link is displayed in the **Access Points** tab indicating that there are new IAPs discovered in the network. Click this link if you want to add these IAPs to the network.
	When Auto-Join feature is disabled, the inactive IAPs are displayed in red.
		To disable auto-join mode:
		`(Instant AP)(config) # no allow-new-aps`
		To enable auto-join mode:
		`(Instant AP)(config) # allow-new-aps`

Terminal access	When terminal access is enabled, you can access the IAP CLI through SSH. The terminal access is enabled by default	`(Instant AP)(config) # terminal-access`
Console access	When enabled, you can access the IAP through the console port.	`(Instant AP)(config) # console`
Telnet server	To start a Telnet session with the IAP CLI, enable access to the Telnet server.	`(Instant AP)(config) # telnet-server`
LED display	LED display status of the IAP. To enable or disable LED display for all IAPs in a cluster, select **Enabled** or **Disabled**, respectively. **NOTE:** The LEDs are always enabled during the IAP reboot.	`(Instant AP)(config) # led-off`
Extended SSID	**Extended SSID** is enabled by default in the factory default settings of IAPs. This disables mesh in the factory default settings. ● The RAP-108/109 access points support up to 6 SSIDs with Extended SSID disabled and up to 8 SSIDs with Extended SSID enabled. ● All other IAPs support up to 14 SSIDs when Extended SSID is disabled and up to 16 SSIDs with Extended SSID enabled.	`(Instant AP)(config) # extended-ssid`

Deny inter user bridging	If you have security and traffic management policies defined in upstream devices, you can disable bridging traffic between two clients connected to the same IAP on the same VLAN. When inter user bridging is denied, the clients can connect to the Internet but cannot communicate with each other, and the bridging traffic between the clients is sent to the upstream device to make the forwarding decision.
	By default, the **Deny inter user bridging** parameter is disabled.
		`(Instant AP)(config) # deny-inter-user-bridging`
		To disable inter-user bridging for the WLAN SSID clients:
		`(Instant AP)(config) # wlan ssid-profile <ssid-profile>`

Table 17: *System Parameters*

Parameter	Description	CLI Configuration
		`(Instant AP)(SSID Profile <ssid-profile>)# deny-inter-user-bridging`
Deny local routing	If you have security and traffic management policies defined in upstream devices, you can disable routing traffic between two clients connected to the same IAP on different VLANs. When local routing is disabled, the clients can connect to the Internet but cannot communicate with each other, and the routing traffic between the clients is sent to the upstream device to make the forwarding decision. By default, the **Deny local routing** parameter is disabled.	`(Instant AP)(config)# deny-local-routing`
Dynamic CPU Utilization	IAPs perform various functions such as wired and wireless client connectivity and traffic flows, wireless security, network management, and location tracking. If an IAP is overloaded, it prioritizes the platform resources across different functions. Typically, the IAPs manage resources automatically in real time. However, under special circumstances, if dynamic resource management needs to be enforced or disabled altogether, the dynamic CPU management feature settings can be modified. To configure dynamic CPU management, select any of the following options from **DYNAMIC CPU UTILIZATION**. ● **Automatic**—When selected, the CPU management is enabled or disabled automatically during runtime. This decision is based on real-time load calculations taking into account all different functions that the CPU needs to perform. This is the default and recommended option. ● **Always Disabled in all APs**—When selected, this setting disables CPU management on all IAPs, typically for small networks. This setting protects user experience. ● **Always Enabled in all APs**—When selected, the client and network management functions are protected. This setting helps in large networks with high client density.	`(Instant AP)(config)# dynamic-cpu-mgmt`

Changing Password

You can update your password details by using the Instant UI or the CLI.

In the Instant UI

To change the admin user password:

1. Navigate to **System > Admin**.
2. Under **Local**, provide a new password that you would like the admin users to use.
3. Click **OK**.

In the CLI

To change the admin user password:

```
(Instant AP)(config)# mgmt-user <username> [password]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Hashing of Management User Password

Starting from Instant 6.5.0.0-4.3.0.0, all the management user passwords can be stored and displayed as hash instead of plain text. Hashed passwords are more secure as they cannot be converted back to plain text format.

Upgrading to the Instant 6.5.0.0-4.3.0.0 version will not automatically enable hashing of management user passwords, as this setting is optional. Users can choose if management passwords need to be stored and displayed as hash, or if the passwords need to remain in encrypted format.

This setting is enabled by default on factory reset IAPs running Instant 6.5.0.0-4.3.0.0 onwards, and is applicable to all IAPs in the cluster.

Hashing of the management user password can be configured by using either the Instant UI or the CLI.

In the Instant UI

To set the management password in hash format:

1. Navigate to **System > Admin**.
2. Click the **show advanced options** link.
3. Select the **Hash Management Password** check box. This will enable the hashing of the management user password.

The check box will appear grayed out after this setting is enabled, as this setting cannot be reversed.

In the CLI

The following example enables the hashing of a management user password:

```
(Instant AP)(config)# hash-mgmt-password
(Instant AP)(config)# end
(Instant AP)# commit apply
```

The following example adds a management user with read-only privilege:

```
(Instant AP)(config)# hash-mgmt-user john password cleartext password01 usertype read-only
(Instant AP)(config)# end
(Instant AP)# commit apply
```

The following examples removes a management user with read-only privilege:

```
(Instant AP)(config)# no hash-mgmt-user read-only
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Chapter 7 Customizing IAP Settings

This chapter describes the procedures for configuring settings that are specific to an IAP in the cluster.

Modifying the IAP Host Name

You can change the host name of an IAP through the Instant UI or the CLI.

In the Instant UI

To change the host name:

1. On the **Access Points** tab, click the IAP you want to rename.
2. Click the **edit** link.
3. Edit the IAP name in **Name**. You can specify a name of up to 32 ASCII characters.
4. Click **OK**.

In the CLI

To change the name:

```
(Instant AP)# hostname <name>
```

Configuring Zone Settings on an IAP

All IAPs in a cluster use the same SSID configuration including master and slave IAPs. However, if you want to assign an SSID to a specific IAP, you can configure zone settings for an IAP.

The following constraints apply to the IAP zone configuration:

- An IAP can belong to only one zone and only one zone can be configured on an SSID.
- If an SSID belongs to a zone, all IAPs in this zone can broadcast this SSID. If no IAP belongs to the zone configured on the SSID, the SSID is not broadcast.
- If an SSID does not belong to any zone, all IAPs can broadcast this SSID.

You can add an IAP zone by using the UI or the CLI.

For the SSID to be assigned to an IAP, the same zone details must be configured on the SSID. For more information on SSID configuration, see Configuring WLAN Settings for an SSID Profile on page 81.

In the Instant UI

1. On the **Access Points** tab, click the IAP for which you want to set the zone. The **edit** link is displayed.
2. Click the **edit** link. The edit window for modifying IAP details is displayed.
3. Specify the IAP zone in **Zone**.
4. Click **OK**.

In the CLI

To change the name:

```
(Instant AP)# zone <name>
```

Specifying a Method for Obtaining IP Address

You can either specify a static IP address or allow the IAP to obtain an IP address from the DHCP server. By default, the IAPs obtain IP address from the DHCP server. You can specify a static IP address for the IAP by using the Instant UI or the CLI.

In the Instant UI

To configure a static IP address:

1. On the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Select **Specify statically** option to specify a static IP address. The following text boxes are displayed:
    a. Enter a new IP address for the IAP in the **IP address** text box.
    b. Enter the subnet mask of the network in the **Netmask** text box.
    c. Enter the IP address of the default gateway in the **Default gateway** text box.
    d. Enter the IP address of the DNS server in the **DNS server** text box.
    e. Enter the domain name in the **Domain name** text box.
4. Click **OK** and reboot the IAP.

In the CLI

To configure a static IP address:

```
(Instant AP)# ip-address <IP-address> <subnet-mask> <NextHop-IP> <DNS-IP-address> <domain-
name>
```

Configuring External Antenna

If your IAP has external antenna connectors, you need to configure the transmit power of the system. The configuration must ensure that the system’s Equivalent Isotropically Radiated Power (EIRP) is in compliance with the limit specified by the regulatory authority of the country in which the IAP is deployed. You can also measure or calculate additional attenuation between the device and the antenna before configuring the antenna gain. To know if your IAP device supports external antenna connectors, refer to the *Aruba Instant Installation Guide* that is shipped along with the IAP device.

EIRP and Antenna Gain

The following formula can be used to calculate the EIRP-limit-related RF power based on selected antennas (antenna gain) and feeder (Coaxial Cable loss):

EIRP = Tx RF Power (dBm) + GA (dB) - FL (dB)

The following table describes this formula:

Table 18: *Formula Variable Definitions*

Formula Element	Description
EIRP	Limit specific for each country of deployment
Tx RF Power	RF power measured at RF connector of the unit
GA	Antenna gain
FL	Feeder loss

Example

For example, the maximum gain that can be configured on an IAP with AP-ANT-1F dual-band and omni-directional antenna is as follows:

Table 19: *Maximum Antenna Gains*

Frequency Band	Gain (dBi)
2.4–2.5 GHz	2.0 dBi
4.9–5.875 GHz	5.0 dBi

For information on antenna gain recommended by the manufacturer, see www.arubanetworks.com.

Configuring Antenna Gain

You can configure antenna gain for IAPs with external connectors by using the Instant UI or the CLI.

In the Instant UI

To configure the antenna gain value:

1. Navigate to the **Access Points** tab, select the IAP to configure, and then click **edit**.
2. In the **Edit Access Point** window, select **External Antenna** to configure the antenna gain value. This option is available only for access points that support external antennas,
3. Enter the antenna gain values in dBm for the 2.4 GHz and 5 GHz bands.
4. Click **OK**.

In the CLI

To configure external antenna for 5 GHz frequency:

```
(Instant AP)# a-external-antenna <dBi>
```

To configure external antenna for 2.4 GHz frequency:

```
(Instant AP)# g-external-antenna <dBi>
```

Configuring Radio Profiles for an IAP

You can configure a radio profile on an IAP either manually or by using the Adaptive Radio Management (ARM) feature.

ARM is enabled on Instant by default. It automatically assigns appropriate channel and power settings for the IAPs. For more information on ARM, see Adaptive Radio Management on page 252.

Configuring ARM-Assigned Radio Profiles for an IAP

To enable ARM-assigned radio profiles:

1. On the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Click the **Radio** tab. The **Radio** tab details are displayed.
4. Select the **Access** mode.
5. Select the **Adaptive radio management assigned** option under the bands that are applicable to the IAP configuration.
6. Click **OK**.

Configuring Radio Profiles Manually for IAP

NOTE

When radio settings are assigned manually by the administrator, the ARM is disabled.

To manually configure radio settings:

1. On the **Access Points** tab, click the IAP for which you want to enable ARM.
2. Click the **edit** link.
3. Click the **Radio** tab.
4. Ensure that an appropriate mode is selected.

By default, the channel and power for an IAP are optimized dynamically using ARM. You can override ARM on the 2.4 GHz and 5 GHz bands and set the channel and power manually if desired. The following table describes various configuration modes for an IAP:

Table 20: *IAP Radio Modes*

Mode	Description
Access	In **Access** mode, the IAP serves clients, while also monitoring for rogue IAPs in the background. If the **Access** mode is selected, perform the following actions: 1. Select **Administrator assigned** in **2.4 GHz** and **5 GHz** band sections. 2. Select appropriate channel number from the **Channel** drop-down list for both **2.4 GHz** and **5 GHz** band sections. 3. Enter appropriate transmit power value in the **Transmit power** text box in **2.4 GHz** and **5 GHz** band sections.
Monitor	In **Monitor** mode, the IAP acts as a dedicated monitor, scanning all channels for rogue IAPs and clients. You can set one radio on the Monitor mode and the other radio on the access mode, so that the clients can use one radio when the other one is in the Air Monitor mode.
Spectrum Monitor	In **Spectrum Monitor** mode, the IAP functions as a dedicated full-spectrum RF monitor, scanning all channels to detect interference, whether from the neighboring IAPs or from non-WiFi devices such as microwaves and cordless phones.

NOTE

In the Spectrum Monitor mode, the IAPs do not provide access services to clients.

4. Click **OK**.

In the CLI

To configure a radio profile:

```
(Instant AP)# wifi0-mode {<access> | <monitor> | <spectrum-monitor>}
(Instant AP)# wifi1-mode {<access> | <monitor> | <spectrum-monitor>}
```

If the access mode is configured, you can configure the channel and transmission power by running the following commands:

```
(Instant AP)# a-channel <channel> <tx-power>
(Instant AP)# g-channel <channel> <tx-power>
```

Configuring Maximum Clients on SSID Radio Profiles

You can also set the maximum number of clients individually for SSID profiles operating on the 2.4 GHz and 5 GHz radios. This configuration is not persistent and is lost once the IAP is rebooted.

To configure maximum clients for an SSID radio profile in the prilvileged exec mode:

```
(Instant AP)# a-max-clients <ssid_profile> <max-clients>
(Instant AP)# g-max-clients <ssid_profile> <max-clients>
```

To view the maximum clients allowed for an SSID profile:

```
(Instant AP)# show a-max-clients <ssid_profile>
(Instant AP)# show g-max-clients <ssid_profile>
```

NOTE

You can also set the maximum clients when configuring SSID profiles using the **Max Clients Threshold** parameter in the Instant UI and **max-clients-threshold** parameter in the Instant CLI. For more information, see Configuring WLAN Settings for an SSID Profile on page 81.

If the maximum clients setting is configured multiple times, using either the configuration mode or Privileged EXEC mode, the latest configuration takes precedence.

Configuring Uplink VLAN for an IAP

Instant supports a management VLAN for the uplink traffic on an IAP. You can configure an uplink VLAN when an IAP needs to be managed from a non-native VLAN. After an IAP is provisioned with the uplink management VLAN, all management traffic sent from the IAP is tagged with the management VLAN.

NOTE

Ensure that the native VLAN of the IAP and uplink are not the same.

You can configure the uplink management VLAN on an IAP by using the Instant UI or the CLI.

In the Instant UI

To configure uplink management VLAN:

1. On the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Click the **Uplink** tab.
4. Specify the VLAN in the **Uplink Management VLAN** text box.
5. Click **OK**.
6. Reboot the IAP.

In the CLI

To configure an uplink VLAN:

```
(Instant AP)# uplink-vlan <VLAN-ID>
```

To view the uplink VLAN status:

```
(Instant AP)# show uplink-vlan
Uplink Vlan Current :0
Uplink Vlan Provisioned :1
```

Changing the IAP Installation Mode

By default, all IAP models initially ship with an indoor or outdoor installation mode. This means that IAPs with an indoor installation mode are normally placed in enclosed, protected environments and those with an outdoor installation mode are used in outdoor environments and exposed to harsh elements.

In most countries, there are different channels and power that are allowed for indoor and outdoor operation. You may want to change an IAP's installation mode from indoor to outdoor or vice versa.

In the Instant UI

To configure the installation mode for an IAP, follow these steps:

1. Navigate to the **Access Points** tab, select the IAP to configure, and then click **edit**.

2. In the **Edit Access Point** window, select **Installation Type** to configure the installation type for the IAP you have selected.

NOTE

Note that, by default, the **Default** mode is selected. This means that the IAP installation type is based on the IAP model.

3. You can either select the **Indoor** option to change the installation to Indoor mode or select the **Outdoor** option to change the installation to Outdoor mode.

the to Outdoor mode.

4. Click **OK**. A pop-up appears on the screen indicating the IAP needs to be rebooted for the changes to take effect.
5. Click **OK**.

In the CLI

To configure the Installation Type:

```
(Instant AP)# ap-installation <type[default|indoor|outdoor]>
```

To view the installation type of the IAPs:

```
(Instant AP)# show ap allowed-channels
```

Changing USB Port Status

The USB port can be enabled or disabled based on your uplink preferences. If you do not want to use the cellular uplink or 3G/4G modem in your current network setup, you can set the USB port status to disabled. By default, the USB port status is enabled.

You can change the USB port status by using the Instant UI or the CLI.

In the Instant UI

To change the USB port status:

1. From the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Click the **Uplink** tab.
4. Set the port status by selecting any of the following options:
   - **Disabled**—To disable the port status.
   - **Enabled**—To re-enable the port status.
5. Click **OK**.
6. Reboot the IAP.

In the CLI

To disable the USB port:

```
(Instant AP)# usb-port-disable
```

To re-enable the USB port:

```
(Instant AP)# no usb-port-disable
```

To view the USB port status:

```
(Instant AP)# show ap-env
Antenna Type:External
usb-port-disable:1
```

Master Election and Virtual Controller

Instant does not require an external Mobility Controller to regulate and manage the Wi-Fi network. Instead, one IAP in every network assumes the role of VC. It coordinates, stores, and distributes the settings required for providing a centralized functionality to regulate and manage the Wi-Fi network. The VC is the single point of configuration and firmware management. When configured, the VC sets up and manages the Virtual Private Network (VPN) tunnel to a mobility controller in the data center.

The VC also functions like any other IAP with full RF scalability. It also acts as a node, coordinating DHCP address allocation for network address translated clients ensuring mobility of the clients when they roam between different IAPs.

Master Election Protocol

The Master Election Protocol enables the Instant network to dynamically elect an IAP to take on a VC role and allow graceful failover to a new VC when the existing VC is not available. This protocol ensures stability of the network during initial startup or when the VC goes down by allowing only one IAP to self-elect as a VC.

Preference to an IAP with 3G/4G Card

The Master Election Protocol prefers the IAP with a 3G/4G card when electing a VC for the Instant network during the initial setup.

The VC is selected based on the following criteria:

- If there is more than one IAP with 3G/4G cards, one of these IAPs is dynamically elected as the VC.
- When an IAP without 3G/4G card is elected as the VC but is up for less than 5 minutes, another IAP with 3G/4G card in the network is elected as the VC to replace it and the previous VC reboots.
- When an IAP without 3G/4G card is already elected as the VC and is up for more than 5 minutes, the VC will not be replaced until it goes down.

NOTE

IAP-135 is preferred over IAP-105 when a VC is elected.

Preference to an IAP with Non-Default IP

The Master Election Protocol prefers an IAP with non-default IP when electing a VC for the Instant network during initial startup. If there are more than one IAPs with non-default IPs in the network, all IAPs with default IP will automatically reboot and the DHCP process is used to assign new IP addresses.

Viewing Master Election Details

To verify the status of an IAP and master election details, execute the following commands:

```
(Instant AP)# show election statistics
(Instant AP)# show summary support
```

Manual Provisioning of Master IAP

In most cases, the master election process automatically determines the best IAP that can perform the role of VC, which will apply its image and configuration to all other IAPs in the same IAP management VLAN. When the VC goes down, a new VC is elected.

Provisioning an IAP as a Master IAP

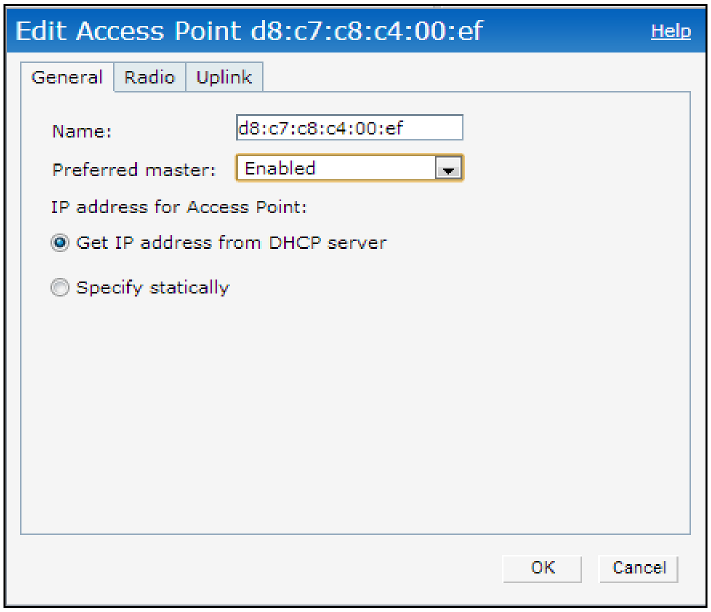
You can provision an IAP as a master IAP by using the Instant UI or the CLI.

In the Instant UI

To provision an IAP as a master IAP:

1. On the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Select **Enabled** from the **Preferred master** drop-down list. This option is disabled by default.

Figure 24 *IAP Settings—Provisioning Master IAP*



Edit Access Point d8:c7:c8:c4:00:ef

Name: d8:c7:c8:c4:00:ef

Preferred master: Enabled

IP address for Access Point:

● Get IP address from DHCP server

○ Specify statically

4. Click **OK**.

In the CLI

To provision an IAP as a master IAP:

```
(Instant AP)# iap-master
```

To verify if the IAP is provisioned as master IAP:

```
(Instant AP)# show ap-env
Antenna Type:Internal
Iap_master:1
```

Adding an IAP to the Network

To add an IAP to the Instant network, assign an IP address. For more information, see Assigning an IP address to the IAP on page 17.

After an IAP is connected to the network, if the Auto-Join feature is enabled, the IAP inherits the configuration from the VC and is listed in the **Access Points** tab.

If the auto-join mode is disabled, perform the following steps by using the Instant UI.

In the Instant UI:

To add an IAP to the network:

1. On the **Access Points** tab, click the **New** link.
2. In the **New Access Point** window, enter the MAC address for the new IAP.
3. Click **OK**.

Removing an IAP from the Network

You can remove an IAP from the network by using the Instant UI, only if the Auto-Join feature is disabled.

In the Instant UI

To remove an IAP from the network:

1. On the **Access Points** tab, click the IAP to delete. The **x** icon is displayed beside the IAP.
2. Click **x** to confirm the deletion.

NOTE

The deleted IAPs cannot join the Instant network anymore and are not displayed in the Instant UI. However, the master IAP details cannot be deleted from the VC database.

This chapter explains the following topics:

- VLAN Pooling
- Uplink VLAN Monitoring and Detection on Upstream Devices

VLAN configuration is required for networks with more devices and broadcast traffic on a WLAN SSID or wired profile. Based on the network type and its requirements, you can configure the VLANs for a WLAN SSID or wired port profile.

For more information on VLAN configuration for a WLAN SSID and wired port profile, see Configuring VLAN Settings for a WLAN SSID Profile on page 86 and Configuring VLAN for a Wired Profile on page 108, respectively.

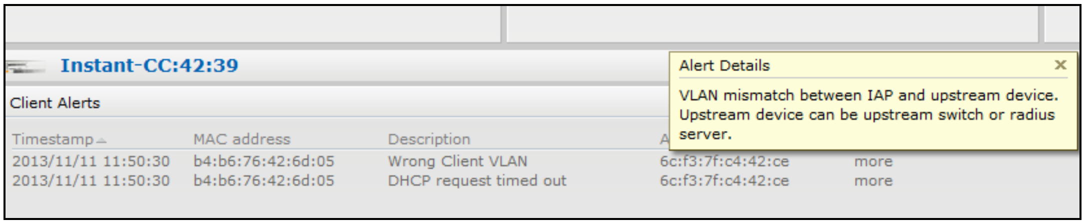
VLAN Pooling

In a single IAP cluster, a large number of clients can be assigned to the same VLAN. Using the same VLAN for multiple clients can lead to a high level of broadcasts in the same subnet. To manage the broadcast traffic, you can partition the network into different subnets and use L3-mobility between those subnets when clients roam. However, if a large number of clients need to be in the same subnet, you can configure VLAN pooling, in which each client is randomly assigned a VLAN from a pool of VLANs on the same SSID. Thus, VLAN pooling allows automatic partitioning of a single broadcast domain of clients into multiple VLANs.

Uplink VLAN Monitoring and Detection on Upstream Devices

If a client connects to an SSID or a wired interface with VLAN that is not allowed on the upstream device, the client will not be assigned an IP address and thus cannot connect to the Internet. In such scenario, the Instant UI now displays the following alert message:

Figure 25 *Uplink VLAN Detection*



Instant-CC:42:39

Client Alerts

Timestamp	MAC address	Description	A	
2013/11/11 11:50:30	b4:b6:76:42:6d:05	Wrong Client VLAN	6c:f3:7f:c4:42:ce	more
2013/11/11 11:50:30	b4:b6:76:42:6d:05	DHCP request timed out	6c:f3:7f:c4:42:ce	more

Alert Details

VLAN mismatch between IAP and upstream device. Upstream device can be upstream switch or radius server.

To resolve this issue, ensure that there is no mismatch in the VLAN configuration.

Chapter 9
IPv6 Support

This chapter includes the following topics:

- IPv6 Notation on page 77
- Enabling IPv6 Support for IAP Configuration on page 77
- Firewall Support for IPv6 on page 79
- Debugging Commands on page 79

IPv6 Notation

IPv6 is the latest version of Internet Protocol (IP) that is suitable for large-scale IP networks. IPv6 supports a 128-bit address to allow 2^{128}, or approximately 3.4×10^{38} addresses while IPv4 supports only 2^{32} addresses.

The IP address of the IPv6 host is always represented as eight groups of four hexadecimal digits separated by colons. For example `2001:0db8:0a0b:12f0:0000:0000:0000:0001`. However, the IPv6 notation can be abbreviated to compress one or more groups of zeroes or to compress leading or trailing zeroes.

The following examples show various representations of the address `2001:0db8:0a0b:12f0:0000:0000:0000:0001`

- Valid format—`2001:db8:a0b:12f0::0:0:1`
- Invalid format—`2001:db8:a0b:12f0::::0:1`. The "`::`" sign appears only once in an address.
- With leading zeros omitted—`2001:db8:a0b:12f0:0:0:0:1`
- Switching from upper to lower case—`2001:DB8:A0B:12f0:0:0:0:1`

IPv6 uses a "/" notation which describes the number of bits in netmask as in IPv4.

```
2001:db8::1/128 - Single Host
2001:db8::/64 - Network
```

NOTE

IPv6 configuration is supported only on IAP-214/215, IAP-224/225, IAP-274/275, IAP-314/315, IAP-324/325, and IAP-334/335 access points.

Enabling IPv6 Support for IAP Configuration

IAPs support IPv6 address mode for the following features:

- Supported IP modes
- Configuring IPv6 Address for an IAP
- RADIUS over IPv6
- SNMP Over IPv6
- SNTP Over IPv6

Supported IP modes

Instant supports two modes of IP address configuration:

- V4-only—The IAP would allow IPv6 clients to pass-through just like the previous Instant release.
- V4-prefer—Supports both IPv4 and IPv6 addresses. If the IAP gets both IPv4 and IPv6 responses for a DNS query, then the IAP would prefer the IPv4 DNS address instead of the IPv6 DNS address.

When the IP mode is set to v4-prefer mode, the IAP derives a link local IPv6 address and attempts to acquire a routable IPv6 address by monitoring Router Advertisements (RA) packets. IAP assigns itself to both Stateless address autoconfiguration (SLAAC) and DHCPv6 client address. IAPs also support IPv6 DNS server addresses and use these for DNS resolution.

In the CLI:

To enable IPv4 mode or dual stack mode:

```
(Instant AP)(config)# ip-mode {v4-only|v4-prefer}
(Instant AP)(config)# end
(Instant AP)(config)# commit apply
```

Configuring IPv6 Address for an IAP

You can enable the IPv6 mode on the IAP and also configure a VC IPv6 address using the Instant UI or the CLI:

In the Instant UI:

To enable IPv6 and configure VC IPv6 address:

1. Go to the **System** link, directly above the Search bar in the Instant UI.
2. Under **General**, select the **Allow IPv6 Management** check box.
3. Enter the IP address in the **Virtual Controller IPv6** address text box.
4. Click **OK**.

In the CLI:

To configure an IPv6 address for an IAP:

```
(Instant AP)(config)# virtual-controller-ipv6 <ipv6 address>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

NOTE

The VC IPv6 address can be configured only after enabling the v4-prefer mode in the Instant CLI.

RADIUS over IPv6

With the address mode set to v4-prefer, the IAP supports an IPv6 IP address for the RADIUS server. The authentication server configuration can also include the NAS IPv6 address (that defaults to the routable IPv6 address when not configured).

To configure an IPv6 address for the RADIUS server:

```
(Instant AP)(config)# wlan auth-server radiusIPv6
(Instant AP)(Auth Server "radiusIPv6")# ip <host>
(Instant AP)(Auth Server "radiusIPv6")# nas-ip <ip_ipv6>
(Instant AP)(Auth Server "radiusIPv6")# end
(Instant AP)# commit apply
```

SNMP Over IPv6

In this release, you can configure a community string to authenticate messages sent between the VC and the SNMP agent, where the IPv6 address will be used as the VC address.For more information on configuring SNMP parameters, see Configuring SNMP on page 367.

To view the SNMP configuration:

```
(Instant AP)# show running-config|include snmp
snmp-server community e96a5ff136b5f481b6b55af75d7735c16ee1f61ba082d7ee
snmp-server host 2001:470:20::121 version 2c aruba-string inform
```

SNTP Over IPv6

To view the SNTP configuration:

```
(Instant AP)# show running-config|include ntp
ntp-server 2001:470:20::121
```

Firewall Support for IPv6

For a given client, a single ACL is used to firewall both IPv4 and IPv6 rules. A rule **any any match any any any permit** in the access rule configuration will expand to two different ACL entries:

- any any any P6
- any any any P4

Similarly, if any IPv6 specific rule is added. For example, if any DHCPv6 or FTPv6 rule is added, the ACE would be expanded as follows:

any 2002::/64 17 0-65535 546-547 6—*destined to network 2002::/64 DHCPv6 is denied*.

any 2001::10/128 6 0-65535 20-21 6—*destined to host 2001::10 FTP is denied*.

For all ACLs the IAP will have an implicit IPv4 and IPv6 **allow all** acl rule.

Debugging Commands

Use the following commands to troubleshoot issues pertaining to IPv6 configuration:

- `show ipv6 interface brief` and `show ipv6 interface details`— displays the configured IPv6 address, and any duplicate addresses.
- `show ipv6 route`—displays the IPv6 routing information.
- `show datapath ipv6 session`—displays IPv6 sessions.
- `show datapath ipv6 user`—displays IPv6 client details.
- `show clients` and `show clients debug`—displays the details about IAP clients.

This chapter provides the following information:

Configuring Wireless Network Profiles

During start up, a wireless client searches for radio signals or beacon frames that originate from the nearest IAP. After locating the IAP, the following transactions take place between the client and the IAP:

1. Authentication—The IAP communicates with a RADIUS server to validate or authenticate the client.
2. Connection—After successful authentication, the client establishes a connection with the IAP.

Network Types

Instant wireless networks are categorized as:

- **Employee network**—An Employee network is a classic Wi-Fi network. This network type is used by the employees in an organization and it supports passphrase-based or 802.1X-based authentication methods. Employees can access the protected data of an enterprise through the employee network after successful authentication. The employee network is selected by default during a network profile configuration.
- **Voice network**—This Voice network type allows you to configure a network profile for devices that provide only voice services—for example, devices such as handsets or applications that require voice traffic prioritization.
- **Guest network**—The Guest wireless network is created for guests, visitors, contractors, and any non-employee users who use the enterprise Wi-Fi network. The VC assigns the IP address for the guest clients. Captive portal or passphrase-based authentication methods can be set for this wireless network. Typically, a guest network is an unencrypted network. However, you can specify the encryption settings when configuring a guest network.

NOTE

When a client is associated to the Voice network, all data traffic is marked and placed into the high-priority queue in the (Quality of Service) QoS.

To configure a new wireless network profile, complete the following procedures:

1. Configuring WLAN Settings
2. Configuring VLAN Settings
3. Configuring Security Settings
4. Configuring Access Rules for a Network

Configuring WLAN Settings for an SSID Profile

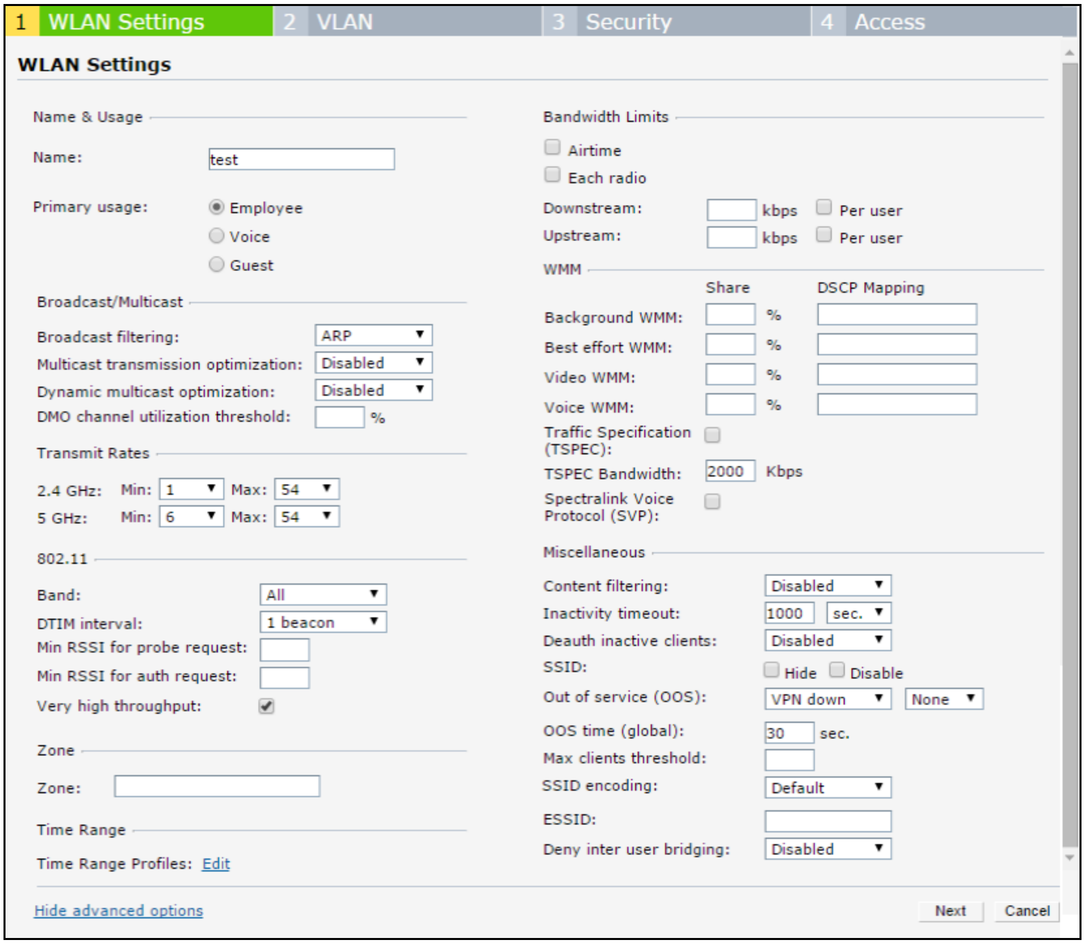
You can configure WLAN settings using the Instant UI or the CLI.

In the Instant UI

To configure WLAN settings:

1. On the **Network** tab of the Instant main window, click the **New** link. The **New WLAN** window is displayed. The following figure shows the contents of the **WLAN Settings** tab:

Figure 26 *WLAN Settings Tab*



WLAN Settings

Name & Usage

Name: test

Primary usage: ● Employee ○ Voice ○ Guest

Broadcast/Multicast

Broadcast filtering: ARP

Multicast transmission optimization: Disabled

Dynamic multicast optimization: Disabled

DMO channel utilization threshold: %

Transmit Rates

2.4 GHz: Min: 1 Max: 54

5 GHz: Min: 6 Max: 54

802.11

Band: All

DTIM interval: 1 beacon

Min RSSI for probe request:

Min RSSI for auth request:

Very high throughput: ☑

Zone

Zone:

Time Range

Time Range Profiles: Edit

Bandwidth Limits

□ Airtime

□ Each radio

Downstream: kbps □ Per user

Upstream: kbps □ Per user

WMM

	Share		DSCP Mapping
Background WMM:		%	
Best effort WMM:		%	
Video WMM:		%	
Voice WMM:		%	

Traffic Specification (TSPEC): □

TSPEC Bandwidth: 2000 Kbps

Spectralink Voice Protocol (SVP): □

Miscellaneous

Content filtering: Disabled

Inactivity timeout: 1000 sec.

Deauth inactive clients: Disabled

SSID: □ Hide □ Disable

Out of service (OOS): VPN down None

OOS time (global): 30 sec.

Max clients threshold:

SSID encoding: Default

ESSID:

Deny inter user bridging: Disabled

Hide advanced options

2. Enter a name that uniquely identifies a wireless network in the **Name (SSID)** text box.

NOTE

The SSID name must be unique and may contain any special character except for **'** and **".**

3. Based on the type of network profile, select any of the following options under **Primary usage**:
   - **Employee**
   - **Voice**
   - **Guest**
4. Click the **Show advanced options** link. The advanced options for configuration are displayed. Specify the following parameters as required.

Table 21: *WLAN Configuration Parameters*

Parameter	Description
Broadcast filtering	Select any of the following values: - **All**—When set to **All**, the IAP drops all broadcast and multicast frames except DHCP and ARP, IGMP group queries, and IPv6 neighbor discovery protocols. - **ARP**—When set to **ARP**, the IAP drops all broadcast and multicast frames except DHCP and ARP, IGMP group queries, and IPv6 neighbor discovery protocols; additionally, it converts ARP requests to unicast and send frames directly to the associated client. The broadcast filtering option is set to **ARP** by default when an SSID profile is created. - **Unicast-ARP-Only**—When set to **Unicast-ARP-Only**, the IAP allows all broadcast and multicast frames as it is, however the ARP requests are converted to unicast frames and sends them to the associated clients. - **Disabled**—When set to **Disabled**, all broadcast and multicast traffic is forwarded to the wireless interfaces.
Multicast transmission optimization	Select **Enabled** if you want the IAP to select the optimal rate for sending broadcast and multicast frames based on the lowest of unicast rates across all associated clients. When this option is enabled, multicast traffic can be sent at up to 24 Mbps. The default rate of sending frames for 2.4 GHz is 1 Mbps and that for 5 GHz is 6 Mbps. This option is disabled by default.
Dynamic multicast optimization	Select **Enabled** to allow the IAP to convert multicast streams into unicast streams over the wireless link. Enabling Dynamic Multicast Optimization (DMO) enhances the quality and reliability of streaming video, while preserving the bandwidth available to the non-video clients. **NOTE:** When you enable DMO on multicast SSID profiles, ensure that the DMO feature is enabled on all SSIDs configured in the same VLAN.
DMO channel utilization threshold	Specify a value to set a threshold for DMO channel utilization. With DMO, the IAP converts multicast streams into unicast streams as long as the channel utilization does not exceed this threshold. The default value is 90% and the maximum threshold value is 100%. When the threshold is reached or exceeds the maximum value, the IAP sends multicast traffic over the wireless link.
Transmit Rates	Specify the following parameters: - **2.4 GHz**—If the 2.4 GHz band is configured on the IAP, specify the minimum and maximum transmission rate. The default value for minimum transmission rate is 1 Mbps and maximum transmission rate is 54 Mbps. - **5 GHz**—If the 5 GHz band is configured on the IAP, specify the minimum and maximum transmission rate. The default value for minimum transmission rate is 6 Mbps and maximum transmission rate is 54 Mbps.
Band	Select a value to specify the band at which the network transmits radio signals. You can set the band to **2.4 GHz**, **5 GHz**, or **All**. The **All** option is selected by default.

Table 21: *WLAN Configuration Parameters*

Parameter	Description
DTIM interval	The **DTIM interval** indicates the delivery traffic indication message (DTIM) period in beacons, which can be configured for every WLAN SSID profile. The DTIM interval determines how often the IAP should deliver the buffered broadcast and multicast frames to associated clients in the powersave mode. The default value is 1, which means the client checks for buffered data on the IAP at every beacon. You can also configure a higher DTIM value for power saving.
Min RSSI probe request	Sets a minimum received signal strength indication (RSSI) threshold for probe requests.
Min RSSI auth request	Sets a minimum RSSI threshold for authentication requests.
Very high throughput	Enables the VHT function on IAP devices that support VHT. For 802.11acIAPs, the VHT function is enabled by default. However, you can disable the VHT function if you want the 802.11ac IAPs to function as 802.11n IAPs. If VHT is configured or disabled on an SSID, the changes will apply only to the SSID on which it is enabled or disabled.
Zone	Specify the zone for the SSID. When the zone is defined in SSID profile and if the same zone is defined on an IAP, the SSID is created on that IAP. For more information on configuring zone details, see Configuring Zone Settings on an IAP on page 66.
Time Range	Click **Edit**, select a Time Range Profile from the list and specify if the profile must be enabled or disabled for the SSID, and then click **OK**.
Bandwidth Limits	Select the required options under **Bandwidth Limits**: • **Airtime**—Select this check box to specify an aggregate amount of airtime that all clients in this network can use for sending and receiving data. Specify the airtime percentage. • **Each radio**—Select this check box to specify an aggregate amount of throughput that each radio is allowed to provide for the connected clients. • **Downstream** and **Upstream**—Specify the downstream and upstream rates within a range of 1 to 65,535 Kbps for the SSID users. If the assignment is specific for each user, select the **Per user** check box.
Wi-Fi Multimedia (WMM) traffic management	Configure the following options for WMM traffic management. WMM supports voice, video, best effort, and background access categories. To allocate bandwidth for the following types of traffic, specify a percentage value under **Share**. To configure Differntiated Service Code Point (DSCP) mapping, specify a value under **DSCP Mapping**. • **Background WMM**—For background traffic such as file downloads or print jobs. • **Best effort WMM**—For best effort traffic such as traffic from legacy devices or traffic from applications or devices that do not support QoS. • **Video WMM**—For video traffic generated from video streaming. • **Voice WMM**—For voice traffic generated from the incoming and outgoing voice communication.

Table 21: *WLAN Configuration Parameters*

Parameter	Description
	For more information on WMM traffic and DSCP mapping, see Wi-Fi Multimedia Traffic Management on page 276.
	For voice traffic and Spectralink Voice Prioritization, configure the following parameters: - **Traffic Specification (TSPEC)**—To prioritize time-sensitive traffic such as voice traffic initiated by the client, select the **Traffic Specification (TSPEC)** check box. - **TSPEC Bandwidth**—To reserve bandwidth, set the TPSEC bandwidth to the desired value within the range of 200–600,000 Kbps. The default value is 2000 Kbps. - **Spectralink Voice Protocol (SVP)**—Select the check box to prioritize voice traffic for SVP handsets.
Content filtering	Select **Enabled** to route all DNS requests for the non-corporate domains to OpenDNS on this network.
Inactivity timeout	Specify an interval for session timeout in seconds, minutes, or hours. If a client session is inactive for the specified duration, the session expires and the user is required to log in again. You can specify a value within the range of 60–86,400 seconds (24 hours) for a client session. The default value is 1000 seconds.
Deauth Inactive Clients	Select **Enabled** to allow the IAP to send a deauthentication frame to the inactive client and clear client entry.
SSID	Select the **Hide** check box if you do not want the SSID (network name) to be visible to users. Select the **Disable** check box if you want to disable the SSID. On selecting this, the SSID will be disabled, but will not be removed from the network. By default, all SSIDs are enabled.
Out of service (OOS)	Enable or disable the SSID based on the following OOS states of the IAP: - VPN down - Uplink down - Internet down - Primary uplink down The network will be out of service when selected event occurs and the SSID is enabled or disabled as per the configuration settings applied. For example, if you select the VPN down option from the drop-down list and set the status to enabled, the SSID is enabled when the VPN connection is down and is disabled when the VPN connection is restored.
OOS time (global)	Configure a hold time interval in seconds within a range of 30–300 seconds, after which the out-of-service operation is triggered. For example, if the VPN is down and the configured hold time is 45 seconds, the effect of this out-of-service state impacts the SSID availability after 45 seconds.
Max clients threshold	Specify the maximum number of clients that can be configured for each Basic Service Set Identifier (BSSID) on a WLAN. You can specify a value within the range of 0–255. The default value is 64. **NOTE:** This is a per-ap configuration setting, hence the maximum client threshold is set

Table 21: *WLAN Configuration Parameters*

Parameter	Description
	individually for each IAP in the cluster.
SSID Encoding	To encode the SSID, select UTF-8. By default, the SSIDs are not encoded. **NOTE:** When a wireless SSID is encoded, by default, UTF-8 is added to the access rules that are active on the SSID. However this does not apply for the access rules that are configured separately for the SSID. UTF-8 is not supported for wired networks.
Deny inter user bridging	When enabled, the bridging traffic between two clients that are connected to the same SSID on the same VLAN is disabled. The clients can connect to the Internet, but cannot communicate with each other, and the bridging traffic between the clients is sent to the upstream device to make the forwarding decision.
ESSID	Enter the Extended Service Set Identifier (ESSID). If the value defined for ESSID value is not the same as the profile name, the SSIDs can be searched based on the ESSID value and not by its profile name.

5. Click **Next** to configure VLAN settings. For more information, see Configuring VLAN Settings for a WLAN SSID Profile on page 86.

In the CLI

To configure WLAN settings for an SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# essid <ESSID-name>
(Instant AP)(SSID Profile <name>)# type {<Employee>|<Voice>|<Guest>}
(Instant AP)(SSID Profile <name>)# broadcast-filter {All|ARP|Unicast-ARP-Only|Disabled}
(Instant AP)(SSID Profile <name>)# dtim-period <number-of-beacons>
(Instant AP)(SSID Profile <name>)# multicast-rate-optimization
(Instant AP)(SSID Profile <name>)# dynamic-multicast-optimization
(Instant AP)(SSID Profile <name>)# dmo-channel-utilization-threshold
(Instant AP)(SSID Profile <name>)# a-max-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# a-min-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# g-max-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# g-min-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# zone <zone>
(Instant AP)(SSID Profile <name>)# bandwidth-limit <limit>
(Instant AP)(SSID Profile <name>)# per-user-bandwidth-limit <limit>
(Instant AP)(SSID Profile <name>)# air-time-limit <limit>
(Instant AP)(SSID Profile <name>)# wmm-background-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-background-share <share>
(Instant AP)(SSID Profile <name>)# wmm-best-effort-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-best-effort-share <share>
(Instant AP)(SSID Profile <name>)# wmm-video-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-video-share <share>
(Instant AP)(SSID Profile <name>)# wmm-voice-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-voice-share <share>
(Instant AP)(SSID Profile <name>)# rf-band {<2.4>|<5>|<all>}
(Instant AP)(SSID Profile <name>)# content-filtering
(Instant AP)(SSID Profile <name>)# mfp-capable
(Instant AP)(SSID Profile <name>)# mfp-required
(Instant AP)(SSID Profile <name>)# hide-ssid
(Instant AP)(SSID Profile <name>)# out-of-service <def> <name>
(Instant AP)(SSID Profile <name>)# time-range <profile name> {<Enable>|<Disable>}
(Instant AP)(SSID Profile <name>)# inactivity-timeout <interval>
(Instant AP)(SSID Profile <name>)# local-probe-req-thresh <threshold>
```

```
(Instant AP)(SSID Profile <name>)# max-clients-threshold <number-of-clients>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Temporal Diversity and Maximum Retries using CLI

Starting from Instant 6.5.0.0-4.3.0.0, when clients are not responding to 802.11 packets with the **temporal-diversity** parameter disabled, which is the default setting, IAPs can attempt only hardware retries. But if this parameter is enabled when the clients are not responding to 802.11 packets, IAPs can perform two hardware retries. When the hardware retry attempts fail, IAPs can perform software retries.

The **max-retries** parameter indicates the maximum number of attempts the IAP performs when clients are not responding to 802.11 packets. By default, the IAP attempts a maximum of eight retries when clients are not responding to 802.11 packets.

The following example shows the configuration of **temporal-diversity** and **max-retries** in a WLAN SSID profile:

```
(Instant AP) (config) # wlan ssid-profile Name
(Instant AP) (SSID Profile "Name") # temporal-diversity
(Instant AP) (SSID Profile "Name") # max-retries 3
(Instant AP) (SSID Profile "Name") # end
(Instant AP) # commit apply
```

Configuring VLAN Settings for a WLAN SSID Profile

If you are creating a new SSID profile, complete the WLAN Settings procedure before configuring the VLAN. For more information, see Configuring WLAN Settings for an SSID Profile on page 81.

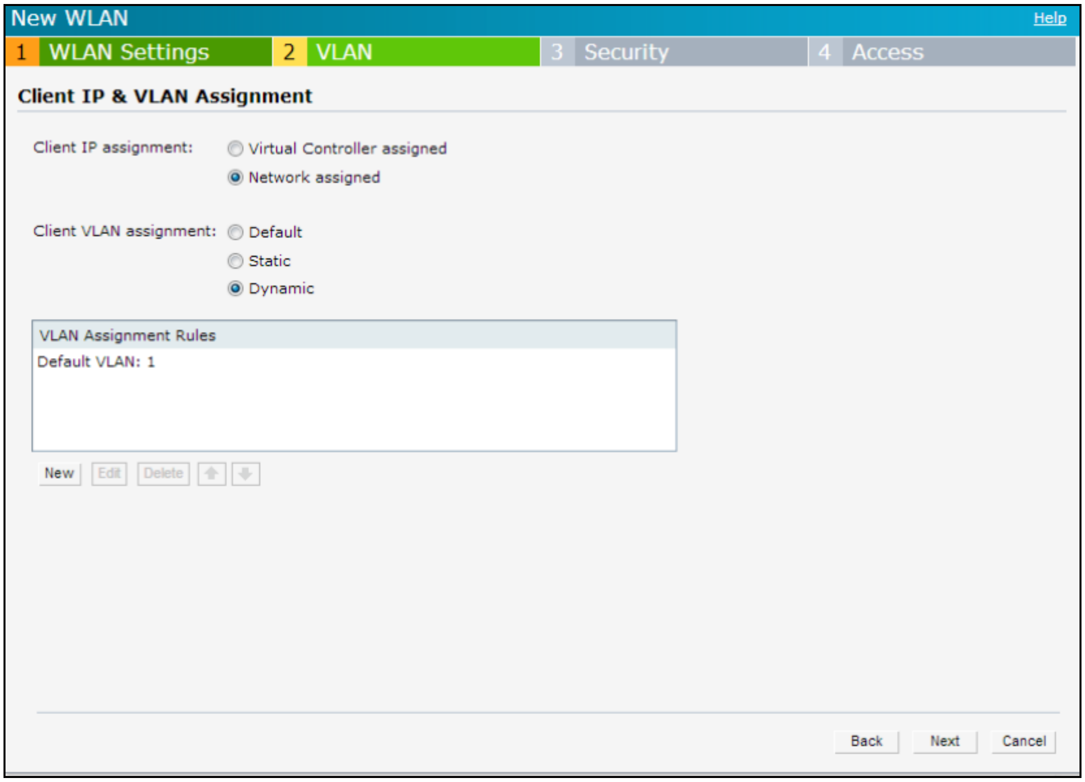
You can configure VLAN settings for an SSID profile using the Instant UI or the CLI.

In the Instant UI

To configure VLAN settings for an SSID:

1. On the **VLAN** tab of the **New WLAN** window, perform the following steps. The following figure displays the contents of the **VLAN** tab.

Figure 27 *VLAN Tab*



Client IP & VLAN Assignment

Client IP assignment: ○ Virtual Controller assigned ● Network assigned

Client VLAN assignment: ○ Default ○ Static ● Dynamic

VLAN Assignment Rules

Default VLAN: 1

2. Select any for the following options for **Client IP assignment**:
   - **Virtual Controller assigned**—On selecting this option, the client obtains the IP address from the VC.
   - **Network assigned**—On selecting this option, the IP address is obtained from the network.
3. Based on the type of client IP assignment mode selected, you can configure the VLAN assignment for clients as described in the following table:

Table 22: *IP and VLAN Assignment for WLAN SSID Clients*

Client IP Assignment	Client VLAN Assignment
Virtual Controller assigned	If **Virtual Controller assigned** is selected for client IP assignment, the VC creates a private subnet and VLAN on the IAP for the wireless clients. The network address translation for all client traffic that goes out of this interface is carried out at the source. This setup eliminates the need for complex VLAN and IP address management for a multisite wireless network. On selecting this option, the following client VLAN assignment options are displayed: ● **Default**—When selected, the default VLAN as determined by the VC is assigned for clients. ● **Custom**—When selected, you can specify a custom VLAN assignment option. You can select an existing DHCP scope for client IP and VLAN assignment or you can create a new DHCP scope by selecting **New**. For more information on DHCP scopes, see Configuring DHCP Scopes on page 210.
Network assigned	If **Network assigned** is selected, you can specify any of the following options for the **Client VLAN assignment**. ● **Default**—On selecting this option, the client obtains the IP address in the same subnet as the IAPs. By default, the client VLAN is assigned to the native VLAN on the wired network. ● **Static**—On selecting this option, you need to specify any one of the following: a single VLAN, a comma separated list of VLANS, or a range of VLANs for all clients on this network. Select this option for configuring VLAN pooling. ● **Dynamic**—On selecting this option, you can assign the VLANs dynamically from a Dynamic Host Configuration Protocol (DHCP) server. To create VLAN assignment rules, click **New** to assign the user to a VLAN. In the **New VLAN Assignment Rule** window, enter the following information: ● **Attribute**—Select an attribute returned by the RADIUS server during authentication. ● **Operator**—Select an operator for matching the string. ● **String**—Enter the string to match . ● **VLAN**—Enter the VLAN to be assigned.

4. Click **Next** to configure security settings for the Employee network. For more information, see Configuring Security Settings for a WLAN SSID Profile on page 89.

In the CLI

To manually assign VLANs for WLAN SSID users:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# vlan <vlan-ID>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To create a new VLAN assignment rule:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-vlan <attribute> {{contains|ends-with|equals|matches-
regular-expression|not-equals|starts-with} <operand> <vlan>|value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Enforcing DHCP

Starting from Instant 6.4.3.4-4.2.1.0, you can configure a WLAN SSID profile to enforce DHCP on IAP clients.

When DHCP is enforced:

- A layer-2 user entry is created when a client associates with an IAP.
- The client DHCP state and IP address are tracked.
- When the client obtains an IP address from DHCP, the DHCP state changes to complete.
- If the DHCP state is complete, a layer-3 user entry is created.
- When a client roams between the IAPs, the DHCP state and the client IP address will be synchronized with the new IAP.

By default, enforcing DHCP feature is disabled.

To enforce DHCP:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# enforce-dhcp
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Configuring Security Settings for a WLAN SSID Profile

This section describes the procedure for configuring security settings for an Employee or Voice network. For information on guest network configuration, see Captive Portal for Guest Access.

NOTE

If you are creating a new SSID profile, configure the WLAN and VLAN settings before defining security settings. For more information, see Configuring WLAN Settings for an SSID Profile on page 81 and Configuring VLAN Settings for a WLAN SSID Profile on page 86.

Configuring Security Settings for an Employee or Voice Network

You can configure security settings for an Employee or Voice network by using the Instant UI or the CLI.

In the Instant UI

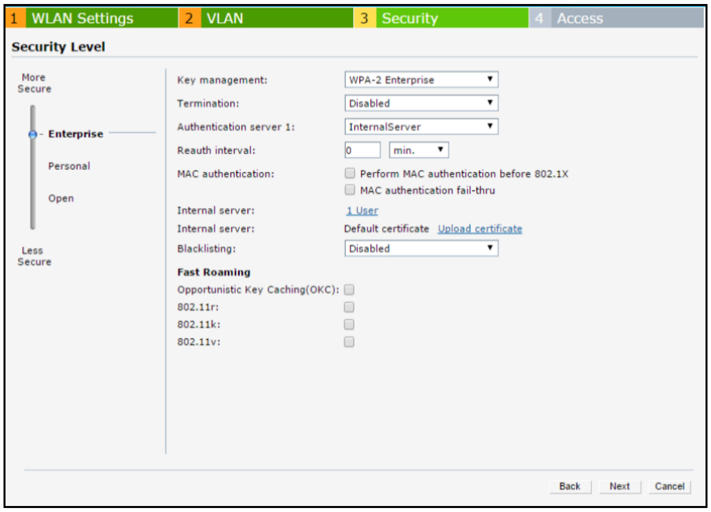
To configure security settings for an Employee or Voice network:

1. On the **Security** tab, specify any of the following types of security levels by moving the slider to a desired level:
   - **Enterprise**—On selecting the enterprise security level, the authentication options applicable to the enterprise network are displayed.
   - **Personal**—On selecting the personal security level, the authentication options applicable to the personalized network are displayed.
   - **Open**—On selecting the open security level, the authentication options applicable to an open network are displayed.

   The default security setting for a network profile is **Personal**.

   The following figures show the configuration options for **Enterprise**, **Personal**, and **Open** security settings:

Figure 28 *Security Tab: Enterprise*



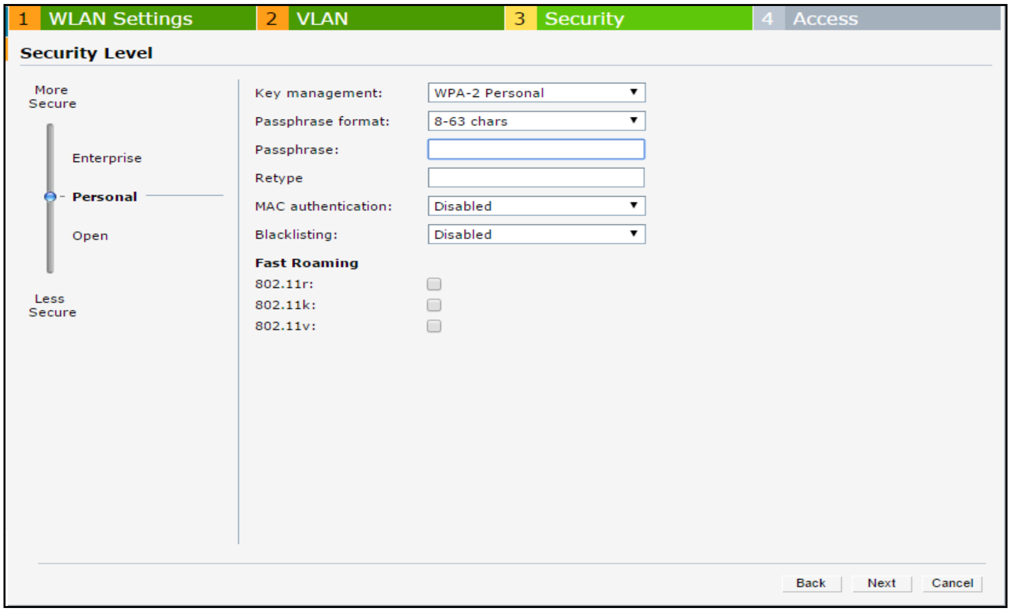
Security Level

Key management: WPA-2 Enterprise
Termination: Disabled
Authentication server 1: InternalServer
Reauth interval: 0 min.
MAC authentication: □ Perform MAC authentication before 802.1X
□ MAC authentication fail-thru
Internal server: 1 User
Internal server: Default certificate Upload certificate
Blacklisting: Disabled

Fast Roaming

Opportunistic Key Caching(OKC): □
802.11r: □
802.11k: □
802.11v: □

Figure 29 *Security Tab: Personal*



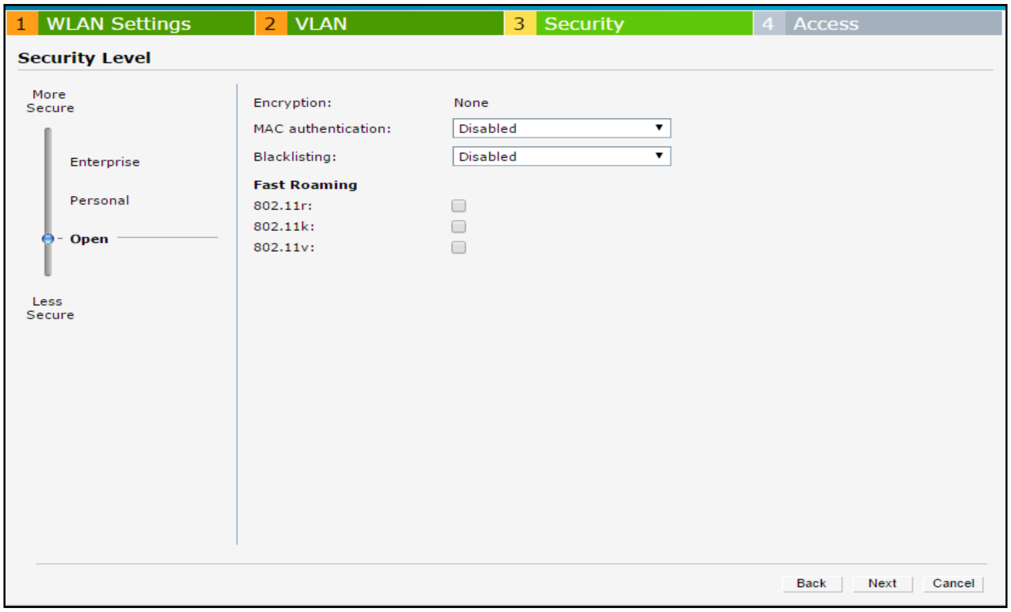
Security Level

Key management: WPA-2 Personal
Passphrase format: 8-63 chars
Passphrase:
Retype
MAC authentication: Disabled
Blacklisting: Disabled

Fast Roaming

802.11r: □
802.11k: □
802.11v: □

Figure 30 *Security Tab: Open*



Security Level

Encryption: None

MAC authentication: Disabled

Blacklisting: Disabled

Fast Roaming

802.11r: □

802.11k: □

802.11v: □

2. Based on the security level selected, specify the following parameters:

Table 23: *Configuration Parameters for WLAN Security Settings in an Employee or Voice Network*

Parameter	Description	Security Level
Key Management	CLick the **Enterprise** security level, select any of the following options from the **Key management** drop-down list: • WPA-2 Enterprise • WPA Enterprise • Both (WPA-2 & WPA) • Dynamic Wired Equivalent Privacy (WEP) with 802.1X—If you do not want to use a session key from the RADIUS server to derive pairwise unicast keys, set **Session Key for LEAP** to **Enabled**. This is required for old printers that use dynamic WEP through Lightweight Extensible Authentication Protocol (LEAP) authentication. The **Session Key for LEAP** feature is set to **Disabled** by default.	Applicable to **Enterprise** and **Personal** security levels only. For the **Open** security level, no encryption settings are required.
	For the **Personal** security level, select any of the following encryption keys from the **Key management** drop-down list. • WPA-2 Personal • WPA-Personal (Both TKIP and AES Encryption) • WPA-Personal (TKIP Encryption only) • WPA-Personal (AES Encryption only) • Both (WPA-2 & WPA) • Static WEP If a WPA-2, WPA encryption, or Both (WPA-2&WPA) is selected, configure the passphrase: 1. Select a passphrase format from the **Passphrase format** drop-down list. The options available are 8–63 alphanumeric characters and 64 hexadecimal characters. 2. Enter a passphrase in the **Passphrase** text box and reconfirm. **NOTE:** The **Passphrase** may contain any special character except for **".** For **Static WEP**, specify the following parameters: 1. Select an appropriate value for **WEP key size** from the WEP key size drop-down list. You can specify 64-bit or 128-bit . 2. Select an appropriate value for Tx key from the **Tx Key** drop-down list. You can specify **1**, **2**, **3**, or **4**. 3. Enter an appropriate **WEP key** and reconfirm.	
Termination	To terminate the Extensible Authentication Protocol (EAP) portion of 802.1X authentication on the IAP instead of the RADIUS server, set **Termination** to **Enabled**. Enabling **Termination** can reduce network traffic to the external RADIUS server by terminating the authorization protocol on the IAP. By default, for 802.1X authorization, the client conducts an EAP exchange with the RADIUS server, and the IAP acts as a relay for this exchange.	**Enterprise** security level

Table 23: *Configuration Parameters for WLAN Security Settings in an Employee or Voice Network*

Parameter	Description	Security Level
	When **Termination** is enabled, the IAP by itself acts as an authentication server and terminates the outer layers of the EAP protocol, only relaying the innermost layer to the external RADIUS server. It can also reduce the number of exchange packets between the IAP and the authentication server. **NOTE:** Instant supports the configuration of primary and backup authentication servers in an EAP termination-enabled SSID. **NOTE:** If you are using LDAP for authentication, ensure that IAP termination is configured to support EAP.	
Authentication server 1 and Authentication server 2	Select any of the following options from the **Authentication server 1** drop-down list: - Select an authentication server from the list if an external server is already configured. To modify the server parameters, click **Edit**. - Select **New** to add a new server. For information on configuring external servers, see Configuring an External Server for Authentication on page 155. - To use an internal server, select **Internal server** and add the clients that are required to authenticate with the internal RADIUS server. Click the **Users** link to add the users. For information on adding a user, see Managing IAP Users on page 142. If an external server is selected, you can also configure another authentication server.	**Enterprise**, **Personal**, and **Open** security levels.
Load balancing	Set this to **Enabled** if you are using two RADIUS authentication servers, so that the load across the two RADIUS servers is balanced. For more information on the dynamic load balancing mechanism, see Dynamic Load Balancing between Two Authentication Servers on page 155.	**Enterprise**, **Personal**, and **Open** security levels.
Reauth interval	Specify a value for **Reauth interval**. When set to a value greater than zero, IAPs periodically reauthenticate all associated and authenticated clients. The following list provides descriptions for three reauthentication interval configuration scenarios: - When Reauth interval is configured on an SSID performing L2 authentication (MAC or 802.1X authentication)—When reauthentication fails, the clients are disconnected. If the SSID is performing only MAC authentication and has a pre-authentication role assigned to the client, the client will get a post-authentication role only after a successful reauthentication. If reauthentication fails, the client retains the pre-authentication role. - When Reauth interval is configured on an SSID performing both L2 and L3 authentication (MAC with captive portal authentication)—When reauthentication succeeds, the client retains the role that is already assigned. If reauthentication fails, a pre-authentication role is assigned to the client.	**Enterprise**, **Personal**, and **Open** security levels.

Table 23: *Configuration Parameters for WLAN Security Settings in an Employee or Voice Network*

Parameter	Description	Security Level
	- When Reauth interval is configured on an SSID performing only L3 authentication (captive portal authentication)—When reauthentication succeeds, a pre-authentication role is assigned to the client that is in a post-authentication role. Due to this, the clients are required to go through captive portal to regain access.	
Blacklisting	To enable blacklisting of the clients with a specific number of authentication failures, select **Enabled** from the **Blacklisting** drop-down list and specify a value for **Max authentication failures**. The users who fail to authenticate the number of times specified in **Max authentication failures** are dynamically blacklisted.	**Enterprise**, **Personal**, and **Open** security levels.
Accounting	Select any of the following options: - To enable accounting, select **Use authentication servers** from the **Accounting** drop-down list. On enabling the accounting function, IAPs post accounting information to the RADIUS server at the specified **Accounting interval**. - To use a separate server for accounting, select **Use separate servers**. The accounting server is distinguished from the authentication server specified for the SSID profile. - To disable the accounting function, select **Disabled**.	**Enterprise**, **Personal**, and **Open** security levels.
Authentication survivability	To enable authentication survivability, set **Authentication survivability** to **Enabled**. Specify a value in hours for **Cache timeout (global)** to set the duration after which the authenticated credentials in the cache must expire. When the cache expires, the clients are required to authenticate again. You can specify a value within a range of 1–99 hours and the default value is 24 hours. **NOTE:** The authentication survivability feature requires ClearPass Policy Manager 6.0.2 or later, and is available only when the **New** server option is selected. On setting this parameter to **Enabled**, Instant authenticates the previously connected clients using EAP-PEAP authentication even when connectivity to ClearPass Policy Manager is temporarily lost. The Authentication survivability feature is not applicable when a RADIUS server is configured as an internal server.	**Enterprise** security level
MAC authentication	To enable MAC-address-based authentication for **Personal** and **Open** security levels, set **MAC authentication** to **Enabled**. For **Enterprise** security level, the following options are available: - **Perform MAC authentication before 802.1X**—Select this check box to use 802.1X authentication only when the MAC authentication is successful. - **MAC authentication fail-thru**—On selecting this check box, the 802.1X authentication is attempted when the MAC authentication fails. **NOTE:** If Enterprise Security level is chosen, the server used for mac	**Enterprise**, **Personal**, and **Open** security levels.

Table 23: *Configuration Parameters for WLAN Security Settings in an Employee or Voice Network*

Parameter	Description	Security Level
	authentication will be the same as the server, defined for 802.1x authentication. You will not be able to use the IAPs internal database for mac authentication and external RADIUS server for 802.1x authentication on the same SSID.	
Delimiter character	Specify a character (for example, colon or dash) as a delimiter for the MAC address string. When configured, the IAP will use the delimiter in the MAC authentication request. For example, if you specify colon as the delimiter, MAC addresses in the xx:xx:xx:xx:xx:xx format are used. If the delimiter is not specified, the MAC address in the xxxxxxxxxxxx format is used. **NOTE:** This option is available only when MAC authentication is enabled.	**Enterprise**, **Personal**, and **Open** security levels.
Uppercase support	Set to **Enabled** to allow the IAP to use uppercase letters in MAC address string for MAC authentication. **NOTE:** This option is available only if MAC authentication is enabled.	**Enterprise**, **Personal**, and **Open** security levels.

Table 23: *Configuration Parameters for WLAN Security Settings in an Employee or Voice Network*

Parameter	Description	Security Level
Upload Certificate	Click **Upload Certificate** and browse to upload a certificate file for the internal server. For more information on certificates, see Uploading Certificates on page 178.	**Enterprise**, **Personal**, and **Open** security levels
Fast Roaming	You can configure the following fast roaming options for the WLAN SSID: - **Opportunistic Key Caching**: You can enable **Opportunistic Key Caching** (OKC) when **WPA-2 Enterprise** and **Both (WPA2 & WPA)** encryption types are selected. If OKC is enabled, a cached pairwise master key (PMK) is used when the client roams to a new IAP. This allows faster roaming of clients without the need for a complete 802.1X authentication. - **802.11r**: Selecting this check box enables fast BSS transition. The Fast BSS Transition mechanism minimizes the delay when a client transitions from one BSS to another within the same cluster. This option is available only when WPA-2 Enterprise and WPA-2 personal encryption keys are selected. - **802.11k**: Selecting this check box enables 802.11k roaming on the SSID profile. The 802.11k protocol enables IAPs and clients to dynamically measure the available radio resources. When 802.11k is enabled, IAPs and clients send neighbor reports, beacon reports, and link measurement reports to each other. - **802.11v**: Selecting this check box enables the 802.11v-based BSS transition. 802.11v standard defines mechanisms for wireless network management enhancements and BSS transition management. It allows client devices to exchange information about the network topology and RF environment. The BSS transition management mechanism enables an IAP to request a voice client to transition to a specific IAP, or suggest a set of preferred IAPs to a voice client, due to network load balancing or BSS termination. It also helps the voice client identify the best IAP to transition to as they roam.	**Enterprise**, **Personal**, and **Open** security levels.

4. Click **Next** to configure access rules. For more information, see Configuring Access Rules for a WLAN SSID Profile on page 97.

In the CLI

To configure enterprise security settings for the Employee and Voice users:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# opmode {wpa2-aes|wpa-tkip,wpa2-aes|dynamic-wep}
(Instant AP)(SSID Profile <name>)# leap-use-session-key
(Instant AP)(SSID Profile <name>)# termination
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# external-server
(Instant AP)(SSID Profile <name>)# server-load-balancing
(Instant AP)(SSID Profile <name>)# blacklist
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# l2-auth-failthrough
(Instant AP)(SSID Profile <name>)# auth-survivability
(Instant AP)(SSID Profile <name>)# radius-accounting
```

```
(Instant AP)(SSID Profile <name>)# radius-accounting-mode {user-association|user-
authentication}
(Instant AP)(SSID Profile <name>)# radius-interim-accounting-interval <minutes>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# max-authentication-failures <number>
(Instant AP)(SSID Profile <name>)# no okc-disable
(Instant AP)(SSID Profile <name>)# dot11r
(Instant AP)(SSID Profile <name>)# dot11k
(Instant AP)(SSID Profile <name>)# dot11v
(Instant AP)(SSID Profile <name>)# exit
(Instant AP)(config)# auth-survivability cache-time-out
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure personal security settings for the Employee and Voice users:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# opmode {wpa2-psk-aes|wpa-tkip|wpa-psk-tkip|wpa-psk-
tkip,wpa2-psk-aes|static-wep}
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# external-server
(Instant AP)(SSID Profile <name>)# server-load-balancing
(Instant AP)(SSID Profile <name>)# blacklist
(Instant AP)(SSID Profile <name>)# max-authentication-failures <number>
(Instant AP)(SSID Profile <name>)# radius-accounting
(Instant AP)(SSID Profile <name>)# radius-accounting-mode {user-association|user-
authentication}
(Instant AP)(SSID Profile <name>)# radius-interim-accounting-interval <minutes>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure open security settings for Employee and Voice users of a WLAN SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# opmode opensystem
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# external-server
(Instant AP)(SSID Profile <name>)# server-load-balancing
(Instant AP)(SSID Profile <name>)# blacklist
(Instant AP)(SSID Profile <name>)# max-authentication-failures <number>
(Instant AP)(SSID Profile <name>)# radius-accounting
(Instant AP)(SSID Profile <name>)# radius-accounting-mode {user-association|user-
authentication}
(Instant AP)(SSID Profile <name>)# radius-interim-accounting-interval <minutes>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Configuring Access Rules for a WLAN SSID Profile

This section describes the procedure for configuring security settings for Employee and Voice networks only. For information on guest network configuration, see Captive Portal for Guest Access.

NOTE

If you are creating a new SSID profile, complete the WLAN settings and configure VLAN and security parameters, before defining access rules. For more information, see Configuring WLAN Settings for an SSID Profile on page 81, Configuring VLAN Settings for a WLAN SSID Profile on page 86, and Configuring Security Settings for a WLAN SSID Profile on page 89.

You can configure up to 128 access rules for an Employee, Voice , or Guest network using the Instant UI or the CLI.

In the Instant UI

To configure access rules for an Employee or Voice network:

1. In the **Access Rules** tab, set the slider to any of the following types of access control:
   - **Unrestricted**—Select this option to set unrestricted access to the network.
   - **Network-based**—Set the slider to **Network-based** to set common rules for all users in a network. The **Allow any to all destinations** access rule is enabled by default. This rule allows traffic to all destinations.

To define an access rule:

   a. Click **New**.
   b. Select appropriate options in the **New Rule** window.
   c. Click **OK**.

   - **Role-based**—Select this option to enable access based on user roles. For role-based access control:
     - Create a user role if required. For more information, see Configuring User Roles.
     - Create access rules for a specific user role. For more information, see Configuring ACL Rules for Network Services on page 181. You can also configure an access rule to enforce captive portal authentication for an SSID that is configured to use 802.1X authentication method. For more information, see Configuring Captive Portal Roles for an SSID on page 137.
     - Create a role assignment rule. For more information, see Configuring Derivation Rules on page 200.
2. Click **Finish**.

In the CLI

To configure access control rules for a WLAN SSID:

```
(Instant AP)(config)# wlan access-rule <name>
(Instant AP)(Access Rule <name>)# rule <dest> <mask> <match> {<protocol> <start-port> <end-
port> {permit|deny|src-nat [vlan <vlan_id>|tunnel]|dst-nat{<IP-address> <port>|<port>}}| app
<app> {permit|deny}| appcategory <appgrp>|webcategory <webgrp> {permit|deny}| webreputation
<webrep> [<option1....option9>]
(Instant AP)(Access Rule <name>)# end
(Instant AP)# commit apply
```

To configure access control rules based on the SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-by-ssid
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure role assignment rules:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role <attribute>{{equals|not-equals|starts-with|ends-
with|contains|matches-regular-expression}<operator><role>|value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure a pre-authentication role:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-pre-auth <role>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure machine and user authentication roles:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-machine-auth <machine_only> <user_only>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure unrestricted access:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-unrestricted
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Example

The following example configures access rules for the wireless network:

```
(Instant AP)(config)# wlan access-rule WirelessRule
(Instant AP)(Access Rule "WirelessRule")# rule 192.0.2.2 255.255.255.0 match 6 4343 4343 log
classify-media
(Instant AP)(Access Rule "WirelessRule")# rule any any match app deny throttle-downstream 256
throttle-up 256
(Instant AP)(Access Rule "WirelessRule")# rule any any match appcategory collaboration permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webcategory gambling deny
(Instant AP)(Access Rule "WirelessRule")# rule any any match webcategory training-and-tools
permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation well-known-sites
permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation safe-sites permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation benign-sites permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation suspicious-sites
deny
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation high-risk-sites
deny
(Instant AP)(Access Rule "WirelessRule")# end
(Instant AP)# commit apply
```

Configuring Per-AP SSID and Per-AP-VLAN Settings on a Wireless Profile

Starting from Instant 6.4.4.4-4.2.3.0, you can set the environment variables, **per_ap_ssid** and **per_ap_vlan** on a **wlan ssid-profile** by using the CLI. The **ssid-profile-essid** and **ssid-profile vlan** parameters must be enhanced to accept the **ssid** and **vlan** variables, respectively.

You can configure the **per-ap-ssid** and the **per-ap-vlan** settings for the **SSID** and **VLAN** profiles, respectively, by using the Instant CLI.

In the CLI

To configure the wlan ssid-profile:

```
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
```

To configure the per-ap-ssid variable:

```
(Instant AP)# per-ap-ssid <text>
```

To configure the per-ap-vlan variable:

```
(Instant AP)# per-ap-vlan <vlan>
```

To verify the per-ap-ssid and per-ap-vlan configurations:

```
(Instant AP)# show ap-env
Antenna Type:Internal
name:TechPubsAP
per_ap_ssid:PCCW
per_ap_vlan:vlan
lacp_mode:enable
```

NOTE

For information on configuring a native VLAN on a wired profile, see Configuring VLAN for a Wired Profile on page 108.

Configuring Fast Roaming for Wireless Clients

Instant supports the following features that enable fast roaming of clients:

- Opportunistic Key Caching
- Fast BSS Transition (802.11r Roaming)
- Radio Resource Management (802.11k)
- BSS Transition Management (802.11v)

Opportunistic Key Caching

Instant now supports opportunistic key caching (OKC)-based roaming. In OKC-based roaming, the IAP stores one pairwise master key (PMK) per client, which is derived from the last 802.1X authentication completed by the client in the network. The cached PMK is used when a client roams to a new IAP. This allows faster roaming of clients between the IAPs in a cluster, without requiring a complete 802.1X authentication.

NOTE

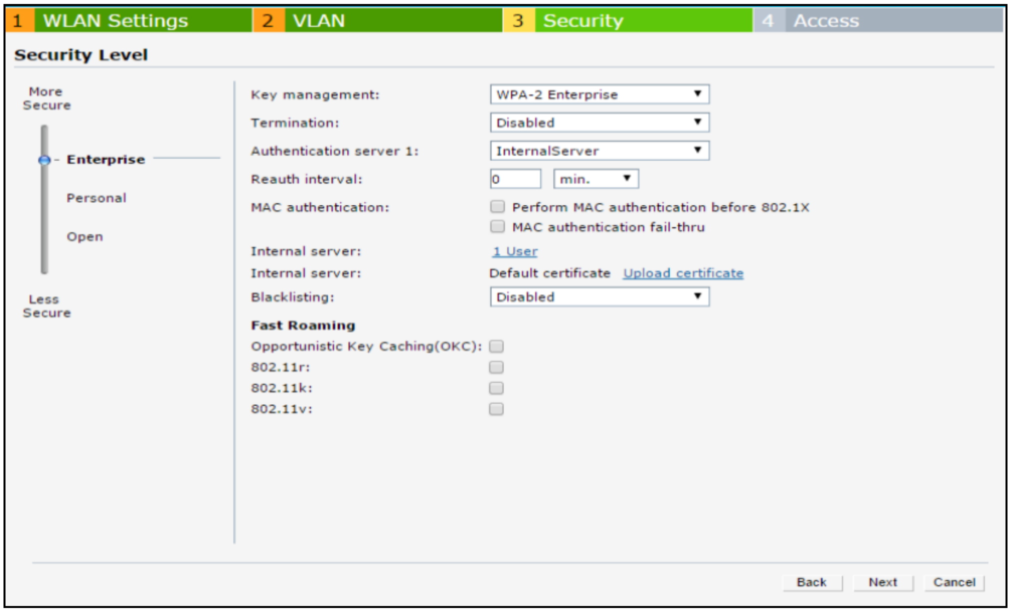
OKC roaming (when configured in the 802.1X Authentication profile) is supported on WPA-2 clients. If the wireless client (the 802.1X supplicant) does not support this feature, a complete 802.1X authentication is required whenever a client roams to a new IAP.

Configuring an IAP for OKC Roaming

You can enable OKC roaming for WLAN SSID by using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard (Go to **Network > New** OR Go to **Network > WLAN SSID** and click **edit**).
2. Click the **Security** tab.
3. Move the slider to the **Enterprise** security level. On selecting the Enterprise security level, the authentication options applicable to the Enterprise network are displayed.



Security Level

Key management: WPA-2 Enterprise

Termination: Disabled

Authentication server 1: InternalServer

Reauth interval: 0 min.

MAC authentication: □ Perform MAC authentication before 802.1X □ MAC authentication fail-thru

Internal server: 1 User

Internal server: Default certificate Upload certificate

Blacklisting: Disabled

Fast Roaming

Opportunistic Key Caching(OKC): □

802.11r: □

802.11k: □

802.11v: □

4. Select the **WPA-2 Enterprise** or **Both (WPA-2 & WPA)** option from the **Key management** drop-down list. When any of these encryption types is selected, **Opportunistic Key Caching** (OKC) is enabled by default.
5. Click **Next** and then click **Finish**.

In the CLI

To disable OKC roaming on a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile "<name>")# opmode {wpa2-aes|wpa-tkip,wpa-aes,wpa2-tkip,wpa2-aes}
(Instant AP)(SSID Profile "<name>")# okc-disable
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To enable OKC roaming on a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile "<name>")# opmode {wpa2-aes| wpa-tkip,wpa-aes,wpa2-tkip,wpa2-aes}
(Instant AP)(SSID Profile "<name>")# no okc-disable
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Fast BSS Transition (802.11r Roaming)

802.11r is a roaming standard defined by IEEE. When enabled, 802.11r reduces roaming delay by pre-authenticating clients with multiple target IAPs before a client roams to an IAP. With 802.11r implementation, clients pre-authenticate with multiple IAPs in a cluster.

As part of the 802.11r implementation, Instant supports the Fast BSS Transition protocol. The Fast BSS Transition mechanism reduces client roaming delay when a client transitions from one BSS to another within the same cluster. This minimizes the time required to resume data connectivity when a BSS transition happens.

NOTE

> Fast BSS Transition is operational only if the wireless client supports 802.11r standard. If the client does not support 802.11r standard, it falls back to the normal WPA-2 authentication method.

Configuring an IAP for 802.11r support

You can configure 802.11r support for a WLAN SSID by using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard (Go to **Network** > **New** OR Go to **Network** > **WLAN SSID** and click **edit**).
2. Click the **Security** tab.
3. Under **Fast Roaming**, select the **802.11r** check box.
4. Click **Next** and then click **Finish**.

In the CLI

To enable 802.11r roaming on a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# dot11r
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan ssid-profile dot11r-profile
(Instant AP)(SSID Profile "dot11r-profile")# dot11r
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Radio Resource Management (802.11k)

The 802.11k standard provides mechanisms for IAPs and clients to dynamically measure the available radio resources and enables stations to query and manage their radio resources. In an 802.11k-enabled network, IAPs and clients can share radio and link measurement information, neighbor reports, and beacon reports with each other. This allows the WLAN network infrastructural elements and clients to assess resources and make optimal mobility decisions to ensure Quality of Service (QoS) and seamless continuity.

Instant supports the following radio resource management information elements with 802.11k support enabled:

- *Power Constraint IE*—The power constraint element contains the information necessary to allow a client to determine the local maximum transmit power in the current channel.
- *AP Channel Report IE*—The IAP channel report element contains a list of channels in a regulatory class where a client is likely to find an IAP, including the IAP transmitting the IAP channel report.
- *Radio Resource Management (RRM) Enabled Capabilities IE*—The RRM-enabled capabilities element signals support for radio measurements in a device. The clients use this IE to specify their radio measurement capabilities.
- *BSS Load Element*—The BSS load element contains information on the density of clients and traffic levels in the QBSS.
- *Transmit Power Control (TPC) Report IE*—The TPC IE contains transmit power and link margin information.
- *Quiet IE*: The Quiet IE defines an interval during which no transmission occurs in the current channel. This interval may be used to assist in making channel measurements without interference from other stations in the BSS.
- *Extended Capabilities IE*—The extended capabilities IE carries information about the capabilities of an IEEE 802.11 station.

Beacon Report Requests and Probe Responses

The beacon request frame is sent by an IAP to request a client to report the list of beacons detected by the client on all channels.

- The beacon request is sent using the radio measurement request action frame.
- It is sent only to those clients that have the capability to generate beacon reports. The clients indicate their capabilities through the *RRM enabled capabilities IE* sent in the association request frames.
- By default, the beacon request frames are sent at a periodicity of 60 seconds.

Configuring a WLAN SSID for 802.11k Support

You can enable 802.11k support on a WLAN SSID by using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard (Go to **Network > New** OR Go to **Network > WLAN SSID** and click **edit**).
2. Click the **Security** tab.
3. Under **Fast Roaming**, select the **802.11k** check box.
4. Click **Next** and then click **Finish**.

NOTE

To allow the IAP and clients to exchange neighbor reports, ensure that Client match is enabled through **RF > ARM > Client match > Enabled** in the UI or by executing the **client-match** command in the **arm** configuration subcommand mode.

In the CLI

To enable 802.11k profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# dot11k
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view the beacon report details:

```
(Instant AP)# show ap dot11k-beacon-report <mac>
```

To view the neighbor details:

```
(Instant AP)# show ap dot11k-nbrs
```

Example

```
(Instant AP)(config)# wlan ssid-profile dot11k-profile
(Instant AP)(SSID Profile "dot11k-profile")# dot11k
(Instant AP)(config)# end
(Instant AP)# commit apply
```

BSS Transition Management (802.11v)

The 802.11v standard provides Wireless Network Management enhancements to the IEEE 802.11 MAC and PHY. It extends radio measurements to define mechanisms for wireless network management of stations including BSS transition management.

IAPs support the generation of the BSS transition management request frames to the 802.11k clients when a suitable IAP is identified for a client through Client Match.

Configuring a WLAN SSID for 802.11v Support

You can enable 802.11v support on a WLAN SSID by using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard (Go to **Network > New** OR Go to **Network > WLAN SSID** and click **edit**).
2. Click the **Security** tab.
3. Under **Fast Roaming**, select the **802.11v** check box.
4. Click **Next** and then click **Finish**.

In the CLI

To enable 802.11v profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# dot11v
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan ssid-profile dot11v-profile
(Instant AP)(SSID Profile "dot11v-profile")# dot11v
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring Modulation Rates on a WLAN SSID

IAPs allow you to enable or disable modulation rates for a radio band; High Throughput (HT) Modulation and Coding Scheme (MCS) set; and Very High Throughput (VHT) MCS rates set, when configuring a WLAN SSID profile. For example, the 802.11g band supports the modulation rate including 1, 2, 5, 6, 9, 11, 12, 18, 24, 36, 48, 54 Mbps and 802.11a band supports a modulation rate set including 6, 9, 12, 18, 24, 36, 48, 54 Mbps.

The 802.11 radio profiles support basic modulation and transmission rates. The 802.11g basic modulation rates determine the 802.11b/g rates for the data that are advertised in beacon frames and probe response and 802.11g transmission rates determine the 802.11b/g rates at which the IAP can transmit data.

For 802.11n clients, you can now configure an HT MCS rate set so that the SSID does not broadcast the disabled MCS rates list.

For 802.11ac clients, only 10 MCS rates supported in the 802.11ac mode and IAPs use a combination of VHT MCSs and spatial streams to convey the supported MCS rates.

In the Instant 6.4.3.4-4.2.1.0 release, the modulation rates can be configured only through the IAP CLI.

To configure modulation rates:

```
(Instant AP)# config terminal
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
(Instant AP)(SSID Profile "<ssid_profile>")# a-basic-rates 6 9 12 18
(Instant AP)(SSID Profile "<ssid_profile>")# a-tx-rates 36 48 54
(Instant AP)(SSID Profile "<ssid_profile>")# supported-mcs-set 1,3,6,7
(Instant AP)(SSID Profile "<ssid_profile>")# vht-support-mcs-map 7, 9, 8
(Instant AP)(SSID Profile "<ssid_profile>")# end
(Instant AP)# commit apply
```

Multi-User-MIMO

The Multi-User Multiple-Input Multiple-Output (MU-MIMO) feature allows the 802.11ac Wave 2 IAPs to send multiple frames to multiple clients simultaneously over the same frequency spectrum. With MU-MIMO, IAPs can support simultaneous directional Radio Frequency (RF) links and up to four simultaneous full-rate Wi-Fi connections (For example, smart phone, tablet, laptop, multimedia player, or other client device).

The MU-MIMO feature is enabled by default on WLAN SSIDs to allow IAPs to use the MU beamformer bit in beacon frames to broadcast to clients. When disabled, the MU beamformer bit is set to unsupported.

Enabling or Disabling MU-MIMO

The MU-MIMO feature is enabled by default on WLAN SSIDs. To disable this feature:

```
(host)(config)# wlan ssid-profile <ssid_profile>
(host)(SSID Profile "<ssid_profile>")# vht-mu-txbf-disable
(host)(SSID Profile "<ssid_profile>")# end
(host)# commit apply
```

To re-enable MU-MIMO:

```
(host)(config)# wlan ssid-profile <ssid_profile>
(host)(SSID Profile "<ssid_profile>")# no vht-mu-txbf-disable
(host)(SSID Profile "<ssid_profile>")# end
(host)# commit apply
```

RTS/CTS Flow Control

The (Request to Send) RTS /(Clear to Send) CTS mechanism allows devices to reserve the RF medium and minimize the frame collisions introduced by hidden stations. When RTS is enabled, a higher number of retransmissions occurring on the WLAN triggers the RTS/CTS handshake and the transmitter station sends an RTS frame to the receiver station. The receiver station responds with a CTS frame. The RTS/CTS frames are sent only when the packet size exceeds the RTS threshold. By default, the RTS threshold is set to 2333 octets.

Configuring RTS/CTS Threshold

You can set the RTS/CTS threshold value within the range of 0–2347 octets. By default, the RTS/CTS threshold is set to 2333.

To configure the RTS/CTS threshold:

```
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
(Instant AP)(SSID Profile "<ssid_profile>")# rts-threshold <threshold>
(Instant AP)(SSID Profile "<ssid_profile>")# end
(Instant AP)# commit apply
```

To disable RTS/CTS, set the RTS threshold value to 0.

Management Frame Protection

Instant supports the IEEE 802.11w standard, also known as Management Frame Protection (MFP). MFP increases the security by providing data confidentiality of management frames. MFP uses 802.11i (Robust Security Network) framework that establishes encryption keys between the client and IAP.

To enable MFP on the IAP:

```
(Instant AP)(config)# wlan ssid-profile myAP
(Instant AP)(SSID Profile "myAP")# mfp-capable
(Instant AP)(SSID Profile "myAP")# mfp-required
(Instant AP)(SSID Profile "myAP")# end
(Instant AP)# commit apply
```

If the *mfp-required* parameter is enabled, the SSID supports only the clients that exhibit the MFP functionality.

If the *mfp-capable* parameter enabled, the SSID supports management frame protection (MFP) capable clients and non-MFP clients.

NOTE

The MFP configuration is a per-SSID configuration.

Disabling Short Preamble for Wireless Client

To improve the network performance and communication between the IAP and its clients, you can enable or disable the transmission and reception of short preamble frames. If the short preamble is optional for the wireless devices connecting to an SSID, you can disable short preamble through the IAP CLI. Short preamble is enabled by default.

To disable the short preamble:

```
(Instant AP)# config terminal
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
(Instant AP)(SSID Profile "<ssid_profile>")# short-preamble-disable
(Instant AP)(SSID Profile "<ssid_profile>")# end
(Instant AP)# commit apply
```

Editing Status of a WLAN SSID Profile

You can enable or disable an SSID profile in the Instant UI or the CLI.

In the Instant UI

To modify the status of a WLAN SSID profile:

1. On the **Network** tab, select the network that you want to edit. The **edit** link is displayed.
2. Click the **edit** link. The **Edit network** window is displayed.
3. Select or clear the **Disable SSID** check box to disable or enable the SSID. The SSID is enabled by default.
4. Click **Next** (or the tab name) to move to the next tab.
5. Click **Finish** to save the modifications.

In the CLI

To disable an SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# disable
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To enable an SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# enable
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Editing a WLAN SSID Profile

To edit a WLAN SSID profile:

1. On the **Network** tab, select the network that you want to edit. The **edit** link is displayed.
2. Click the **edit** link. The **Edit network** window is displayed.
3. Modify the settings as required. Click **Next** to move to the next tab.
4. Click **Finish** to save the changes.

Deleting a WLAN SSID Profile

To delete a WLAN SSID profile:

1. On the **Network** tab, click the network that you want to delete. A **x** link is displayed beside the network to be deleted.
2. Click **x**. A delete confirmation window is displayed.
3. Click **Delete Now**.

Chapter 11
Wired Profiles

This chapter describes the following procedures:

- Configuring a Wired Profile on page 107
- Assigning a Profile to Ethernet Ports on page 112
- Editing a Wired Profile on page 112
- Deleting a Wired Profile on page 113
- Link Aggregation Control Protocol on page 113
- Understanding Hierarchical Deployment on page 114

Configuring a Wired Profile

The Ethernet ports allow third-party devices such as VoIP phones or printers (which support only wired connections) to connect to the wireless network. You can also configure an Access Control List (ACL) for additional security on the Ethernet downlink.

The wired profile configuration for Employee network involves the following procedures:

1. Configuring Wired Settings on page 107
2. Configuring VLAN for a Wired Profile on page 108
3. Configuring Security Settings for a Wired Profile on page 109
4. Configuring Access Rules for a Wired Profile on page 110

For information on creating a wired profile for guest network, see Captive Portal for Guest Access.

Configuring Wired Settings

You can configure wired settings for a wired profile by using the Instant UI or the CLI.

In the Instant UI

1. Click the **Wired** link under **More** on the Instant main window. The **Wired** window is displayed.
2. Click **New** under **Wired Networks**. The **New Wired Network** window is displayed.
3. Click the **Wired Settings** tab and configure the following parameters:
   a. **Name**—Specify a name for the profile.
   b. **Primary Usage**—Select **Employee** or **Guest**.
   c. **Speed/Duplex**—Ensure that appropriate values are selected for **Speed/Duplex**. Contact your network administrator if you need to assign speed and duplex parameters.
   d. **POE**—Set **POE** to **Enabled** to enable Power over Ethernet.
   e. **Admin Status**—Ensure that an appropriate value is selected. The **Admin Status** indicates if the port is up or down.
4. Click **Show advanced options** and configure the following parameters as required:
   a. **Content Filtering**—To ensure that all DNS requests to non-corporate domains on this wired network are sent to OpenDNS, select **Enabled** for **Content Filtering**.
   b. **Uplink**—Select **Enabled** to configure uplink on this wired profile. If **Uplink** is set to **Enabled** and this network profile is assigned to a specific port, the port will be enabled as Uplink port. For more

information on assigning a wired network profile to a port, see Assigning a Profile to Ethernet Ports on page 112.

   c. **Spanning Tree**—Select the **Spanning Tree** check box to enable Spanning Tree Protocol (STP) on the wired profile. STP ensures that there are no loops in any bridged Ethernet network and operates on all downlink ports, regardless of forwarding mode. STP will not operate on the uplink port and is supported only on IAPs with three or more ports. By default, Spanning Tree is disabled on wired profiles.
   d. **Inactivity Timeout**—Specify the time out interval within the range of 60–86,400 seconds for inactive wired clients. The default interval is 1000 seconds.

5. Click **Next**. The **VLAN** tab details are displayed.
6. Configure VLAN for the wired profile. For more information, see Configuring VLAN for a Wired Profile on page 108.

In the CLI

To configure the settings for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type {<employee>|<guest>}
(Instant AP)(wired ap profile <name>)# speed {10|100|1000|auto}
(Instant AP)(wired ap profile <name>)# duplex {half|full|auto}
(Instant AP)(wired ap profile <name>)# no shutdown
(Instant AP)(wired ap profile <name>)# poe
(Instant AP)(wired ap profile <name>)# uplink-enable
(Instant AP)(wired ap profile <name>)# content-filtering
(Instant AP)(wired ap profile <name>)# spanning-tree
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring VLAN for a Wired Profile

NOTE

If you are creating a new wired profile, complete the Wired Settings procedure before configuring the VLAN settings. For more information, see Configuring Wired Settings on page 107.

You can configure VLAN using the Instant UI or the CLI.

In the Instant UI

To configure a VLAN:

1. In the **VLAN** tab, enter the following information.
   a. **Mode**—You can specify any of the following modes:
      - **Access**—Select this mode to allow the port to carry a single VLAN specified as the native VLAN.
      - **Trunk**—Select this mode to allow the port to carry packets for multiple VLANs specified as allowed VLANs.

   b. Specify any of the following values for **Client IP Assignment**:
      - **Virtual Controller Assigned**: Select this option to allow the VC to assign IP addresses to the wired clients. When the VC assignment is used, the source IP address is translated for all client traffic that goes through this interface. The VC can also assign a guest VLAN to a wired client.
      - **Network Assigned**: Select this option to allow the clients to receive an IP address from the network to which the VC is connected. On selecting this option, the **New** button to create a VLAN is displayed. Create a new VLAN if required.

   c. If the **Trunk** mode is selected:
      - Specify the VLAN in **Allowed VLAN**, enter a list of comma separated digits or ranges, for example, 1,2,5 or 1–4, or all. The Allowed VLAN refers to the VLANs carried by the port in Access mode.

  - If **Client IP Assignment** is set to **Network Assigned**, specify a value for **Native VLAN**. A VLAN that does not have a VLAN ID tag in the frames is referred to as Native VLAN. You can specify a value within the range of 1–4093.

  d. If the **Access** mode is selected:

  - If **Client IP Assignment** is set to **Virtual Controller Assigned**, proceed to step 2.
  - If **Client IP Assignment** is set to **Network Assigned**, specify a value for **Access VLAN** to indicate the VLAN carried by the port in the **Access** mode.

2. Click **Next**. The **Security** tab details are displayed.
3. Configure security settings for the wired profile. For more information, see Configuring Security Settings for a Wired Profile on page 109.

In the CLI

To configure VLAN settings for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# switchport-mode {trunk|access}
(Instant AP)(wired ap profile <name>)# allowed-vlan <vlan>
(Instant AP)(wired ap profile <name>)# native-vlan {<guest|1…4095>}
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To configure a new VLAN assignment rule:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-vlan <attribute>{equals|not-equals|starts-with|
ends-with|contains| matches-regular-expression} <operator> <VLAN-ID>|value-of}
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring Security Settings for a Wired Profile

NOTE

If you are creating a new wired profile, complete the Wired Settings and VLAN procedures before specifying the security settings. For more information, see Configuring Wired Settings on page 107 and Configuring VLAN Settings for a WLAN SSID Profile on page 86.

Configuring Security Settings for a Wired Employee Network

You can configure security parameters for the Employee network by using the Instant UI or the CLI.

In the Instant UI

To configure security parameters for the Employee network:

1. Configure the following parameters in the **Security** tab.

   - **Port type**—To support trusted ports in an IAP, select **Trusted**. When the Port type is trusted, MAC and 802.1X authentication parameters cannot be configured. The Port Type is **Untrusted** by default.

   In a trusted mode, IAPs will not create any user entry. A predefined ACL is applied to the trusted port in order to control the client traffic that needs to be source NATed.

   - **MAC authentication**—To enable MAC authentication, select **Enabled**. The MAC authentication is disabled by default.
   - **802.1X authentication**—To enable 802.1X authentication, select **Enabled**. The 802.1X authentication is disabled by default.
   - **MAC authentication fail-thru**—To enable authentication fail-thru, select **Enabled**. When this feature is enabled, 802.1X authentication is attempted when MAC authentication fails. The **MAC**

authentication fail-thru check box is displayed only when both **MAC authentication** and **802.1X authentication** are **Enabled**.

- Select any of the following options for **Authentication server 1**:
  - **New**—On selecting this option, an external RADIUS server must be configured to authenticate the users. For information on configuring an external server, see Configuring an External Server for Authentication on page 155.Authentication and User Management on page 142
  - **Internal server**— If an internal server is selected, add the clients that are required to authenticate with the internal RADIUS server. Click the **Users** link to add users. For information on adding a user, see Managing IAP Users on page 142.
- **Accounting**—Select any of the following options:
  - **Disabled**—Disables accounting.
  - **Use authentication servers**—When selected, the authentication servers configured for the wired profile are used for accounting purposes.
  - **Use separate servers**—Allows you to configure separate accounting servers.
  - **Accounting interval**—Allows you set an accounting interval within the range of 0–60 minutes for sending interim accounting information to the RADIUS server.
  - **Reauth interval**—Specify the interval at which all associated and authenticated clients must be reauthenticated.
- **Load balancing**—Set this to **Enabled** if you are using two RADIUS authentication servers, so that the load across the two RADIUS servers is balanced. For more information on the dynamic load balancing mechanism, see Dynamic Load Balancing between Two Authentication Servers on page 155.

2. Click **Next**. The **Access** tab details are displayed.

In the CLI

To configure security settings for an employee network:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# mac-authentication
(Instant AP)(wired ap profile <name>)# l2-auth-failthrough
(Instant AP)(wired ap profile <name>)# auth-server <name>
(Instant AP)(wired ap profile <name>)# server-load-balancing
(Instant AP)(wired ap profile <name>)# radius-accounting
(Instant AP)(wired ap profile <name>)# radius-accounting-mode {user-association|user-
authentication}
(Instant AP)(wired ap profile <name>)# radius-interim-accounting-interval <minutes>
(Instant AP)(wired ap profile <name>)# radius-reauth-interval <Minutes>
(Instant AP)(wired ap profile <name>)# trusted
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring Access Rules for a Wired Profile

The Ethernet ports allow third-party devices such as Voice over Internet Protocol (VoIP) phones or printers (that support only wired connections) to connect to the wireless network. You can also configure an Access Control List (ACL) for additional security on the Ethernet downlink.

NOTE

If you are creating a new wired profile, complete the Wired Settings and configure the VLAN and security parameters before defining access rules. For more information, see Configuring Wired Settings on page 107, Configuring VLAN for a Wired Profile on page 108, and Configuring Security Settings for a Wired Profile on page 109.

You can configure access rules by using the Instant UI or the CLI.

In the Instant UI

To configure access rules:

1. On the **Access** tab, configure the following access rule parameters.
   a. Select any of the following types of access control:
      - **Role-based**—Allows the users to obtain access based on the roles assigned to them.
      - **Unrestricted**—Allows the users to obtain unrestricted access on the port.
      - **Network-based**—Allows the users to be authenticated based on access rules specified for a network.

   b. If the **Role-based** access control is selected, perform the following steps:
      - Under **Roles**, select an existing role for which you want to apply the access rules, or click **New** and add the required role. The list of roles defined for all networks is displayed under **Roles**.

NOTE

The default role with the same name as the network is automatically defined for each network. The default roles cannot be modified or deleted.

- Select the access rule associated with a specific role and modify if required. To add a new access rule, click **New** in the **Access Rules** window. You can configure up to 64 access rules. For more information on configuring access rules, see Configuring ACL Rules for Network Services on page 181.
- Configure rules to assign roles for an authenticated client. You can also configure rules to derive VLANs for the wired network profile. For more information on role assignment rules and VLAN derivation rules, see Configuring Derivation Rules on page 200 and Configuring VLAN Derivation Rules on page 205.
- Select the **Assign pre-authentication role** check box to add a pre-authentication role that allows some access to the users before client authentication.
- Select the **Enforce Machine Authentication** check box, to configure access rights to clients based on whether the client device supports machine authentication. Select the **Machine auth only** and **User auth only** rules. Machine Authentication is only supported on Windows devices and devices such as iPads.

NOTE

If **Enforce Machine Authentication** is enabled, both the device and the user must be authenticated for the role assignment rule to apply.

2. Click **Finish**.

In the CLI

To configure access rules for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# access-rule-name <name>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To configure role assignment rules:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-role <attribute>{{equals|not-equal|starts-with|
ends-with|contains|matches-regular-expression}<operator> <role>|value-of}
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To configure a pre-authentication role:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-role-pre-auth <role>
```

```
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To configure machine and user authentication roles:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-role-machine-auth <machine_only> <user-only>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To configure unrestricted access:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-role-unrestricted
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Assigning a Profile to Ethernet Ports

You can assign profiles to Ethernet ports using the Instant UI or the CLI.

In the Instant UI

To assign profiles to Ethernet ports:

1. Click the **Wired** link under **More** on the Instant main window. The **Wired** window is displayed.
2. To assign an Ethernet downlink profile to Ethernet 0 port:
   a. Ensure that the wired bridging on the port is enabled. For more information, see Configuring Wired Bridging on Ethernet 0 for Mesh Point on page 341.
   b. Select and assign a profile from the **0/0** drop-down list.
   c. To assign a wired profile to Ethernet 0/1 port, select the profile from the **0/1** drop-down list.
   d. If the IAP supports E2, E3, and E4 ports, assign profiles to other Ethernet ports by selecting a profile from the **0/2**, **0/3**, and **0/4** drop-down lists.

In the CLI

To assign profiles to Ethernet ports:

```
(Instant AP)(config)# enet0-port-profile <name>
(Instant AP)(config)# enet1-port-profile <name>
(Instant AP)(config)# enet2-port-profile <name>
(Instant AP)(config)# enet3-port-profile <name>
(Instant AP)(config)# enet4-port-profile <name>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Editing a Wired Profile

To edit a wired profile:

1. Click the **Wired** link under **More** on the Instant main window. The **Wired** window is displayed.
2. In the **Wired** window, select the wired profile to modify.
3. Click **Edit**. The **Edit Wired Network** window is displayed.
4. Modify the required settings.
5. Click **Finish** to save the modifications.

Deleting a Wired Profile

To delete a wired profile:

1. Click the **Wired** link under **More** on the Instant main window. The **Wired** window is displayed.
2. In the **Wired** window, select the wired profile to delete.
3. Click **Delete**. The wired profile is deleted.

Link Aggregation Control Protocol

The IAP-220 Series access points and IAP-270 Series support the IEEE 802.11ac standard for high-performance WLAN. To support maximum traffic, port aggregation is required as it increases throughput and enhances reliability. To support port aggregation, Instant supports Link Aggregation Control Protocol (LACP) based on the IEEE 802.3ad standard. The 802.3ad standard for Ethernet aggregation uses LACP as a method to manage link configuration and balance traffic among aggregated ports.

LACP provides a standardized means for exchanging information with partner systems to form a dynamic link aggregation group. The LACP feature is automatically enabled during IAP boots and it dynamically detects the IAP if connected to a partner system with LACP capability, by checking if there is any LACP Protocol Data Unit (PDU) received on either Ethernet 0 or Ethernet 1 port.

If a switch in the cluster has the LACP capability, you can combine Ethernet 0 or Ethernet 1 interfaces into the link aggregation group to form a single logical interface (port-channel). Port-channels can be used to provide additional bandwidth or link redundancy between two devices. IAP supports link aggregation using either standard port-channel (configuration based) or Link Aggregation Control Protocol (protocol signaling based). You can deploy IAP-22x Series or IAP-27x Series access points with LACP configuration to benefit from the higher (greater than 1 Gbps) aggregate throughput capabilities of the two radios.

NOTE

The LACP feature is supported only on IAP-22x Series and IAP-27x Series access points.

Enabling Port-Channel on a Switch

To enable port-channel on an S3500 Mobility Access Switch:

1. Create a switching profile by running the following commands:

```
(Instant AP)(config)# interface-profile switching-profile <profile-name>
(Instant AP)(Switch Profile <profile-name>)# switchport-mode {trunk}
(Instant AP)(Switch Profile <profile-name>)# exit
```

2. Create a port-channel and associate the switching profile by running the following commands:

```
(Instant AP)(config)# interface port-channel <0-63>
(Instant AP)(config)# port-channel-members [<interface-list>|[add|delete]
(Instant AP)(config)# gigabitethernet <slot/module/port>]
(Instant AP)(config)# shutdown
(Instant AP)(config)# switching-profile <profile-name>
```

Verifying LACP Configuration on the IAP

There is no configuration required on the IAP for enabling LACP support. However, you can view the status of LACP on IAPs by using the following command:

```
(Instant AP)# show lacp status
AP LACP Status
--------------
```

```
Link Status  LACP Rate  Num Ports  Actor Key  Partner Key  Partner MAC
-----------  ---------  ---------  ---------  -----------  -----------
Up           slow       2          17         1            70:81:05:11:3e:80
Slave Interface Status
----------------------
Slave I/f Name  Permanent MAC Addr  Link Status  Member of LAG  Link Fail Count
--------------  ------------------  -----------  -------------  ---------------
eth0            6c:f3:7f:c6:76:6e   Up           Yes            0
eth1            6c:f3:7f:c6:76:6f   Up           Yes            0
Traffic Sent on Enet Ports
--------------------------
Radio Num  Enet 0 Tx Count  Enet 1 Tx Count
---------  ---------------  ---------------
0          0                0
1          0                0
non-wifi   2                17
```

Enabling Static LACP Configuration

When IAPs connect to switches which have the LACP capability, the LACP feature does not work as expected. To enable a static LACP configuration, new commands are introduced.

IAPs support the dynamic LACP configuration according to a peer switch. When the peer switch enables LACP configuration, the IAPs form the LACP. Users can enable, disable, and remove the static LACP configuration in the IAP. When the IAP boots up, it forms the LACP according to the static configuration.

NOTE

The static LACP mode is supported on IAP-225, IAP-275,and IAP-325 access points.

To enable the static LACP mode on IAPs:

```
(Instant AP)# lacp-mode enable
```

To disable the static LACP mode on IAPs:

```
(Instant AP)# lacp-mode disable
```

Verifying Static LACP Mode

To verify the static LACP configuration, execute the following command in the IAP CLI:

```
(Instant AP)# show ap-env
Antenna Type:Internal
name:TechPubsAP
per_ap_ssid:1234
per_ap_vlan:abc
lacp_mode:enable
```

Understanding Hierarchical Deployment

An IAP with more than one wired port) can be connected to the downlink wired port of another IAP (Ethernet X). An IAP with a single Ethernet port (like IAP-90 or IAP-100 Series access points) can be provisioned to use Ethernet bridging, so that Ethernet 0 port is converted to a downlink wired port.

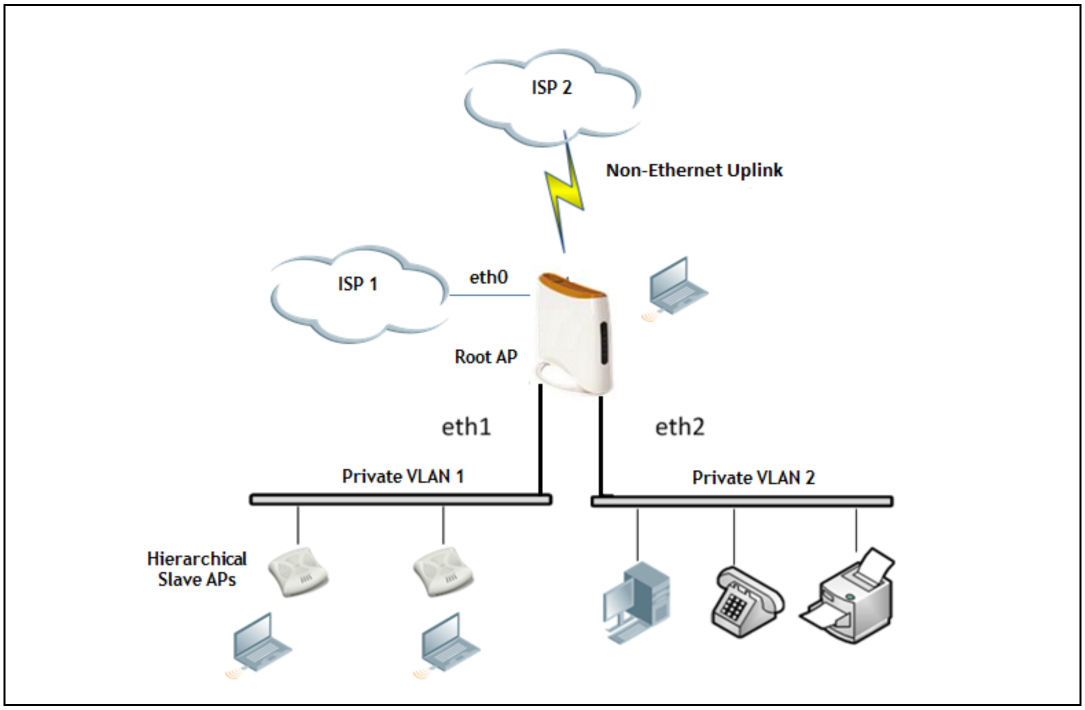
You can also form an IAP network by connecting the downlink port of an IAP to other IAPs. Only one IAP in the network uses its downlink port to connect to the other IAPs. This IAP (called the root IAP) acts as the wired device for the network, provides DHCP service and an L3 connection to the ISP uplink with NAT. The root IAP is always the master of the Instant network. In a single Ethernet port platform deployment, the root IAP must be configured to use the 3G uplink.

A typical hierarchical deployment consists of the following:

- A direct wired ISP connection or a wireless uplink.
- One or more DHCP pools for private VLANs.
- One downlink port configured on a private VLAN without authentication for connecting to slave IAPs. Ensure that the downlink port configured in a private VLAN is not used for any wired client connection. Other downlink ports can be used for connecting to the wired clients.

The following figure illustrates a hierarchical deployment scenario:

Figure 31 *Hierarchical Deployment*



This chapter provides the following information:

Understanding Captive Portal

Instant supports the captive portal authentication method, where a web page is presented to the guest users when they try to access the Internet from hotels, conference centers, or Wi-Fi hotspots. The web page also prompts the guest users to authenticate or accept the usage policy and terms. Captive portals are used at many Wi-Fi hotspots and can be used to control wired access as well.

The Instant captive portal solution consists of the following:

- The captive portal web login page hosted by an internal or external server.
- The RADIUS authentication or user authentication against IAP's internal database.
- The SSID broadcast by the IAP.

Using Instant, the administrators can create a wired or WLAN guest network based on captive portal authentication for guests, visitors, contractors, and any non-employee users who can use the enterprise Wi-Fi network. The administrators can also create guest accounts and customize the captive portal page with organization-specific logo, terms, and usage policy. With captive portal authentication and guest profiles, the devices that connect to the guest SSID are assigned IP addresses and an initial role. When a guest user tries to access a URL through HTTP or HTTPS, the captive portal web page prompting the user to authenticate with a username and password is displayed.

Types of Captive Portal

Instant supports the following types of captive portal authentication:

- **Internal captive portal**—For Internal captive portal authentication, an internal server is used for hosting the captive portal service. It supports the following types of authentication:
  - **Internal Authenticated**—When **Internal Authenticated** is enabled, a guest user must authenticate in the captive portal page to access the Internet. The guest users who are required to authenticate must already be added to the user database.
  - **Internal Acknowledged**—When **Internal Acknowledged** is enabled, a guest user must accept the terms and conditions to access the Internet.

- **External captive portal**—For external captive portal authentication, an external portal on the cloud or on a server outside the enterprise network is used.

Walled Garden

The administrators can also control the resources that the guest users can access and the amount of bandwidth or airtime they can use at any given time. When an external captive portal is used, the administrators can configure a walled garden, which determines access to the URLs requested by the guest users. For example, a hotel environment where the unauthenticated users are allowed to navigate to a designated login page (for example, a hotel website) and all its contents. The users who do not sign up for the Internet service can view only the "allowed" websites (typically hotel property websites).

The administrators can allow or block access to specific URLs by creating a whitelist and blacklist. When the users attempt to navigate to other websites, which are not in the whitelist of the walled garden profile, the users are redirected to the login page. If the requested URL is on the blacklist, it is blocked. If it appears on neither list, the request is redirected to the external captive portal.

Configuring a WLAN SSID for Guest Access

You can create an SSID for guest access by using the Instant UI or the CLI:

In the Instant UI

1. On the **Network** tab of the Instant main window, click the **New** link. The **New WLAN** window is displayed.
2. Enter a name that uniquely identifies a wireless network in the **Name (SSID)** text box.
3. Select the **Guest** option for **Primary usage**.
4. Click the **Show advanced options** link. The advanced options for configuration are displayed.
5. Enter the required values for the following configuration parameters:

Table 24: *WLAN Configuration Parameters*

Parameter	Description
Broadcast filtering	Select any of the following values: - **All**—When set to **All**, the IAP drops all broadcast and multicast frames except DHCP and ARP, IGMP group queries, and IPv6 neighbor discovery protocols. - **ARP**—When set to **ARP**, the IAP drops all broadcast and multicast frames except DHCP and ARP, IGMP group queries, and IPv6 neighbor discovery protocols and additionally converts ARP requests to unicast and send frames directly to the associated client. - **Unicast-ARP-Only** — When set to **Unicast-ARP-Only**, the IAP allows all broadcast and multicast frames as it is, however the ARP requests are converted to unicast frames and sends them to the associated clients. The broadcast filtering is set to **Unicast-ARP-Only** by default when an SSID profile is created. - **Disabled**— When set to **Disabled**, all broadcast and multicast traffic is forwarded to the wireless interfaces.
Multicast transmission optimization	Select **Enabled** if you want the IAP to select the optimal rate for sending broadcast and multicast frames based on the lowest of unicast rates across all associated clients. When this option is enabled, multicast traffic can be sent at up to 24 Mbps. The default rate for sending frames for 2.4 GHz is 1 Mbps and 5 GHz is 6 Mbps. This option is disabled by default.
Dynamic multicast optimization	Select **Enabled** to allow IAP to convert multicast streams into unicast streams over the wireless link. Enabling Dynamic Multicast Optimization (DMO) enhances the quality and reliability of streaming video, while preserving the bandwidth available to the non-video clients. **NOTE:** When you enable DMO on multicast SSID profiles, ensure that the DMO feature is enabled on all SSIDs configured in the same VLAN.
DMO channel utilization threshold	Specify a value to set a threshold for DMO channel utilization. With DMO, the IAP converts multicast streams into unicast streams as long as the channel utilization does not exceed this threshold. The default value is 90% and the maximum threshold value is 100%. When the threshold is reached or exceeds the maximum value, the IAP sends multicast traffic over the wireless link.
Transmit Rates	Specify the following parameters: - **2.4 GHz**—If the 2.4 GHz band is configured on the IAP, specify the minimum and maximum transmission rate. The default value for minimum transmission rate is 1 Mbps and maximum transmission rate is 54 Mbps. - **5 GHz**—If the 5 GHz band is configured on the IAP, specify the minimum and maximum transmission rate. The default value for minimum transmission rate is 6 Mbps and maximum transmission rate is 54 Mbps.
Band	Select a value to specify the band at which the network transmits radio signals. You can set the band to **2.4 GHz**, **5 GHz**, or **All**. The **All** option is selected by default.

Table 24: *WLAN Configuration Parameters*

Parameter	Description
DTIM interval	The **DTIM interval** indicates the delivery traffic indication message (DTIM) period in beacons, which can be configured for every WLAN SSID profile. The DTIM interval determines how often the IAP should deliver the buffered broadcast and multicast frames to associated clients in the powersave mode. The default value is 1, which means the client checks for buffered data on the IAP at every beacon. You can also configure a higher DTIM value for power saving.
Min RSSI probe request	Sets a minimum Received signal strength indication (RSSI) threshold for probe requests.
Min RSSI auth request	Sets a minimum RSSI threshold for authentication requests.
Very high throughput	Enables VHT function on IAP devices that support VHT. For 802.11acIAPs, the VHT function is enabled by default. However, you can disable the VHT function if you want the 802.11ac IAPs to function as 802.11n IAPs. If VHT is configured or disabled on an SSID, the changes will apply only to the SSID on which it is enabled or disabled.
Zone	Specify the zone for the SSID. When the zone is defined in SSID profile and if the same zone is defined on an IAP, the SSID is created on that IAP. For more information on configuring zone details, see Configuring Zone Settings on an IAP on page 66. The following constraints apply to the zone configuration: ● An IAP can belong to only one zone and only one zone can be configured on an SSID. ● If an SSID belongs to a zone, all IAPs in this zone can broadcast this SSID. If no IAP belongs to the zone configured on the SSID, the SSID is not broadcast. ● If an SSID does not belong to any zone, all IAPs can broadcast this SSID.
Time Range	Click **Edit**, select a Time Range Profile from the list and specify if the profile must be enabled or disabled for the SSID, and then click **OK**.
Bandwidth Limits	Under **Bandwidth Limits**: ● **Airtime**—Select this check box to specify an aggregate amount of airtime that all clients in this network can use for sending and receiving data. Specify the airtime percentage. ● **Each radio**—Select this check box to specify an aggregate amount of throughput that each radio is allowed to provide for the connected clients. ● **Downstream** and **Upstream**—Specify the downstream and upstream rates within a range of 1 to 65,535 Kbps for the SSID users. If the assignment is specific for each user, select the **Peruser** check box.
Wi-Fi Multimedia (WMM) traffic management	Configure the following options for WMM traffic management. WMM supports voice, video, best effort, and background access categories. To allocate bandwidth for the following types of traffic, specify a percentage value under **Share**. To configure DSCP mapping, specify a value under **DSCP Mapping**. ● **Background WMM**—For background traffic such as file downloads or print jobs. ● **Best effort WMM**—For best effort traffic such as traffic from legacy devices or traffic

Table 24: *WLAN Configuration Parameters*

Parameter	Description
	from applications or devices that do not support QoS. - **Video WMM**—For video traffic generated from video streaming. - **Voice WMM**— For voice traffic generated from the incoming and outgoing voice communication. For more information on WMM traffic and DSCP mapping, see Wi-Fi Multimedia Traffic Management on page 276
	For voice traffic and Spectralink Voice Prioritization, configure the following parameters: - **Traffic Specification (TSPEC)**—To prioritize time-sensitive traffic such as voice traffic initiated by the client, select the **Traffic Specification (TSPEC)** check box. - **TSPEC Bandwidth**—To reserve bandwidth, set the TPSEC bandwidth to the desired value within the range of 200–600,000 Kbps. The default value is 2000 Kbps. - **Spectralink Voice Protocol (SVP)**—Select the check box to prioritize voice traffic for SVP handsets.
Content filtering	Select **Enabled** to route all DNS requests for the non-corporate domains to OpenDNS on this network.
Inactivity timeout	Specify an interval for session timeout in seconds, minutes or hours. If a client session is inactive for the specified duration, the session expires and the users are required to log in again. You can specify a value within the range of 60-86,400 seconds or up to 24 hours for a client session. The default value is 1000 seconds.
Deauth Inactive Clients	Select **Enabled** to allow the IAP to send a deauthentication frame to the inactive client and clear client entry.
SSID	Select the **Hide** check box if you do not want the SSID (network name) to be visible to users. Select the **Disable** check box if you want to disable the SSID. On selecting this, the SSID will be disabled, but will not be removed from the network. By default, all SSIDs are enabled.
Out of service (OOS)	Enable or disable the SSID based on the following out-of-service states of the IAP: - VPN down - Uplink down - Internet down - Primary uplink down The network will be out of service when selected event occurs and the SSID is enabled or disabled as per the configuration settings applied. For example, if you select the VPN down option from the drop-down list and set the status to enabled, the SSID is enabled when the VPN connection is down and is disabled when the VPN connection is restored.
OOS time (global)	Configure a hold time interval in seconds within a range of 30 to 300 seconds, after which the out-of-service operation is triggered. For example, if the VPN is down and the configured hold time is 45 seconds, the effect of this out-of-service state impacts the SSID availability after 45 seconds.

Table 24: *WLAN Configuration Parameters*

Parameter	Description
Max clients threshold	Specify the maximum number of clients that can be configured for each BSSID on a WLAN. You can specify a value within the range of 0 to 255. The default value is 64.
SSID Encoding	To encode the SSID, select UTF8. By default, the SSIDs are not encoded.
Deny inter user bridging	When enabled, the bridging traffic between two clients connected to the same SSID on the same VLAN is disabled. The clients can connect to the Internet, but cannot communicate with each other, and the bridging traffic between the clients is sent to the upstream device to make the forwarding decision.
ESSID	Enter the ESSID. If the value defined for ESSID value is not the same as profile name, the SSIDs can be searched based on the ESSID value and not by its profile name.

6. Click **Next** to configure VLAN settings. The VLAN tab contents are displayed.
7. Select any for the following options for **Client IP assignment**:
   - **Virtual Controller assigned**—On selecting this option, the client obtains the IP address from the VC.
   - **Network assigned**—On selecting this option, the IP address is obtained from the network.
8. Based on the type client IP assignment mode selected, you can configure the VLAN assignment for clients as described in the following table:

Table 25: *IP and VLAN Assignment for WLAN SSID Clients*

Client IP Assignment	Client VLAN Assignment
Virtual Controller assigned	If the **Virtual Controller assigned** is selected for client IP assignment, the VC creates a private subnet and VLAN on the IAP for the wireless clients. The network address translation for all client traffic that goes out of this interface is carried out at the source. This setup eliminates the need for complex VLAN and IP address management for a multi-site wireless network. On selecting this option, the following client VLAN assignment options are displayed: ● **Default**: When selected, the default VLAN as determined by the VC is assigned for clients. ● **Custom**: When selected, you can specify a custom VLAN assignment option. You can select an existing DHCP scope for client IP and VLAN assignment or you can create a new DHCP scope by selecting **New**. For more information on DHCP scopes, see Configuring DHCP Scopes on page 210.
Network assigned	If the **Network assigned** is selected, you can specify any of the following options for the **Client VLAN assignment**. ● **Default**—On selecting this option, the client obtains the IP address in the same subnet as the IAPs. By default, the client VLAN is assigned to the native VLAN on the wired network. ● **Static**—On selecting this option, you need to specify a single VLAN, a comma separated list of VLANS, or a range of VLANs for all clients on this network. Select this option for configuring VLAN pooling. ● **Dynamic**—On selecting this option, you can assign the VLANs dynamically from a Dynamic Host Configuration Protocol (DHCP) server. To create VLAN assignment rules, click **New** to assign the user to a VLAN. In the **New VLAN Assignment Rule** window, enter the following information: ● **Attribute**—Select an attribute returned by the RADIUS server during authentication. ● **Operator**—Select an operator for matching the string. ● **String**—Enter the string to match ● **VLAN**—Enter the VLAN to be assigned.

9. Click **Next** to configure internal or external captive portal authentication, roles, and access rules for the guest users.

NOTE

If the client IP assignment mode is set to **Network assigned** in a guest SSID profile, the guest clients can log out of the captive portal network by accessing the https://securelogin.arubanetworks.com/auth/logout.html URL.

In the CLI

To configure WLAN settings for an SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# essid <ESSID-name>
(Instant AP)(SSID Profile <name>)# type <Guest>
(Instant AP)(SSID Profile <name>)# broadcast-filter <type>
(Instant AP)(SSID Profile <name>)# dtim-period <number-of-beacons>
(Instant AP)(SSID Profile <name>)# multicast-rate-optimization
(Instant AP)(SSID Profile <name>)# dynamic-multicast-optimization
(Instant AP)(SSID Profile <name>)# dmo-channel-utilization-threshold
```

```
(Instant AP)(SSID Profile <name>)# a-max-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# a-min-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# g-max-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# g-min-tx-rate <rate>
(Instant AP)(SSID Profile <name>)# zone <zone>
(Instant AP)(SSID Profile <name>)# bandwidth-limit <limit>
(Instant AP)(SSID Profile <name>)# per-user-bandwidth-limit <limit>
(Instant AP)(SSID Profile <name>)# air-time-limit <limit>
(Instant AP)(SSID Profile <name>)# wmm-background-share <percentage-of-traffic_share>
(Instant AP)(SSID Profile <name>)# wmm-best-effort-share<percentage-of-traffic-share>
(Instant AP)(SSID Profile <name>)# wmm-video-share <percentage-of-traffic_share>
(Instant AP)(SSID Profile <name>)# wmm-voice-share <percentage-of-traffic_share>
(Instant AP)(SSID Profile <name>)# rf-band {<2.4>|<5.0>|<all>}
(Instant AP)(SSID Profile <name>)# content-filtering
(Instant AP)(SSID Profile <name>)# hide-ssid
(Instant AP)(SSID Profile <name>)# inactivity-timeout <interval>
(Instant AP)(SSID Profile <name>)# local-probe-req-thresh <threshold>
(Instant AP)(SSID Profile <name>)# max-clients-threshold <number-of-clients>
```

To manually assign VLANs for WLAN SSID users:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# vlan <vlan-ID>
```

To create a new VLAN assignment rule:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-vlan <attribute>{equals|not-equals|starts-with|ends-
with|contains|matches-regular-expression} <operator> <VLAN-ID>|value-of}
```

Configuring Wired Profile for Guest Access

You can configure wired settings for a wired profile by using the Instant UI or the CLI.

In the Instant UI

1. Click the **Wired** link under **More** on the Instant main window. The **Wired** window is displayed.
2. Click **New** under **Wired Networks**. The **New Wired Network** window is displayed.
3. Click the **Wired Settings** tab and enter the following information:
   a. **Name**—Specify a name for the profile.
   b. **Primary Usage**—Select **Employee** or **Guest**.
   c. **Speed/Duplex**—Ensure that appropriate values are selected for **Speed/Duplex**. Contact your network administrator if you need to assign speed and duplex parameters.
   d. **POE**—Set **POE** to **Enabled** to enable Power over Ethernet.
   e. **Admin Status**—Ensure that an appropriate value is selected. The **Admin Status** indicates if the port is up or down.
   f. **Content Filtering**—To ensure that all DNS requests to non-corporate domains on this wired network are sent to OpenDNS, select **Enabled** for **Content Filtering**.
   g. **Uplink**—Select **Enabled** to configure uplink on this wired profile. If **Uplink** is set to **Enabled** and this network profile is assigned to a specific port, the port will be enabled as Uplink port. For more information on assigning a wired network profile to a port, see Assigning a Profile to Ethernet Ports on page 112.
   h. **Spanning Tree**—Select the **Spanning Tree** check box to enable Spanning Tree Protocol (STP) on the wired profile. STP ensures that there are no loops in any bridged Ethernet network and operates on all downlink ports, regardless of forwarding mode. STP will not operate on the uplink port and is supported only on IAPs with three or more ports. By default Spanning Tree is disabled on wired profiles.
4. Click **Next**. The VLAN tab details are displayed.

5. Enter the following information.
    a. **Mode**—You can specify any of the following modes:
        - **Access**—Select this mode to allow the port to carry a single VLAN specified as the native VLAN.
        - **Trunk**—Select this mode to allow the port to carry packets for multiple VLANs specified as allowed VLANs.
    b. Specify any of the following values for **Client IP Assignment**:
        - **Virtual Controller Assigned**: Select this option to allow the VC to assign IP addresses to the wired clients. When the VC assignment is used, the source IP address is translated for all client traffic that goes through this interface. The VC can also assign a guest VLAN to a wired client.
        - **Network Assigned**: Select this option to allow the clients to receive an IP address from the network to which the VC is connected. On selecting this option, the **New** button to create a VLAN is displayed. Create a new VLAN if required.
    c. If the **Trunk** mode is selected:
        - Specify the **Allowed VLAN**, enter a list of comma separated digits or ranges: for example, 1,2,5 or 1–4, or all. The Allowed VLAN refers to the VLANs carried by the port in Access mode.
        - If the **Client IP Assignment** is set to **Network Assigned**, specify a value for **Native VLAN**. A VLAN that does not have a VLAN ID tag in the frames is referred to as Native VLAN. You can specify a value within the range of 1–4093.
    d. If the **Access** mode is selected:
        - If the **Client IP Assignment** is set to **Virtual Controller Assigned**, proceed to step 2.
        - If the **Client IP Assignment** is set to **Network Assigned**, specify a value for **Access VLAN** to indicate the VLAN carried by the port in the **Access** mode.
6. Click **Next** to configure internal or external captive portal authentication, roles, and access rules for the guest users.

In the CLI

To configure the settings for the wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type <guest>
(Instant AP)(wired ap profile <name>)# speed {10|100|1000|auto}
(Instant AP)(wired ap profile <name>)# duplex {half|full|auto}
(Instant AP)(wired ap profile <name>)# no shutdown
(Instant AP)(wired ap profile <name>)# poe
(Instant AP)(wired ap profile <name>)# uplink-enable
(Instant AP)(wired ap profile <name>)# content-filtering
(Instant AP)(wired ap profile <name>)# spanning-tree
```

To configure VLAN settings for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# switchport-mode {trunk|access}
(Instant AP)(wired ap profile <name>)# allowed-vlan <vlan>
(Instant AP)(wired ap profile <name>)# native-vlan {<guest|1…4095>}
```

To configure a new VLAN assignment rule:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-vlan <attribute>{equals|not-equals|starts-
with|ends-with|contains|matches-regular-expression} <operator> <VLAN-ID>|value-of}
```

Configuring Internal Captive Portal for Guest Network

For internal captive portal authentication, an internal server is used for hosting the captive portal service. You can configure internal captive portal authentication when adding or editing a guest network created for wireless or wired profile through the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard or Wired window.
   - To configure internal captive portal authentication for a WLAN SSID, on the **Network** tab, click **New** to create a new network profile or **edit** to modify an existing profile.
   - To configure internal captive portal authentication for a wired profile, click **More > Wired**. In the **Wired** window, click **New** under **Wired Networks** to create a new network profile, or click **Edit** to select and modify an existing profile.
2. Click the **Security** tab and assign values for the configuration parameters:

Table 26: *Internal Captive Portal Configuration Parameters*

Parameter	Description
Splash page type	Select any of the following from the drop-down list. ● **Internal - Authenticated**—When **Internal Authenticated** is enabled, the guest users are required to authenticate in the captive portal page to access the Internet. The guest users who are required to authenticate must already be added to the user database. ● **Internal - Acknowledged**—When **Internal Acknowledged** is enabled, the guest users are required to accept the terms and conditions to access the Internet.
MAC authentication	Select **Enabled** from the **Mac Authentication** drop-down list to enable MAC authentication.
Delimiter character	Specify a character (for example, colon or dash) as a delimiter for the MAC address string. When configured, the IAP will use the delimiter in the MAC authentication request. For example, if you specify colon as the delimiter, MAC addresses in the xx:xx:xx:xx:xx:xx format are used. If the delimiter is not specified, the MAC address in the xxxxxxxxxxxx format is used. **NOTE:** This option is available only when MAC authentication is enabled.
Uppercase support	Set to **Enabled** to allow the IAP to use uppercase letters in MAC address string for MAC authentication. **NOTE:** This option is available only if MAC authentication is enabled.
WISPr (Applicable for WLAN SSIDs only.)	Select **Enabled** if you want to enable WISPr authentication. For more information on WISPr authentication, see Configuring WISPr Authentication on page 174. **NOTE:** The WISPr authentication is applicable only for Internal-Authenticated splash pages and is not applicable for wired profiles.
Auth server 1 Auth server 2	Select any one of the following: ● A server from the list of servers, if the server is already configured. ● **Internal Server** to authenticate user credentials at run time.

Table 26: *Internal Captive Portal Configuration Parameters*

Parameter	Description
	- Select **New** for configuring a new external RADIUS or LDAP server for authentication.
Load balancing	Select **Enabled** to enable load balancing if two authentication servers are used.
Reauth interval	Select a value to allow the IAPs to periodically reauthenticate all associated and authenticated clients.
Blacklisting (Applicable for WLAN SSIDs only.)	If you are configuring a wireless network profile, select **Enabled** to enable blacklisting of the clients with a specific number of authentication failures.
Accounting mode (Applicable for WLAN SSIDs only)	Select an accounting mode from the **Accounting mode** drop-down list for posting accounting information at the specified accounting interval. When the accounting mode is set to **Authentication**, the accounting starts only after client authentication is successful and stops when the client logs out of the network. If the accounting mode is set to **Association**, the accounting starts when the client associates to the network successfully and stops when the client is disconnected.

Table 26: *Internal Captive Portal Configuration Parameters*

Parameter	Description
Accounting interval	Configure an accounting interval in minutes within the range of 0–60, to allow IAPs to periodically post accounting information to the RADIUS server.
Encryption (Applicable for WLAN SSIDs only.)	Select **Enabled** to configure encryption parameters. Select an encryption and configure a passphrase.
Splash Page Design	Under **Splash Page Visuals**, use the editor to specify display text and colors for the initial page that will be displayed to the users when they connect to the network. The initial page asks for user credentials or email, depending on the splash page type (Internal - Authenticated or Internal - Acknowledged). To customize the splash page design, perform the following steps: ● To change the color of the splash page, click the **Splash page** rectangle and select the required color from the **Background Color** palette. ● To change the welcome text, click the first square box in the splash page, type the required text in the **Welcome** text box, and click **OK**. Ensure that the welcome text does not exceed 127 characters. ● To change the policy text, click the second square box in the splash page, type the required text in the **Policy** text box, and click **OK**. Ensure that the policy text does not exceed 255 characters. ● To upload a custom logo, click **Upload your own custom logo Image**, browse the image file, and click **upload image**. Ensure that the image file size does not exceed 16 KB. ● To redirect users to another URL, specify a URL in **Redirect URL**. ● Click **Preview** to preview the captive portal page. **NOTE:** You can customize the captive portal page using double-byte characters. Traditional Chinese, Simplified Chinese, and Korean are a few languages that use double-byte characters. Click the banner, term, or policy in the **Splash Page Visuals** to modify the text in the red box. These fields accept double-byte characters or a combination of English and double-byte characters.

3. Click **Next** to configure access rules.

In the CLI

To configure internal captive portal authentication:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# essid <ESSID-name>
(Instant AP)(SSID Profile <name>)# type <Guest>
(Instant AP)(SSID Profile <name>)# captive-portal <internal-authenticated> exclude-uplink
{3G|4G|Wifi|Ethernet}
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# auth-server <server1>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <Minutes>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure internal captive portal for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
```

```
(Instant AP)(wired ap profile <name>)# type <guest>
(Instant AP)(wired ap profile <name>)# captive-portal {<internal-authenticated>|<internal-
acknowledged>} exclude-uplink {3G|4G|Wifi|Ethernet}
(Instant AP)(wired ap profile <name>)# mac-authentication
(Instant AP)(wired ap profile <name>)# auth-server <server1>
(Instant AP)(wired ap profile <name>)# radius-reauth-interval <Minutes>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To customize internal captive portal splash page:

```
(Instant AP)(config)# wlan captive-portal
(Instant AP)(Captive Portal)# authenticated
(Instant AP)(Captive Portal)# background-color <color-indicator>
(Instant AP)(Captive Portal)# banner-color <color-indicator>
(Instant AP)(Captive Portal)# banner-text <text>
(Instant AP)(Captive Portal)# decoded-texts <text>
(Instant AP)(Captive Portal)# redirect-url <url>
(Instant AP)(Captive Portal)# terms-of-use <text>
(Instant AP)(Captive Portal)# use-policy <text>
(Instant AP)(Captive Portal)# end
(Instant AP)# commit apply
```

To upload a customized logo from a TFTP server to the IAP:

```
(Instant AP)# copy config tftp <ip-address> <filename> portal logo
```

Configuring External Captive Portal for a Guest Network

This section provides the following information:

- External Captive Portal Profiles on page 128
- Creating a Captive Portal Profile on page 128
- Configuring an SSID or Wired Profile to Use External Captive Portal Authentication on page 130
- External Captive Portal Redirect Parameters

External Captive Portal Profiles

You can now configure external captive portal profiles and associate these profiles to a user role or SSID. You can create a set of captive portal profiles in the **External Captive Portal** window (accessed from the **Security** tab) and associate these profiles with an SSID or a wired profile. You can also create a new captive portal profile on the **Security** tab of the WLAN wizard or a Wired Network window. In the current release, you can configure up to 16 external captive portal profiles.

When the captive portal profile is associated to an SSID, it is used before user authentication. If the profile is associated to a role, it is used only after the user authentication. When a captive portal profile is applied to an SSID or wired profile, the users connecting to the SSID or wired network are assigned a role with the captive portal rule. The guest user role allows only DNS and DHCP traffic between the client and the network, and directs all HTTP or HTTPS requests to the captive portal unless explicitly permitted to allow all types of traffic.

Creating a Captive Portal Profile

You can create a captive portal profile using the Instant UI or the CLI.

In the Instant UI

1. Go to **Security** > **External Captive Portal**.
2. Click **New**. The **New** popup window is displayed.
3. Specify values for the following parameters:

Table 27: *Captive Portal Profile Configuration Parameters*

Parameter	Description
Name	Enter a name for the profile.
Type	Select any one of the following types of authentication: ● **Radius Authentication**—Select this option to enable user authentication against a RADIUS server. ● **Authentication Text**—Select this option to specify an authentication text. The specified text will be returned by the external server after a successful user authentication.
IP or hostname	Enter the IP address or the host name of the external splash page server.
URL	Enter the URL for the external captive portal server.
Port	Enter the port number.
Use https (Available only if RADIUS Authentication is selected)	Select **Enabled** to enforce clients to use HTTPS to communicate with the captive portal server.
Captive Portal failure	Allows you to configure Internet access for the guest clients when the external captive portal server is not available. Select **Deny Internet** to prevent clients from using the network, or **Allow Internet** to allow the guest clients to access Internet when the external captive portal server is not available.
Automatic URL Whitelisting	Select **Enabled** to enable the automatic whitelisting of URLs. On selecting the check box for the external captive portal authentication, the URLs that are allowed for the unauthenticated users to access are automatically whitelisted. The automatic URL whitelisting is disabled by default.
Auth Text (Available only if Authentication Text is selected)	If the External Authentication splash page is selected, specify the authentication text to be returned by the external server after successful authentication.
Server Offload	Select **Enabled** to enable server offload. The server offload feature ensures that the non-browser client applications are not unnecessarily redirected to the external portal server and thereby reducing the load on the external captive portal server. The **Server Offload** option is **Disabled** by default.
Prevent frame overlay	When the **Prevent frame overlay** option is enabled, a frame can display a page only if it is in the same domain as the main page. This option is **Enabled** by default and can be used to prevent the overlay of frames.
Switch IP	Sends the IP address of the VC in the redirection URL when external captive portal servers are used. This option is disabled by default.
Redirect URL	Specify a redirect URL if you want to redirect the users to another URL.

In the CLI

To configure an external captive portal profile:

```
(Instant AP)(config)# wlan external-captive-portal [profile_name]
(Instant AP)(External Captive Portal)# server <server>
(Instant AP)(External Captive Portal)# port <port>
(Instant AP)(External Captive Portal)# url <url>
(Instant AP)(External Captive Portal)# https
(Instant AP)(External Captive Portal)# redirect-url <url>
(Instant AP)(External Captive Portal)# server-fail-through
(Instant AP)(External Captive Portal)# no auto-whitelist-disable
(Instant AP)(External Captive Portal)# server-offload
(Instant AP)(External Captive Portal)# switch-ip
(Instant AP)(External Captive Portal)# prevent-frame-overlay
(Instant AP)(External Captive Portal)# end
(Instant AP)# commit apply
```

Configuring an SSID or Wired Profile to Use External Captive Portal Authentication

You can configure external captive portal authentication when adding or editing a guest network profile using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard or Wired window.

- To configure external captive portal authentication for a WLAN SSID, on the **Network** tab, click **New** to create a new network profile or **edit** to modify an existing profile.
- To configure external captive portal authentication for a wired profile, Go to **More > Wired**. In the **Wired** window, click **New** under **Wired Networks** to create a new network, or click **Edit** to select an existing profile.

2. On the **Security** tab, select **External** from the **Splash page type** drop-down list.
3. From the **Captive Portal Profile** drop-down list, select a profile. You can select and modify a default profile, or an already existing profile, or click **New** and create a new profile.
4. Configure the following parameters based on the type of splash page you selected.

Table 28: *External Captive Portal Configuration Parameters*

Parameter	Description
Captive-portal proxy server	If required, configure a captive portal proxy server or a global proxy server to match your browser configuration by specifying the IP address and port number in the **Captive-portal proxy server** text box.
WISPr	Select **Enabled** if you want to enable WISPr authentication. For more information on WISPr authentication, see Configuring WISPr Authentication on page 174. **NOTE:** The WISPr authentication is applicable only for the **External** and **Internal-Authenticated** splash pages and is not applicable for wired profiles.
MAC authentication	Select **Enabled** if you want to enable MAC authentication. For information on MAC authentication, see Configuring MAC Authentication for a Network Profile on page 170.

Table 28: *External Captive Portal Configuration Parameters*

Parameter	Description
Delimiter character	Specify a character (for example, colon or dash) as a delimiter for the MAC address string. When configured, the IAP will use the delimiter in the MAC authentication request. For example, if you specify colon as the delimiter, MAC addresses in the xx:xx:xx:xx:xx:xx format are used. If the delimiter is not specified, the MAC address in the xxxxxxxxxxxx format is used. **NOTE:** This option is available only when MAC authentication is enabled.
Uppercase support	Set to **Enabled** to allow the IAP to use uppercase letters in MAC address string for MAC authentication. **NOTE:** This option is available only if MAC authentication is enabled.
Authentication server	To configure an authentication server, select any of the following options: ● If the server is already configured, select the server from the list. ● To create new external RADIUS server, select **New**. For more information, see Configuring an External Server for Authentication on page 155.
Reauth interval	Specify a value for the reauthentication interval at which the IAPs periodically reauthenticate all associated and authenticated clients.
Accounting mode	Select an accounting mode from the **Accounting mode** drop-down list for posting accounting information at the specified **Accounting interval**. When the accounting mode is set to **Authentication**, the accounting starts only after client authentication is successful and stops when the client logs out of the network. If the accounting mode is set to **Association**, the accounting starts when the client associates to the network successfully and stops when the client is disconnected.
Accounting interval	Configure an accounting interval in minutes within the range of 0–60, to allow IAPs to periodically post accounting information to the RADIUS server.
Blacklisting	If you are configuring a wireless network profile, select **Enabled** to enable blacklisting of the clients with a specific number of authentication failures.
Max authentication failures	If you are configuring a wireless network profile and **Blacklisting** is enabled, specify the maximum number of authentication failures after which users who fail to authenticate must be dynamically blacklisted.
Walled garden	Click the link to open the **Walled Garden** window. The walled garden configuration determines access to the websites. For more information, see Configuring Walled Garden Access on page 140.
Disable if uplink type is	Select the type of the uplink to exclude.
Encryption	Select Enabled to configure encryption settings and specify the encryption parameters.

5. Click **Next** to continue and then click **Finish** to apply the changes.

In the CLI

To configure security settings for guest users of the WLAN SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# essid <ESSID-name>
(Instant AP)(SSID Profile <name>)# type <Guest>
(Instant AP)(SSID Profile <name>)# captive-portal{<type>[exclude-uplink <types>]|external
[exclude-uplink <types>| profile <name>[exclude-uplink <types>]]}
(Instant AP)(SSID Profile <name>)# captive-portal-proxy-server <IP> <port>
(Instant AP)(SSID Profile <name>)# blacklist
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# max-authentication-failures <number>
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant Access Point (SSID Profile <name>)# radius-accounting
(Instant Access Point (SSID Profile <name>)# radius-interim-accounting-interval
(Instant Access Point (SSID Profile <name>)# radius-accounting-mode {user-association|user-
authentication}
(Instant AP)(SSID Profile <name>)# wpa-passphrase <WPA_key>
(Instant AP)(SSID Profile <name>)# wep-key <WEP-key> <WEP-index>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure security settings for guest users of the wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type <Guest>
(Instant AP)(wired ap profile <name>)# captive-portal{<type>[exclude-uplink <types>]|external
[exclude-uplink <types>| profile <name>[exclude-uplink <types>]]}
(Instant AP)(wired ap profile <name>)# mac-authentication
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

External Captive Portal Redirect Parameters

If the external captive portal redirection is enabled on a network profile, IAP sends an HTTP response with the redirect URL to display the splash page and enforce captive portal authentication by clients. The HTTP response from the IAP includes the following parameters:

Table 29: *External Captive Portal Redirect Parameters*

Parameter	Example Value	Description
cmd	login	Type of operation
mac	34:02:86:c6:d2:3e	Client MAC address
essid	guest-ecp-109	ESSID
ip	192.0.2.0	Client IP address
apname	9c:1c:12:cb:a2:90	IAP host name
apmac	9c:1c:12:cb:a2:90	IAP MAC address
vcname	instant-C8:1D:DA"	VC name
switchip	securelogin.arubanetworks.com	Captive portal domain used for external captive portal authentication
url	http://www.google.com/	original URL

Configuring External Captive Portal Authentication Using ClearPass Guest

You can configure Instant to point to ClearPass Guest as an external captive portal server. With this configuration, the user authentication is performed by matching a string in the server response and that in the RADIUS server (either ClearPass Guest or a different RADIUS server).

Creating a Web Login Page in ClearPass Guest

The ClearPass Guest Visitor Management Appliance provides a simple and personalized user interface through which operational staff can quickly and securely manage visitor network access. With ClearPass Guest, the users can have a controlled access to a dedicated visitor management user database. Through a customizable web portal, the administrators can easily create an account, reset a password, or set an expiry time for visitors. Visitors can be registered at reception and provisioned with an individual guest account that defines the visitor profile and the duration of their visit. By defining a web login page on the ClearPass Guest Visitor Management Appliance, you can to provide a customized graphical login page for visitors accessing the network.

For more information on setting up the RADIUS web login page, refer to the *RADIUS Services* section in the *ClearPass Guest Deployment Guide*.

Configuring RADIUS Server in Instant UI

To configure Instant to point to ClearPass Guest as an external captive portal server:

1. Select the WLAN SSID for which you want to enable external captive portal authentication with ClearPass Policy Manager. You can also configure the RADIUS server when configuring a new SSID profile.
2. On the **Security** tab, select **External** from the **Splash page type** drop-down list.
3. Select **New** from the **Captive portal profile** drop-down list and update the following:
   a. Enter the IP address of the ClearPass Guest server in the **IP or hostname** text box. Obtain the ClearPass Guest IP address from your system administrator.
   b. Enter **/page_name.php** in the **URL** text box. This URL must correspond to the **Page Name** configured in the ClearPass Guest RADIUS Web Login page. For example, if the Page Name is **Aruba**, the URL should be **/Aruba.php** in the Instant UI**.**
   c. Enter the **Port** number (generally should be **80**). The ClearPass Guest server uses this port for HTTP services.
   d. Click **OK**.
4. To create an external RADIUS server, select **New** from the **Authentication server 1** drop-down list. For information on authentication server configuration parameters, see Configuring an External Server for Authentication on page 155.
5. Click **Next** and then click **Finish**.
6. Click the updated SSID in the **Network** tab.
7. Open any browser and type any URL. Instant redirects the URL to ClearPass Guest login page.
8. Log in to the network with the username and password specified while configuring the RADIUS server.

Configuring RADIUS Attribute for ClearPass Policy Manager Server Load Balancing

Starting from Instant 6.4.3.4-4.2.1.0, the administrators can configure a RADIUS server IP address as one of the parameters on ClearPass Policy Manager server for external captive portal user authentication. Configuring a RADIUS server attribute for guest user authentication allows the administrators to balance the load on the ClearPass Policy Manager servers.

When the RADIUS server IP address is configured under **Extra Fields** in the ClearPass Guest login page, the RADIUS server IP parameter is submitted to the server as part of the HTTP or HTTPS POST data when the guest users initiate an HTTP or HTTPS request. The IAP intercepts this information to perform the actual RADIUS authentication with the server IP defined in the POST message. For more information on guest registration customization on ClearPass Guest, refer to the *ClearPass Guest User Guide*.

Configuring Facebook Login

Instant supports the Facebook Wi-Fi feature that allows the captive portal clients using a Facebook account to authenticate on an IAP. You can configure a guest network to use a customized Facebook page as an external captive portal URL and allow the IAP to redirect clients to a Facebook page when it receives an HTTP request. The users can select the appropriate option to authenticate and access the Internet. By configuring the Facebook login feature, businesses can pair their network with the Facebook Wi-Fi service, so that the users logging into Wi-Fi hotspots are presented with a business page, before gaining access to the network.

The Facebook Wi-Fi integration with the IAP includes the following procedures:

- Setting up a Facebook Page
- Configuring an SSID
- Configuring the Facebook Portal Page
- Accessing the Portal Page

Setting up a Facebook Page

To enable integration with the IAP, ensure that you have a Facebook page created as a local business with a valid location.

- For more information on creating a Facebook page, see the online help available at https://www.facebook.com/help.
- For more information on setting up and using Facebook Wi-Fi service, see https://www.facebook.com/help/126760650808045.

Configuring an SSID

You can a configure guest network profile and enable Facebook login through the Instant UI or the CLI.

In the Instant UI

To enable Facebook login:

1. Navigate to **Network > New** to create a new network profile.
2. Enter a name for the SSID.
3. Select **Guest** under **Primary usage**.
4. Configure other required parameters in the **WLAN Settings** and **VLAN** tabs.
5. On the **Security** tab, select **Facebook** from the **Splash page type** drop-down list.
6. Click **Next**. The **Access** tab contents are displayed.
7. Click **OK**. The SSID with the Facebook option is created. After the SSID is created, the IAP automatically registers with Facebook. If the IAP registration is successful, the **Facebook configuration** link is displayed in the **Security** tab of the WLAN wizard.

In the CLI

To configure an account for captive portal authentication:

```
(Instant AP)(config)# wlan ssid-profile <name>
```

```
(Instant AP)(SSID Profile <name>)# captive-portal {<type>[exclude-uplink <types>]|external
[exclude-uplink <types>|profile <name>[exclude-uplink <types>]]}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Example

The following example configures a Facebook account for captive portal authentication:

```
(Instant AP)(config)# wlan ssid-profile guestNetwork
(Instant AP)(SSID Profile "guestNetwork")# captive-portal facebook
(Instant AP)(SSID Profile "guestNetwork")# end
(Instant AP)# commit apply
```

Configuring the Facebook Portal Page

To bind the VC with the Facebook portal:

1. Open the SSID with the Facebook option enabled, navigate to the **Security** tab and click the **Facebook configuration** link. The Facebook page is displayed.

NOTE

The **Facebook configuration** link is displayed only if the IAP is successfully registered with Facebook.

2. Log in with your Facebook credentials. The **Facebook Wi-Fi Configuration** page is displayed.
3. Select the Facebook page.
4. Under **Bypass Mode**, select any of the following options:
   - **Skip Check-in link**—When selected, the users are not presented with your business Facebook page, but are allowed to access the Internet by clicking the **Skip Check-in** link.
   - **Require Wi-Fi code**—When selected, the users are assigned a Wi-Fi code to gain access to the Facebook page.
5. Customize the session length and terms of service if required.
6. Click **Save Settings**.

Accessing the Portal Page

To access the portal page:

1. Connect to the SSID with the Facebook option enabled.
2. Launch a web browser. The browser opens the Facebook Wi-Fi page. If the Wi-Fi-code based login is enabled, the users are prompted to enter the Wi-FI code. If the **Skip Check-in** link is displayed, click the link to skip checking in to the Facebook business page and proceed to access the Internet.
3. If you want to check in the business page, click **Check In** and provide your credentials. After checking in, click **Continue Browsing** to access the web page that was originally requested.

Configuring Guest Logon Role and Access Rules for Guest Users

For captive portal profile, you can create any the following types of roles:

- A pre-authenticated role—This role is assigned before the captive portal authentication. The user can only access certain destinations with this role.
- A guest role—This role is assigned after user authentication.
- A captive-portal role—This role can be assigned to any network such as Empolyee, Voice, or Guest. When the user is assigned with this role, a splash page is displayed after opening a browser and the users may need to authenticate.

You can configure up to 128 access rules for guest user roles through the Instant UI or the CLI.

In the Instant UI

To configure roles and access rules for the guest network:

1. On the **Access Rules** tab, set the slider to any of the following types of access control:
   - **Unrestricted**—Select this to set unrestricted access to the network.
   - **Network-based**—Set the slider to **Network-based** to set common rules for all users in a network. The **Allow any to all destinations** access rule is enabled by default. This rule allows traffic to all destinations. To define an access rule:

     a. Click **New**.

     b. Select appropriate options in the **New Rule** window.

     c. Click **OK**.
   - **Role-based**—Select **Role-based** to enable access based on user roles.

For role-based access control:

- Create a user role if required. For more information, see Configuring User Roles.
- Create access rules for a specific user role. For more information, see Configuring ACL Rules for Network Services on page 181. You can also configure an access rule to enforce captive portal authentication for an SSID with the 802.1X authentication method. For more information, see Configuring Captive Portal Roles for an SSID on page 137.
- Create a role assignment rule. For more information, see Configuring Derivation Rules on page 200. Instant supports role derivation based on the DHCP option for captive portal authentication. When the captive portal authentication is successful, a new user role is assigned to the guest users based on DHCP option configured for the SSID profile instead of the pre-authenticated role.

2. Click **Finish**.

In the CLI

To configure access control rules for a WLAN SSID:

```
(Instant AP)(config)# wlan access-rule <name>
(Instant AP)(Access Rule <name>)# rule <dest> <mask> <match> {<protocol> <start-port> <end-port> {permit|deny|src-nat|dst-nat{<IP-address> <port>|<port>}}| app <app> {permit|deny}|
appcategory <appgrp>|webcategory <webgrp> {permit|deny}|webreputation <webrep>
[<option1....option9>]
(Instant AP)(Access Rule <name>)# end
(Instant AP)# commit apply
```

To configure access control rules based on the SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-by-ssid
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure role assignment rules:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role <attribute>{{equals|not-equals|starts-with|ends-with|contains|matches-regular-expression}<operator><role>|value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure a pre-authentication role:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-pre-auth <role>
```

```
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure machine and user authentication roles:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-machine-auth <machine_only> <user_only>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure unrestricted access:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-unrestricted
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Example

The following example configures access rules for the wireless network:

```
(Instant AP)(config)# wlan access-rule WirelessRule
(Instant AP)(Access Rule "WirelessRule")# rule 192.0.2.2 255.255.255.0 match 6 4343 4343 log
classify-media
(Instant AP)(Access Rule "WirelessRule")# rule any any match app deny throttle-downstream 256
throttle-up 256
(Instant AP)(Access Rule "WirelessRule")# rule any any match appcategory collaboration permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webcategory gambling deny
(Instant AP)(Access Rule "WirelessRule")# rule any any match webcategory training-and-tools
permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation well-known-sites
permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation safe-sites permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation benign-sites permit
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation suspicious-sites
deny
(Instant AP)(Access Rule "WirelessRule")# rule any any match webreputation high-risk-sites
deny
(Instant AP)(Access Rule "WirelessRule")# end
(Instant AP)# commit apply
```

Configuring Captive Portal Roles for an SSID

You can configure an access rule to enforce captive portal authentication for SSIDs that use 802.1X authentication to authenticate clients. You can configure rules to provide access to external or internal captive portal, so that some of the clients using this SSID can derive the captive portal role.

The following conditions apply to the 802.1X and captive portal authentication configuration:

- If a user role does not have captive portal settings configured, the captive portal settings configured for an SSID are applied to the client's profile.
- If the SSID does not have captive portal settings configured, the captive portal settings configured for a user role are applied to the client's profile.
- If captive portal settings are configured for both SSID and user role, the captive portal settings configured for a user role are applied to the client's profile.

You can create a captive portal role for both **Internal** and **External** splash page types.

To enforce the captive portal role, use the Instant UI or the CLI.

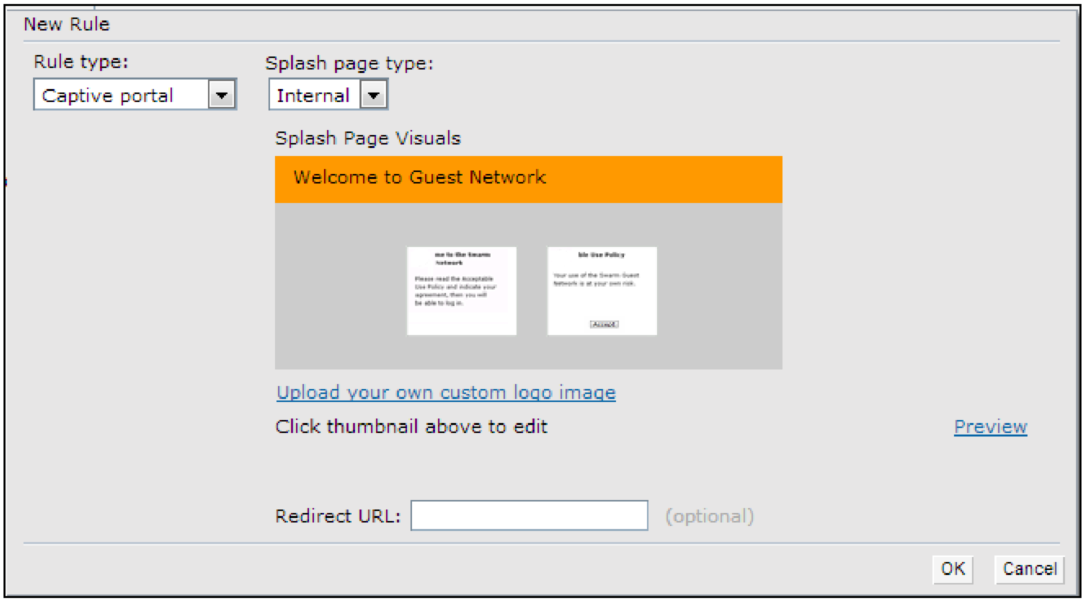
In the Instant UI

To create a captive portal role:

1. Select an SSID profile from the **Network** tab. The **Edit <WLAN-Profile>** window is displayed.

2. On the **Access** tab, move the slider to **Role-based** access control by using the scroll bar.
3. Select a role or create a new one if required.
4. Click **New** to add a new rule. The **New Rule** window is displayed.
5. In the **New Rule** window, specify the following parameters. The following figures show the parameters for captive portal role configuration:

Figure 32 *Captive Portal Rule for* ***Internal*** *Splash Page Type*



New Rule

Rule type: Captive portal

Splash page type: Internal

Splash Page Visuals

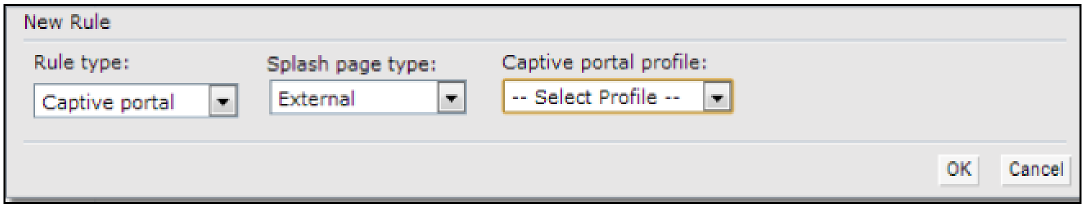
Welcome to Guest Network

Upload your own custom logo image

Click thumbnail above to edit

Redirect URL: (optional)

Figure 33 *Captive Portal Rule for* ***External*** *Splash Page Type*



New Rule

Rule type: Captive portal

Splash page type: External

Captive portal profile: -- Select Profile --

Table 30: *Captive Portal Rule Configuration Parameters*

Parameter	Description
Rule type	Select **Captive Portal** from the RuleType drop-down list.
Splash Page Type	Select any of the following attributes: ● Select **Internal** to configure a rule for internal captive portal authentication. ● Select **External** to configure a rule for external captive portal authentication.
Internal	If **Internal** is selected as splash page type, perform the following steps: ● Under **Splash Page Visuals**, use the editor to specify display text and colors for the initial page that would be displayed to users connecting to the network. The initial page asks for user credentials or email, depending on the splash page type configured. ● To change the color of the splash page, click the **Splash page** rectangle and select the required color from the **Background Color** palette.

Table 30: *Captive Portal Rule Configuration Parameters*

Parameter	Description
	- To change the welcome text, click the first square box in the splash page, type the required text in the **Welcome** text box, and then click **OK**. Ensure that the welcome text does not exceed 127 characters. - To change the policy text, click the second square box in the splash page, type the required text in the **Policy** text box, and click **OK**. Ensure that the policy text does not exceed 255 characters. - Specify the URL to which you want to redirect the guest users. - To upload a custom logo, click **Upload your own custom logo Image**, browse the image file, and click **upload image**. - To preview the captive portal page, click **Preview**.
External	If **External** is selected, perform the following steps: - Select a profile from the **Captive portal profile** drop-down list. - If you want to edit the profile, click **Edit** and update the following parameters: - **Type**—Select either **Radius Authentication** (to enable user authentication against a RADIUS server) or **Authentication Text** (to specify the authentication text to be returned by the external server after a successful user authentication). - **IP or hostname**— Enter the IP address or the host name of the external splash page server. - **URL**— Enter the URL for the external splash page server. - **Port**—Enter the port number. - **Redirect URL**—Specify a redirect URL if you want to redirect the users to another URL. - **Captive Portal failure**—The **Captive Portal failure** drop-down list allows you to configure Internet access for the guest clients when the external captive portal server is not available. Select **Deny Internet** to prevent clients from using the network, or **Allow Internet** to allow the guest clients to access Internet when the external captive portal server is not available. - **Automatic URL Whitelisting**—Select **Enabled** or **Disabled** to enable or disable automatic whitelisting of URLs. On selecting the check box for the external captive portal authentication, the URLs allowed for the unauthenticated users to access are automatically whitelisted. The automatic URL whitelisting is disabled by default. - **Auth Text**—Indicates the authentication text returned by the external server after a successful user authentication.

6. Click **OK**. The enforce captive portal rule is created and listed as an access rule.
7. Create a role assignment rule based on the user role to which the captive portal access rule is assigned.
8. Click **Finish**.

The client can connect to this SSID after authenticating with username and password. After a successful user login, the captive portal role is assigned to the client.

In the CLI

To create a captive portal role:

```
(Instant AP)(config)# wlan access-rule <Name>
(Instant AP)(Access Rule <Name>)# captive-portal {external [profile <name>]|internal}
(Instant AP)(Access Rule <Name>)# end
(Instant AP)# commit apply
```

Configuring Walled Garden Access

On the Internet, a walled garden typically controls access to web content and services. The walled garden access is required when an external captive portal is used. For example, a hotel environment where the unauthenticated users are allowed to navigate to a designated login page (for example, a hotel website) and all its contents.

The users who do not sign up for the Internet service can view the allowed websites (typically hotel property websites). The website names must be DNS-based and support the option to define wildcards. When a user attempts to navigate to other websites that are not in the whitelist of the walled garden profile, the user is redirected to the login page. IAP supports walled garden only for the HTTP requests. For example, if you add yahoo.com in walled garden whitelist and the client sends an HTTPS request (https://yahoo.com), the requested page is not displayed and the users are redirected to the captive portal login page.

In addition, a blacklisted walled garden profile can also be configured to explicitly block the unauthenticated users from accessing some websites.

You can create a walled garden access in Instant UI or the CLI.

In the Instant UI

To create a walled garden access:

1. Click the **Security** link at the top of the Instant main window. The **Security** window is displayed.
2. Click **Walled Garden**. The **Walled Garden** tab contents are displayed.
3. To allow the users to access a specific domain, click **New** and enter the domain name or URL in the **Whitelist** section of the window. This allows access to a domain while the user remains unauthenticated. Specify a POSIX regular expression (regex(7)). For example:
   - yahoo.com matches various domains such as news.yahoo.com, travel.yahoo.com and finance.yahoo.com
   - www.apple.com/library/test is a subset of www.apple.com site corresponding to path /library/test/*
   - favicon.ico allows access to /favicon.ico from all domains.
4. To deny users access to a domain, click **New** and enter the domain name or URL in the **Blacklist** section of the window. This prevents the unauthenticated users from viewing specific websites. When a URL specified in the blacklist is accessed by an unauthenticated user, IAP sends an HTTP 403 response to the client with an error message. If the requested URL does not appear on the blacklist or whitelist, the request is redirected to the external captive portal.
5. To modify the list, select the domain name/URL and click **Edit** . To remove an entry from the list, select the URL from the list and click **Delete**.
6. Click **OK** to apply the changes.

In the CLI

To create a walled garden access:

```
(Instant AP)(config)# wlan walled-garden
(Instant AP)(Walled Garden)# white-list <domain>
(Instant AP)(Walled Garden)# black-list <domain>
(Instant AP)(Walled Garden)# end
(Instant AP)# commit apply
```

Disabling Captive Portal Authentication

To disable captive portal authentication:

1. Select a wireless or wired profile. Depending on the network profile selected, the **Edit <WLAN-Profile>** or **Edit Wired Network** window is displayed.

NOTE

You can also customize splash page design on the **Security** tab of **New WLAN** (WLAN wizard) and **New Wired Network** (wired profile window) when configuring a new profile.

2. Navigate to the **Security** tab.
3. Select **None** from the **Splash page type** drop-down list. Although the splash page is disabled, you can enable MAC authentication, configure authentication servers, set accounting parameters, blacklist clients based on MAC authentication failures, and configure encryption keys for authorized access.
4. If required, configure the security parameters.
5. Click **Next** and then click **Finish** to apply the changes.

Chapter 13
Authentication and User Management

This chapter provides the following information:

Managing IAP Users

The IAP users can be classified as follows:

- Administrator—An admin user who creates SSIDs, wired profiles, and DHCP server configuration parameters; and manages the local user database. The admin users can access the VC Management UI.
- Guest administrator—A guest interface management user who manages guest users added in the local user database.
- Administrator with read-only access—The read-only admin user does not have access to the Instant CLI. The Instant UI will be displayed in the read-only mode for these users.
- Employee users—Employees who use the enterprise network for official tasks.
- Guest users—Visiting users who temporarily use the enterprise network to access the Internet.

The user access privileges are determined by IAP management settings in the AirWave Management client and Aruba Central, and the type of the user. The following table outlines the access privileges defined for the admin user, guest management interface admin, and read-only users.

Table 31: *User Privileges*

User Category	Aruba Central or AMP in Management Mode	IAP in Monitor Mode or without AMP or Aruba Central
administrator	Access to local user database only	Complete access to the IAP
read-only administrator	No write privileges	No write privileges
guest administrator	Access to local user database only	Access to local user database only

Configuring IAP Users

The Instant user database consists of a list of guest and employee users. The addition of a user involves specifying the login credentials for a user. The login credentials for these users are provided outside the Instant system.

A guest user can be a visitor who is temporarily using the enterprise network to access the Internet. However, if you do not want to allow access to the internal network and the Intranet, you can segregate the guest traffic from the enterprise traffic by creating a guest WLAN and specifying the required authentication, encryption, and access rules.

An employee user is the employee who is using the enterprise network for official tasks. You can create Employee WLANs, specify the required authentication, encryption and access rules, and allow the employees to use the enterprise network.

NOTE

The user database is also used when an IAP is configured as an internal RADIUS server.

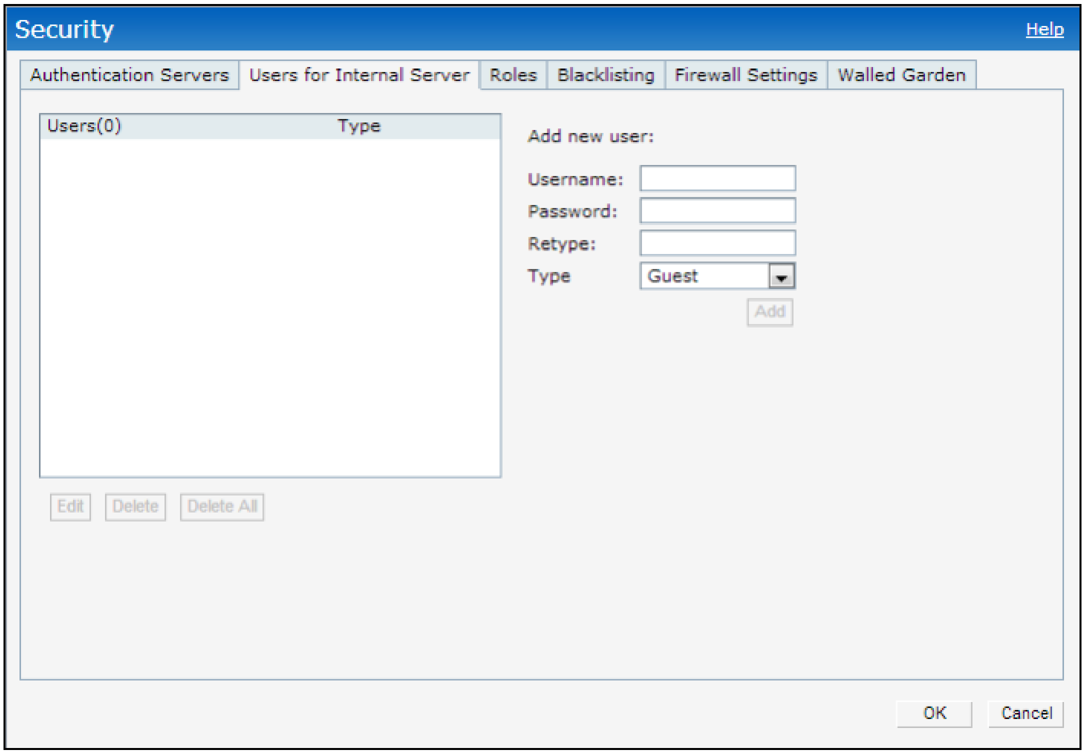
The local user database of IAPs can support up to 512 user entries.

In the Instant UI

To configure users:

1. Click the **Security** link located directly above the Search bar in the Instant main window.
2. Click **Users for Internal Server**. The following figure shows the contents of the **Users for Internal Server** tab.

Figure 34 *Adding a User*



Type Guest

3. Enter the user name in the **Username** text box.
4. Enter the password in the **Password** text box and reconfirm.
5. Select the type of network from the **Type** drop-down list.
6. Click **Add** and click **OK.** The users are listed in the **Users** list.

Edit or Delete User Settings

1. To edit user settings:
   a. Select the user you want to modify from the **Users** list in the table.
   b. Click **Edit** to modify user settings.
   c. Click **OK**.
2. To delete a user:
   a. Select the user you want to delete from the **Users** list in the table.
   b. Click **Delete**.
   c. Click **OK**.
3. To delete all or multiple users at a time:
   a. Select multiple users you want to delete from the **Users** list in the table.
   b. Click **Delete All**.
   c. Click **OK**.

NOTE

Deleting a user only removes the user record from the user database, and will not disconnect the online user associated with the user name.

In the CLI

To configure an employee user:

```
(Instant AP)(config)# user <username> <password> radius
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure a guest user:

```
(Instant AP)(config)# user <username> <password> portal
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring Authentication Parameters for Management Users

You can configure RADIUS or Terminal Access Controller Access Control System (TACACS) authentication servers to authenticate and authorize the management users of an IAP. The authentication servers determine if the user has access to administrative interface. The privilege level for different types of management users is defined on the RADIUS or TACACS server instead of the IAP. The IAPs map the management users to the corresponding privilege level and provide access to the users based on the attributes returned by the RADIUS or TACACS server.

You can configure authentication parameters for local admin, read-only, and guest management administrator account settings through the Instant UI or the CLI.

In the Instant UI

1. Navigate to **System > Admin**. The **Admin** tab details are displayed.

Table 32: *Authentication Parameters for Management Users*

Type of User	Authentication Options	Steps to Follow
Local administrator	Internal	Select **Internal** if you want to specify a single set of user credentials. If using an internal authentication server: 1. Specify the **Username** and **Password**. 2. Retype the password to confirm.
	Authentication server	Select the RADIUS or TACACS authentication servers. You can also create a new server by selecting **New** from the **Authentication server** drop-down list. - **Authentication server w/ fallback to internal**—Select **Authentication server w/ fallback to internal** option if you want to use both internal and external servers. When enabled, the authentication switches to **Internal** if there is no response from the RADIUS server (RADIUS server timeout). To use this option, select the authentication servers and configure the user credentials for internal-server-based authentication. - **Load balancing**—If two servers are configured, users can use them in the primary or backup mode, or load balancing mode. To enable load balancing, select **Enabled** from the **Load balancing** drop-down list. For more information on load balancing, see Dynamic Load Balancing between Two Authentication Servers on page 155. - **TACACS accounting**—If a TACACS server is selected, enable **TACACS accounting** to report management commands if required.
Administrator with Read-Only Access	Internal	Select **Internal** to specify a single set of user credentials. If using an internal authentication server: 1. Specify the **Username** and **Password**. 2. Retype the password to confirm.
	Authentication server	If a RADIUS or TACACS server is configured, select **Authentication server** for authentication.
Guest	Internal	Select **Internal** to specify a single set of user credentials. If using an internal authentication server: 1. Specify the **Username** and **Password**. 2. Retype the password to confirm.
	Authentication server	If a RADIUS or TACACS server is configured, select **Authentication server** for authentication.

3. Click **OK**.

In the CLI

To configure a local admin user:

```
(Instant AP)(config)# mgmt-user <username> [password]
```

To configure guest management administrator credentials:

```
(Instant AP)(config)# mgmt-user <username> [password] guest-mgmt
```

To configure a user with read-only privilege:

```
(Instant AP)(config)# mgmt-user <username> [password] read-only
```

To configure management authentication settings:

```
(Instant AP)(config)# mgmt-auth-server <server1>
(Instant AP)(config)# mgmt-auth-server <server2>
(Instant AP)(config)# mgmt-auth-server-load-balancing
(Instant AP)(config)# mgmt-auth-server-local-backup
```

To enable TACACS accounting:

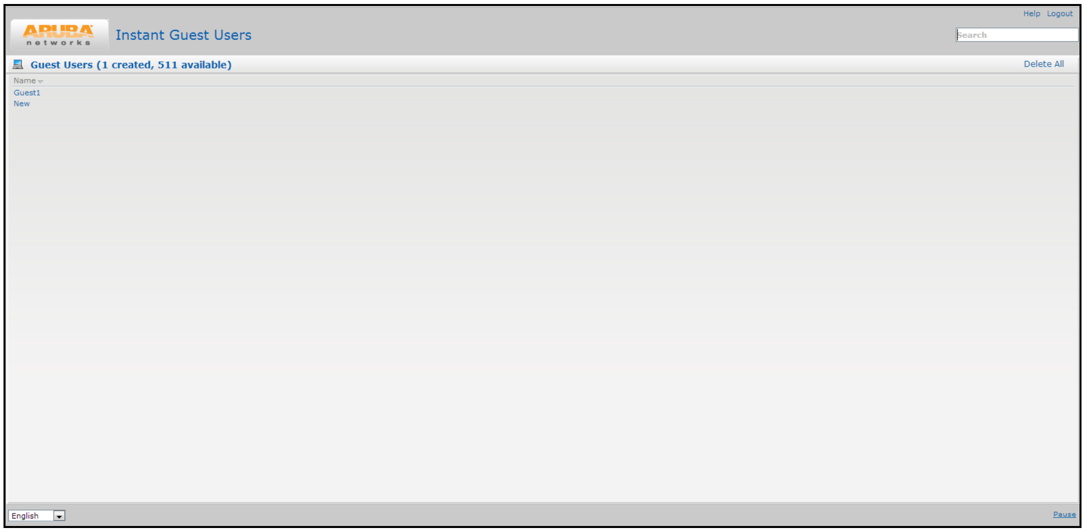
```
(Instant AP)(config)# mgmt-accounting command all
```

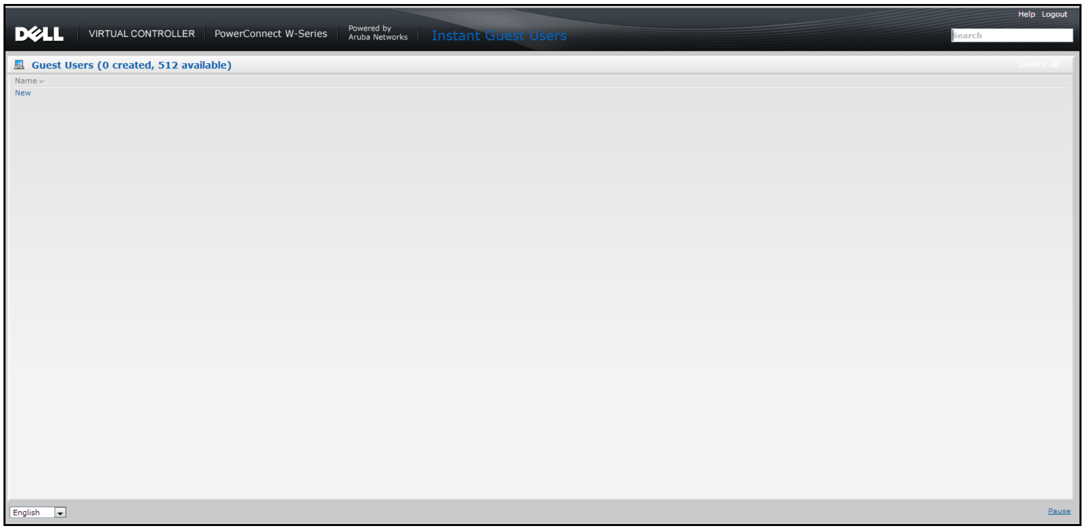
Adding Guest Users through the Guest Management Interface

To add guest users through the Guest Management interface:

1. Log in to the Instant UI with the guest management interface administrator credentials. The guest management interface is displayed.

Figure 35 *Guest Management Interface*





2. To add a user, click **New**. The **New Guest User** popup window is displayed.
3. Specify a **Username** and **Password**.
4. Retype the password to confirm.
5. Click **OK**.

Supported Authentication Methods

Authentication is a process of identifying a user through a valid username and password or based on the user's MAC addresses. The following authentication methods are supported in Instant:

- 802.1X Authentication
- MAC Authentication
- MAC Authentication with 802.1X Authentication
- Captive Portal Authentication
- MAC Authentication with Captive Portal Authentication
- 802.1X Authentication with Captive Portal Role
- WISPr Authentication

802.1X Authentication

802.1X is an IEEE standard that provides an authentication framework for WLANs. The 802.1X standard uses the Extensible Authentication Protocol (EAP) to exchange messages during the authentication process. The authentication protocols that operate inside the 802.1X framework include EAP-Transport Layer Security (EAP-TLS), Protected EAP (PEAP), and EAP-Tunneled TLS (EAP-TTLS). These protocols allow the network to authenticate the client while also allowing the client to authenticate the network. For more information on EAP authentication framework supported by the IAPs, see Supported EAP Authentication Frameworks on page 149.

The 802.1X authentication method allows an IAP to authenticate the identity of a user before providing network access to the user. The Remote Authentication Dial In User Service (RADIUS) protocol provides centralized authentication, authorization, and accounting management. For authentication purpose, the wireless client can associate to a network access server (NAS) or RADIUS client such as a wireless IAP. The wireless client can pass data traffic only after a successful 802.1X authentication.

For more information on configuring an IAP to use 802.1X authentication, see Configuring 802.1X Authentication for a Network Profile on page 167.

MAC Authentication

MAC authentication is used for authenticating devices based on their physical MAC addresses. MAC authentication requires that the MAC address of a machine matches a manually defined list of addresses. This authentication method is not recommended for scalable networks and the networks that require stringent security settings. For more information on configuring an IAP to use MAC authentication, see Configuring MAC Authentication for a Network Profile on page 170.

MAC Authentication with 802.1X Authentication

This authentication method has the following features:

- MAC authentication precedes 802.1X authentication—The administrators can enable MAC authentication for 802.1X authentication. MAC authentication shares all the authentication server configurations with 802.1X authentication. If a wireless or wired client connects to the network, MAC authentication is performed first. If MAC authentication fails, 802.1X authentication does not trigger. If MAC authentication is successful, 802.1X authentication is attempted. If 802.1X authentication is successful, the client is assigned an 802.1X authentication role. If 802.1X authentication fails, the client is assigned a **deny-all** role or **mac-auth-only** role.
- MAC authentication only role—Allows you to create a **mac-auth-only** role to allow role-based access rules when MAC authentication is enabled for 802.1X authentication. The **mac-auth-only** role is assigned to a client when the MAC authentication is successful and 802.1X authentication fails. If 802.1X authentication is successful, the **mac-auth-only** role is overwritten by the final role. The **mac-auth-only** role is primarily used for wired clients.
- L2 authentication fall-through—Allows you to enable the **l2-authentication-fallthrough** mode. When this option is enabled, the 802.1X authentication is allowed even if the MAC authentication fails. If this option is disabled, 802.1X authentication is not allowed. The **l2-authentication-fallthrough** mode is disabled by default.

  For more information on configuring an IAP to use MAC as well as 802.1X authentication, see Configuring MAC Authentication with 802.1X Authentication on page 172.

Captive Portal Authentication

Captive portal authentication is used for authenticating guest users. For more information on captive portal authentication, see Captive Portal for Guest Access on page 116.

MAC Authentication with Captive Portal Authentication

You can enforce MAC authentication for captive portal clients. For more information on configuring an IAP to use MAC authentication with captive portal authentication, see Configuring MAC Authentication with Captive Portal Authentication on page 173.

802.1X Authentication with Captive Portal Role

This authentication mechanism allows you to configure different captive portal settings for clients on the same SSID. For example, you can configure an 802.1X SSID and create a role for captive portal access, so that some of the clients using the SSID derive the captive portal role. You can configure rules to indicate access to external or internal captive portal, or none. For more information on configuring captive portal roles for an SSID with 802.1X authentication, see Configuring Captive Portal Roles for an SSID on page 137.

WISPr Authentication

Wireless Internet Service Provider roaming (WISPr) authentication allows the smart clients to authenticate on the network when they roam between wireless Internet service providers, even if the wireless hotspot uses an Internet Service Provider (ISP) with whom the client may not have an account.

If a hotspot is configured to use WISPr authentication in a specific ISP and a client attempts to access the Internet at that hotspot, the WISPr AAA server configured for the ISP authenticates the client directly and allows the client to access the network. If the client only has an account with a *partner* ISP, the WISPr AAA server forwards the client's credentials to the partner ISP's WISPr AAA server for authentication. When the client is authenticated on the partner ISP, it is also authenticated on the hotspot's own ISP as per their service agreements. The IAP assigns the default WISPr user role to the client when the client's ISP sends an authentication message to the IAP. For more information on WISPr authentication, see Configuring WISPr Authentication on page 174.

Supported EAP Authentication Frameworks

The following EAP authentication frameworks are supported in the Instant network:

- EAP-TLS—The Extensible Authentication Protocol-Transport Layer Security (EAP-TLS) method supports the termination of EAP-TLS security using the internal RADIUS server . The EAP-TLS requires both server and certification authority (CA) certificates installed on the IAP. The client certificate is verified on the VC (the client certificate must be signed by a known CA) before the username is verified on the authentication server.
- EAP-TTLS (MS-CHAPv2)—The Extensible Authentication Protocol-Tunneled Transport Layer Security (EAP-TTLS) method uses server-side certificates to set up authentication between clients and servers. However, the actual authentication is performed using passwords.
- EAP-PEAP (MS-CHAPv2)—EAP-PEAP is an 802.1X authentication method that uses server-side public key certificates to authenticate clients with server. The PEAP authentication creates an encrypted SSL/TLS tunnel between the client and the authentication server. Exchange of information is encrypted and stored in the tunnel ensuring the user credentials are kept secure.
- LEAP—Lightweight Extensible Authentication Protocol (LEAP) uses dynamic WEP keys for authentication between the client and authentication server.

To use the IAP's internal database for user authentication, add the usernames and passwords of the users to be authenticated.

NOTE

Aruba does not recommend the use of LEAP authentication, because it does not provide any resistance to network attacks.

Authentication Termination on IAP

IAPs support EAP termination for enterprise WLAN SSIDs. The EAP termination can reduce the number of exchange packets between the IAP and the authentication servers. Instant allows Extensible Authentication Protocol (EAP) termination for Protected Extensible Authentication Protocol-Generic Token Card (PEAP-GTC) and Protected Extensible Authentication Protocol-Microsoft Challenge Handshake Authentication Protocol version 2 (PEAP-MS-CHAV2). PEAP-GTC termination allows authorization against a Lightweight Directory Access Protocol (LDAP) server and external RADIUS server while PEAP-MS-CHAV2 allows authorization against an external RADIUS server.

This allows the users to run PEAP-GTC termination with their username and password to a local Microsoft Active Directory (MAD) server with LDAP authentication.

- EAP-Generic Token Card (GTC)—This EAP method permits the transfer of unencrypted usernames and passwords from the client to the server. The main uses for EAP-GTC are procuring one-time token cards such as SecureID and using LDAP or RADIUS as the user authentication server. You can also enable caching of user credentials on the IAP to an external authentication server for user data backup.
- EAP-Microsoft Challenge Authentication Protocol version 2 (MS-CHAPv2)—This EAP method is widely supported by Microsoft clients. A RADIUS server must be used as the back-end authentication server.

Configuring Authentication Servers

This section describes the following procedures:

- Configuring an External Server for Authentication on page 155
- Enabling RADIUS Communication over TLS on page 160
- Configuring Dynamic RADIUS Proxy Parameters on page 162

Supported Authentication Servers

Based on the security requirements, you can configure internal or external authentication servers. This section describes the types of servers that can be configured for client authentication:

- Internal RADIUS Server on page 150
- External RADIUS Server on page 150
- Dynamic Load Balancing between Two Authentication Servers on page 155

Starting from Instant 6.4.0.2-4.1 release, you can configure TACACS+ server for authenticating management users. For more information on management users and TACACS+ server-based authentication, see Configuring Authentication Parameters for Management Users .

Internal RADIUS Server

Each IAP has an instance of free RADIUS server operating locally. When you enable the internal RADIUS server option for the network, the client on the IAP sends a RADIUS packet to the local IP address. The internal RADIUS server listens and replies to the RADIUS packet. Instant serves as a RADIUS server for 802.1X authentication. However, the internal RADIUS server can also be configured as a backup RADIUS server for an external RADIUS server.

External RADIUS Server

In the external RADIUS server, the IP address of the VC is configured as the NAS IP address. Instant RADIUS is implemented on the VC and this eliminates the need to configure multiple NAS clients for every IAP on the RADIUS server for client authentication. Instant RADIUS dynamically forwards all the authentication requests from a NAS to a remote RADIUS server. The RADIUS server responds to the authentication request with an **Access-Accept** or **Access-Reject** message, and the clients are allowed or denied access to the network depending on the response from the RADIUS server. When you enable an external RADIUS server for the network, the client on the IAP sends a RADIUS packet to the local IP address. The external RADIUS server then responds to the RADIUS packet.

Instant supports the following external authentication servers:

- RADIUS
- LDAP
- ClearPass Policy Manager Server for AirGroup CoA

To use an LDAP server for user authentication, configure the LDAP server on the VC, and configure user IDs and passwords. To use a RADIUS server for user authentication, configure the RADIUS server on the VC.

RADIUS Server Authentication with VSA

An external RADIUS server authenticates network users and returns to the IAP the vendor-specific attribute (VSA) that contains the name of the network role for the user. The authenticated user is placed into the management role specified by the VSA.

Instant supports the following VSAs for user role and VLAN derivation rules:

- AP-Group
- AP-Name

- ARAP-Features
- ARAP-Security
- ARAP-Security-Data
- ARAP-Zone-Access
- Acct-Authentic
- Acct-Delay-Time
- Acct-Input-Gigawords
- Acct-Input-Octets
- Acct-Input-Packets
- Acct-Interim-Interval
- Acct-Link-Count
- Acct-Multi-Session-Id
- Acct-Output-Gigawords
- Acct-Output-Octets
- Acct-Output-Packets
- Acct-Session-Id
- Acct-Session-Time
- Acct-Status-Type
- Acct-Terminate-Cause
- Acct-Tunnel-Packets-Lost
- Add-Port-To-IP-Address
- Aruba-AP-Group
- Aruba-AP-IP-Address
- Aruba-AS-Credential-Hash
- Aruba-AS-User-Name
- Aruba-Admin-Path
- Aruba-Admin-Role
- Aruba-AirGroup-Device-Type
- Aruba-AirGroup-Shared-Group
- Aruba-AirGroup-Shared-Role
- Aruba-AirGroup-Shared-User
- Aruba-AirGroup-User-Name
- Aruba-AirGroup-Version
- Aruba-Auth-SurvMethod
- Aruba-Auth-Survivability
- Aruba-CPPM-Role
- Aruba-Calea-Server-Ip
- Aruba-Device-Type
- Aruba-Essid-Name
- Aruba-Framed-IPv6-Address
- Aruba-Location-Id
- Aruba-Mdps-Device-Iccid

- Aruba-Mdps-Device-Imei
- Aruba-Mdps-Device-Name
- Aruba-Mdps-Device-Product
- Aruba-Mdps-Device-Profile
- Aruba-Mdps-Device-Serial
- Aruba-Mdps-Device-Udid
- Aruba-Mdps-Device-Version
- Aruba-Mdps-Max-Devices
- Aruba-Mdps-Provisioning-Settings
- Aruba-Named-User-Vlan
- Aruba-Network-SSO-Token
- Aruba-No-DHCP-Fingerprint
- Aruba-Port-Bounce-Host
- Aruba-Port-Id
- Aruba-Priv-Admin-User
- Aruba-Template-User
- Aruba-User-Group
- Aruba-User-Role
- Aruba-User-Vlan
- Aruba-WorkSpace-App-Name
- Authentication-Sub-Type
- Authentication-Type
- CHAP-Challenge
- Callback-Id
- Callback-Number
- Chargeable-User-Identity
- Class
- Connect-Info
- Connect-Rate
- Crypt-Password
- DB-Entry-State
- Digest-Response
- Domain-Name
- EAP-Message
- Error-Cause
- Event-Timestamp
- Exec-Program
- Exec-Program-Wait
- Expiration
- Fall-Through
- Filter-Id
- Framed-AppleTalk-Link

- Framed-AppleTalk-Network
- Framed-AppleTalk-Zone
- Framed-Compression
- Framed-IP-Address
- Framed-IP-Netmask
- Framed-IPX-Network
- Framed-IPv6-Pool
- Framed-IPv6-Prefix
- Framed-IPv6-Route
- Framed-Interface-Id
- Framed-MTU
- Framed-Protocol
- Framed-Route
- Framed-Routing
- Full-Name
- Group
- Group-Name
- Hint
- Huntgroup-Name
- Idle-Timeout
- Location-Capable
- Location-Data
- Location-Information
- Login-IP-Host
- Login-IPv6-Host
- Login-LAT-Node
- Login-LAT-Port
- Login-LAT-Service
- Login-Service
- Login-TCP-Port
- Menu
- Message-Auth
- NAS-IPv6-Address
- NAS-Port-Type
- Operator-Name
- Password
- Password-Retry
- Port-Limit
- Prefix
- Prompt
- Rad-Authenticator
- Rad-Code

- Rad-Id
- Rad-Length
- Reply-Message
- Requested-Location-Info
- Revoke-Text
- Server-Group
- Server-Name
- Service-Type
- Session-Timeout
- Simultaneous-Use
- State
- Strip-User-Name
- Suffix
- Termination-Action
- Termination-Menu
- Tunnel-Assignment-Id
- Tunnel-Client-Auth-Id
- Tunnel-Client-Endpoint
- Tunnel-Connection-Id
- Tunnel-Medium-Type
- Tunnel-Preference
- Tunnel-Private-Group-Id
- Tunnel-Server-Auth-Id
- Tunnel-Server-Endpoint
- Tunnel-Type
- User-Category
- User-Name
- User-Vlan
- Vendor-Specific
- fw_mode
- dhcp-option
- dot1x-authentication-type
- mac-address
- mac-address-and-dhcp-options

TACACS Servers

You can now configure a TACACS server as the authentication server to authenticate and authorize all types of management users, and account user sessions. When configured, the TACACS server allows a remote access server to communicate with an authentication server to determine if the user has access to the network. The IAP users can create several TACACS server profiles and associate these profiles to the user accounts to enable authentication of the management users.

TACACS supports the following types of authentication:

- ASCII

- PAP
- CHAP
- ARAP
- MS-CHAP

NOTE The TACACS server cannot be attributed to any SSID or wired profile in general as the authentication server and is configured only for the IAP management users.

Dynamic Load Balancing between Two Authentication Servers

You can configure two authentication servers to serve as a primary and backup RADIUS server and enable load balancing between these servers. Load balancing of authentication servers ensures that the authentication load is split across multiple authentication servers and enables the IAPs to perform load balancing of authentication requests destined to authentication servers such as RADIUS or LDAP.

The load balancing in IAP is performed based on outstanding authentication sessions. If there are no outstanding sessions and if the rate of authentication is low, only primary server will be used. The secondary is used only if there are outstanding authentication sessions on the primary server. With this, the load balance can be performed across RADIUS servers of asymmetric capacity without the need to obtain inputs about the server capabilities from the administrators.

Configuring an External Server for Authentication

You can configure RADIUS, TACACS, LDAP, and ClearPass Policy Manager servers through the Instant UI or the CLI.

In the Instant UI

To configure an external authentication server:

1. Navigate to **Security** > **Authentication Servers**. The **Security** window is displayed.
2. To create a new server, click **New**. A window for specifying details for the new server is displayed.
3. Configure parameters based on the type of sever.

- **RADIUS**—To configure a RADIUS server, specify the attributes described in the following table:

Table 33: *RADIUS Server Configuration Parameters*

Parameter	Description
Name	Enter a name for the server.
Server address	Enter the host name or the IP address of the external RADIUS server.
RadSec	Set **RadSec** to **Enabled** to enable secure communication between the RADIUS server and IAP clients by creating a TLS tunnel between the IAP and the server. If **RadSec** is enabled, the following configuration options are displayed: ● **RadSec port**—Communication port number for RadSec TLS connection. By default, the port number is set to 2083. ● RFC 3576 ● RFC 5997 ● NAS IP address

Table 33: *RADIUS Server Configuration Parameters*

Parameter	Description
	- NAS identifier For more information on RadSec configuration, see Enabling RADIUS Communication over TLS on page 160.
Auth port	Enter the authorization port number of the external RADIUS server within the range of 1–65,535. The default port number is 1812.
Accounting port	Enter the accounting port number within the range of 1–65,535. This port is used for sending accounting records to the RADIUS server. The default port number is 1813.
Shared key	Enter a shared key for communicating with the external RADIUS server.
Retype key	Re-enter the shared key.
Timeout	Specify a timeout value in seconds. The value determines the timeout for one RADIUS request. The IAP retries to send the request several times (as configured in the **Retry count**) before the user gets disconnected. For example, if the **Timeout** is 5 seconds, **Retry counter** is 3, user is disconnected after 20 seconds. The default value is 5 seconds.
Retry count	Specify a number between 1 and 5. Indicates the maximum number of authentication requests that are sent to the server group, and the default value is 3 requests.
RFC 3576	Select **Enabled** to allow the IAPs to process RFC 3576-compliant Change of Authorization (CoA) and disconnect messages from the RADIUS server. Disconnect messages cause a user session to be terminated immediately, whereas the CoA messages modify session authorization attributes such as data filters.
RFC 5997	This helps to detect the server status of the RADIUS server. Every time there is an authentication or accounting request timeout, the IAP will send a status request enquiry to get the actual status of the RADIUS server before confirming the status of the server to be DOWN. - **Authentication**—Select this checkbox to ensure the IAP sends a status-server request to determine the actual state of the authentication server before marking the server as unavailable. - **Accounting**—Select this checkbox to ensure the IAP sends a status-server request to determine the actual state of the accounting server before marking the server as unavailable. **NOTE:** You can choose to select either the Authentication or Accounting checkboxes or select both checkboxes to support RFC5997.
NAS IP address	Allows you to configure an arbitrary IP address to be used as RADIUS attribute 4, NAS IP Address, without changing source IP Address in the IP header of the RADIUS packet. **NOTE:** If you do not enter the IP address, the VC IP address is used by default when **Dynamic RADIUS Proxy** is enabled.

Table 33: *RADIUS Server Configuration Parameters*

Parameter	Description
NAS Identifier	Allows you to configure strings for RADIUS attribute 32, NAS Identifier, to be sent with RADIUS requests to the RADIUS server.
Dead Time	Specify a dead time for authentication server in minutes. When two or more authentication servers are configured on the IAP and a server is unavailable, the dead time configuration determines the duration for which the authentication server would be available if the server is marked as unavailable.
Dynamic RADIUS proxy parameters	Specify the following dynamic RADIUS proxy (DRP) parameters: ● DRP IP—IP address to be used as source IP for RADIUS packets. ● DRP Mask—Subnet mask of the DRP IP address. ● DRP VLAN—VLAN in which the RADIUS packets are sent. ● DRP Gateway—Gateway IP address of the DRP VLAN. For more information on dynamic RADIUS proxy parameters and configuration procedure, see Configuring Dynamic RADIUS Proxy Parameters on page 162.

To assign the RADIUS authentication server to a network profile, select the newly added server when configuring security settings for a wireless or wired network profile.

NOTE

You can also add an external RADIUS server by selecting the **New** option when configuring a WLAN or wired profile. For more information, see Configuring Security Settings for a WLAN SSID Profile on page 89 and Configuring Security Settings for a Wired Profile on page 109.

- **LDAP**—To configure an LDAP server, select the **LDAP** option and configure the attributes described in the following table:

Table 34: *LDAP Server Configuration Parameters*

Parameter	Description
Name	Enter a name for the server.
IP address	Enter the IP address of the LDAP server.
Auth port	Enter the authorization port number of the LDAP server. The default port number is 389.
Admin-DN	Enter a distinguished name for the admin user with read/search privileges across all the entries in the LDAP database (the user need not have write privileges, but the user must be able to search the database, and read attributes of other users in the database).
Admin password	Enter a password for administrator.
Base-DN	Enter a distinguished name for the node that contains the entire user database.
Filter	Specify the filter to apply when searching for a user in the LDAP database. The default filter string is **(objectclass=*)**.

Table 34: *LDAP Server Configuration Parameters*

Parameter	Description
Key Attribute	Specify the attribute to use as a key while searching for the LDAP server. For Active Directory, the value is **sAMAccountName**
Timeout	Enter a value between 1 and 30 seconds. The default value is 5.
Retry count	Enter a value between 1 and 5. The default value is 3.
Dead Time	Specify a dead time for the authentication server in minutes within the range of 1–1440 minutes. The default dead time interval is 5 minutes. When two or more authentication servers are configured on the IAP and a server is unavailable, the dead time configuration determines the duration for which the authentication server would be available if the server is marked as unavailable.

- **TACACS**—To configure TACACS server, select the **TACACS** option and configure the following parameters:

Table 35: *TACACS Configuration Parameters*

Parameter	Description
Name	Enter a name for the server.
IP address	Enter the IP address of the TACACS server.
Auth Port	Enter a TCPIP port used by the server. The default port number is 49.
Shared Key	Enter a secret key of your choice to authenticate communication between the TACACS+ client and the server.
Retype Key	Re-enter the shared key.
Timeout	Enter a number between 1 and 30 seconds to indicate the timeout period for TACACS+ requests. The default value is 20 seconds.
Retry Count	Enter a number between 1 and 5 to indicate the maximum number of authentication attempts. The default value is 3.
Dead time	Specify a dead time in minutes within the range of 1–1440 minutes. The default dead time interval is 5 minutes.
Session authorization	Enables or disables session authorization. When enabled, the optional authorization session is turned on for the admin users. By default, session authorization is disabled.

NOTE

You can also add TACACS server by selecting the **New** option when configuring authentication parameters for management users. For more information, see Configuring Authentication Parameters for Management Users on page 144.

- **CPPM Server** for AirGroup CoA—To configure a ClearPass Policy Manager server used for AirGroup CoA (Change of Authorization), select the **CoA only** check box. The RADIUS server is automatically selected.

Table 36: *ClearPass Policy Manager Server Configuration Parameters for AirGroup CoA*

Parameter	Description
Name	Enter a name of the server.
Server address	Enter the host name or IP address of the server.
Air Group CoA port	Enter a port number for sending AirGroup CoA on a port different from the standard CoA port. The default value is 5999.
Shared key	Enter a shared key for communicating with the external RADIUS server.
Retype key	Re-enter the shared key.

4. Click **OK**.

NOTE

The ClearPass Policy Manager server acts as a RADIUS server and asynchronously provides the AirGroup parameters for the client device including shared user, role, and location.

In the CLI

To configure a RADIUS server with DRP parameters:

```
(Instant AP)(config)# wlan auth-server <profile-name>
(Instant AP)(Auth Server <profile-name>)# ip <host>
(Instant AP)(Auth Server <profile-name>)# key <key>
(Instant AP)(Auth Server <profile-name>)# port <port>
(Instant AP)(Auth Server <profile-name>)# acctport <port>
(Instant AP)(Auth Server <profile-name>)# nas-id <NAS-ID>
(Instant AP)(Auth Server <profile-name>)# nas-ip <NAS-IP-address>
(Instant AP)(Auth Server <profile-name>)# timeout <seconds>
(Instant AP)(Auth Server <profile-name>)# retry-count <number>
(Instant AP)(Auth Server <profile-name>)# rfc3576
(Instant AP)(Auth Server <profile-name>)# rfc5997 {auth-only|acct-only}
(Instant AP)(Auth Server <profile-name>)# deadtime <minutes>
(Instant AP)(Auth Server <profile-name>)# drp-ip <IP-address> <mask> vlan <vlan> gateway
<gateway-IP-address)
(Instant AP)(Auth Server <profile-name>)# end
(Instant AP)# commit apply
```

To enable RadSec:

```
(Instant AP)(config)# wlan auth-server <profile-name>
(Instant AP)(Auth Server "name")# ip <host>
(Instant AP)(Auth Server "name")# radsec [port <port>]
(Instant AP)(Auth Server "name")# rfc3576
(Instant AP)(Auth Server "name")# rfc5997 {auth-only|acct-only}
(Instant AP)(Auth Server "name")# nas-id <id>
(Instant AP)(Auth Server "name")# nas-ip <ip>
(Instant AP)(Auth Server "name")# end
(Instant AP)# commit apply
```

To configure an LDAP server:

```
(Instant AP)(config)# wlan ldap-server <profile-name>
(Instant AP)(LDAP Server <profile-name>)# ip <IP-address>
(Instant AP)(LDAP Server <profile-name>)# port <port>
(Instant AP)(LDAP Server <profile-name>)# admin-dn <name>
(Instant AP)(LDAP Server <profile-name>)# admin-password <password>
(Instant AP)(LDAP Server <profile-name>)# base-dn <name>
```

```
(Instant AP)(LDAP Server <profile-name>)# filter <filter>
(Instant AP)(LDAP Server <profile-name>)# key-attribute <key>
(Instant AP)(LDAP Server <profile-name>)# timeout <seconds>
(Instant AP)(LDAP Server <profile-name>)# retry-count <number>
(Instant AP)(LDAP Server <profile-name>)# deadtime <minutes>
(Instant AP)(LDAP Server <profile-name>)# end
(Instant AP)# commit apply
```

To configure a TACACS+ server:

```
(Instant AP)(config)# wlan tacacs-server <profile-name>
(Instant AP)(TACACS Server <profile-name>)# ip <IP-address>
(Instant AP)(TACACS Server <profile-name>)# port <port>
(Instant AP)(TACACS Server <profile-name>)# key <key>
(Instant AP)(TACACS Server <profile-name>)# timeout <seconds>
(Instant AP)(TACACS Server <profile-name>)# retry-count <number>
(Instant AP)(TACACS Server <profile-name>)# deadtime <minutes>
(Instant AP)(TACACS Server <profile-name>)# end
(Instant AP)# commit apply
```

To configure a ClearPass Policy Manager server used for AirGroup CoA:

```
(Instant AP)(config)# wlan auth-server <profile-name>
(Instant AP)(Auth Server <profile-name>)# ip <host>
(Instant AP)(Auth Server <profile-name>)# key <key>
(Instant AP)(Auth Server <profile-name>)# cppm-rfc3576-port <port>
(Instant AP)(Auth Server <profile-name>)# cppm-rfc3576-only
(Instant AP)(Auth Server <profile-name>)# end
(Instant AP)# commit apply
```

Enabling RADIUS Communication over TLS

You can configure an IAP to use Transport Layer Security (TLS) tunnel and to enable secure communication between the RADIUS server and IAP clients. Enabling RADIUS communication over TLS increases the level of security for authentication that is carried out across the cloud network. When configured, this feature ensures that RadSec protocol is used for safely transmitting the authentication and accounting data between the IAP clients and the RADIUS server in cloud.

The following configuration conditions apply to RadSec configuration:

- When the TLS tunnel is established, RADIUS packets will go through the tunnel and server adds CoA on this tunnel.
- By default, the TCP port 2083 is assigned for RadSec. Separate ports are not used for authentication, accounting, and dynamic authorization changes.
- Instant supports dynamic CoA (RFC 3576) over RadSec and the RADIUS server uses an existing TLS connection opened by the IAP to send the request.
- For authentication between the IAP clients and the TLS server, RadSec certificate must be uploaded to IAP. For more information on uploading certificates, see Uploading Certificates on page 178.

Configuring RadSec Protocol

You can configure RadSec Protocl using the Instant UI or the CLI;

In the Instant UI

To configure the RadSec protocol in the UI:

1. Navigate to **Security > Authentication Servers**. The **Security** window is displayed.
2. To create a new server, click **New**. A popup window for specifying details for the new server is displayed.
3. Under **RADIUS Server**, configure the following parameters:
   a. Enter the name of the server.

b. Enter the host name or the IP address of the server.

c. Select **Enabled** to enable RadSec.

d. Ensure that the port defined for RadSec is correct. By default, the port number is set to 2083.

e. To allow the IAPs to process RFC 3576-compliant Change of Authorization (CoA) and disconnect messages from the RADIUS server, set **RFC 3576** to **Enabled**. Disconnect messages cause a user session to be terminated immediately, whereas the CoA messages modify session authorization attributes such as data filters.

f. If **RFC 3576** is enabled, specify an AirGroup CoA port if required.

g. Enter the NAS IP address.

h. Specify the NAS identifier to configure strings for RADIUS attribute 32 and to send it with RADIUS requests to the RADIUS server.

4. Click **OK**.

In the CLI

To configure the RadSec protocol:

```
(Instant AP)(config)# wlan auth-server <profile-name>
(Instant AP)(Auth Server "name")# ip <host>
(Instant AP)(Auth Server "name")# radsec [port <port>]
(Instant AP)(Auth Server "name")# rfc3576
(Instant AP)(Auth Server "name")# nas-id <id>
(Instant AP)(Auth Server "name")# nas-ip <ip>
(Instant AP)(Auth Server "name")# end
(Instant AP)(Auth Server "name")# commit apply
```

Associate the Server Profile with a Network Profile

You can associate the server profile with a network profile using the Instant UI or the CLI.

In the Instant UI

To associate an authentication server in the Instant UI:

1. Access the WLAN wizard or the Wired Settings window.
   - To open the WLAN wizard, select an existing SSID on the **Network** tab, and click **edit**.
   - To open the wired settings window, click **More > Wired**. In the **Wired** window, select a profile and click **Edit**.

   You can also associate the authentication servers when creating a new WLAN or wired profile.
2. Click the **Security** tab and select a splash page profile.
3. Select an authentication type.
4. From the **Authentication Server 1** drop-down list, select the server name on which RadSec is enabled.
5. Click **Next** and then click **Finish**.

In the CLI

To associate an authentication server to a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# end
((Instant AP)# commit apply
```

To associate an authentication server to a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# auth-server <name>
(Instant AP)(wired ap profile <name>)# end
```

```
(Instant AP)# commit apply
```

Configuring Dynamic RADIUS Proxy Parameters

The RADIUS server can be deployed at different locations and VLANs. In most cases, a centralized RADIUS or local server is used to authenticate users. However, some user networks can use a local RADIUS server for employee authentication and a centralized RADIUS-based captive portal server for guest authentication. To ensure that the RADIUS traffic is routed to the required RADIUS server, the dynamic RADIUS proxy feature must be enabled.

NOTE

The dynamic RADIUS proxy parameters configuration is not required if RadSec is enabled in the RADIUS server profile.

If the IAP clients need to authenticate to the RADIUS servers through a different IP address and VLAN, ensure that the following steps are completed:

1. Enable dynamic RADIUS proxy.
2. Configure dynamic RADIUS proxy IP, VLAN, netmask, and gateway for each authentication server.
3. Associate the authentication servers to SSID or a wired profile to which the clients connect.

After completing the configuration steps mentioned above, you can authenticate the SSID users against the configured dynamic RADIUS proxy parameters.

Enabling Dynamic RADIUS Proxy

You can enable RADIUS server support using the Instant UI or the CLI.

In the Instant UI

To enable RADIUS server support:

1. In the Instant main window, click the **System** link. The **System** window is displayed.
2. On the **General** tab of the **System** window, select the **RADIUS** check box for **Dynamic Proxy**.
3. Click **OK**.

NOTE

When dynamic RADIUS proxy is enabled, the VC network uses the IP Address of the VC for communication with external RADIUS servers. Ensure that the VC IP Address is set as a NAS IP when configuring RADIUS server attributes with dynamic RADIUS proxy enabled. For more information on configuring RADIUS server attributes, see Configuring an External Server for Authentication on page 155.

In case of VPN deployments, the tunnel IP received when establishing a VPN connection is used as the NAS IP. In such cases, the VC IP need not be configured for the external RADIUS servers.

In the CLI

To enable the dynamic RADIUS proxy feature:

```
(Instant AP)(config)# dynamic-radius-proxy
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring Dynamic RADIUS Proxy Parameters

You can configure DRP parameters for the authentication server by using the Instant UI or the CLI.

In the Instant UI

To configure dynamic RADIUS proxy in the Instant UI:

1. Go to **Security > Authentication Servers**.

2. To create a new server, click **New** and configure the required RADIUS server parameters as described in Table 33.
3. Ensure that the following dynamic RADIUS proxy parameters are configured:
   - **DRP IP**—IP address to be used as source IP for RADIUS packets.
   - **DRP Mask**—Subnet mask of the DRP IP address.
   - **DRP VLAN**—VLAN in which the RADIUS packets are sent.
   - **DRP Gateway**—Gateway IP address of the DRP VLAN.
4. Click **OK**.

In the CLI

To configure dynamic RADIUS proxy parameters:

```
(Instant AP)(config)# wlan auth-server <profile-name>
(Instant AP)(Auth Server <profile-name>)# ip <IP-address>
(Instant AP)(Auth Server <profile-name>)# key <key>
(Instant AP)(Auth Server <profile-name>)# port <port>
(Instant AP)(Auth Server <profile-name>)# acctport <port>
(Instant AP)(Auth Server <profile-name>)# nas-id <NAS-ID>
(Instant AP)(Auth Server <profile-name>)# nas-ip <NAS-IP-address>
(Instant AP)(Auth Server <profile-name>)# timeout <seconds>
(Instant AP)(Auth Server <profile-name>)# retry-count <number>
(Instant AP)(Auth Server <profile-name>)# deadtime <minutes>
(Instant AP)(Auth Server <profile-name>)# drp-ip <IP-address> <mask> vlan <vlan> gateway
<gateway-IP-address>
(Instant AP)(Auth Server <profile-name>)# end
(Instant AP)# commit apply
```

Associate Server Profiles to a Network Profile

To associate the authentication server profiles with a network profile:

1. Access the WLAN wizard or the Wired Settings window.
   - To open the WLAN wizard, select an existing SSID on the **Network** tab, and click **edit**.
   - To open the wired settings window, click **More > Wired**. In the **Wired** window, select a profile and click **Edit**.

   You can also associate the authentication servers when creating a new WLAN or wired profile.
2. Click the **Security** tab.
3. If you are configuring the authentication server for a WLAN SSID, on the **Security** tab, move the slider to **Enterprise** security level.
4. Ensure that an authentication type is enabled.
5. From the **Authentication Server 1** drop-down list, select the server name on which dynamic RADIUS proxy parameters are enabled. You can also create a new server with RADIUS and RADIUS proxy parameters by selecting **New**.
6. Click **Next** and then click **Finish**.
7. To assign the RADIUS authentication server to a network profile, select the newly added server when configuring security settings for a wireless or wired network profile.

NOTE

You can also add an external RADIUS server by selecting New for Authentication Server when configuring a WLAN or wired profile. For more information, see Configuring Security Settings for a WLAN SSID Profile on page 89 and Configuring Security Settings for a Wired Profile on page 109.

In the CLI

To associate an authentication server to a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# end
((Instant AP)# commit apply
```

To associate an authentication server to a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# auth-server <name>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Understanding Encryption Types

Encryption is the process of converting data into a cryptic format or code when it is transmitted on a network. Encryption prevents unauthorized use of the data.

Instant supports the following types of encryption:

- **WEP**—Wired Equivalent Privacy (WEP) is an authentication method where all users share the same key. WEP is not as secure as other encryption types such as TKIP.
- **TKIP**—Temporal Key Integrity Protocol (TKIP) uses the same encryption algorithm as WEP. However, TKIP is more secure and has an additional message integrity check (MIC).
- **AES**—The Advanced Encryption Standard (AES) encryption algorithm is a widely supported encryption type for all wireless networks that contain any confidential data. AES in Wi-Fi leverages 802.1X or PSKs to generate per-station keys for all devices. AES provides a high level of security like IP Security (IPsec) clients.

NOTE

WEP and TKIP are limited to WLAN connection speed of 54 Mbps. The 802.11n connection supports only AES encryption. Aruba recommends AES encryption. Ensure that all devices that do not support AES are upgraded or replaced with the devices that support AES encryption.

WPA and WPA-2

WPA is created based on the draft of 802.11i, which allowed users to create more secure WLANs. WPA-2 encompasses the full implementation of the 802.11i standard. WPA-2 is a superset that encompasses the full WPA feature set.

The following table summarizes the differences between the two certifications:

Table 37: *WPA and WPA-2 Features*

Certification	Authentication	Encryption
WPA	• PSK • IEEE 802.1X with Extensible Authentication Protocol (EAP)	TKIP with message integrity check (MIC)
WPA-2	• PSK • IEEE 802.1X with EAP	AES—Counter Mode with Cipher Block Chaining Message Authentication Code (AESCCMP)

WPA and WPA-2 can be further classified as follows:

- **Personal**—Personal is also called Pre-Shared Key (PSK). In this type, a unique key is shared with each client in the network. Users have to use this key to securely log in to the network. The key remains the same until it is changed by authorized personnel. You can also configure key change intervals .
- **Enterprise**—Enterprise is more secure than WPA Personal. In this type, every client automatically receives a unique encryption key after securely logging in to the network. This key is automatically updated at regular intervals. WPA uses TKIP and WPA-2 uses the AES algorithm.

Recommended Authentication and Encryption Combinations

The following table summarizes the recommendations for authentication and encryption combinations for the Wi-Fi networks.

Table 38: *Recommended Authentication and Encryption Combinations*

Network Type	Authentication	Encryption
Employee	802.1X	AES
Guest Network	Captive portal	None
Voice Network or Handheld devices	802.1X or PSK as supported by the device	AES if possible, TKIP or WEP if necessary (combine with security settings assigned for a user role).

Configuring Authentication Survivability

The authentication survivability feature supports a survivable authentication framework against any remote link failures when working with external authentication servers. When enabled, this feature allows the IAPs to authenticate the previously connected clients against the cached credentials if the connection to the authentication server is temporarily lost.

Instant supports the following EAP standards for authentication survivability:

- **EAP-PEAP**: The Protected Extensible Authentication Protocol, also known as Protected EAP or PEAP, is a protocol that encapsulates EAP within a potentially encrypted and authenticated Transport Layer Security (TLS) tunnel. The EAP-PEAP supports MS-CHAPv2 and GTC methods.
- **EAP-TLS**: EAP-Transport Layer Security (EAP-TLS) is an IETF open standard that uses the Transport Layer Security (TLS) protocol.

When the authentication survivability feature is enabled, the following authentication process is used:

1. The client associates to an IAP and authenticates to the external authentication server. The external authentication server can be either ClearPass Policy Manager (for EAP-PEAP) or RADIUS server (EAP-TLS).
2. Upon successful authentication, the associated IAP caches the authentication credentials of the connected clients for the configured duration. The cache expiry duration for authentication survivability can be set within the range of 1–99 hours, with 24 hours being the default cache timeout duration.
3. If the client roams or tries to reconnect to the IAP and the remote link fails due to the unavailability of the authentication server, the IAP uses the cached credentials in the internal authentication server to authenticate the user. However, if the client tries to reconnect after the cache expiry, the authentication fails.
4. When the authentication server is available and if the client tries to reconnect, the IAP detects the availability of server and allows the client to authenticate to the server. Upon successful authentication, the IAP cache details are refreshed.

Enabling Authentication Survivability

You can enable authentication survivability for a wireless network profile through the UI or the CLI.

In the Instant UI

To configure authentication survivability for a wireless network:

1. On the **Network** tab, click **New** to create a new network profile or select an existing profile for which you want to enable authentication survivability and click **edit**.
2. In the **Edit <profile-name>** or the **New WLAN** window, ensure that all required WLAN and VLAN attributes are defined, and then click **Next**.
3. On the **Security** tab, under **Enterprise** security settings, select an existing authentication server or create a new server by clicking **New**.
4. To enable authentication survivability, select **Enabled** from the **Authentication survivability** drop-down list. On enabling this, the IAP authenticates the previously connected clients using EAP-PEAP and EAP-TLS authentication when connection to the external authentication server is temporarily lost.
5. Specify the cache timeout duration, after which the cached details of the previously authenticated clients expire. You can specify a value within the range of 1–99 hours and the default cache timeout duration is 24 hours.
6. Click **Next** and then click **Finish** to apply the changes.

Important Points to Remember

- Any client connected through ClearPass Policy Manager and authenticated through IAP remains authenticated with the IAP even if the client is removed from the ClearPass Policy Manager server during the ClearPass Policy Manager downtime.
- Do not make any changes to the authentication survivability cache timeout duration when the authentication server is down.
- For EAP-PEAP authentication, ensure that the ClearPass Policy Manager 6.0.2 or later version is used for authentication. For EAP-TLS authentication, any external or third-party server can be used.
- For EAP-TLS authentication, ensure that the server and CA certificates from the authentication servers are uploaded on the IAP. For more information, see Uploading Certificates on page 178.

In the CLI

To configure authentication survivability for a wireless network:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# type {<Employee>|<Voice>|<Guest>}
(Instant AP)(SSID Profile <name>)# auth-server <server-name1>
(Instant AP)(SSID Profile <name>)# auth-survivability
(Instant AP)(SSID Profile <name>)# exit
(Instant AP)(config)# auth-survivability cache-time-out <hours>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view the cache expiry duration:

```
(Instant AP)# show auth-survivability time-out
```

To view the information cached by the IAP:

```
(Instant AP)# show auth-survivability cached-info
```

To view logs for debugging:

```
(Instant AP)# show auth-survivability debug-log
```

Configuring 802.1X Authentication for a Network Profile

This section consists of the following procedures:

- Configuring 802.1X Authentication for Wireless Network Profiles on page 167
- Configuring 802.1X Authentication for Wired Profiles on page 168

The Instant network supports internal RADIUS server and external RADIUS server for 802.1X authentication.

The steps involved in 802.1X authentication are as follows:

1. The NAS requests authentication credentials from a wireless client.
2. The wireless client sends authentication credentials to the NAS.
3. The NAS sends these credentials to a RADIUS server.
4. The RADIUS server checks the user identity and authenticates the client if the user details are available in its database. The RADIUS server sends an **Access-Accept** message to the NAS. If the RADIUS server cannot identify the user, it stops the authentication process and sends an **Access-Reject** message to the NAS. The NAS forwards this message to the client and the client must re-authenticate with appropriate credentials.
5. After the client is authenticated, the RADIUS server forwards the encryption key to the NAS. The encryption key is used for encrypting or decrypting traffic sent to and from the client.

NOTE

The NAS acts as a gateway to guard access to a protected resource. A client connecting to the wireless network first connects to the NAS.

Configuring 802.1X Authentication for Wireless Network Profiles

You can configure 802.1X authentication for a wireless network profile in the Instant UI or the CLI.

In the Instant UI

To enable 802.1X authentication for a wireless network:

1. On the **Network** tab, click **New** to create a new network profile or select an existing profile for which you want to enable 802.1X authentication and click **edit**.
2. In the **Edit <profile-name>** or the **New WLAN** window, ensure that all required WLAN and VLAN attributes are defined, and then click **Next**.
3. On the **Security** tab, specify the following parameters for the **Enterprise** security level:
   a. Select any of the following options from the **Key management** drop-down list.
      - WPA-2 Enterprise
      - WPA Enterprise
      - Both (WPA-2 & WPA)
      - Dynamic WEP with 802.1X
4. If you do not want to use a session key from the RADIUS server to derive pairwise unicast keys, set **Session Key for LEAP** to **Enabled**.
5. To terminate the EAP portion of 802.1X authentication on the IAP instead of the RADIUS server, set **Termination** to **Enabled**.

   By default, for 802.1X authentication, the client conducts an EAP exchange with the RADIUS server, and the IAP acts as a relay for this exchange. When **Termination** is enabled, the IAP by itself acts as an authentication server and terminates the outer layers of the EAP protocol, only relaying the innermost layer to the external RADIUS server.
6. Specify the type of authentication server to use and configure other required parameters. You can also configure two different authentication servers to function as primary and backup servers when

Termination is enabled. For more information on RADIUS authentication configuration parameters, see Configuring an External Server for Authentication on page 155.

7. Click **Next** to define access rules, and then click **Finish** to apply the changes.

In the CLI

To configure 802.1X authentication for a wireless network:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# type {<Employee>|<Voice>}
(Instant AP)(SSID Profile <name>)# opmode {wpa2-aes|wpa-tkip|wpa-tkip,wpa2-aes|dynamic-wep}
(Instant AP)(SSID Profile <name>)# leap-use-session-key
(Instant AP)(SSID Profile <name>)# termination
(Instant AP)(SSID Profile <name>)# auth-server <server1>
(Instant AP)(SSID Profile <name>)# auth-server <server2>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# auth-survivability
(Instant AP)(SSID Profile <name>)# exit
(Instant AP)(config)# auth-survivability cache-time-out <hours>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring 802.1X Authentication for Wired Profiles

You can configure 802.1X authentication for a wired profile in the Instant UI or the CLI.

In the Instant UI

To enable 802.1X authentication for a wired profile:

1. Click the **Wired** link under **More** in the main window. The **Wired** window is displayed.
2. Click **New** under **Wired Networks** to create a new network or select an existing profile for which you want to enable 802.1X authentication and then click **Edit**.
3. In the **New Wired Network** or the **Edit Wired Network** window, ensure that all the required Wired and VLAN attributes are defined, and then click **Next**.
4. On the **Security** tab, select **Enabled** from the **802.1X authentication** drop-down list.
5. Specify the type of authentication server to use and configure other required parameters. For more information on configuration parameters, see Configuring Security Settings for a Wired Profile on page 109.
6. Click **Next** to define access rules, and then click **Finish** to apply the changes.
7. Assign the profile to an Ethernet port. For more information, see Assigning a Profile to Ethernet Ports on page 112.

In the CLI

To enable 802.1X authentication for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type {<employee>|<guest>}
(Instant AP)(wired ap profile <name>)# dot1x
(Instant AP)(wired ap profile <name>)# auth-server <server1>
(Instant AP)(wired ap profile <name>)# auth-server <server2>
(Instant AP)(wired ap profile <name>)# server-load-balancing
(Instant AP)(wired ap profile <name>)# radius-reauth-interval <Minutes>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Enabling 802.1X Supplicant Support

The 802.1X authentication protocol prevents the unauthorized clients from gaining access to the network through publicly accessible ports. If the ports to which the IAPs are connected, are configured to use the 802.1X authentication method, ensure that you configure the IAPs to function as an 802.1X client or supplicant. If your network requires all wired devices to authenticate using PEAP or TLS protocol, you need to configure the IAP uplink ports for 802.1X authentication, so that the switch grants access to the IAP only after completing the authentication as a valid client.

To enable the 802.1X supplicant support on an IAP, ensure that the 802.1X authentication parameters are configured on all IAPs in the cluster and are stored securely in the IAP flash.

NOTE

The 802.1X supplicant support feature is not supported with mesh and Wi-Fi uplink.

Configuring an IAP for 802.1X Supplicant Support

To enable 802.1X supplicant support, configure 802.1X authentication parameters on every IAP using the Instant UI or the CLI.

In the UI

1. To use PEAP protocol-based 802.1X authentication method, complete the following steps:
   a. In the **Access Points** tab, click the IAP on which you want to set the variables for 802.1X authentication, and then click the **edit** link.
   b. In the **Edit Access Point** window, click the **Uplink** tab.
   c. Under PEAP user, enter the username, password, and retype the password for confirmation. The IAP username and password are stored in IAP flash. When the IAP boots, the */tmp/ap1xuser* and */tmp/ap1xpassword* files are created based on these two variables.

NOTE

The default inner authentication protocol for PEAP is MS-CHAPV2.

2. To upload server certificates for validating the authentication server credentials, complete the following steps:
   a. Click **Upload New Certificate**.
   b. Specify the URL from where you want to upload the certificates and select the type of certificate.
3. Click **OK**.
4. To configure 802.1X authentication on uplink ports of an IAP, complete the following steps:
   a. Go to **System > Show advanced options > Uplink**.
   b. Click AP1X.
   c. Select PEAP or TLS as the authentication type.
   d. If you want to validate the server credentials using server certificate, select the **Validate Server** check box. Ensure that the server certificates for validating server credentials are uploaded to IAP database.
   e. Click **OK**.
5. Reboot the IAP.

In the CLI

To set username and password variable used by the PEAP protocol-based 802.1X authentication:

```
(Instant AP)# ap1x-peap-user <ap1xuser> <password>
```

To set the PEAP 802.1X authentication type:

```
(Instant AP)(config)# ap1x peap [validate-server]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To set TLS 802.1X authentication type:

```
(Instant AP)(config)# ap1x tls <tpm|user> [validate-server]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To upload user or CA certificates for PEAP or TLS authentication:

```
(Instant AP)# copy tftp <addr> <file> ap1x {ca|cert <password>} format pem
```

To download user or server certificates from a TFTP, FTP, or web server:

```
(Instant AP)# download ap1x <url> format pem [psk <psk>]
(Instant AP)# download ap1xca <url> format pem
```

To view the certificate details:

```
(Instant AP)# show ap1xcert
```

To verify the configuration, use any of the following commands:

```
(Instant AP)# show ap1x config
(Instant AP)# show ap1x debug-logs
(Instant AP)# show ap1x status
```

Configuring MAC Authentication for a Network Profile

MAC authentication can be used alone or it can be combined with other forms of authentication such as WEP authentication. However, it is recommended that you do not use the MAC-based authentication.

This section describes the following procedures:

- Configuring MAC Authentication for Wireless Network Profiles on page 170
- Configuring MAC Authentication for Wired Profiles on page 171

Configuring MAC Authentication for Wireless Network Profiles

You can configure MAC authentication for a wired profile in the Instant UI or the CLI.

In the Instant UI

To enable MAC Authentication for a wireless network:

1. On the **Network** tab, click **New** to create a new network profile or select an existing profile for which you want to enable MAC authentication and click **edit**.
2. In the **Edit <profile-name>** or the **New WLAN** window, ensure that all required WLAN and VLAN attributes are defined, and then click **Next**.
3. On the **Security** tab, select **Enabled** from the **MAC authentication** drop-down list for the **Personal** or the **Open** security level.
4. Specify the type of authentication server to use.
5. If an internal authentication server is used, perform the following steps to allow MAC-address-based authentication:
   a. Click the **Users** link beside the **Internal server** parameter. The **Users** window is displayed.
   b. Specify the client MAC address as the username and password.
   c. Specify the type of the user (employee or guest).
   d. Click **Add**.
   e. Repeat the steps to add more users.

f. Click **OK**.

6. To allow the IAP to use a delimiter in the MAC authentication request, specify a character (for example, colon or dash) as a delimiter for the MAC address string. For example, if you specify colon as the delimiter, MAC addresses in the xx:xx:xx:xx:xx:xx format are used. If the delimiter is not specified, the MAC address in the xxxxxxxxxxxx format is used.
7. To allow the IAP to use uppercase letters in the MAC address string, set **Uppercase support** to **Enabled**.
8. Configure other parameters as required.
9. Click **Next** to define access rules, and then click **Finish** to apply the changes.

In the CLI

To configure MAC-address based authentication with external server:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# type {<Employee>|<Voice>|<Guest>}
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# mac-authentication-delimiter <delim>
(Instant AP)(SSID Profile <name>)# mac-authentication-upper-case
(Instant AP)(SSID Profile <name>)# external-server
(Instant AP)(SSID Profile <name>)# auth-server <server-name1>
(Instant AP)(SSID Profile <name>)# auth-server <server-name2>
(Instant AP)(SSID Profile <name>)# server-load-balancing
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To add users for MAC authentication based on internal authentication server:

```
(Instant AP)(config)# user <username> [<password>] [portal|radius]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring MAC Authentication for Wired Profiles

You can configure MAC authentication for a wired profile in the Instant UI or the CLI.

In the Instant UI

To enable MAC authentication for a wired profile:

1. Click the **Wired** link under **More** in the main window. The **Wired** window is displayed.
2. Click **New** under **Wired Networks** to create a new network or select an existing profile for which you want to enable MAC authentication and then click **Edit**.
3. In the **New Wired Network** or the **Edit Wired Network** window, ensure that all the required Wired and VLAN attributes are defined, and then click **Next**.
4. On the **Security** tab, select **Enabled** from the **MAC authentication** drop-down list.
5. Specify the type of authentication server to use.
6. If an internal authentication server is used, perform the following steps to allow MAC-address-based authentication:
   a. Click the **Users** link beside **Internal server**. The **Users** window is displayed.
   b. Specify the client MAC address as the username and password.
   c. Specify the type of the user (employee or guest).
   d. Click **Add**.
   e. Repeat the steps to add more users.
   f. Click **OK**.

7. Configure other parameters as required.
8. Click **Next** to define access rules, and then click **Finish** to apply the changes.

In the CLI

To configure MAC-address-based authentication with external server:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type {<employee>|<guest>}
(Instant AP)(wired ap profile <name>)# mac-authentication
(Instant AP)(wired ap profile <name>)# auth-server <server-1>
(Instant AP)(wired ap profile <name>)# auth-server <server-2>
(Instant AP)(wired ap profile <name>)# server-load-balancing
(Instant AP)(wired ap profile <name>)# radius-reauth-interval <Minutes>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

To add users for MAC authentication based on internal authentication server:

```
(Instant AP)(config)# user <username> [<password>] [portal|radius]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring MAC Authentication with 802.1X Authentication

This section describes the following procedures:

- Configuring MAC and 802.1X Authentications for Wireless Network Profiles on page 172
- Configuring MAC and 802.1X Authentications for Wired Profiles on page 173

Configuring MAC and 802.1X Authentications for Wireless Network Profiles

You can configure MAC authentication with 802.1X authentication for a wireless network profile using the Instant UI or the CLI.

In the Instant UI

To configure both MAC and 802.1X authentications for a wireless network:

1. On the **Network** tab, click **New** to create a new network profile or select an existing profile for which you want to enable MAC and 802.1X authentications and click **edit**.
2. In the **Edit <profile-name>** or the **New WLAN** window, ensure that all required WLAN and VLAN attributes are defined, and then click **Next**.
3. On the **Security** tab, ensure that the required parameters for MAC authentication and 802.1X authentication are configured.
4. Select the **Perform MAC authentication before 802.1X** check box to use 802.1X authentication only when the MAC authentication is successful.
5. Select the **MAC authentication fail-thru** check box to use 802.1X authentication even when the MAC authentication fails.
6. Click **Next** and then click **Finish** to apply the changes.

In the CLI

To configure both MAC and 802.1X authentications for a wireless network:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# type {<Employee>|<Voice>|<Guest>}
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# l2-auth-failthrough
(Instant AP)(SSID Profile <name>)# auth-server <server-name1>
```

```
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# auth-survivability
(Instant AP)(SSID Profile <name>)# exit
(Instant AP)(config)# auth-survivability cache-time-out <hours>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring MAC and 802.1X Authentications for Wired Profiles

You can configure MAC and 802.1X authentications for a wired profile in the Instant UI or the CLI.

In the Instant UI

To enable MAC and 802.1X authentications for a wired profile:

1. Click the **Wired** link under **More** in the main window. The **Wired** window is displayed.
2. Click **New** under **Wired Networks** to create a new network or select an existing profile for which you want to enable MAC authentication and then click **Edit**.
3. In the **New Wired Network** or the **Edit Wired Network** window, ensure that all the required Wired and VLAN attributes are defined, and then click **Next**.
4. On the **Security** tab, perform the following steps:
   - Select **Enabled** from the **MAC authentication** drop-down list.
   - Select **Enabled** from the **802.1X authentication** drop-down list.
   - Select **Enabled** from the **MAC authentication fail-thru** drop-down list.
5. Specify the type of authentication server to use and configure other required parameters. For more information on configuration parameters, see Configuring Security Settings for a Wired Profile on page 109.
6. Click **Next** to define access rules, and then click **Finish** to apply the changes.

In the CLI

To enable MAC and 802.1X authentications for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile "<name>")# type {<employee>|<guest>}
(Instant AP)(wired ap profile "<name>")# mac-authentication
(Instant AP)(wired ap profile "<name>")# dot1x
(Instant AP)(wired ap profile "<name>")# l2-auth-failthrough
(Instant AP)(wired ap profile "<name>")# auth-server <name>
(Instant AP)(wired ap profile "<name>")# server-load-balancing
(Instant AP)(wired ap profile "<name>")# radius-reauth-interval <Minutes>
(Instant AP)(wired ap profile "<name>")# end
(Instant AP)# commit apply
```

Configuring MAC Authentication with Captive Portal Authentication

The following configuration conditions apply to MAC + captive portal authentication method:

- If the captive portal splash page type is **Internal-Authenticated** or **External-RADIUS Server**, MAC authentication reuses the server configurations.
- If the captive portal splash page type is **Internal-Acknowledged** or **External-Authentication Text** and MAC authentication is enabled, a server configuration page is displayed.

You can configure the MAC authentication with captive portal authentication for a network profile using the Instant UI or the CLI.

In the Instant UI

1. Select an existing wireless or wired profile for which you want to enable MAC with captive portal authentication. Depending on the network profile selected, the **Edit <WLAN-Profile>** or the **Edit Wired Network** window is displayed.

To enable MAC authentication with captive portal authentication on a new WLAN SSID or wired profile, click the **Security** tab on the **New WLAN** window and the **New Wired Network** window.

2. On the **Security** tab, specify the following parameters:
   a. Select **Enabled** from the **MAC authentication** drop-down list to enable MAC authentication for captive portal users. If the MAC authentication fails, the captive portal authentication role is assigned to the client.
   b. To enforce MAC authentication, click the **Access** tab and select **Enforce MAC auth only role** check box.
3. Click **Next** and then click **Finish** to apply the changes.

In the CLI

To configure MAC authentication with captive portal authentication for a wireless profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# type <guest>
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# captive-portal {<type> [exclude-uplink <types>]|external
[Profile <name>] [exclude-uplink <types>]}
(Instant AP)(SSID Profile <name>)# set-role-mac-auth <mac-only>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure MAC authentication with captive portal authentication for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# type <guest>
(Instant AP)(wired ap profile <name>)# mac-authentication
(Instant AP)(wired ap profile <name>)# captive-portal <type>
(Instant AP)(wired ap profile <name>)# captive-portal {<type> [exclude-uplink <types>]
|external [Profile <name>] [exclude-uplink <types>]}
(Instant AP)(wired ap profile <name>)# set-role-mac-auth <mac-only>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring WISPr Authentication

Instant supports the following smart clients:

- iPass
- Boingo

These smart clients enable client authentication and roaming between hotspots by embedding iPass Generic Interface Specification (GIS) *redirect*, *authentication*, and *logoff* messages within HTML messages that are sent to the IAP.

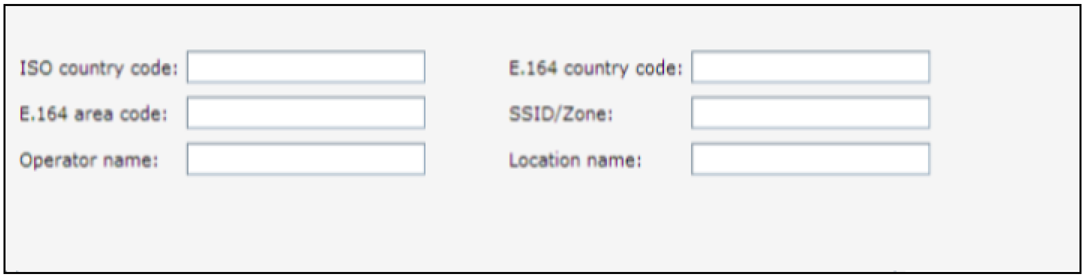
Wireless Internet Service Provider roaming (WISPr) authentication is supported only for the **Internal - Authenticated** and **External - RADIUS Server** captive portal authentication. Select the **Internal – Authenticated** or the **External - RADIUS Server** option from the **Splash page type** drop-down list to configure WISPr authentication for a WLAN profile.

You can configure WISPr authentication using the Instant UI or the CLI.

In the Instant UI

1. Click the **System** link located directly above the Search bar in the Instant main window. The **System** window is displayed.
2. Click **Show advanced options**.
3. Click **WISPr** tab. The **WISPr** tab contents are displayed. The following figure shows the **WISPr** tab contents:

Figure 36 *Configuring WISPr Authentication*



4. Enter the ISO Country Code for the WISPr Location ID in the **ISO country code** text box.
5. Enter the E.164 Area Code for the WISPr Location ID in the **E.164 area code** text box.
6. Enter the operator name of the hotspot in the **Operator name** text box.
7. Enter the E.164 Country Code for the WISPr Location ID in the **E.164 country code** text box.
8. Enter the SSID/Zone section for the WISPr Location ID in the **SSID/Zone** text box.
9. Enter the name of the Hotspot location in the **Location name** text box. If no name is defined, the name of the IAP to which the user is associated is used.
10. Click **OK** to apply the changes.

The WISPr RADIUS attributes and configuration parameters are specific to the RADIUS server used by your ISP for the WISPr authentication. Contact your ISP to determine these values. You can find a list of ISO and ITU country and area codes at the ISO and ITU websites (www.iso.org and http://www.itu.int).

NOTE

A Boingo smart client uses a NAS identifier in the <CarrierID>_<VenueID> format for location identification. To support Boingo clients, ensure that you configure the NAS identifier parameter in the RADIUS server profile for the WISPr server.

In the CLI

```
(Instant AP)(config)# wlan wispr-profile
(Instant AP)(WISPr)# wispr-location-id-ac
(Instant AP)(WISPr)# wispr-location-id-cc
(Instant AP)(WISPr)# wispr-location-id-isocc
(Instant AP)(WISPr)# wispr-location-id-network
(Instant AP)(WISPr)# wispr-location-name-location
(Instant AP)(WISPr)# wispr-location-name-operator-name
(Instant AP)(WISPr)# end
(Instant AP)# commit apply
```

Blacklisting Clients

The client blacklisting denies connection to the blacklisted clients. When a client is blacklisted, it is not allowed to associate with an IAP in the network. If a client is connected to the network when it is blacklisted, a deauthentication message is sent to force client disconnection.

This section describes the following procedures:

- Blacklisting Clients Manually on page 176
- Blacklisting Users Dynamically on page 176

Blacklisting Clients Manually

Manual blacklisting adds the MAC address of a client to the blacklist. These clients are added into a permanent blacklist. These blacklisted clients are not allowed to connect to the network unless they are removed from the blacklist.

Adding a Client to the Blacklist

You can add a client to the blacklist manually using the Instant UI or the CLI.

In the Instant UI

1. Click the **Security** link located directly above the Search bar in the Instant main window.
2. Click the **Blacklisting** tab.
3. Under the **Manual Blacklisting**, click **New**.
4. Enter the MAC address of the client to be blacklisted in the **MAC address to add** text box.

> NOTE
>
> For the blacklisting to take effect on the MAC address, you must enable blacklisting in the SSID profile. For more information, see Blacklisting on page 94.

5. Click **OK**. The **Blacklisted Since** tab displays the time at which the current blacklisting has started for the client.
6. To delete a client from the manual blacklist, select the MAC Address of the client under the **Manual Blacklisting**, and then click **Delete**.

In the CLI

To blacklist a client:

```
(Instant AP)(config)# blacklist-client <MAC-Address>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To enable blacklisting in the SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# blacklisting
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To view the blacklisted clients:

```
(Instant AP)# show blacklist-client
Blacklisted Clients
-------------------
MAC                Reason        Timestamp  Remaining time(sec)  AP name
---                ------        ---------  -------------------  -------
00:1c:b3:09:85:15  user-defined  17:21:29   Permanent            -
```

Blacklisting Users Dynamically

The clients can be blacklisted dynamically when they exceed the authentication failure threshold or when a blacklisting rule is triggered as part of the authentication process.

Authentication Failure Blacklisting

When a client takes time to authenticate and exceeds the configured failure threshold, it is automatically blacklisted by an IAP.

Session Firewall-Based Blacklisting

In session firewall-based blacklisting, an ACL rule is used to enable the option for dynamic blacklisting. When the ACL rule is triggered, it sends out blacklist information and the client is blacklisted.

Configuring Blacklist Duration

You can set the blacklist duration using the Instant UI or the CLI.

In the Instant UI

To set a blacklist duration:

1. Click the **Security** link located directly above the Search bar in the Instant main window.
2. Click the **Blacklisting** tab.
3. Under **Dynamic Blacklisting**:
4. For **Auth failure blacklist time**, the duration in seconds after which the clients that exceed the authentication failure threshold must be blacklisted.
5. For **PEF rule blacklisted time**, enter the duration in seconds after which the clients can be blacklisted due to an ACL rule trigger.

You can configure a maximum number of authentication failures by the clients, after which a client must be blacklisted. For more information on configuring maximum authentication failure attempts, see Configuring Security Settings for a WLAN SSID Profile on page 89.

To enable session-firewall-based blacklisting, click **New** and navigate to **WLAN Settings > VLAN > Security > Access** window, and enable the **Blacklist** option of the corresponding ACL rule.

In the CLI

To dynamically blacklist clients:

```
(Instant AP)(config)# auth-failure-blacklist-time <seconds>
(Instant AP)(config)# blacklist-time <seconds>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To enable blacklisting in the SSID profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# blacklisting
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To view the blacklisted clients:

```
(Instant AP)# show blacklist-client config
Blacklist Time               :60
Auth Failure Blacklist Time  :60
Manually Blacklisted Clients
----------------------------
MAC  Time
---  ----
Dynamically Blacklisted Clients
-------------------------------
MAC  Reason  Timestamp  Remaining time(sec)  AP IP
---  ------  ---------  -------------------  -----
Dyn Blacklist Count  :0
```

Uploading Certificates

A certificate is a digital file that certifies the identity of the organization or products of the organization. It is also used to establish your credentials for any web transactions. It contains the organization name, a serial number, expiration date, a copy of the certificate-holder's public key, and the digital signature of the certificate-issuing authority so that a recipient can ensure that the certificate is real.

Instant supports the following certificate files:

- Authentication server (PEM format)
- Captive portal server (PEM format)—Customized certificate for internal captive portal server
- CA certificate (PEM or DER format)
- RadSec certificate (PEM or DER format)

This section describes the following procedures:

- Loading Certificates through Instant UI on page 178
- Loading Certificates through Instant CLI on page 179
- Removing Certificates on page 179
- Loading Certificates Through AirWave on page 179

Loading Certificates through Instant UI

To load a certificate in the Instant UI:

1. Click the **Maintenance** link located directly above the Search bar in the Instant main window.
2. Click the **Certificates** tab. The **Certificates** tab contents are displayed.
3. To upload a certificate, click **Upload New Certificate**. The **New Certificate** window is displayed.
4. Browse and select the file to upload.
5. Select any of the following types of certificates from the **Certificate type** drop-down list:
    - CA—CA certificate to validate the identity of the client.
    - Auth Server—The authentication server certificate to verify the identity of the server to the client.
    - Captive portal server—Captive portal server certificate to verify the identity of internal captive portal server to the client.
    - RadSec—The RadSec server certificate to verify the identity of the server to the client.
    - RadSec CA—The RadSec CA certificate for mutual authentication between the IAP clients and the TLS server.
6. Select the certificate format from the **Certificate format** drop-down list.
7. If you have selected **Auth Server**, **Captive portal server**, or **RadSec** as the type of certificate, enter a passphrase in **Passphrase** and retype the passphrase. If the certificate does not include a passphrase, there is no passphrase required.
8. Click **Browse** and select the appropriate certificate file, and click **Upload Certificate**. The **Certificate Successfully Installed** message is displayed.

NOTE

The IAP database can have only one authentication server certificate and one captive portal server certificate at any point in time.

When a Captive Portal server certificate is uploaded using the Instant UI, the default management certificate on the UI is also replaced by the Captive portal server certificate.

Loading Certificates through Instant CLI

To upload a CA, server, or captive portal certificate:

```
(Instant AP)# copy tftp <ip-address> <filename> {cpserver cert <password> format {p12|pem}|
radsec {ca|cert <password>} format pem|system {1xca format {der|pem}| 1xcert <password> format
pem}}
```

To download RadSec certificates:

```
(Instant AP)# download-cert radsec ftp://192.0.2.7 format pem [psk <psk>]
(Instant AP)# download-cert radsecca ftp://192.0.2.7 format pem
```

Removing Certificates

To clear a certificate:

```
(Instant AP)# clear-cert {ca|cp|radsec|radsecca|server}
```

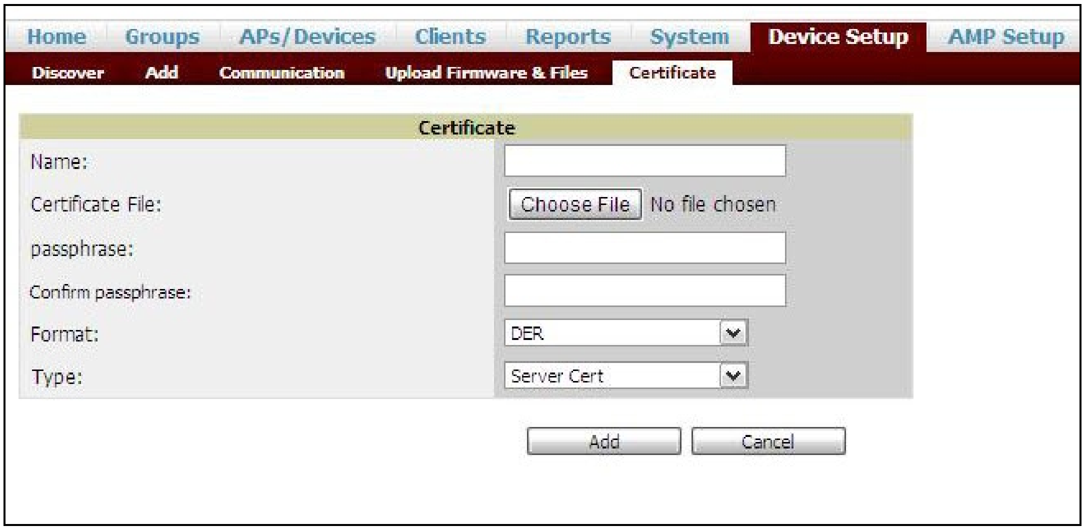
Loading Certificates Through AirWave

You can manage certificates using AirWave. The AMP directly provisions the certificates and performs basic certificate verification (such as certificate type, format, version, serial number, and so on) before accepting the certificate and uploading to an IAP network. The AMP packages the text of the certificate into an HTTPS message and sends it to the VC. After the VC receives this message, it draws the certificate content from the message, converts it to the right format, and saves it on the RADIUS server.

To load a certificate in AirWave:

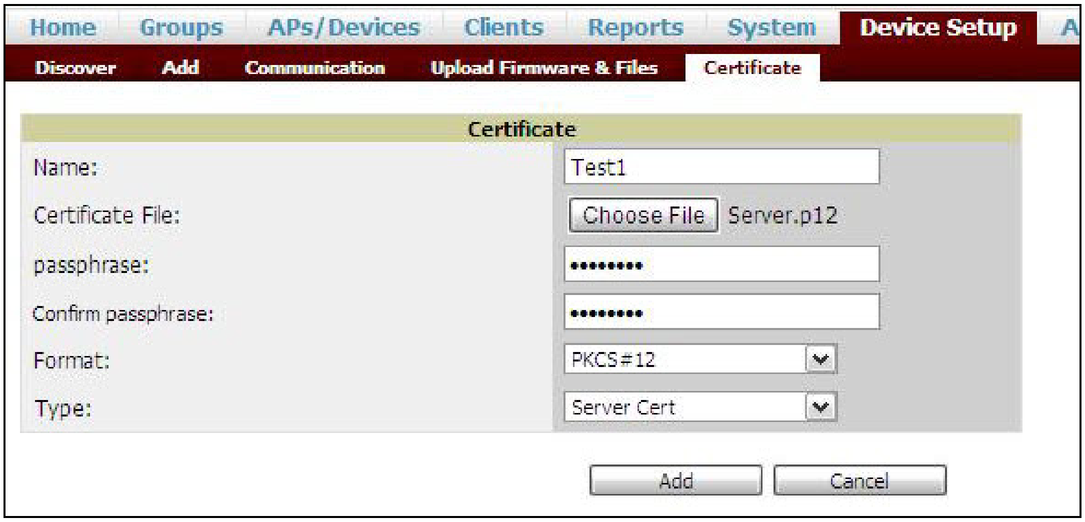
1. Navigate to **Device Setup > Certificate** and then click **Add** to add a new certificate. The **Certificate** window is displayed.
2. Enter the certificate **Name**, and click **Choose File** to browse and upload the certificate.

Figure 37 *Loading Certificate through AirWave*



3. Select the appropriate **Format** that matches the certificate filename.
   - Select **Server Cert** for certificate **Type**, and provide the passphrase if you want to upload a server certificate.
   - Select either **Intermediate CA** or **Trusted CA** certificate **Type**, if you want to upload a CA certificate.

Figure 38 *Server Certificate*

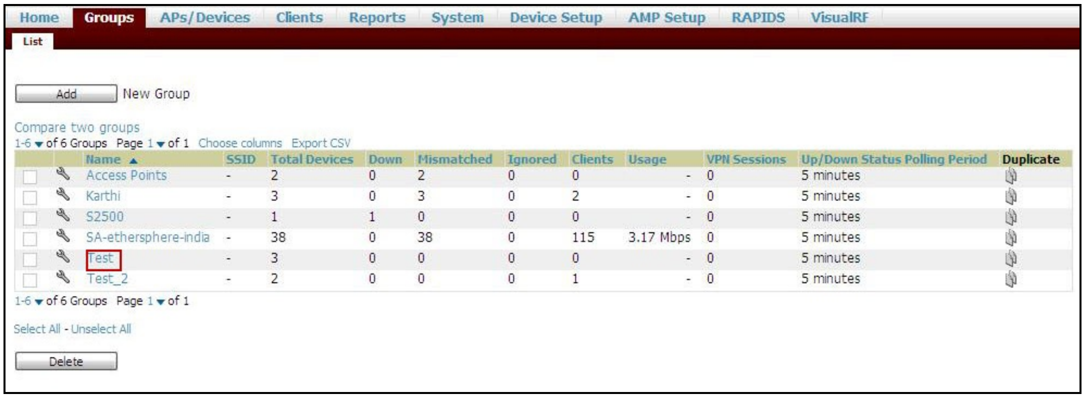


Certificate

Name:	Test1
Certificate File:	Choose File Server.p12
passphrase:	••••••••
Confirm passphrase:	••••••••
Format:	PKCS#12
Type:	Server Cert

4. After you upload the certificate, navigate to **Groups,** click the Instant **Group** and then select **Basic**. The Group name is displayed only if you have entered the **Organization** name in the Instant UI. For more information, see Configuring Organization String on page 314 for further information.

Figure 39 *Selecting the Group*



	Name ▲	SSID	Total Devices	Down	Mismatched	Ignored	Clients	Usage	VPN Sessions	Up/Down Status Polling Period
□	Access Points	-	2	0	2	0	0	-	0	5 minutes
□	Karthi	-	3	0	3	0	2	-	0	5 minutes
□	S2500	-	1	1	0	0	0	-	0	5 minutes
□	SA-ethersphere-india	-	38	0	38	0	115	3.17 Mbps	0	5 minutes
□	Test	-	3	0	0	0	0	-	0	5 minutes
□	Test_2	-	2	0	0	0	1	-	0	5 minutes

The **Virtual Controller Certificate** section displays the certificates (CA cert and Server).

5. Click **Save** to apply the changes only to AirWave. Click **Save and Apply** to apply the changes to the IAP.
6. To clear the certificate options, click **Revert**.

This chapter describes the procedures for configuring user roles, role assignment, and firewall policies.

Firewall Policies

Instant firewall provides identity-based controls to enforce application-layer security, prioritization, traffic forwarding, and network performance policies for wired and wireless networks. Using Instant firewall, you can enforce network access policies that define access to the network, areas of the network that users may access, and the performance thresholds of various applications.

Instant supports a role-based stateful firewall. Instant firewall recognizes flows in a network and keeps track of the state of sessions. Instant firewall manages packets according to the first rule that matches the packet. The firewall logs on the IAPs are generated as syslog messages.

Access Control List Rules

You can use Access Control List (ACL) rules to either permit or deny data packets passing through the IAP. You can also limit packets or bandwidth available to a set of user roles by defining access rules. By adding custom rules, you can block or allow access based on the service or application, source or destination IP addresses.

You can create access rules to allow or block data packets that match the criteria defined in an access rule. You can create rules for either inbound traffic or outbound traffic. Inbound rules explicitly allow or block the inbound network traffic that matches the criteria in the rule. Outbound rules explicitly allow or block the network traffic that matches the criteria in the rule. For example, you can configure a rule to explicitly block outbound traffic to an IP address through the firewall.

The IAP clients are associated with user roles, that determine the client’s network privileges and the frequency at which clients re-authenticate.

Instant supports the following types of ACLs:

- ACLs that permit or deny traffic based on the source IP address of the packet.
- ACLs that permit or deny traffic based on the source or destination IP address, and the source or destination port number.
- ACLs that permit or deny traffic based on network services, application, application categories, web categories, and security ratings.

NOTE

You can configure up to 128 access control entries in an ACL for a user role.

The maximum configurable universal role is 4096.

Configuring ACL Rules for Network Services

This section describes the procedure for configuring ACLs to control access to network services.

- For information on configuring access rules based on application and application categories, see Configuring ACL Rules for Application and Application Categories on page 270.
- For information on configuring access rules based on web categories and web reputation, see Configuring Web Policy Enforcement Service on page 273.

In the Instant UI

To configure ACL rules for a user role:

1. Navigate to **Security > Roles**. The **Roles** tab contents are displayed.

Alternatively, you can configure access rules for a wired or wireless client through the WLAN wizard or the Wired Profile window.

   a. To configure access rules through the Wired Profile window:
      - Navigate to **More > Wired**.
      - Click **Edit** and then **Edit Wired Network**.
      - Click **Access**.

   b. To configure access rules through WLAN wizard:
      - Navigate to **Network > WLAN SSID**.
      - Click **Edit** and then **Edit WLAN**.
      - Click **Access**.

2. Select the role for which you want to configure access rules.
3. In the **Access rules** section, click **New** to add a new rule. The **New Rule** window is displayed.
4. Ensure that the rule type is set to **Access Control**.
5. To configure a rule to control access to network services, select **Network** under service category and specify the following parameters:

Table 39: *Access Rule Configuration Parameters*

Service Category	Description
Network	Select a service from the list of available services. You can allow or deny access to any or all of the services based on your requirement: - **any**—Access is allowed or denied to all services. - **custom**—Available options are TCP, UDP, and Other. If you select the TCP or UDP options, enter appropriate port numbers. If you select the Other option, enter the appropriate ID. **NOTE:** If Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) use the same port, ensure that you configure separate access rules to permit or deny access.
Action	Select any of following actions: - Select **Allow** to allow access to users based on the access rule. - Select **Deny** to deny access to users based on the access rule. - Select **Destination-NAT** to allow making changes to the destination IP address. - Select **Source-NAT** to allow making changes to the source IP address. **Default**: All client traffic is directed to the default VLAN. **Tunnel**: The traffic from the Network Assigned clients is directed to the VPN tunnel. **VLAN**: Specify the non-default VLAN ID to which the guest traffic needs to be redirected to.
Destination	Select a destination option for the access rules for network services, applications, and application categories. You can allow or deny access to any the following destinations based on your requirements. - **to all destinations**— Access is allowed or denied to all destinations. - **to a particular server**—Access is allowed or denied to a particular server. After selecting this option, specify the IP address of the destination server. - **except to a particular server**—Access is allowed or denied to servers other than the specified server. After selecting this option, specify the IP address of the destination server. - **to a network**—Access is allowed or denied to a network. After selecting this option, specify the IP address and netmask for the destination network. - **except to a network**—Access is allowed or denied to networks other than the specified network. After selecting this option, specify the IP address and netmask of the destination network. - **to domain name**—Access is allowed or denied to the specified domains. After selecting this option, specify the domain name in the **Domain Name** text box.
Log	Select the **Log** check box if you want a log entry to be created when this rule is triggered. Instant supports firewall-based logging. Firewall logs on the IAPs are generated as security logs.

Table 39: *Access Rule Configuration Parameters*

Service Category	Description
Blacklist	Select the **Blacklist** check box to blacklist the client when this rule is triggered. The blacklisting lasts for the duration specified as **Auth failure blacklist time** on the Blacklisting tab of the **Security** window. For more information, see Blacklisting Clients on page 175.
Classify media	Select the **Classify media** check box to prioritize video and voice traffic. When enabled, a packet inspection is performed on all non-NAT traffic and the traffic is marked as follows: ● Video: Priority 5 (Critical) ● Voice: Priority 6 (Internetwork Control)
Disable scanning	Select **Disable scanning** check box to disable ARM scanning when this rule is triggered. The selection of **Disable scanning** applies only if ARM scanning is enabled. For more information, see Configuring Radio Settings on page 259.
DSCP tag	Select the **DSCP tag** check box to specify a DSCP value to prioritize traffic when this rule is triggered. Specify a value within the range of 0–63. To assign a higher priority, specify a higher value.
802.1p priority	Select the **802.1p priority** check box to specify an 802.1p priority. Specify a value between 0 and 7. To assign a higher priority, specify a higher value.

6. Click **OK** and then click **Finish**.

In the CLI

To configure access rules:

```
(Instant AP)(config)# wlan access-rule <access-rule-name>
(Instant AP)(Access Rule <Name>)#rule <dest> <mask> <match/invert> {<protocol> <start-port>
<end-port> {permit|deny|src-nat [vlan <vlan_id>|tunnel]|dst-nat{<IP-address> <port>|<port>}}
[<option1....option9>]
(Instant AP)(Access Rule <Name>)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan access-rule employee
(Instant AP)(Access Rule "employee")# rule 10.17.88.59 255.255.255.255 match 6 4343 4343 log
classify-media
(Instant AP)(Access Rule "employee")# rule 192.0.2.8 255.255.255.255 invert 6 110 110 permit
(Instant AP)(Access Rule "employee")# rule 192.0.2.2 255.255.255.0 192.0.2.7 255.255.255.0
match tcp 21 21 deny
(Instant AP)(Access Rule "employee")# rule 192.0.2.2 255.255.255.0 192.0.2.7 255.255.255.0
match udp 21 21 deny
(Instant AP)(Access Rule "employee")# rule 192.0.2.2 255.255.255.0 match 6 631 631 permit
(Instant AP)(Access Rule "employee")# rule 192.0.2.8 255.255.255.255 invert 6 21 21 deny
(Instant AP)(Access Rule "employee")# rule 192.0.2.1 255.255.255.0 invert 17 67 69 deny
(Instant AP)(Access Rule "employee")# end
(Instant AP)# commit apply
```

Configuring Network Address Translation Rules

Network Address Translation (NAT) is the process of modifying network address information when packets pass through a routing device. The routing device acts as an agent between the public (the Internet) and the private (local network), which allows translation of private network IP addresses to a public address space.

Instant supports the NAT mechanism to allow a routing device to use the translation tables for mapping the private addresses into a single IP address. When packets are sent from this address, they appear to originate from the routing device. Similarly, if packets are sent to the private IP address, the destination address is translated as per the information stored in the translation tables of the routing device.

Configuring a Source-NAT Access Rule

The source-NAT action in access rules allows the user to override the routing profile entries. For example, when a routing profile is configured to use 0.0.0.0/0, the client traffic in L3 mode access on an SSID destined to the corporate network is sent to the tunnel. When an access rule is configured with **Source-NAT** action, the users can specify the service, protocol, or destination to which the source-NAT is applied.

You can also configure source-based routing to allow client traffic on one SSID to reach the Internet through the corporate network, while the other SSID can be used as an alternate uplink. You can create an access rule to perform source-NAT by using the Instant UI or the CLI.

In the Instant UI

To configure a source-NAT access rule:

1. Navigate to the WLAN wizard or the Wired settings window:
   - To configure access rules for a WLAN SSID, in the **Network** tab, click **New** to create a new network profile or click **edit** to modify an existing profile.
   - To configure access rules for a wired profile, **More > Wired**. In the **Wired** window, click **New** under **Wired Networks** to create a new network or click **Edit** to select an existing profile.
2. Click the **Access** tab.
3. To configure access rules for the network, move the slider to the **Network-based** access control type. To configure access rules for user roles, move the slider to the **Role-based** access control type.
4. To create a new rule for the network, click **New**. To create an access rule for a user role, select the user role and then click **New**. The **New Rule** window is displayed.
5. In the **New Rule** window, perform the following steps:
   a. Select **Access control** from the **Rule type** drop-down list.
   b. Select **Source-NAT** from the **Action** drop-down list, to allow for making changes to the source IP address.
   c. Select a service from the list of available services.

      Default: All client traffic by default will be directed to the native vlan.

      Tunnel: All network-based traffic will be directed to the VPN tunnel.

      VLAN: All client based traffic will be directed to the specified uplink VLAN using the IP address of the interface that IAP has on that VLAN. If the interface is not found, this option has no effect.
   d. Select the required option from the **Destination** drop-down list.
   e. If required, enable other parameters such as **Log**, **Blacklist**, **Classify media**, **Disable scanning**, **DSCP tag**, and **802.1p priority**.
   f. Click **OK**.
6. Click **Finish**.

In the CLI

To configure source-NAT access rule:

```
(Instant AP)(config)# wlan access-rule <access_rule>
(Instant AP)(Access Rule "<access_rule>")# rule <dest> <mask> <match> <protocol> <sport>
<eport> src-nat [vlan <vlan_id>|tunnel]
(Instant AP)(Access Rule "<access_rule>")# end
(Instant AP)# commit apply
```

Configuring Policy-Based Corporate Access

To allow different forwarding policies for different SSIDs, you can configure policy-based corporate access. The configuration overrides the routing profile configuration and allows any destination or service to be configured to have direct access to the Internet (bypassing VPN tunnel) based on the ACL rule definition. When policy-based corporate access is enabled, the VC performs source-NAT by using its uplink IP address.

To configure policy-based corporate access:

1. Ensure that an L3 subnet with netmask, gateway, VLAN, and IP address is configured. For more information on configuring L3 subnet, see Configuring L3-Mobility on page 344.
2. Ensure that the source IP address is associated with the IP address configured for the L3 subnet.
3. Create an access rule for the SSID profile with Source-NAT action as described in Configuring a Source-NAT Access Rule on page 185. The source-NAT pool is configured and corporate access entry is created.

Configuring a Destination-NAT Access Rule

Instant supports configuration of the destination-NAT rule, which can be used to redirect traffic to the specified IP address and destination port. The destination-NAT configuration is supported only in the bridge mode without VPN.

You can configure a destination-NAT access rule by using the Instant UI or the CLI.

In the Instant UI

To configure a destination-NAT access rule:

1. Navigate to the WLAN wizard or the Wired settings window:
   - To configure access rules for a WLAN SSID, in the **Network** tab, click **New** to create a new network profile or click **edit** to modify an existing profile.
   - To configure access rules for a wired profile, **More > Wired**. In the **Wired** window, click **New** under **Wired Networks** to create a new network or click **Edit** to select an existing profile.
2. Click the **Access** tab and perform any of the following steps:
   - To configure access rules for the network, move the slider to the **Network-based** access control type.
   - To configure access rules for user roles, move the slider to the **Role-based** access control type.
3. To create a new rule for the network, click **New**. To create an access rule for a user role, select the user role and then click **New**. The **New Rule** window is displayed.
4. In the **New Rule** window, perform the following steps:
   a. Select **Access control** from the **Rule type** drop-down list.
   b. Select **destination-NAT** from the **Action** drop-down list, to allow for making changes to the source IP address.
   c. Specify the IP address and port details.
   d. Select a service from the list of available services.
   e. Select the required option from the **Destination** drop-down list.

f. If required, enable other parameters such as **Log**, **Blacklist**, **Classify media**, **Disable scanning**, **DSCP tag**, and **802.1p priority**.

g. Click **OK**.

5. Click **Finish**.

In the CLI

To configure destination-NAT access rule:

```
(Instant AP)(config)# wlan access-rule <access_rule>
(Instant AP)(Access Rule "<access_rule>")# rule <dest> <mask> <match> <protocol> <sport>
<eport> dst-nat ip <IP-address> [<port>]
(Instant AP)(Access Rule "<access_rule>")# end
(Instant AP)# commit apply
```

Configuring ALG Protocols

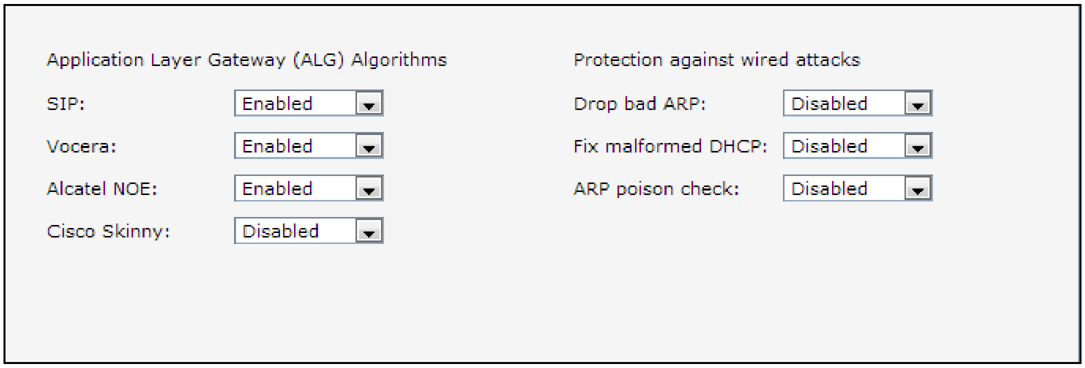
You can enable or disable protocols for Application Layer Gateway (ALG) using the Instant UI or the CLI.

In the Instant UI

To enable or disable ALG protocols:

1. Click the **Security** link located directly above the Search bar on the Instant main window.
2. Click the **Firewall Settings** tab. The **Firewall Settings** tab contents are displayed. The following figure shows the contents of the **Firewall Settings** tab:

Figure 40 *Firewall Settings—ALG Protocols*



Application Layer Gateway (ALG) Algorithms

SIP: Enabled

Vocera: Enabled

Alcatel NOE: Enabled

Cisco Skinny: Disabled

Protection against wired attacks

Drop bad ARP: Disabled

Fix malformed DHCP: Disabled

ARP poison check: Disabled

3. Select **Enabled** from the corresponding drop-down lists to enable SIP, VOCERA, Alcatel NOE, and Cisco Skinny protocols.
4. Click **OK**.

When the protocols for ALG are set to **Disabled**, the changes are not applied until the existing user sessions expire. Reboot the IAP and the client, or wait for a few minutes to view the changes.

In the CLI

To configure protocols for ALG:

```
(Instant AP)(config)# alg
(Instant AP)(ALG)# sccp-disable
(Instant AP)(ALG)# no sip-disable
(Instant AP)(ALG)# no ua-disable
(Instant AP)(ALG)# no vocera-disable
(Instant AP)(ALG)# end
(Instant AP)# commit apply
```

To view the ALG configuration:

```
(Instant AP)# show alg

Current ALG
-----------
ALG      Status
---      ------
sccp     Disabled
sip      Enabled
ua       Enabled
vocera   Enabled
```

Configuring Firewall Settings for Protection from ARP Attacks

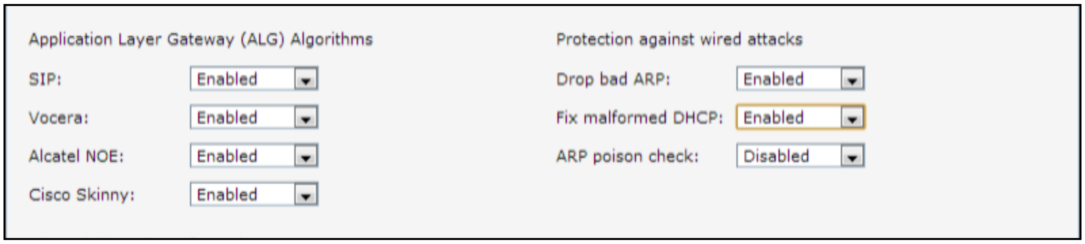
You can configure firewall settings to protect the network against attacks using the Instant UI or the CLI.

In the Instant UI

To configure firewall settings:

1. Click the **Security** link located directly above the Search bar on the Instant main window.
2. Click the **Firewall Settings** tab. The **Firewall Settings** tab contents are displayed.
3. To configure protection against security attacks, select the following check boxes:
   - Select **Drop bad ARP** to enable the IAP to drop the fake ARP packets.
   - Select **Fix malformed DHCP** for the IAP to fix the malformed DHCP packets.
   - Select **ARP poison check** to enable the IAP to trigger an alert notifying the user about the ARP poisoning that may have been caused by the rogue IAPs.

Figure 41 *Firewall Settings —Protection Against Wired Attacks*



Application Layer Gateway (ALG) Algorithms

SIP: Enabled

Vocera: Enabled

Alcatel NOE: Enabled

Cisco Skinny: Enabled

Protection against wired attacks

Drop bad ARP: Enabled

Fix malformed DHCP: Enabled

ARP poison check: Disabled

4. Click **OK.**

In the CLI

To configure firewall settings to prevent attacks:

```
(Instant AP)(config)# attack
(Instant AP)(ATTACK)# drop-bad-arp-enable
(Instant AP)(ATTACK)# fix-dhcp-enable
(Instant AP)(ATTACK)# poison-check-enable
(Instant AP)(ATTACK)# end
(Instant AP)# commit apply
```

To view the configuration status:

```
(Instant AP)# show attack config

Current Attack
--------------
Attack        Status
------        ------
drop-bad-arp  Enabled
fix-dhcp      Enabled
poison-check  Enabled
```

To view the attack statistics

```
(Instant AP)# show attack stats

attack counters
--------------------------------------
Counter                                Value
-------                                -------
arp packet counter                     0
drop bad arp packet counter            0
dhcp response packet counter           0
fixed bad dhcp packet counter          0
send arp attack alert counter          0
send dhcp attack alert counter         0
arp poison check counter               0
garp send check counter                0
```

Configuring Firewall Settings to Disable Auto Topology Rules

By default, the auto topology rules in an IAP are enabled. You can disable the rules by configuring firewall settings in the IAP.

In order to deny auto topology communication outside the IAP subnet, the inbound firewall settings must be enabled.

When the inbound firewall settings are enabled:

- Access Control Entities (ACEs) must be configured to block auto topology messages, as there is no default rule at the top of predefined ACLs.
- ACEs must be configured to override the guest VLAN auto-expanded ACEs. In other words, the user defined ACEs take higher precedence over guest VLAN ACEs.

For more information on inbound firewall settings, see Managing Inbound Traffic.

NOTE

The priority of a particular ACE is determined based on the order in which it is programmed. Ensure that you do not accidentally override the guest VLAN ACEs.

You can change the status of auto topology rules by using the Instant UI or the CLI:

In the Instant UI

1. Click the **Security** located directly above the Search bar in the Instant main window.
2. Go to the **Firewall Settings** tab.
3. In **Firewall** section, select **Disabled** from the **Auto topology rules** drop-down list.
4. Click **OK**.

In the CLI

```
(Instant AP)(config)# firewall
(Instant AP)(firewall)# disable-auto-topology-rules
(Instant AP)(firewall)# end
(Instant AP)# commit apply
```

To view the configuration status:

```
Firewall
--------
Type                 Value
----                 -----
Auto topology rules  disable
```

Managing Inbound Traffic

Instant now supports an enhanced inbound firewall by allowing the configuration of firewall rules and management subnets, and restricting corporate access through an uplink switch.

To allow flexibility in firewall configuration, Instant supports the following features:

- Inbound firewall rules
- Configurable management subnets
- Restricted corporate access

Configuring Inbound Firewall Rules

You can now configure firewall rules for the inbound traffic coming through the uplink ports of an IAP. The rules defined for the inbound traffic are applied if the destination is not a user connected to the IAP. If the destination already has a user role assigned, the user role overrides the actions or options specified in the inbound firewall configuration. However, if a deny rule is defined for the inbound traffic, it is applied irrespective of the destination and user role. Unlike the ACL rules in a WLAN SSID or a wired profile, the inbound firewall rules can be configured based on the source subnet.

For all subnets, a deny rule is created by default as the last rule. If at least one rule is configured, the deny all rule is applied to the upstream traffic by default.

Management access to the IAP is allowed irrespective of the inbound firewall rule. For more information on configuring restricted management access, see Configuring Management Subnets on page 192.

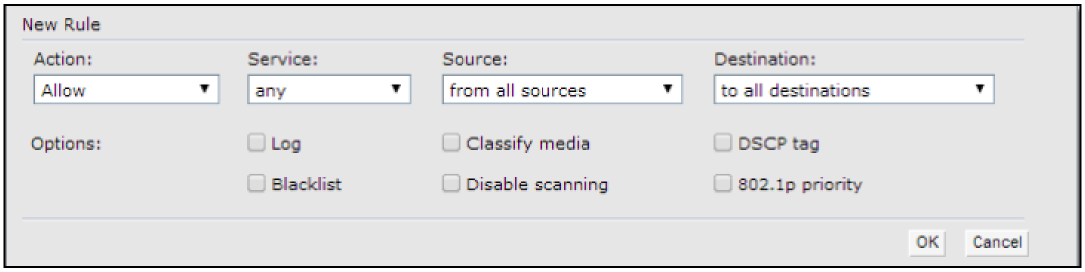
The inbound firewall is not applied to traffic coming through the GRE tunnel.

You can configure inbound firewall rules through the Instant UI or the CLI.

In the Instant UI

1. Navigate to **Security > Inbound Firewall**. The **Inbound Firewall** tab contents are displayed.
2. Under **Inbound Firewall Rules**, click **New**. The **New Rule** window is displayed.

Figure 42 *Inbound Firewall Rules - New Rule Window*



New Rule

Action: Allow

Service: any

Source: from all sources

Destination: to all destinations

Options: □ Log □ Blacklist □ Classify media □ Disable scanning □ DSCP tag □ 802.1p priority

3. Configure the following parameters:

Table 40: *Inbound Firewall Rule Configuration Parameters*

Parameter	Description
Action	Select any of following actions: • Select **Allow** to allow to access users based on the access rule. • Select **Deny** to deny access to users based on the access rule. • Select **Destination-NAT** to allow making changes to the destination IP address. • Select **Source-NAT** to allow making changes to the source IP address. The destination-NAT and source-NAT actions apply only to the network services rules.
Service	Select a service from the list of available services. You can allow or deny access to any or all of the services based on your requirement: • **any**—Access is allowed or denied to all services. • **custom**—Available options are TCP, UDP, and Other. If you select the TCP or UDP options, enter appropriate port numbers. If the **Other** option is selected, ensure that an appropriate ID is entered.
Source	Select any of the following options: • **from all sources**—Traffic from all sources is either allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. • **from a host**—Traffic from a particular host is either allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. After selecting this option, specify the IP address of the host. • **from a network**—Traffic from a particular network is either allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. After selecting this option, specify the IP address and netmask of the source network.
Destination	Select a destination option for the access rules for network services, applications, and application categories. You can allow or deny access to any the following destinations based on your requirements. • **to all destinations**—Traffic for all destinations is allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. • **to a particular server**—Traffic to a specific server is allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. After selecting this option, specify the IP address of the destination server. • **except to a particular server**—Access is allowed or denied to servers other than the specified server. After selecting this option, specify the IP address of the destination server. • **to a network**—Traffic to the specified network is allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. After selecting this option, specify the IP address and netmask for the destination network. • **except to a network**—Access is allowed or denied to networks other than the specified network. After selecting this option, specify the IP address and netmask of the destination network. • **to domain name**—Traffic to the specified domain is allowed, denied, or the IP address is translated at the source or the destination as defined in the rule. After selecting this option, specify the domain name in the **Domain Name** text box.

Table 40: *Inbound Firewall Rule Configuration Parameters*

Parameter	Description
Log	Select the **Log** check box if you want a log entry to be created when this rule is triggered. Instant supports firewall-based logging function. Firewall logs on the IAPs are generated as security logs.
Blacklist	Select the **Blacklist** check box to blacklist the client when this rule is triggered. The blacklisting lasts for the duration specified in the **Auth failure blacklist time** on the **Blacklisting** tab of the **Security** window. For more information, see Blacklisting Clients on page 175.
Classify media	Select the **Classify media** check box to prioritize video and voice traffic. When enabled, a packet inspection is performed on all non-NAT traffic and the traffic is marked as follows: ● Video: Priority 5 (Critical) ● Voice: Priority 6 (Internetwork Control)
Disable scanning	Select **Disable scanning** check box to disable ARM scanning when this rule is triggered. The selection of **Disable scanning** applies only if ARM scanning is enabled. For more information, see Configuring Radio Settings on page 259.
DSCP tag	Select the **DSCP tag** check box to specify a DSCP value to prioritize traffic when this rule is triggered. Specify a value within the range of 0–63. To assign a higher priority, specify a higher value.
802.1p priority	Select the **802.1p priority** check box to specify an 802.1p priority. Specify a value between 0 and 7. To assign a higher priority, specify a higher value.

4. Click **OK** and then click **Finish**.

In the CLI

To configure inbound firewall rules:

```
(Instant AP)(config)# inbound-firewall
(Instant AP)(inbound-firewall)# rule <subnet> <smask> <dest> <mask> <protocol> <sport> <eport>
{permit|deny|src-nat|dst-nat <IP-address> <port>} [<option1....option9>]
(Instant AP)(inbound-firewall)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# inbound-firewall
(Instant AP)(inbound-firewall)# rule 192.0.2.1 255.255.255.255 any any match 6 631 631 permit
(Instant AP)(inbound-firewall)# end
(Instant AP)# commit apply
```

Configuring Management Subnets

You can configure subnets to ensure that the IAP management is carried out only from these subnets. When the management subnets are configured, access through Telnet, SSH, and UI is restricted to these subnets only.

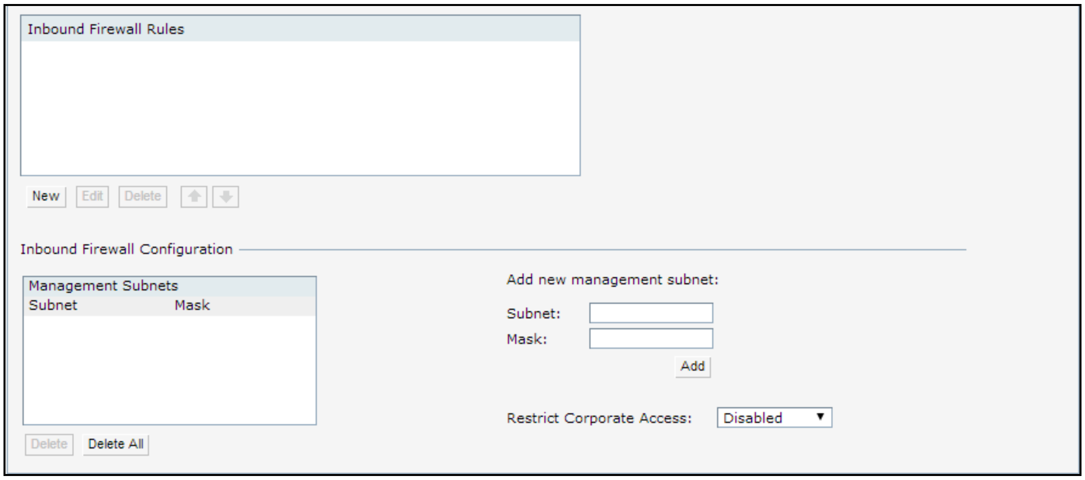
You can configure management subnets by using the Instant UI or the CLI.

In the Instant UI

To configure management subnets:

1. Navigate to **Security > Inbound Firewall**. The **Inbound Firewall** tab contents are displayed.

Figure 43 *Firewall Settings—Management Subnets*



2. To add a new management subnet:
   - In the **Add new management subnet** section, enter the subnet address in **Subnet**.
   - Enter the subnet mask in **Mask.**
   - Click **Add**.
3. To add multiple subnets, repeat step 2.
4. Click **OK**.

In the CLI

To configure a management subnet:

```
(Instant AP)(config) # restricted-mgmt-access <subnet-IP-address> <subnet-mask>
(Instant AP)(config) # end
(Instant AP)# commit apply
```

Configuring Restricted Access to Corporate Network

You can configure restricted corporate access to block unauthorized users from accessing the corporate network. When restricted corporate access is enabled, corporate access is blocked from the uplink port of master IAP, including clients connected to a slave IAP. You can configure restricted corporate access by using the Instant UI or the CLI.

In the Instant UI

To configure restricted corporate access:

1. Navigate to **Security > Inbound Firewall** . The **Inbound Firewall** (see Figure 43) tab contents are displayed.
2. Select **Enabled** from the **Restrict Corporate Access** drop-down list.
3. Click **OK**.

In the CLI

To configure restricted management access:

```
(Instant AP)(config) # restrict-corp-access
(Instant AP)(config) # end
(Instant AP)# commit apply
```

Content Filtering

The content filtering feature allows you to route DNS requests to the OpenDNS platform and create content filtering policies.

With content filter, you can achieve the following:

- Allow all DNS requests to the non-corporate domains on a wireless or wired network to be sent to the OpenDNS server. When the OpenDNS credentials are configured, the IAP uses these credentials to access OpenDNS and provide enterprise-level content filtering. For more information, see Configuring OpenDNS Credentials on page 297.
- Block certain categories of websites based on your organization policy. For example, if you block the **web-based-email** category, clients who are assigned this policy will not be able to visit email-based websites such as mail.yahoo.com.
- Prevent known malware hosts from accessing your wireless network.
- Improve employee productivity by limiting access to certain websites.
- Reduce bandwidth consumption significantly.

NOTE

Regardless of whether content filtering is disabled or enabled, the DNS requests to http://instant.arubanetworks.com are always resolved internally on Instant.

The content filtering configuration applies to all IAPs in the network and the service is enabled or disabled globally across the wireless or wired network profiles.

Enabling Content Filtering

This section describes the following procedures:

- Enabling Content Filtering for a Wireless Profile on page 194
- Enabling Content Filtering for a Wired Profile on page 194

Enabling Content Filtering for a Wireless Profile

To enable content filtering for a wireless SSID, perform the following steps:

In the Instant UI

1. Select a wireless profile in the **Network** tab and then click the **edit** link. The window for editing the WLAN SSID profile is displayed.
2. Click **Show advanced options**.
3. Select **Enabled** from the **Content Filtering** drop-down list, and click **Next** to continue.

You can also enable content filtering while adding a new wireless profile. For more information, see Configuring WLAN Settings for an SSID Profile on page 81.

In the CLI

To enable content filtering on a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# content-filtering
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Enabling Content Filtering for a Wired Profile

To enable content filtering for a wired profile, perform the following steps:

In the Instant UI

1. Click the **Wired** link under **More** in the Instant main window. The **Wired** window is displayed.
2. In the **Wired** window, select the wired profile to modify.
3. Click **Edit**. The **Edit Wired Network** window is displayed.
4. In the **Wired Settings** tab, select **Enabled** from the **Content Filtering** drop-down list, and click **Next** to continue.

In the CLI

To enable content filtering for a wired profile in the CLI:

```
(Instant AP)(config)# wired-port-profile test
(Instant AP)(wired ap profile <name>)# content-filtering
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring Enterprise Domains

The enterprise domain names list displays the DNS domain names that are valid on the enterprise network. This list is used to determine how client DNS requests must be routed. When **Content Filtering** is enabled, the DNS request of the clients is verified and the domain names that do not match the names in the list are sent to the OpenDNS server.

You can configure an enterprise domain through the Instant UI or the CLI.

In the Instant UI

To manually add a domain:

1. Navigate to **System** > **General** and click **Show advanced options** > **Enterprise Domains**. The **Enterprise Domain** tab contents are displayed.
2. Click **New** and enter a **New Domain Name**. Using asterisk (*) as an enterprise domain causes all DNS traffic to go through the tunnel to the original DNS server of clients. If you are configuring routing profile with split-tunnel disabled, you need to add asterisk (*) to the enterprise domain list.
3. Click **OK** to apply the changes.

To delete a domain, select the domain and click **Delete**. This will remove the domain name from the list.

In the CLI

To configure an enterprise domain:

```
(Instant AP)(config)# internal-domains
(Instant AP)(domain)# domain-name <name>
(Instant AP)(domain)# end
(Instant AP)# commit apply
```

Configuring URL Filtering Policies

You can configure URL filtering policies to block certain categories of websites based on your organization specifications by defining ACL rules either through the Instant UI or the CLI.

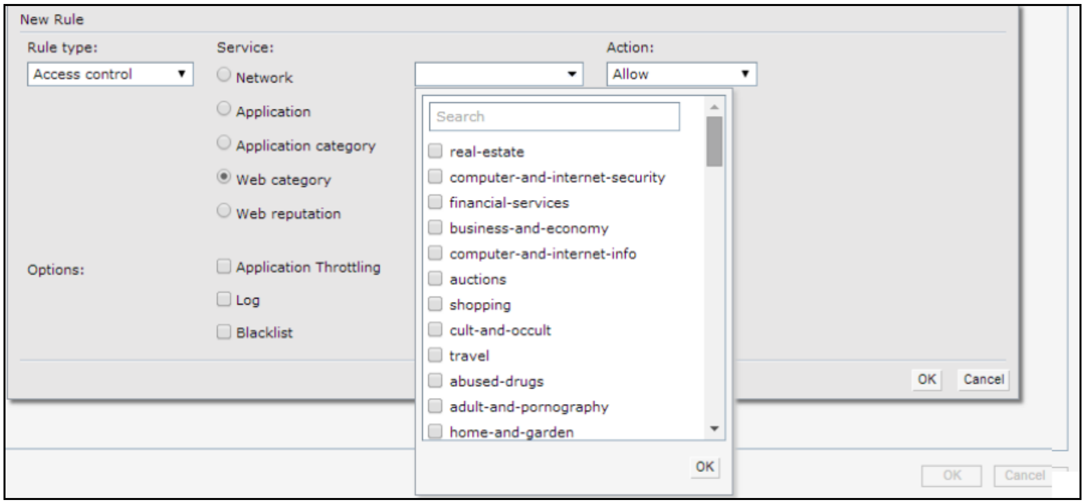
In the Instant UI

To control access based on web categories and security settings:

1. Navigate to **Security** > **Roles**.
2. Select any WLAN SSID or wired profile role, and click **New** in the Access Rules section. The New Rule window appears.
3. Select **Access Control** from the **Rule Type** drop-down list.

4. To set an access policy based on the web category:
   a. Under **Service** section, select **Web category** and expand the **Web categories** drop-down list.

Figure 44 *Roles—New Rule*



New Rule

Rule type: Access control

Service: ● Web category

Action: Allow

   b. Select the categories to which you want to deny or allow access. You can also search for a web category and select the required option.
   c. From the **Action** drop-down list, select **Allow** or **Deny** as required.
   d. Click **OK**.
5. To filter access based on the security ratings of the website:
   a. Select **Web reputation** under **Service** section.
   b. Move the slider to the required security rating level.
   c. From the **Action** drop-down list, select **Allow** or **Deny** as required.
6. To set a bandwidth limit based on web category or web reputation score, select **Application Throttling** check box and specify the downstream and upstream rates in Kbps. For example, you can set a higher bandwidth for trusted sites and a low bandwidth rate for high-risk sites.
7. Click **OK** to save the rules.
8. Click **OK** in the **Roles** tab to save the changes to the role for which you defined ACL rules.

In the CLI

To control access based on web categories and security ratings:

```
(Instant AP)(config)# wlan access-rule <access_rule>
(Instant AP)(Access Rule "<access-rule>")# rule <dest> <mask> <match> webcategory <webgrp>
{permit| deny}[<option1....option9>]
(Instant AP)(Access Rule "<access-rule>")# rule <dest> <mask> <match> webreputation <webrep>
{permit|deny}[<option1....option9>]
(Instant AP)(Access Rule "<access-rule>")# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan access-rule URLFilter
(Instant AP)(Access Rule "URLFilter")# rule any any match webcategory gambling deny
(Instant AP)(Access Rule "URLFilter")# rule any any match webcategory training-and-tools
permit
(Instant AP)(Access Rule "URLFilter")# rule any any match webreputation trustworthy-sites
permit
(Instant AP)(Access Rule "URLFilter")# rule any any match webreputation suspicious-sites deny
(Instant AP)(Access Rule "URLFilter")# end
(Instant AP)# commit apply
```

Creating Custom Error Page for Web Access Blocked by AppRF Policies

You can create a list of URLs to which the users are redirected when they access blocked websites. You can define an access rule to use these redirect URLs and assign the rule to a user role in the WLAN network.

You can create a list of custom URLs and ACL rules for blocked websites either through the Instant UI or the CLI.

Creating a List of Error Page URLs

To create a list of error page URLs:

In the Instant UI

1. Navigate to **Security > Custom Blocked Page URL**.
2. Click **New** and enter the URL that you want to block.
3. Repeat the procedure to add more URLs. You can add up to 8 URLs to the blocked page list.
4. Click **OK**.

In the CLI

```
(Instant AP)(config)# dpi-error-page-url <idx> <url>
(Instant AP)(config)# exit
(Instant AP)# commit apply
```

Configuring ACL Rules to Redirect Blocked HTTP Websites to a Custom Error Page URL

To redirect blocked HTTP websites to a custom error page URL:

In the UI

1. Navigate to **Security > Roles**.
2. Select any WLAN SSID or Wired profile role, and click **New** in the Access Rules section.
3. In the **New Rule** window, select the rule type as **Blocked Page URL**.
4. Select the URLs from the existing list of custom redirect URLs. To add a new URL, click **New**.
5. Click **OK**.
6. Click **OK** in the **Roles** tab to save the changes.

In the CLI

To configure an ACL rule to redirect blocked HTTP websites to a custom error page URL:

```
(Instant AP)(config)# wlan access-rule <access_rule_name>
(Instant AP) (Access Rule "<access_rule_name>")# dpi-error-page-url <idx>
(Instant AP) (Access Rule "<access_rule_name>")# end
(Instant AP)# commit apply
```

Configuring ACL Rules to Redirect Blocked HTTPS Websites to a Custom Blocked Page URL

NOTE

Before you configure an ACL rule for a specific WLAN SSID or Wired profile to redirect HTTPS websites to a custom error page, you must ensure that the Blocked Page URL rule is configured for the HTTP websites blocked for the same WLAN SSID or Wired profile. In this scenario, all the blocked HTTP and HTTPS websites will be redirected to the custom error page URL.

To redirect blocked HTTPS websites to a custom error page URL

In the UI

1. Navigate to **Security > Roles**.
2. Select any WLAN SSID or Wired profile role, and click **New** in the Access Rules section.

3. In the **New Rule** window, select the rule type as **Redirect Blocked HTTPS**.
4. Click **OK**.
5. Click **OK** in the **Roles** tab to save the changes.

In the CLI

To configure an ACL rule to redirect blocked HTTPS to a custom error page URL:

```
(Instant AP)(config)# wlan access-rule <access_rule_name>
(Instant AP) (Access Rule "<access_rule_name>")# dpi-error-page-url <idx>
(Instant AP) (Access Rule "<access_rule_name>")# redirect-blocked-https-traffic
Instant AP) (Access Rule "<access_rule_name>")# end
(Instant AP)# commit apply
```

Configuring User Roles

Every client in the Instant network is associated with a user role that determines the network privileges for a client, the frequency of reauthentication, and the applicable bandwidth contracts.

NOTE

Instant allows you to configure up to 32 user roles. If the number of roles exceed 32, an error message is displayed.

The user role configuration on an IAP involves the following procedures:

- Creating a User Role on page 198
- Assigning Bandwidth Contracts to User Roles on page 199
- Configuring Machine and User Authentication Roles on page 200

Creating a User Role

You can create a user role by using the Instant UI or the CLI.

In the Instant UI

To create a user role:

1. Click the **Security** link located directly above the Search bar in the Instant main window. The **Security** window is displayed.
2. Click the **Roles** tab. The Roles tab contents are displayed.
3. Under Roles, click **New**.
4. Enter a name for the new role and click **OK**.

NOTE

You can also create a user role when configuring wireless or wired network profiles. For more information, see Configuring Access Rules for a WLAN SSID Profile on page 97 and Configuring Access Rules for a Wired Profile on page 110.

In the CLI

To configure user roles and access rules:

```
(Instant AP)(config)# wlan access-rule <access-rule-name>
(Instant AP)(Access Rule <Name>)# rule <dest> <mask> <match> <protocol> <start-port> <end-
port> {permit|deny|src-nat [vlan <vlan_id>|tunnel]|dst-nat {<IP-address> <port>|<port>}}
[<option1…option9>]
```

Assigning Bandwidth Contracts to User Roles

The administrators can manage bandwidth utilization by assigning either maximum bandwidth rates, or bandwidth contracts to user roles. The administrator can assign a bandwidth contract configured in Kbps to upstream (client to the IAP) or downstream (IAP to clients) traffic for a user role. The bandwidth contract will not be applicable to the user traffic on the bridged out (same subnet) destinations. For example, if clients are connected to an SSID, you can restrict the upstream bandwidth rate allowed for each user to 512 Kbps.

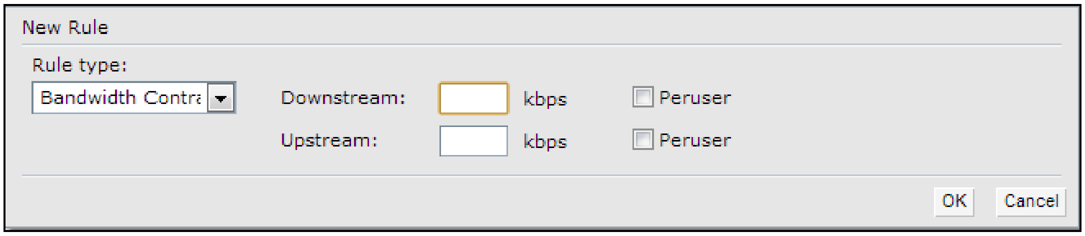
By default, all users that belong to the same role share a configured bandwidth rate for upstream or downstream traffic. The assigned bandwidth will be served and shared among all the users. You can also assign bandwidth rate per user to provide every user a specific bandwidth within a range of 1–65,535 Kbps. If there is no bandwidth contract specified for a traffic direction, unlimited bandwidth is allowed.

NOTE

In the earlier releases, bandwidth contract could be assigned per SSID. In the current release, the bandwidth contract can also be assigned for each SSID user. If the bandwidth contract is assigned for an SSID in the Instant 6.2.1.0-3.4.0.0 version, and when the IAP is upgraded to Instant 6.5.1.0-4.3.1.0 release version, the bandwidth configuration per SSID will be treated as a per-user downstream bandwidth contract for that SSID.

In the Instant UI

1. Click the **Security** link located directly above the Search bar in the Instant main window. The **Security** window is displayed.
2. Click the **Roles** tab. The **Roles** tab contents are displayed.
3. Create a new role (see Creating a User Role on page 198) or select an existing role.
4. Under **Access Rules**, click **New**. The **New Rule** window is displayed.
5. Select **Bandwidth Contract** from the **Rule Type** drop-down list.



New Rule

Rule type: Bandwidth Contra

Downstream: kbps □ Peruser

Upstream: kbps □ Peruser

6. Specify the downstream and upstream rates in Kbps. If the assignment is specific for each user, select the **Peruser** check box.
7. Click **OK**.
8. Associate the user role to a WLAN SSID or a wired profile.

You can also create a user role and assign bandwidth contracts when configuring an SSID or a wired profile.

In the CLI:

To assign a bandwidth contract in the CLI:

```
(Instant AP)(config)# wlan access-rule <name>
(Instant AP) (Access Rule <name>)# bandwidth-limit {downstream <kbps>|upstream <kbps>|peruser
{downstream <kbps>| upstream <kbps>}}
(Instant AP) (Access Rule <name>)# end
(Instant AP) # commit apply
```

To associate the access rule to a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# access-rule-name <access-rule-name>
(Instant AP)(wired ap profile <name>)# end
(Instant AP) # commit apply
```

Configuring Machine and User Authentication Roles

You can assign different rights to clients based on whether their hardware device supports machine authentication. Machine authentication is only supported on Windows devices, so that this can be used to distinguish between Windows devices and other devices such as iPads.

You can create any of the following types of rules:

- **Machine Auth only** role—This indicates a Windows machine with no user logged in. The device supports machine authentication and has a valid RADIUS account, but a user has not yet logged in and authenticated.
- **User Auth only** role—This indicates a known user or a non-Windows device. The device does not support machine authentication or does not have a RADIUS account, but the user is logged in and authenticated.

When a device does both machine and user authentication, the user obtains the default role or the derived role based on the RADIUS attribute.

You can configure machine authentication with role-based access control using the Instant UI or the CLI.

In the Instant UI

To configure machine authentication with role-based access control:

1. In the **Access** tab of the WLAN wizard (**New WLAN** or **Edit <WLAN-profile>**) or in the wired profile configuration window (**New Wired Network** or **Edit Wired Network**), under **Roles**, create **Machine auth only** and **User auth only** roles.
2. Configure access rules for these roles by selecting the role, and applying the rule. For more information on configuring access rules, see Configuring ACL Rules for Network Services on page 181.
3. Select **Enforce Machine Authentication** and select the **Machine auth only** and **User auth only** roles.
4. Click **Finish** to apply these changes.

In the CLI

To configure machine and user authentication roles for a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role-machine-auth <machine_only> <user_only>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure machine and user authentication roles for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(wired ap profile <name>)# set-role-machine-auth <machine_only> <user_only>
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Configuring Derivation Rules

Instant allows you to configure role and VLAN derivation-rules. You can configure these rules to assign a user role or a VLAN to the clients connecting to an SSID or a wired profile.

Understanding Role Assignment Rule

When an SSID or a wired profile is created, a default role for the clients connecting to this SSID or wired profile is assigned. You can assign a user role to the clients connecting to an SSID by any of the following methods. The role assigned by some methods may take precedence over the roles assigned by the other methods.

RADIUS VSA Attributes

The user role can be derived from Aruba Vendor-Specific Attributes (VSA) for RADIUS server authentication. The role derived from an Aruba VSA takes precedence over roles defined by other methods.

MAC-Address Attribute

The first three octets in a MAC address are known as Organizationally Unique Identifier (OUI), and are purchased from the Institute of Electrical and Electronics Engineers, Incorporated (IEEE) Registration Authority. This identifier uniquely identifies a vendor, manufacturer, or other organization (referred to by the IEEE as the "assignee") globally and effectively reserves a block of each possible type of derivative identifier (such as MAC addresses) for the exclusive use of the assignee.

IAPs use the OUI part of a MAC address to identify the device manufacturer and can be configured to assign a desired role for users who have completed 802.1X authentication and MAC authentication. The user role can be derived from the user attributes after a client associates with an IAP. You can configure rules to assign a user role to clients that match a MAC-address-based criteria. For example, you can assign a voice role to any client with a MAC address starting with a0:a1:a2.

Roles Based on Client Authentication

The user role can be the default user role configured for an authentication method, such as 802.1X authentication. For each authentication method, you can configure a default role for the clients who are successfully authenticated using that method.

DHCP Option and DHCP Fingerprinting

The DHCP fingerprinting allows you to identify the operating system of a device by looking at the options in the DHCP frame. Based on the operating system type, a role can be assigned to the device.

For example, to create a role assignment rule with the DHCP option, select **equals** from the **Operator** drop-down list and enter 370103060F77FC in the **String** text box. Since 370103060F77FC is the fingerprint for Apple iOS devices such as iPad and iPhone, IAP assigns Apple iOS devices to the role that you choose.

Table 41: *Validated DHCP Fingerprint*

Device	DHCP Option	DHCP Fingerprint
Apple iOS	Option 55	370103060F77FC
Android	Option 60	3C64686370636420342E302E3135
Blackberry	Option 60	3C426C61636B4265727279
Windows 7/Vista Desktop	Option 55	37010f03062c2e2f1f2179f92b
Windows XP (SP3, Home, Professional)	Option 55	37010f03062c2e2f1f21f92b
Windows Mobile	Option 60	3c4d6963726f736f66742057696e646f777320434500
Windows 7 Phone	Option 55	370103060f2c2e2f
Apple Mac OS X	Option 55	370103060f775ffc2c2e2f

Creating a Role Derivation Rule

You can configure rules for determining the role that is assigned for each authenticated client.

NOTE

When creating more than one role assignment rule, the first matching rule in the rule list is applied.

You can create a role assignment rule by using the Instant UI or the CLI.

In the Instant UI

1. Navigate to the WLAN wizard or the Wired settings window:
   - To configure access rules for a WLAN SSID, in the **Network** tab, click **New** to create a new network profile or **edit** to modify an existing profile.
   - To configure access rules for a wired profile, go to **More > Wired**. In the **Wired** window, click **New** under **Wired Networks** to create a new network or click **Edit** to select an existing profile.
2. Click the **Access** tab.
3. Under **Role Assignment Rules**, click **New**. The **New Role Assignment** window allows you to define a match method by which the string in *Operand* is matched with the attribute value returned by the authentication server.
4. Select the attribute that matches with the rule from the **Attribute** drop-down list. The list of supported attributes includes RADIUS attributes, dhcp-option, dot1x-authentication-type, mac-address, and mac-address-and-dhcp-options. For information on a list of RADIUS attributes, see RADIUS Server Authentication with VSA on page 150.
5. Select the operator from the **Operator** drop-down list. The following types of operators are supported:
   - **contains**—The rule is applied only if the attribute value contains the string specified in *Operand*.
   - **Is the role**—The rule is applied if the attribute value is the role.
   - **equals**—The rule is applied only if the attribute value is equal to the string specified in *Operand*.
   - **not-equals**—The rule is applied only if the attribute value is not equal to the string specified in *Operand*.
   - **starts-with**—The rule is applied only if the attribute value starts with the string specified in *Operand*.
   - **ends-with**—The rule is applied only if the attribute value ends with the string specified in *Operand*.
   - **matches-regular-expression**—The rule is applied only if the attribute value matches the regular expression pattern specified in *Operand*. This operator is available only if the **mac-address-and-dhcp-options** attribute is selected in the **Attribute** drop-down list. The **mac-address-and-dhcp-options** attribute and **matches-regular-expression** are applicable only for the WLAN clients.
6. Enter the string to match the attribute in the **String** text box.
7. Select the appropriate role from the **Role** drop-down list.
8. Click **OK**.

NOTE

When **Enforce Machine Authentication** is enabled, both the device and the user must be authenticated for the role assignment rule to apply.

In the CLI

To configure role assignment rules for a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role <attribute>{{equals|not-equals|starts-with|ends-
with|contains|matches-regular-expression} <operator><role>|value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure role assignment rules for a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
```

```
(Instant AP)(wired ap profile <name>)# set-role <attribute>{{equals|not-equal|starts-with|
ends-with|contains}<operator> <role>|value-of}
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan ssid-profile Profile1
(Instant AP)(SSID Profile "Profile1")# set-role mac-address-and-dhcp-options matches-regular-
expression \bring\b Profile1
(Instant AP)(SSID Profile"Profile1")# end
(Instant AP)# commit apply
```

Understanding VLAN Assignment

You can assign VLANs to a client based on the following configuration conditions:

- The default VLAN configured for the WLAN can be assigned to a client.
- If VLANs are configured for a WLAN SSID or an Ethernet port profile, the VLAN for the client can be derived before the authentication, from the rules configured for these profiles.
- If a rule derives a specific VLAN, it is prioritized over the user roles that may have a VLAN configured.
- The user VLANs can be derived from the default roles configured for 802.1X authentication or MAC authentication.
- After client authentication, the VLAN can be derived from Vendor-Specific Attributes (VSA) for RADIUS server authentication.
- The DHCP-based VLANs can be derived for captive portal authentication.

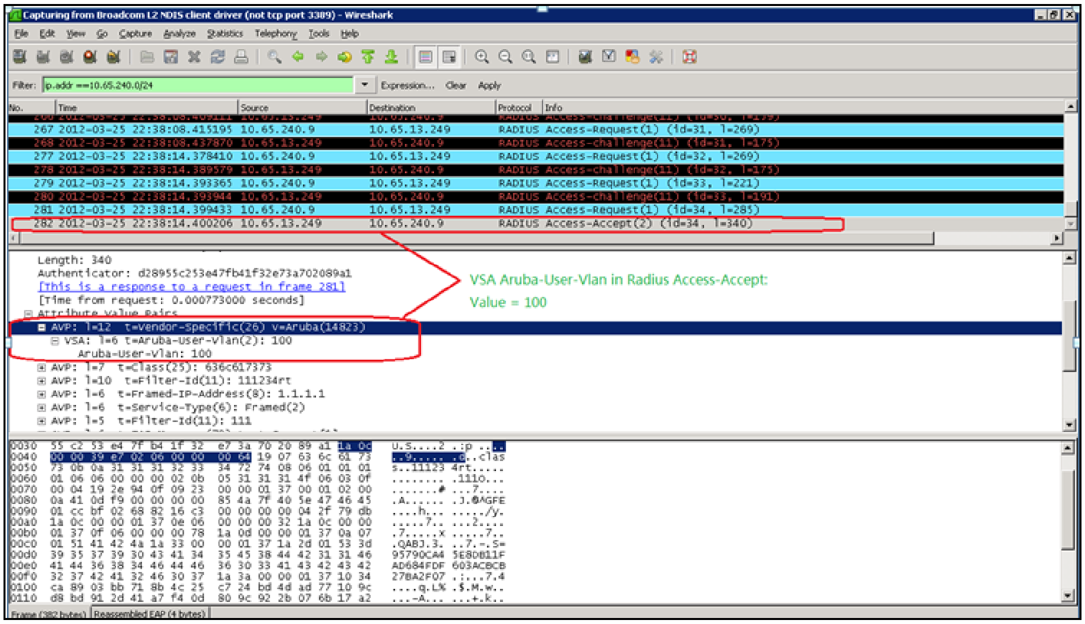
NOTE

Instant supports role derivation based on the DHCP option for captive portal authentication. When the captive portal authentication is successful, the role derivation based on the DHCP option assigns a new user role to the guest users, instead of the pre-authenticated role.

Vendor-Specific Attributes

When an external RADIUS server is used, the user VLAN can be derived from the **Aruba-User-Vlan** VSA. The VSA is then carried in an *Access-Accept* packet from the RADIUS server. The IAP can analyze the return message and derive the value of the VLAN which it assigns to the user.

Figure 45 *RADIUS Access-Accept Packets with VSA*


Capturing from Broadcom L2 NDIS client driver (not tcp port 3389) - Wireshark
File Edit View Go Capture Analyze Statistics Telephony Tools Help
Filter: ip.addr ==10.65.240.0/24
Expression... Clear Apply
No. Time Source Destination Protocol Info
Frame (382 bytes) Reassembled EAP (4 bytes)

```
267 2012-03-25 22:38:08.415195 10.65.240.9    10.65.13.249   RADIUS Access-Request(1) (id=31, l=269)
268 2012-03-25 22:38:08.437870 10.65.13.249   10.65.240.9    RADIUS Access-challenge(11) (id=31, l=175)
277 2012-03-25 22:38:14.378410 10.65.240.9    10.65.13.249   RADIUS Access-Request(1) (id=32, l=269)
278 2012-03-25 22:38:14.389579 10.65.13.249   10.65.240.9    RADIUS Access-challenge(11) (id=32, l=175)
279 2012-03-25 22:38:14.393365 10.65.240.9    10.65.13.249   RADIUS Access-Request(1) (id=33, l=221)
280 2012-03-25 22:38:14.393944 10.65.13.249   10.65.240.9    RADIUS Access-challenge(11) (id=33, l=191)
281 2012-03-25 22:38:14.399433 10.65.240.9    10.65.13.249   RADIUS Access-Request(1) (id=34, l=285)
282 2012-03-25 22:38:14.400206 10.65.13.249   10.65.240.9    RADIUS Access-Accept(2) (id=34, l=340)
```

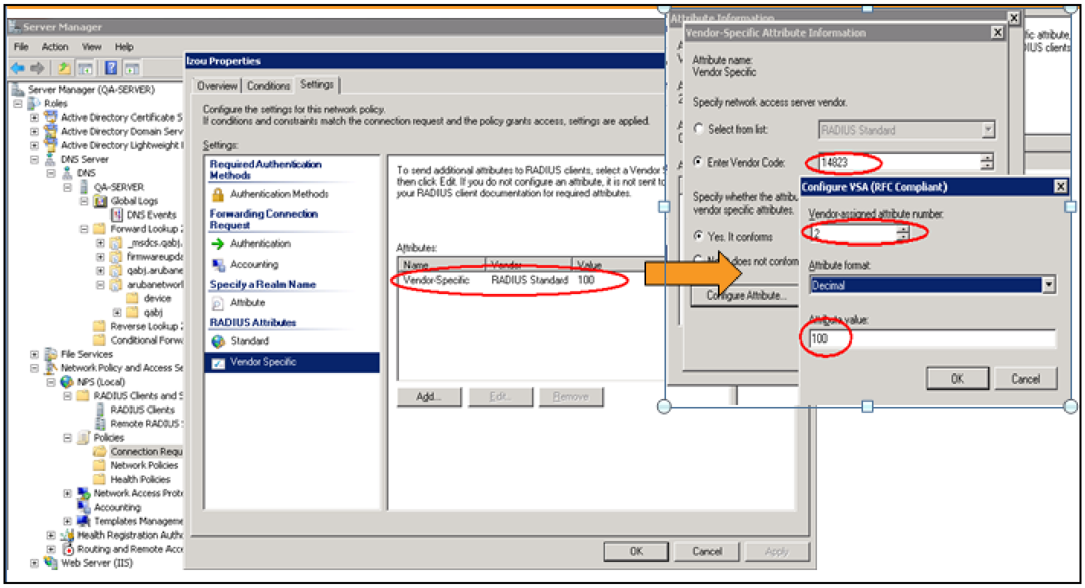
```
    Length: 340
    Authenticator: d28955c253e47fb41f32e73a702089a1
    [This is a response to a request in frame 281]
    [Time from request: 0.000773000 seconds]
  ⊟ Attribute Value Pairs
    ⊟ AVP: l=12  t=Vendor-Specific(26) v=Aruba(14823)
      ⊟ VSA: l=6 t=Aruba-User-Vlan(2): 100
          Aruba-User-Vlan: 100
    ⊞ AVP: l=7  t=Class(25): 636c617373
    ⊞ AVP: l=10  t=Filter-Id(11): 111234rt
    ⊞ AVP: l=6  t=Framed-IP-Address(8): 1.1.1.1
    ⊞ AVP: l=6  t=Service-Type(6): Framed(2)
    ⊞ AVP: l=5  t=Filter-Id(11): 111
```

VSA Aruba-User-Vlan in Radius Access-Accept:

Value = 100

```
0030  55 c2 53 e4 7f b4 1f 32  e7 3a 70 20 89 a1 1a 0c   U.S....2 .:p ....
0040  00 00 39 e7 02 06 00 00  00 64 19 07 63 6c 61 73   ..9..... .d..clas
0050  73 0b 0a 31 31 31 32 33  34 72 74 08 06 01 01 01   s..11123 4rt.....
0060  01 06 06 00 00 00 02 0b  05 31 31 31 4f 06 03 0f   ........ .111o...
0070  00 04 19 2e 94 0f 09 23  00 00 01 37 00 01 02 00   .......# ...7....
0080  0a 41 0d f9 00 00 00 00  85 4a 7f 40 5e 47 46 45   .A...... .J.@^GFE
0090  01 cc bf 02 68 82 16 c3  00 00 00 00 04 2f 79 db   ....h... ...../y.
00a0  1a 0c 00 00 01 37 0e 06  00 00 00 32 1a 0c 00 00   .....7.. ...2....
00b0  01 37 0f 06 00 00 00 78  1a 0d 00 00 01 37 0a 07   .7.....x .....7..
00c0  01 51 41 42 4a 1a 33 00  00 01 37 1a 2d 01 53 3d   .QABJ.3. ..7.-.S=
00d0  39 35 37 39 30 43 41 34  35 45 38 44 42 31 31 46   95790CA4 5E8DB11F
00e0  41 44 36 38 34 46 44 46  36 30 33 41 43 42 43 42   AD684FDF 603ACBCB
00f0  32 37 42 41 32 46 30 37  1a 3a 00 00 01 37 10 34   27BA2F07 .:...7.4
0100  ca 89 03 bb 71 8b 4c 25  c7 24 bd 4d ad 77 10 9c   ....q.L% .$.M.w..
0110  d8 bd 91 2d 41 a7 f4 0d  80 9c 92 2b 07 6b 17 a2   ...-A... ...+.k..
```

Figure 46 *Configure VSA on a RADIUS Server*



Izou Properties

Configure the settings for this network policy.
If conditions and constraints match the connection request and the policy grants access, settings are applied.

Settings:

To send additional attributes to RADIUS clients, select a Vendor S then click Edit. If you do not configure an attribute, it is not sent to your RADIUS client documentation for required attributes.

Attributes:

Name	Vendor	Value
Vendor-Specific	RADIUS Standard	100

Attribute Information

Vendor-Specific Attribute Information

Attribute name:
Vendor Specific

Specify network access server vendor.

○ Select from list: RADIUS Standard

● Enter Vendor Code: 14823

Specify whether the attribu vendor specific attributes.

● Yes. It conforms

○ No. It does not conform

Configure VSA (RFC Compliant)

Vendor-assigned attribute number: 2

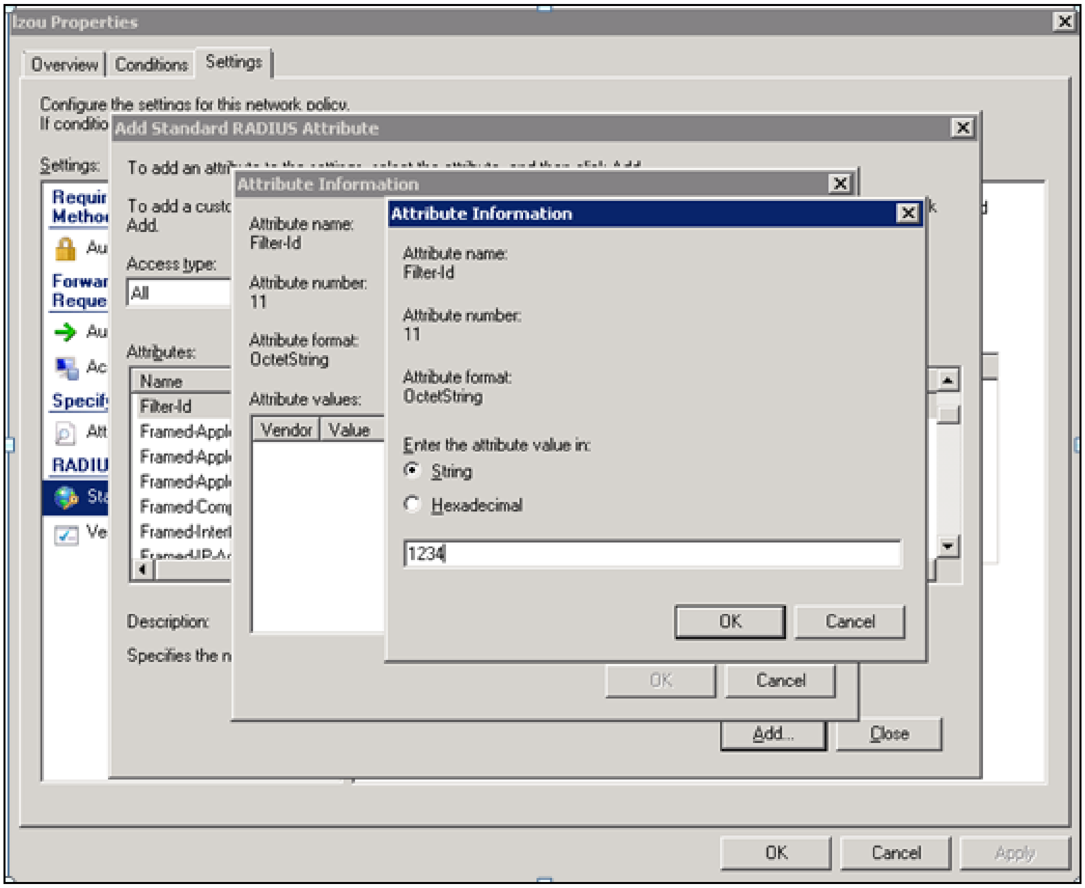
Attribute format: Decimal

Attribute value: 100

VLAN Assignment Based on Derivation Rules

When an external RADIUS server is used for authentication, the RADIUS server may return a reply message for authentication. If the RADIUS server supports return attributes, and sets an attribute value to the reply message, the IAP can analyze the return message and match attributes with a user pre-defined VLAN derivation rule. If the rule is matched, the VLAN value defined by the rule is assigned to the user. For a complete list of RADIUS server attributes, see RADIUS Server Authentication with VSA on page 150.

Figure 47 *Configuring RADIUS Attributes on the RADIUS Server*



Izou Properties

Configure the settings for this network policy.
If conditio

Settings:

Add Standard RADIUS Attribute

To add an attribute to the settings, select the attribute, and then click Add.

To add a custo Add.

Access type: All

Attributes:

Description:

Specifies the n

Attribute Information

Attribute name:
Filter-Id

Attribute number:
11

Attribute format:
OctetString

Attribute values:

Attribute Information

Attribute name:
Filter-Id

Attribute number:
11

Attribute format:
OctetString

Enter the attribute value in:

● String

○ Hexadecimal

1234

User Role

If the VSA and VLAN derivation rules are not matching, then the user VLAN can be derived by a user role.

VLANs Created for an SSID

If the VSA and VLAN derivation rules are not matching, and the User Role does not contain a VLAN, the user VLAN can be derived by VLANs configured for an SSID or an Ethernet port profile.

Configuring VLAN Derivation Rules

The VLAN derivation rules allow administrators to assign a VLAN to the IAP clients based on the attributes returned by the RADIUS server.

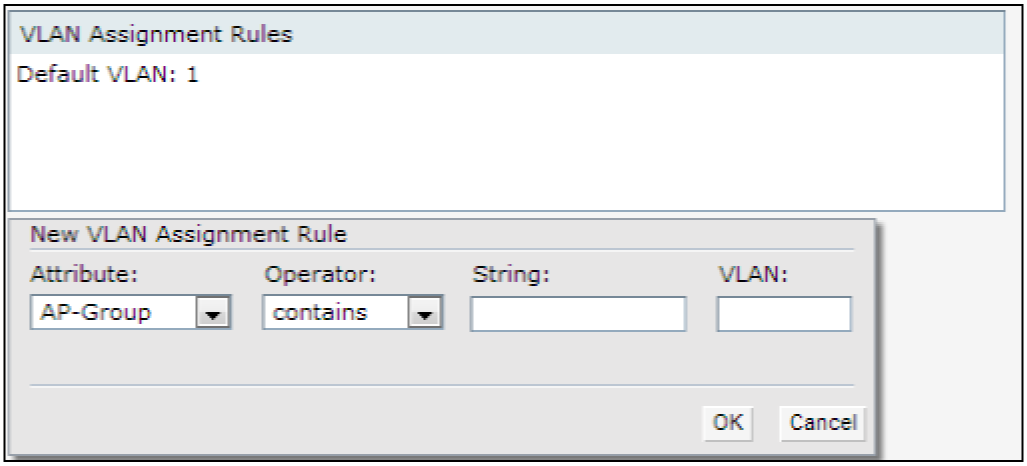
You can configure VLAN derivation rules for an SSID profile by using the Instant UI or the CLI.

In the Instant UI

To configure VLAN derivation rules:

1. Perform the following steps:
   - To configure VLAN derivation rule for a WLAN SSID profile, navigate to **Network > New > New WLAN > VLAN** or **Network > edit > Edit <WLAN-profile> > VLAN**. Select the **Dynamic** option under the **Client VLAN assignment**.
   - To configure VLAN derivation rule for a wired network profile, navigate to **Wired > New > New Wired Network > VLAN** or **Wired > Edit > Edit Wired Network > VLAN**. The **VLAN** tab contents are displayed.
2. Click **New** to create a VLAN assignment rule. The **New VLAN Assignment Rule** window is displayed. In this window, you can define a match method by which the string in *Operand* is matched with the attribute values returned by the authentication server.

Figure 48 *VLAN Assignment Rule Window*



VLAN Assignment Rules

Default VLAN: 1

New VLAN Assignment Rule

Attribute: AP-Group

Operator: contains

String:

VLAN:

3. Select the attribute from the **Attribute** drop-down list. The list of supported attributes includes RADIUS attributes, dhcp-option, dot1x-authentication-type, mac-address, and mac-address-and-dhcp-options. For information on a list of RADIUS attributes, see RADIUS Server Authentication with VSA on page 150.
4. Select the operator from the **Operator** drop-down list. The following types of operators are supported:
   - **contains**—The rule is applied only if the attribute value contains the string specified in *Operand*.
   - **Is the VLAN**—The rule is applied if the VLAN is the same as the one returned by the RADIUS attribute.
   - **equals**—The rule is applied only if the attribute value is equal to the string specified in *Operand*.
   - **not-equals**—The rule is applied only if the attribute value is not equal to the string specified in *Operand*.
   - **starts-with**—The rule is applied only if the attribute value starts with the string specified in *Operand*.

- **ends-with**—The rule is applied only if the attribute value ends with the string specified in *Operand*.

5. Enter the string to match the attribute in the **String** text box.
6. Select the appropriate VLAN ID from the **VLAN** drop-down list.
7. Click **OK**.
8. Ensure that the required security and access parameters are configured.
9. Click **Finish** to apply the changes.

In the CLI

To create a VLAN assignment rule for a WLAN SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-vlan <attribute>{equals|not-equals|starts-with|ends-
with|contains}<operator><VLAN-ID>|value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

To configure a VLAN assignment rule for a wired profile:

```
(Instant AP)(config)# wired-port-profile <nname>
(Instant AP)(wired ap profile <name>)# set-vlan <attribute>{equals|not-equals|starts-
with|ends-with|contains}<operator><VLAN-ID>|value-of}
(Instant AP)(wired ap profile <name>)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# wlan ssid-profile Profile1
(Instant AP)(SSID Profile "Profile1")# set-vlan mac-address-and-dhcp-options matches-regular-
expression ..link 100
(Instant AP)(SSID Profile "Profile1")# end
(Instant AP)# commit apply
```

Using Advanced Expressions in Role and VLAN Derivation Rules

For complex policies of role and VLAN derivation using device DHCP fingerprints, you can use a regular expression to match with the combined string of the MAC address and the DHCP options. The combined string is formed by concatenating the hexadecimal presentation of the MAC address and all of the DHCP options sent by a particular device. The regular expression is a powerful pattern description language that can be used to perform advanced pattern matching of the above string.

If the combined device fingerprint string matches the specified regular expression, the role or VLAN can be set to the WLAN client.

The following table lists some of the most commonly used regular expressions, which can be used in user role and user VLAN derivation rules:

Table 42: *Regular Expressions*

Operator	Description
.	Matches any character. For example, l..k matches lack, lark, link, lock, look, Lync, and so on.
\	Matches the character that follows the backslash. For example, \192.\.0\.. matches IP address ranges that start with 192.0, such as 192.0.1.1. The expression looks up only for the single characters that match.
[ ]	Matches any one character listed between the brackets. For example, [bc]lock matches block and clock.
\b	Matches the words that begin and end with the given expression. For example, \bdown matches downlink, linkdown, shutdown.
\B	Matches the middle of a word. For example, \Bvice matches services, devices, serviceID, deviceID, and so on.
^	Matches the characters at starting position in a string. For example, ^bcd matches bcde or bcdf, but not abcd.
[^]	Matches any characters that are not listed between the brackets. For example, [^u]link matches downlink, link, but not uplink.
?	Matches any one occurrence of the pattern. For example, ?est matches best, nest, rest, test, and so on.
$	Matches the end of an input string. For example, eth$ matches Eth, but not Ethernet.
*	Matches the declared element multiple times if it exists. For example, eth* matches all occurrences of eth, such as Eth, Ethernet, Eth0, and so on.
+	Matches the declared element one or more times. For example, aa+ matches occurrences of aa and aaa.
( )	Matches nested characters. For example, (192)* matches any number of the character string 192.
|	Matches the character patterns on either side of the vertical bar. You can use this expression to construct a series of options.
\<	Matches the beginning of the word. For example, \<wire matches wired, wireless, and so on.
\>	Matches the end of the word. For example, \>list matches blacklist, whitelist, and so on.
{n}	Where n is an integer. Matches the declared element exactly n times. For example, {2}link matches uplink, but not downlink.
{n,}	Where n is an integer. Matches the declared element at n times. For example, {2,}ink matches downlink, but not uplink.

For information on how to use regular expressions in role and VLAN derivation rules, see the following topics:

- Creating a Role Derivation Rule on page 201
- Configuring VLAN Derivation Rules on page 205

Configuring a User Role for VLAN Derivation

This section describes the following procedures:

- Creating a User VLAN Role on page 208
- Assigning User VLAN Roles to a Network Profile on page 208

Creating a User VLAN Role

You can create a user role for VLAN derivation using the Instant UI or the CLI.

In the Instant UI

To configure a user role for VLAN derivation:

1. Click the **Security** link located directly above the Search bar in the Instant main window.
2. Click the **Roles** tab. The Roles tab contents are displayed.
3. Under **Roles**, click **New**.
4. Enter a name for the new role and click **OK**.
5. Under **Access rules**, click **New**.
6. Select the **Rule type** as **VLAN assignment**.
7. Enter the ID of the VLAN in the **VLAN ID** text box.
8. Click **OK**.

In the CLI

To create a VLAN role:

```
(Instant AP)(config)# wlan access-rule <rule-name>
(Instant AP)(Access Rule <rule-name>)# vlan 200
(Instant AP)(Access Rule <rule-name>)# end
(Instant AP)# commit apply
```

Assigning User VLAN Roles to a Network Profile

You can configure user VLAN roles for a network profile using Instant UI or the CLI.

In the Instant UI

To assign a user VLAN role:

1. Click **Network > New > New WLAN > Access** or click **Network > edit > Edit <WLAN-profile> > Access**.
2. On the **Access** tab, ensure that the slider is at the **Role-based** option.
3. Click **New** under the **New Role Assignment** and configure the following parameters:
   a. Select the attribute from the **Attribute** drop-down list.
   b. Select the operator to match attribute from the **Operator** drop-down list.
   c. Enter the string to match in the **String** text box.
   d. Select the role to be assigned from the **Role** text box.
4. Click **OK**.

In the CLI

To assign VLAN role to a WLAN profile:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role <attribute>{{equals <operator> <role>|not-equals
<operator> <role>|starts-with <operator> <role>|ends-with <operator> <role>|contains
<operator> <role>}|value-of}
(Instant AP)(SSID Profile <name>)# end
```

```
(Instant AP)# commit apply
```

This chapter provides the following information:

Configuring DHCP Scopes

The VC supports different modes of Dynamic Host Configuration Protocol (DHCP) address assignment. With each DHCP address assignment mode, various client traffic forwarding modes are associated. For more information on client traffic forwarding modes for IAP-VPN, see IAP-VPN Forwarding Modes on page 242.

NOTE

When using a local DHCP scope in an IAP cluster, ensure that the VLANs configured for this DHCP scope is allowed in the uplink switch.

In a single IAP network, when using a client DHCP scope for wired clients, ensure that client VLAN is not added in the allowed VLAN list for the port to which the IAP E0 port is connected.

This section describes the following procedures:

Configuring Local DHCP Scopes

You can configure Local; Local, L2; and Local, L3 DHCP scopes through the Instant UI or the CLI.

- **Local**—In this mode, the VC acts as both the DHCP server and the default gateway. The configured subnet and the corresponding DHCP scope are independent of the subnets configured in other IAP clusters. The VC assigns an IP address from a local subnet and forwards traffic to both **corporate** and **non-corporate** destinations. The network address is translated appropriately and the packet is forwarded through the IPsec tunnel or through the uplink. This DHCP assignment mode is used in the Networks Address Translation (NAT) forwarding mode.
- **Local, L2**—In this mode, the VC acts as a DHCP server and the gateway located outside the IAP.
- **Local, L3**—This DHCP assignment mode is used with the L3 forwarding mode. In this mode, the VC acts as a DHCP server and the gateway, and assigns an IP address from the local subnet. The IAP routes the packets sent by clients on its uplink. The Local, L3 subnets can access corporate network through the IPsec tunnel. The network address for all client traffic, which is generated in the Local, L3 subnets and destined to the corporate network, is translated at the source with the tunnel inner IP. However, if corporate access to Local, L3 is not required, you can configure ACL rules to deny access.

In the Instant UI

To configure a Local or a Local, L3 DHCP scope:

1. Click **More > DHCP Server**. The **DHCP Server** window is displayed.
2. To configure a **Local**; **Local, L2**; or **Local, L3** DHCP scopes, click **New** under **Local DHCP Scopes**. The **New DHCP Scope** window is displayed.
3. Based on the type of DHCP scope selected, configure the following parameters:

Table 43: *Local DHCP Mode Configuration Parameters*

Parameter	Description
Name	Enter a name for the DHCP scope.
Type	Select any of the following options: - **Local**—On selecting **Local**, the DHCP server for local branch network is used for keeping the scope of the subnet local to the IAP. In the NAT mode, the traffic is forwarded through the IPsec tunnel or the uplink. - **Local, L2**—On selecting **Local, L2**, the VC acts as a DHCP server and a default gateway in the local network that is used. - **Local, L3**—On selecting **Local, L3**, the VC acts as a DHCP server and a gateway. In this mode, the network address for traffic destined to the corporate network is translated at the source with the inner IP of the IPsec tunnel and is forwarded through the IPsec tunnel. The traffic destined to the non-corporate network is routed.
VLAN	Specify a VLAN ID. To use this subnet, ensure that the VLAN ID specified here is assigned to an SSID profile. For more information on SSID profile configuration, see Configuring VLAN Settings for a WLAN SSID Profile on page 86 and Configuring VLAN for a Wired Profile on page 108.
Network	Specify the network to use.
Netmask	If **Local**; **Local, L2**; or **Local, L3** is selected, specify the subnet mask. The subnet mask and the network determine the size of the subnet.
Excluded address	Specify a range of IP addresses to exclude. You can add up to two exclusion ranges. Based on the size of the subnet and the value configured for **Excluded address**, the IP addresses either before or after the defined range are excluded.
Default Router	If **Local, L2** is selected for type of DHCP scope, specify the IP address of the default router.
DNS Server	If required, specify the IP address of a DNS server for the **Local**; **Local, L2**; and **Local, L3** scopes.
Domain Name	If required, specify the domain name for the **Local**; **Local, L2**; and **Local, L3** scopes.
Lease Time	Specify a lease time for the client in minutes within a range of 2–1440 minutes. The default value is 720 minutes.
Option	Specify the type and a value for the DHCP option. You can configure the organization-specific DHCP options supported by the DHCP server. For example, 176, 242, and 161. To add multiple DHCP options, click the + icon.

4. Click **OK**.

In the CLI

To configure a Local DHCP scope:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# server-type <local>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
```

```
(Instant AP)(DHCP Profile <profile-name>)# subnet <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# subnet-mask <subnet-mask>
(Instant AP)(DHCP Profile <profile-name>)# dns-server <name>
(Instant AP)(DHCP Profile <profile-name>)# domain-name <domain-name>
(Instant AP)(DHCP Profile <profile-name>)# lease-time <seconds>
(Instant AP)(DHCP Profile <profile-name>)# option <type> <value>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

To configure a Local, L2 DHCP scope:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# server-type <local,l2>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# subnet <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# subnet-mask <subnet-mask>
(Instant AP)(DHCP Profile <profile-name>)# exclude-address <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# default-router
(Instant AP)(DHCP Profile <profile-name>)# dns-server <name>
(Instant AP)(DHCP Profile <profile-name>)# domain-name <domain-name>
(Instant AP)(DHCP Profile <profile-name>)# lease-time <seconds>
(Instant AP)(DHCP Profile <profile-name>)# option <type> <value>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

To configure a Local, L3 DHCP scope:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# server-type <local,l3>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# subnet <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# subnet-mask <subnet-mask>
(Instant AP)(DHCP Profile <profile-name>)# exclude-address <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# dns-server <name>
(Instant AP)(DHCP Profile <profile-name>)# domain-name <domain-name>
(Instant AP)(DHCP Profile <profile-name>)# lease-time <seconds>
(Instant AP)(DHCP Profile <profile-name>)# option <type> <value>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

Configuring Distributed DHCP Scopes

Instant allows you to configure the DHCP address assignment for the branches connected to the corporate network through Virtual Private Network (VPN). You can configure the range of DHCP IP addresses used in the branches and the number of client addresses allowed per branch. You can also specify the IP addresses that must be excluded from those assigned to clients, so that they are assigned statically.

Instant supports the following distributed DHCP scopes:

- **Distributed, L2—**In this mode, the VC acts as the DHCP server, but the default gateway is in the data center. Based on the number of clients specified for each branch, the range of IP addresses is divided. Based on the IP address range and client count configuration, the DHCP server in the VC controls a scope that is a subset of the complete IP address range for the subnet distributed across all the branches. This DHCP assignment mode is used with the L2 forwarding mode.
- **Distributed, L3**—In this mode, the VC acts as the DHCP server and the default gateway. Based on the number of clients specified for each branch, the range of IP addresses is divided. Based on the IP address range and client count configuration, the DHCP server in the VC is configured with a unique subnet and a corresponding scope.

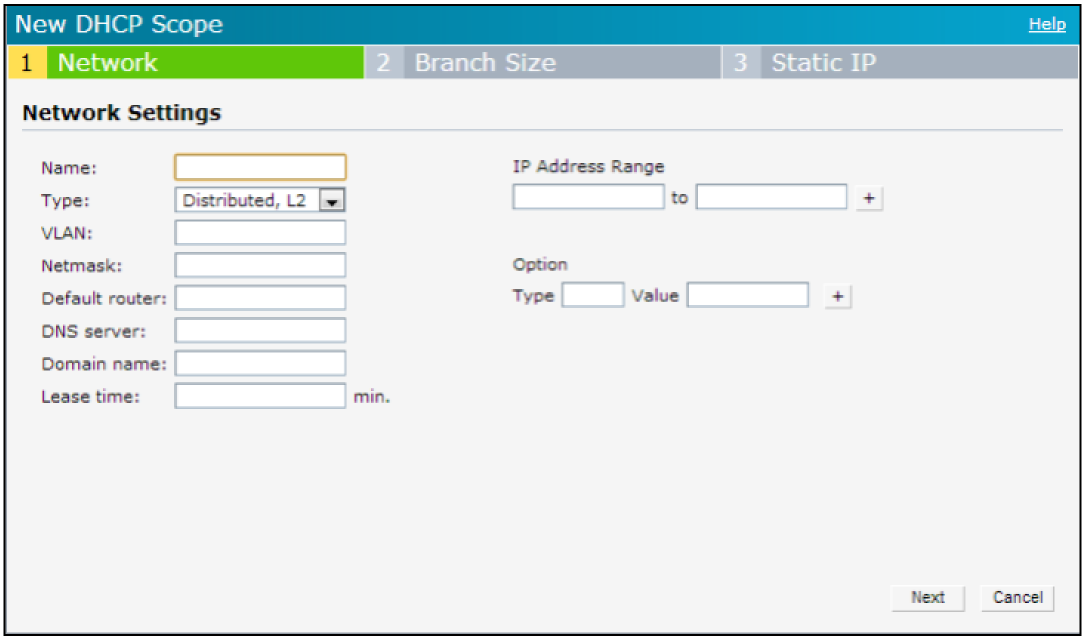
You can configure distributed DHCP scopes such as Distributed, L2 or Distributed, L3 by using the Instant UI or the CLI.

In the Instant UI

To configure distributed DHCP scopes such as Distributed, L2 or Distributed, L3:

1. Click **More > DHCP Server**. The **DHCP Server** window is displayed.
2. To configure a distributed DHCP mode, click **New** under **Distributed DHCP Scopes**. The **New DHCP Scope** window is displayed. The following figure shows the contents of the **New DHCP Scope** window.

Figure 49 *New DHCP Scope: Distributed DHCP Mode*



3. Based on the type of distributed DHCP scope, configure the following parameters:

Table 44: *Distributed DHCP Mode Configuration Parameters*

Parameter	Description
Name	Enter a name for the DHCP scope.
Type	Select any of the following options: - **Distributed, L2**—On selecting **Distributed, L2**, the VC acts as the DHCP server but the default gateway is in the data center. Traffic is bridged into VPN tunnel. - **Distributed, L3**—On selecting **Distributed, L3**, the VC acts as both DHCP server and default gateway. Traffic is routed into the VPN tunnel.
VLAN	Specify a VLAN ID. To use this subnet, ensure that the VLAN ID specified here is assigned to an SSID profile. For more information on SSID profile configuration, see Configuring VLAN Settings for a WLAN SSID Profile on page 86 and Configuring VLAN for a Wired Profile on page 108.
Netmask	If **Distributed, L2** is selected for the type of DHCP scope, specify the subnet mask. The subnet mask and the network determine the size of subnet.

Table 44: *Distributed DHCP Mode Configuration Parameters*

Parameter	Description
Default router	If **Distributed, L2** is selected for the type of DHCP scope, specify the IP address of the default router.
DNS server	If required, specify the IP address of a DNS server.
Domain name	If required, specify the domain name.
Lease time	Specify a lease time for the client in minutes within a range of 2–1440 minutes. The default value is 720 minutes.
Dynamic DNS	Select the **Dynamic DNS** check box to enable dynamic DNS on the Distributed, L3 client. **Key**—Enter the TSIG shared secret key.
IP Address Range	Specify a range of IP addresses to use. To add another range, click the + icon. You can specify up to four different ranges of IP addresses. ● For the **Distributed, L2** mode, ensure that all IP ranges are in the same subnet as the default router. On specifying the IP address ranges, a subnet validation is performed to ensure that the specified ranges of IP address are in the same subnet as the default router and subnet mask. The configured IP range is divided into blocks based on the configured client count. ● For the **Distributed, L3** mode, you can configure any discontiguous IP ranges. The configured IP range is divided into multiple IP subnets that are sufficient to accommodate the configured client count. **NOTE:** You can allocate multiple branch IDs (BID) per subnet. The IAP generates a subnet name from the DHCP IP configuration, which the controller can use as a subnet identifier. If static subnets are configured in each branch, all of them are assigned the with BID 0, which is mapped directly to the configured static subnet.
Option	Specify the type and a value for the DHCP option. You can configure the organization-specific DHCP options supported by the DHCP server. For example, 176, 242, 161, and so on. To add multiple DHCP options, click the + icon. You can add up to eight DHCP options.

4. Click **Next**.
5. Specify the number of clients to use per branch. The client count configured for a branch determines the use of IP addresses from the IP address range defined for a DHCP scope. For example, if 20 IP addresses are available in an IP address range configured for a DHCP scope and a client count of 9 is configured, only a few IP addresses (in this example, 9) from this range will be used and allocated to a branch. The IAP does not allow the administrators to assign the remaining IP addresses to another branch, although a lower value is configured for the client count.
6. Click **Next**. The **Static IP** tab is displayed.
7. Specify the number of first and last IP addresses to reserve in the subnet.
8. Click **Finish**.

In the CLI

To configure a Distributed, L2 DHCP scope:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# ip dhcp server-type <Distributed,L2>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# subnet-mask <subnet-mask>
(Instant AP)(DHCP Profile <profile-name>)# default-router <IP-address>
(Instant AP)(DHCP Profile <profile-name>)# client-count <number>
(Instant AP)(DHCP Profile <profile-name>)# dns-server <name>
(Instant AP)(DHCP Profile <profile-name>)# domain-name <domain-name>
(Instant AP)(DHCP Profile <profile-name>)# lease-time <seconds>
(Instant AP)(DHCP Profile <profile-name>)# ip-range <start-IP> <end-IP>
(Instant AP)(DHCP Profile <profile-name>)# reserve {first|last} <count>
(Instant AP)(DHCP Profile <profile-name>)# option <type> <value>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

To configure a Distributed, L3 DHCP scope:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# ip dhcp server-type <Distributed,L3>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# client-count <number>
(Instant AP)(DHCP Profile <profile-name>)# dns-server <name>
(Instant AP)(DHCP Profile <profile-name>)# domain-name <domain-name>
(Instant AP)(DHCP Profile <profile-name>)# lease-time <seconds>
(Instant AP)(DHCP Profile <profile-name>)# dynamic-dns [key <TSIG KEY>]
(Instant AP)(DHCP Profile <profile-name>)# ip-range <start-IP> <end-IP>
(Instant AP)(DHCP Profile <profile-name>)# reserve {first|last} <count>
(Instant AP)(DHCP Profile <profile-name>)# option <type> <value>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

Configuring Centralized DHCP Scopes

When a centralized DHCP scope is configured, the following points are to be noted:

- The VC does not assign an IP address to the client and the DHCP traffic is directly forwarded to the DHCP server.
- For Centralized, L2 clients, the VC bridges the DHCP traffic to the controller over the VPN/GRE tunnel. The IP address is obtained from the DHCP server behind the controller serving the VLAN/GRE of the client. This DHCP assignment mode also allows you to add the DHCP option 82 to the DHCP traffic forwarded to the controller.
- For Centralized, L3 clients, the VC acts as a DHCP relay agent that forwards the DHCP traffic to the DHCP server located either in the corporate or local network. The Centralized, L3 VLAN IP is used as the source IP. The IP address is obtained from the DHCP server.

You can configure a centralized DHCP scope through the Instant UI or the CLI.

In the Instant UI

To configure a centralized DHCP scope:

1. Click **More > DHCP Server**. The **DHCP Server** window is displayed.
2. To configure a centralized DHCP scope, click **New** under **Centralized DHCP Scopes**. The **New DHCP Scope** window is displayed.
3. To configure a centralized profile, select the profile type as **Centralized, L2** or **Centralized, L3** and configure the following parameters.

Table 45: *Centralized DHCP Mode Configuration Parameters*

Parameter	Description
Name	Enter a name for the DHCP scope.
Type	Set the type as follows: - **Centralized, L2** for the Centralized, L2 profile - **Centralized, L3** for the Centralized, L3 profile
VLAN	Specify a VLAN ID. To use this subnet, ensure that the VLAN ID specified here is assigned to an SSID profile. For more information on SSID profile configuration, see Configuring VLAN Settings for a WLAN SSID Profile on page 86 and Configuring VLAN for a Wired Profile on page 108.
Split tunnel	Set this to **Enabled** or **Disabled** for split tunnel functionality for the Centralized, L2 subnet. Enabling split tunnel allows a VPN user to access a public network and a local LAN or WAN network at the same time through the same physical network connection. For example, a user can use a remote access VPN software client connecting to a corporate network using a home wireless network. The user with split tunneling enabled is able to connect to file servers, database servers, mail servers, and other servers on the corporate network through the VPN connection. When the user connects to Internet resources (websites, FTP sites, and so on), the connection request goes directly to the gateway provided by the home network. The split-DNS functionality intercepts DNS requests from clients for non-corporate domains (as configured in Enterprise Domains list) and forwards to the IAP's own DNS server. When split-tunnel is disabled, all the traffic including the corporate and Internet traffic is tunneled irrespective of the routing profile specifications. If the GRE tunnel is down and when the corporate network is not reachable, the client traffic is dropped.
DHCP relay	If you are configuring a Centralized, L2 DHCP profile, you can select **Enabled** to allow the IAPs to intercept the broadcast packets and relay DHCP requests to the centralized DHCP server. **NOTE:** The **DHCP relay** option is not available for Centralized, L3 profile configuration.
Helper address	Specify the IP address of the DHCP server. **NOTE:** For Centralized, L2 DHCP profiles, the **Helper address** option is displayed only when DHCP relay is enabled.
VLAN IP	Specify the Centralized, L3 DHCP subnet gateway IP.
VLAN Mask	Specify the subnet mask of the Centralized, L3 DHCP subnet gateway IP.
Option82	Select **Alcatel** to enable DHCP Option 82 and allow clients to send DHCP packets with the Option 82 string. The Option 82 string is available only in the Alcatel (ALU) format. The ALU format for the Option 82 string consists of the following: - Remote Circuit ID; X AP-MAC; SSID; SSID-Type - Remote Agent; X IDUE-MAC **NOTE:** The Option 82 string is specific to Alcatel and is not configurable.

4. Click **OK**.

The following table describes the behavior of the DHCP Relay Agent and Option 82 in the IAP.

Table 46: *DHCP Relay and Option 82*

DHCP Relay	Option 82	Result
Enabled	Enabled	DHCP packet relayed with the ALU-specific Option 82 string
Enabled	Disabled	DHCP packet relayed without the ALU-specific Option 82 string
Disabled	Enabled	DHCP packet not relayed, but broadcast with the ALU-specific Option 82 string
Disabled	Disabled	DHCP packet not relayed, but broadcast without the ALU-specific Option 82 string

In the CLI

To configure a Centralized, L2 DHCP profile:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# server-type <centralized>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# option82 alu
(Instant AP)(DHCP Profile <profile-name>)# disable-split-tunnel
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

To configure a Centralized, L3 DHCP profile:

```
(Instant AP)(config)# ip dhcp <profile-name>
(Instant AP)(DHCP Profile <profile-name>)# server-type <centralized>
(Instant AP)(DHCP Profile <profile-name>)# server-vlan <vlan-ID>
(Instant AP)(DHCP Profile <profile-name>)# dhcp-relay
(Instant AP)(DHCP Profile <profile-name>)# dhcp-server <DHCP-relay-server>
(Instant AP)(DHCP Profile <profile-name>)# vlan-ip <DHCP IP address> mask <VLAN mask>
(Instant AP)(DHCP Profile <profile-name>)# end
(Instant AP)# commit apply
```

Configuring the Default DHCP Scope for Client IP Assignment

The DHCP server is a built-in server, used for networks in which clients are assigned IP address by the VC. You can customize the DHCP pool subnet and address range to provide simultaneous access to more number of clients. The largest address pool supported is 2048. The default size of the IP address pool is 512.

NOTE

When a DHCP server is configured and if the **Client IP assignment** parameter for an SSID profile is set to **Virtual Controller Assigned**, the VC assigns the IP addresses to the WLAN or the wired clients. By default, the IAP automatically determines a suitable DHCP pool for **Virtual Controller Assigned** networks.

IAPs typically select the 172.31.98.0/23 subnet. If the IP address of the IAP is within the 172.31.98.0/23 subnet, the IAP selects the 10.254.98.0/23 subnet. However, this mechanism does not guarantee that it would avoid all possible conflicts with the wired network. If your wired network uses either 172.31.98.0/23 or 10.254.98.0/23, and you experience problems with the **Virtual Controller Assigned** networks after upgrading to Aruba Instant 6.2.1.0-3.4.0.0 or later, manually configure the DHCP pool by following the steps described in this section.

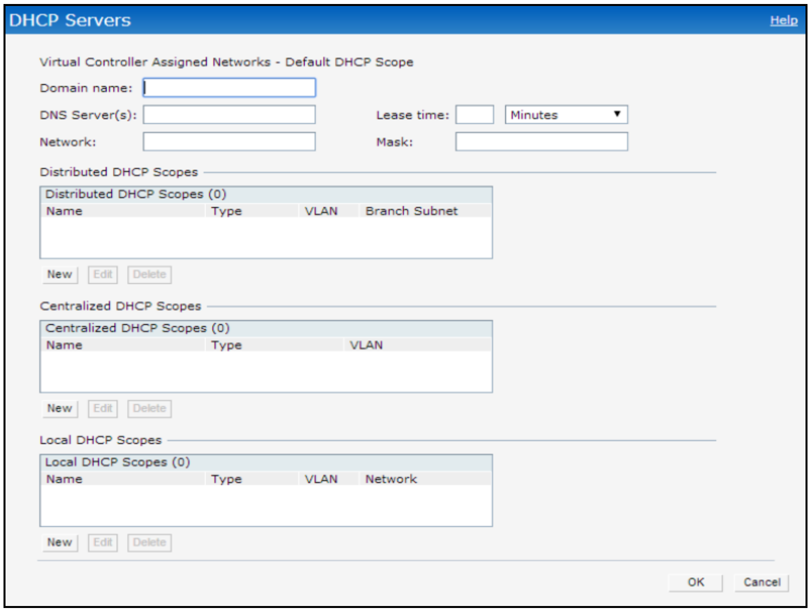
You can configure a domain name, DNS server, and DHCP server for client IP assignment using the Instant UI or the CLI.

In the Instant UI

To configure a DHCP pool:

1. Navigate to **More > DHCP Server**. The **DHCP Server** tab contents are displayed.

Figure 50 *DHCP Servers Window*



2. Enter the domain name of the client in the **Domain name** text box.
3. Enter the IP addresses of the DNS servers separated by a comma (,) in the **DNS server(s)** text box.
4. Enter the duration of the DHCP lease in the **Lease time** text box. Select any of the following values from the drop-down list next to **Lease time**:
   - **Minutes**—For minutes, specify a value between 2 and 59.
   - **Hours**—For hours, specify a value between 1 and 23.
   - **Days** —For days, specify a value between 1 and 30.

   The default lease time is 0.
5. Enter the network range for the client IP addresses in the **Network** text box. The system generates a network range automatically that is sufficient for 254 addresses. If you want to provide simultaneous access to more number of clients, specify a larger range.
6. Specify the subnet mask details for the network range in the **Mask** text box.
7. Click **OK** to apply the changes.

In the CLI

To configure a DHCP pool:

```
(Instant AP)(config)# ip dhcp pool
(Instant AP)(DHCP)# domain-name <domain>
(Instant AP)(DHCP)# dns-server <DNS-IP-address>
(Instant AP)(DHCP)# lease-time <minutes>
(Instant AP)(DHCP)# subnet <IP-address>
(Instant AP)(DHCP)# subnet-mask <subnet-mask>
(Instant AP)(DHCP)# end
(Instant AP)# commit apply
```

To view the DHCP database:

```
(Instant AP)# show ip dhcp database

DHCP Subnet          :192.0.2.0
DHCP Netmask        :255.255.255.0
DHCP Lease Time(m)  :20
DHCP Domain Name    :example.com
DHCP DNS Server     :192.0.2.1
```

Chapter 16
Configuring Time-Based Services

This chapter describes time range profiles and the procedure for configuring time-based services. It includes the following topics:

Time Range Profiles

Starting from Instant 6.4.3.4-4.2.1.0, IAPs allow you to enable or disable an SSID for users at a particular time of the day. You can now create a time range profile and assign it to a WLAN SSID, so that user access to the Internet or network is restricted during a specific time period.

IAPs support the configuration of both absolute and periodic time range profiles. You can configure an absolute time range profile to execute during a specific timeframe or create a periodic profile to execute at regular intervals based on the periodicity specified in the configuration.

The following configuration conditions apply to the time-based services:

- Time-based services require an active NTP server connection. IAPs use the default NTP server for time synchronization. However, the administrators can also configure an NTP server on the IAP. To verify the time synchronization between the NTP server and the IAP, execute the **show time-range** command and check if the time on the NTP server is in synchronization with the local time. For more information on NTP server configuration, see NTP Server.
- For a time range profile configured to **enable** the SSID on the IAP:
  - When the timer starts, if the current time is greater than the start time and lesser than the end time, the SSID will be brought UP. If the SSID is already UP, then there is no effect on the SSID.
  - When the timer ends, if the current time is greater than the end time, the SSID is brought DOWN. If the SSID is already DOWN, then there is no effect on the SSID.
- For a time range profile configured to **disable** the SSID on the IAP:
  - When the timer starts, if the current time is greater than the start time and lesser than the end time, the SSID will be brought DOWN. If the SSID is already DOWN, then there is no effect on the SSID.
  - When the timer ends, if the current time is greater than the end time, the SSID is brought UP. If the SSID is already UP, then there is no effect on the SSID.

Configuring a Time Range Profile

You can create time range profiles using the Instant UI or the CLI.

In the Instant UI

To create a time range profile:

1. Navigate to **System > Show advanced options > Time Based Services** .
2. Click **New** under **Time Range Profiles**. The **New Profile** window for creating time range profiles is displayed.
3. Configure the parameters listed in the following table:

Table 47: *Time Range Profile Configuration Parameters*

Parameter	Description
Name	Specify a name for the time range profile.
Type	Select the type of time range profile. **Periodic**—When configured, the state of the IAP changes based on the time range configured in the profile. **Absolute**—When configured, the state of the IAP changes during a specific date / day and time.
Period Type	For periodic time range profiles, specify a periodic interval (day/weekday/weekend/daily) at which the time range profile must be applied.
Start Day and End Day	For absolute time range profiles, specify the start day and the end day to configure a specific time period during which the time range profile is applied. **NOTE:** The year selected for Start Day and End Day cannot exceed the year 2037.
Start Time	Select the start time for the time range profile in the hh:mm format.
End Time	Select the end time for the time range profile in hh:mm format.

4. Click **OK**.

In the CLI:

To create an absolute time range profile:

```
(Instant AP)(config)# time-range <name> absolute start <startday> <starttime> end <endday>
<endtime>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure a periodic time range profile:

```
(Instant AP)(config)# time-range <name> periodic {<startday>|daily|weekday|weekend}
<starttime> to <endtime>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Applying a Time Range Profile to a WLAN SSID

To apply a time range profile to a WLAN SSID using the Instant UI:

1. Navigate to the WLAN SSID profile configuration wizard
   a. Click **Network > New** or
   b. Select an existing WLAN SSID and click **edit**.
2. Click **Show advanced options**.
3. Click **Edit**, select a time range profile from the list, then select a value from the **Status** drop-down list, and then click **OK**.
   - When a time range profile is enabled on an SSID, the SSID is made available to the users for the configured time range. For example, if the specified time range is 12:00–13:00, the SSID becomes available only between 12 PM and 1 PM on a given day.

- If a time range is disabled, the SSID becomes unavailable for the configured time range. For example, if the configured time range is 14:00–17:00, the SSID is made unavailable from 2 PM to 5 PM on a given day.

4. Click **Next** and then click **Finish**.

NOTE

If the SSID has two time range profiles enabled with an overlapping duration, the time range profile will be executed as per the configuration conditions described earlier in this chapter. For example, if profile1 has 9AM-12PM as the duration and profile2 has 10AM-11AM as the duration and both are enabled on the SSID, the SSID becomes available only in the time range 9AM-11AM.

In the CLI

To enable a time range profile on an SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile "<name>")# time-range <name> enable
(Instant AP)(SSID Profile "<name>")# end
(Instant AP)# commit apply
```

To disable a time range profile on an SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile "<name>")# time-range <name> disable
(Instant AP)(SSID Profile "<name>")# end
(Instant AP)# commit apply
```

Verifying the Configuration

To view the time range profiles created on an IAP:

```
(Instant AP) # show time-range
Time Range Summary
------------------
Profile Name  Type      Start Day    Start Time  End Day     End Time  Valid
------------  ----      ---------    ----------  -------     --------  -----
test          Periodic  daily        13:00       -           14:00     No
test1         Absolute  11/17/2015   10:00       11/24/2015  17:00     No
Lunchbreak    Periodic  weekday      12:00       -           13:00     No
Lunchbreak1   Periodic  daily        12:00       -           13:00     No
```

To verify if the time range profile is enabled on an SSID:

```
(Instant AP)# show time-profile
Time Range SSID Profile
-----------------------
Time Profile Name  SSID profile Name  Enable/Disable
-----------------  -----------------  --------------
Lunch Break         Test123             Enable
```

Example

The following command creates an absolute time range profile :

```
(Instant AP)(config)# time-range timep1 absolute start 10/20/2013 10:40 end 10/20/2015 10:50
```

The following command creates a periodic time range profile that executes on the specified day of the week:

```
(Instant AP)(config)# time-range timep2 periodic monday 10:40 to tuesday 10:50
```

The following command creates a periodic time range profile that executes daily:

```
(Instant AP)(config)# time-range testhshs12 periodic daily 10:20 to 10:35
```

The following command creates a periodic time range profile that executes during the weekday:

```
(Instant AP)(config)# time-range timep3 periodic weekday 10:20 to 10:35
```

The following command creates a periodic time range profile that executes during the weekend:

```
(Instant AP)(config)# time-range timep4 periodic weekend 10:20 to 10:30
```

The following command removes the time range configuration:

```
(Instant AP)(config)# no time-range testhshs12
```

This chapter describes the procedure for configuring Dynamic DNS (DDNS) on IAPs and their clients. It includes the following topics:

Enabling Dynamic DNS

Starting from Instant 6.4.4.4-4.2.3.0, IAPs support the dynamic DNS feature which enables updating the DNS records of the IAP and the clients connected to it. In a scenario where the public IP address is dynamically handed to the IAP by the ISP, there are instances when the client loses remote connectivity to the IAP when there is a change in the IP address. Similarly, in case of IAP clients, where the IAP acts as a DHCP server, the host becomes unreachable when the dynamically assigned IP address is changed. The dynamic DNS feature eliminates these issues by configuring a domain name, thus providing a uniform approach to access the IAP or the clients. The IP address of the dynamic DNS client is mapped to the domain name and this gets automatically updated each time the IP address is changed.

You can enable Dynamic DNS using the Instant UI or the CLI.

In the Instant UI

To enable dynamic DNS:

1. Navigate to **Services** > **Dynamic DNS**.
2. Select the **Enable Dynamic DNS** check box.

Table 48: *Dynamic DNS Configuration Parameters*

Parameter	Description	Example

Key	Configures a Transaction Signature (TSIG) shared secret key to secure the dynamic updates.
	The following algorithm names are supported:
	- hmac-md5 (used by default if algo-name is not specified)
	- hmac-sha1
	- hmac-sha256
	NOTE: When a **key** is configured, the update is successful only if IAP and DNS server clocks are in sync.
		`hmac-sha1:arubaddns:`
		`16YuLPdH21rQ6PuK9udsVLtJw3Y=`

Server IP	Enter the server IP address of the DNS server to which the client updates are sent.	`10.17.132.85`
Interval	Specify the time interval (in secs) at which the DNS updates are to be synced to the server. The default time interval is 12 hours, minimum time interval is 15 minutes, and maximum time interval is 100 days.	`900`

3. Click **OK**.

In the CLI:

To enable dynamic DNS on an IAP

```
(Instant AP)(config)# dynamic-dns-ap
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure a TSIG key and server IP address:

```
(Instant AP)(config)# dynamic-dns-ap key <algo-name:keyname:keystring>
(Instant AP)(config)# dynamic-dns-ap server <ddns_server>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure a time interval:

```
(Instant AP)(config)# dynamic-dns-interval <ddns_interval>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring Dynamic DNS Updates for Clients

You can enable DDNS updates when creating or editing a DHCP scope for **Distributed, L3** clients. When enabled, the DDNS updates of the clients are periodically sent during the specified time to the DNS server that is configured in the DHCP profile. If there is no DNS server configured in the DHCP profile, the client DNS updates will be dropped. The DDNS updates are secured by using TSIG shared secret keys, when communicating between the client and the server. For more information, see Configuring Distributed DHCP Scopes on page 212.

In the Instant UI

To enable DDNS for clients:

1. Navigate to **More > DHCP Servers**, select the **Distributed, L3** DHCP Scope under **Distributed DHCP Scopes** and click **Edit**.
2. Select the **Dynamic DNS** check box.
3. Enter the TSIG shared secret **key**.
4. Click **Next** and then click **Finish**.

In the CLI

To enable DDNS for IAP clients:

```
(Instant AP)(config)# ip dhcp <profile name>
(Instant AP)(DHCP profile "<name>")# dynamic-dns
(Instant AP)(DHCP profile "<name>")# dynamic-dns key <algo-name:keyname:keystring>
(Instant AP)(DHCP Profile "<name>")# end
(Instant AP)# commit apply
```

Verifying the Configuration

To view the DDNS status on an IAP:

```
(Instant AP)# show ddns
DDNS Enabled      :Enabled
DDNS Server       :10.1.1.23
DDNS Key          :dynamic-dns delete 10.17.132.7 test.ddns host-anand 10.17.132.85 key hmac-
sha1:arubaddns:16YuLPdH21rQ6PuK9udsVLtJw3Y=
DDNS Interval     :900
```

To view the list of DDNS clients:

```
(Instant AP)# show ddns clients
DDNS Client List
----------------
Host Name       Domain Name  IP Address      DHCP profile name  Success Count  Failure Count
---------       -----------  ----------      -----------------  -------------  -------------
iap1-ddns-home  test.ddns    192.192.192.17  None               16             22
132-13-Auto-PC  test.ddns    192.168.99.18   DistL3             9              3
132-14-Auto-PC  test.ddns    192.168.99.4    DistL3             2              0

Last updated    Last update status
------------    ------------------
7 seconds ago   Success
7 seconds ago   Success
7 seconds ago   Success
```

NOTE

DHCP profile name is None for the Master IAP update sent.

The **show running-config** command displays the **Key** in the encrypted format.

You can also configure dynamic DNS on an IAP or clients using the privileged execution mode in the CLI. For more information, refer to the **show ddns clients** command in the *Aruba Instant 6.4.4.4-4.2.3.0 CLI Reference Guide.*

Chapter 18
VPN Configuration

This chapter describes the following VPN configuration procedures:

- Understanding VPN Features on page 227
- Configuring a Tunnel from an IAP to a Mobility Controller on page 228
- Configuring Routing Profiles on page 239

Understanding VPN Features

As IAPs use a VC architecture, the IAP network does not require a physical controller to provide the configured WLAN services. However, a physical controller is required for terminating Virtual Private Networks (VPN) tunnels from the IAP networks at branch locations to datacenters, where the Aruba controller acts as a VPN concentrator.

When a VPN is configured, the IAP acting as the VC creates a VPN tunnel to an Aruba Mobility Controller in your corporate office. The controller acts as a VPN endpoint and does not supply the IAP with any configuration.

The VPN features are recommended for the following setups:

- Enterprises with many branches that do not have a dedicated VPN connection to the corporate office.
- Branch offices that require multiple IAPs.
- Individuals working from home and, connecting to the VPN.

The survivability feature of IAPs with the VPN connectivity of RAPs allows you to provide corporate connectivity on non-corporate networks.

Supported VPN Protocols

Instant supports the following VPN protocols for remote access:

Table 49: *VPN Protocols*

VPN Protocol	Description
Aruba IPsec	IPsec is a protocol suite that secures IP communications by authenticating and encrypting each IP packet of a communication session. You can configure an IPsec tunnel to ensure that the data flow between the networks is encrypted. However, you can configure a split-tunnel to encrypt only the corporate traffic. When IPsec is configured, ensure that you add the IAP MAC addresses to the whitelist database stored on the controller or an external server. IPsec supports Local, L2, and L3 modes of IAP-VPN operations. **NOTE:** The IAPs support IPsec only with Aruba controllers.
Layer-2 (L2) GRE	Generic Routing Encapsulation (GRE) is a tunnel protocol for encapsulating multicast, broadcast, and L2 packets between a GRE-capable device and an endpoint. IAPs support the configuration of L2 GRE (Ethernet over GRE) tunnel with an Aruba controller to encapsulate the packets sent and received by the IAP. You can use the GRE configuration for L2 deployments when there is no encryption requirement between the IAP and controller for client traffic. IAPs support two types of GRE configuration: ● **Manual GRE**—The manual GRE configuration sends unencrypted client traffic with an additional GRE header and does not support failover. When manual GRE is configured on the IAP, ensure that the GRE tunnel settings are enabled on the controller. ● **Aruba GRE**—With Aruba GRE, no configuration on the controller is required except for adding the IAP MAC addresses to the whitelist database stored on the controller or an external server. Aruba GRE reduces manual configuration when **Per-AP tunnel** configuration is required and supports failover between two GRE endpoints. **NOTE:** IAPs support manual and Aruba GRE configuration only for L2 mode of operations. Aruba GRE configuration is supported only on Aruba controllers.
L2TPv3	The Layer 2 Tunneling Protocol version 3 (L2TPv3) feature allows the IAP to act as an L2TP Access Concentrator (LAC) and tunnel all wireless client's L2 traffic from the IAP to L2TP Network Server (LNS). In a Centralized, L2 model, the VLAN on the corporate side is extended to remote branch sites. Wireless clients associated with an IAP gets the IP address from the DHCP server running on LNS. For this, the IAP has to transparently allow DHCP transactions through the L2TPv3 tunnel.

Configuring a Tunnel from an IAP to a Mobility Controller

IAP supports the configuration of tunneling protocols such as Generic Routing Encapsulation (GRE), IPsec, and L2TPv3. This section describes the procedure for configuring VPN host settings on an IAP to enable communication with a controller in a remote location:

- Configuring an IPsec Tunnel on page 229
- Configuring an L2-GRE Tunnel on page 230
- Configuring an L2TPv3 Tunnel on page 233

Configuring an IPsec Tunnel

An IPsec tunnel is configured to ensure that the data flow between the networks is encrypted. When configured, the IPsec tunnel to the controller secures corporate data.

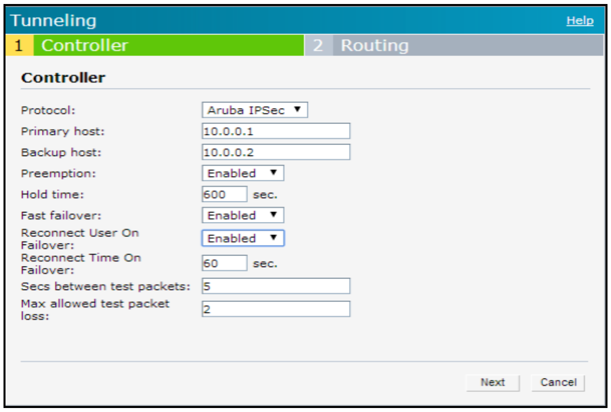
You can configure an IPsec tunnel from the VC using the Instant UI or the CLI.

In the Instant UI

To configure a tunnel for IPsec protocol:

1. Click the **More > VPN** link in the Instant UI. The **Tunneling** window is displayed.
2. Select **Aruba IPSec** from the **Protocol** drop-down list.
3. Enter the IP address or fully qualified domain name (FQDN) for the primary VPN/IPsec endpoint in the **Primary host** text box.
4. Enter the IP address or FQDN for the backup VPN/IPsec endpoint in the **Backup host** text box. This entry is optional. When you specify the primary and backup host details, the other details are displayed.
5. Specify the following parameters. A sample configuration is shown in Figure 51.
   a. To allow the VPN tunnel to switch back to the primary host when it becomes available again, select **Enabled** from the **Preemption** drop-down list. This step is optional.
   b. If **Preemption** is enabled, specify a value in seconds for **Hold time**. When preemption is enabled and the primary host comes up, the VPN tunnel switches back to the primary host after the specified hold-time. The default value for **Hold time** is 600 seconds.
   c. To allow the IAP to create a backup VPN tunnel to the controller along with the primary tunnel, and maintain both the primary and backup tunnels separately, select **Enabled** from the **Fast failover** drop-down list. When fast failover is enabled and if the primary tunnel fails, the IAP can switch the data stream to the backup tunnel. This reduces the total failover time to less than one minute.
   d. To disconnect all wired and wireless users when the system switches during VPN tunnel transition from primary to backup and backup to primary, set **Reconnect User On Failover** to **Enabled**.
   e. To configure an interval during which the wired and wireless users are disconnected during a VPN tunnel switch, specify a value in seconds for **Reconnect Time On Failover** within a range of 30–900 seconds. By default, the reconnection duration is set to 60 seconds.
   f. Specify a value in seconds for **Secs between test packets**. Based on the configured frequency, the IAP can verify if an active VPN connection is available. The default value is 5 seconds, which means that the IAP sends one packet to the controller every 5 seconds.
   g. Enter a value for **Max allowed test packet loss** to define a number for lost packets, exceeding which the IAP can determine that the VPN connection is unavailable. The default value is 2.

Figure 51 *IPsec Configuration*



Controller

Protocol:	Aruba IPSec ▼
Primary host:	10.0.0.1
Backup host:	10.0.0.2
Preemption:	Enabled ▼
Hold time:	600 sec.
Fast failover:	Enabled ▼
Reconnect User On Failover:	Enabled ▼
Reconnect Time On Failover:	60 sec.
Secs between test packets:	5
Max allowed test packet loss:	2

6. Click **Next** to create routing profiles. When the IPsec tunnel configuration is completed, the packets that are sent from and received by an IAP are encrypted.

In the CLI

To configure an IPsec VPN tunnel:

```
(Instant AP)(config)# vpn primary <name>
(Instant AP)(config)# vpn backup <name>
(Instant AP)(config)# vpn fast-failover
(Instant AP)(config)# vpn hold-time <seconds>
(Instant AP)(config)# vpn preemption
(Instant AP)(config)# vpn monitor-pkt-send-freq <frequency>
(Instant AP)(config)# vpn monitor-pkt-lost-cnt <count>
(Instant AP)(config)# vpn reconnect-user-on-failover
(Instant AP)(config)# vpn reconnect-time-on-failover <down_time>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# vpn primary 192.0.2.18
(Instant AP)(config)# vpn backup 192.0.2.20
(Instant AP)(config)# vpn fast-failover
(Instant AP)(config)# vpn preemption

(Instant AP)(config)# ip dhcp distl2
(Instant AP)(DHCP Profile "distL2")# server-type Distributed,L2
(Instant AP)(DHCP Profile "distL2")# server-vlan 2
(Instant AP)(DHCP Profile "distL2")# ip-range 10.15.205.0 10.15.205.255
(Instant AP)(DHCP Profile "distL2")# subnet-mask 255.255.255.0
(Instant AP)(DHCP Profile "distL2")# lease-time 86400
(Instant AP)(DHCP Profile "distL2")# default-router 10.15.205.254
(Instant AP)(DHCP Profile "distL2")# dns-server 10.13.6.110,10.1.1.50
(Instant AP)(DHCP Profile "distL2")# domain-name arubanetworks.com
(Instant AP)(DHCP Profile "distL2")# client-count 5

(Instant AP)(config)# ip dhcp local
(Instant AP)(DHCP Profile "local")# server-type Local
(Instant AP)(DHCP Profile "local")# server-vlan 200
(Instant AP)(DHCP Profile "local")# subnet 172.16.200.1
(Instant AP)(DHCP Profile "local")# subnet-mask 255.255.255.0
(Instant AP)(DHCP Profile "local")# lease-time 86400
(Instant AP)(DHCP Profile "local")# dns-server 10.13.6.110,10.1.1.50
(Instant AP)(DHCP Profile "local")# domain-name arubanetworks.com
```

To view the VPN configuration:

```
(Instant AP)# show vpn config
```

Configuring an L2-GRE Tunnel

This section describes the following procedures:

- Configuring Manual GRE Parameters
- Configuring Aruba GRE Parameters

Configuring Manual GRE Parameters

You can configure a GRE tunnel between the IAP and the controller using either the VC IP or the IAP IP, based on the following IAP settings:

- If a VC IP is configured and if **Per-AP tunnel** is disabled, use VC IP.
- If a VC IP is not configured or if **Per-AP tunnel** is enabled, use the IAP IP.

For information on the GRE tunnel configuration on the controller, refer to the *ArubaOS 6.5.x.x User Guide*.

In the Instant UI

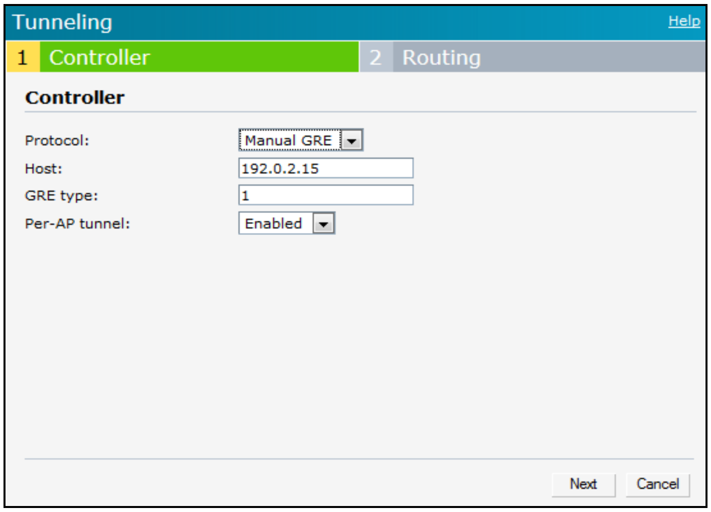
To configure a GRE tunnel:

1. Click the **More > VPN** link located directly above the Search bar in the Instant UI. The **Tunneling** window is displayed.
2. Select **Manual GRE** from the **Protocol** drop-down list.
3. Specify the following parameters. A sample configuration is shown in Figure 52.
   a. Enter an IP address or an FQDN for the main VPN/GRE endpoint in the **Host** text box.
   b. Enter a value in the **GRE type** text box.
   c. Select **Enabled** or **Disabled** from the **Per-AP tunnel** drop-down list. Enable this option to create a GRE tunnel from each IAP to the VPN/GRE endpoint rather than the tunnels created just from the master IAP. When enabled, the traffic to the corporate network is sent through a Layer-2 GRE tunnel from the IAP itself and need not be forwarded through the master IAP.

NOTE

By default, the **Per-AP tunnel** option is disabled.

Figure 52 *Manual GRE Configuration*



Controller

Protocol: Manual GRE
Host: 192.0.2.15
GRE type: 1
Per-AP tunnel: Enabled

4. Click **Next** to continue. When the GRE tunnel configuration is completed on both the IAP and the controller, the packets sent from and received by an IAP are encapsulated, but not encrypted.

In the CLI

To configure a manual GRE VPN tunnel:

```
(Instant AP)(config)# gre primary <name>
(Instant AP)(config)# gre type <type>
(Instant AP)(config)# gre per-ap-tunnel
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view VPN configuration details:

```
(Instant AP)# show vpn config
```

To configure GRE tunnel on the controller:

```
(Instant AP)(config)# interface tunnel <Number>
(Instant AP)(config-tunnel)# description <Description>
(Instant AP)(config-tunnel)# tunnel mode gre <ID>
```

```
(Instant AP)(config-tunnel)# tunnel source <controller-IP>
(Instant AP)(config-tunnel)# tunnel destination <AP-IP>
(Instant AP)(config-tunnel)# trusted
(Instant AP)(config-tunnel)# tunnel vlan <allowed-VLAN>
```

Configuring Aruba GRE Parameters

The Aruba GRE feature uses the IPsec connection between the IAP and the controller to send the control information for setting up a GRE tunnel. When Aruba GRE configuration is enabled, a single IPsec tunnel between the IAP cluster and the controller, and one or several GRE tunnels are created based on the Per-AP tunnel configuration on the IAP. For Aruba GRE, no manual configuration is required on the controller to create the GRE tunnel.

NOTE

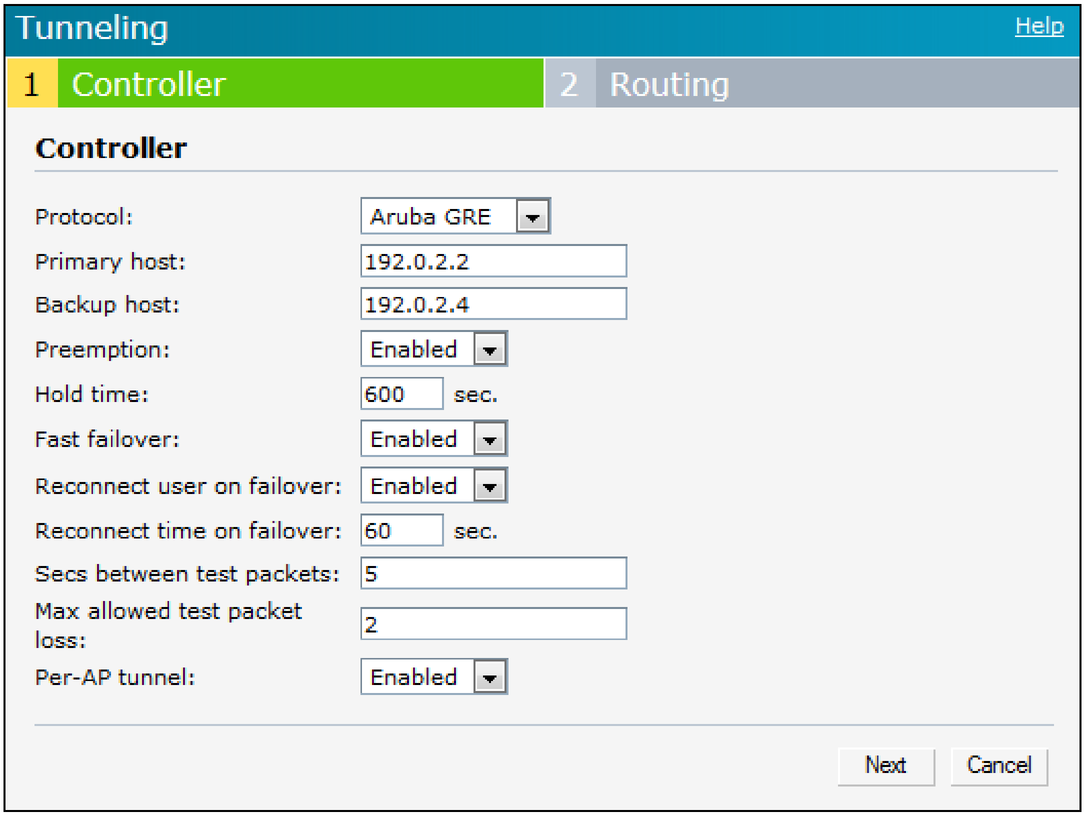
Aruba GRE is supported only on Aruba Controllers running ArubaOS 6.4.x.x or later versions.

In the Instant UI

To configure Aruba GRE:

1. Click the **More > VPN** link located directly above the Search bar in the Instant UI. The **Tunneling** window is displayed.
2. Select **Aruba GRE** from the **Protocol** drop-down list.
3. Enter the IP address or the FQDN for the main VPN/IPsec endpoint in the **Primary host** text box.
4. Enter the IP address or the FQDN for the backup VPN/IPsec endpoint in the **Backup host** text box. This entry is optional. When you enter the primary host IP address and backup host IP address, other details are displayed.
5. Specify the following parameters. A sample configuration is shown in Figure 52.
   a. To allow the VPN tunnel to switch back to the primary host when it becomes available again, select **Enabled** from the **Preemption** drop-down list. This step is optional.
   b. If **Preemption** is enabled, specify a value in seconds for **Hold time**. When preemption is enabled and the primary host comes up, the VPN tunnel switches to the primary host after the specified hold time. The default value for **Hold time** is 600 seconds.
   c. To allow the IAP to create a backup VPN tunnel to the controller along with the primary tunnel, and maintain both the primary and backup tunnels separately, select **Enabled** from the **Fast failover** drop-down list. If this option is enabled, when the primary tunnel fails, the IAP can switch the data stream to the backup tunnel. This reduces the total failover time to less than one minute.
   d. To disconnect all wired and wireless users when the system switches during VPN tunnel transition from primary to backup and backup to primary, set **Reconnect user on failover** to **Enabled**.
   e. To configure an interval for which wired and wireless users are disconnected during a VPN tunnel switch, specify a value in seconds for **Reconnect time on failover** within the range of 30–900 seconds. By default, the reconnection duration is set to 60 seconds.
   f. Specify a value in seconds for **Secs between test packets**. Based on the configured frequency, the IAP can verify if an active VPN connection is available. The default value is 5 seconds, which means that the IAP sends one packet to the controller every 5 seconds.
   g. Enter a value for **Max allowed test packet loss** to define a number for lost packets, exceeding which the IAP can determine that the VPN connection is unavailable. The default value is 2.
   h. Select **Enabled** or **Disabled** from the **Per-AP tunnel** drop-down list. The administrator can enable this option to create a GRE tunnel from each IAP to the VPN/GRE endpoint rather than the tunnels created just from the master IAP. When enabled, the traffic to the corporate network is sent through a Layer-2 GRE tunnel from the IAP itself and need not be forwarded through the master IAP.

Figure 53 *Aruba GRE Configuration*



Controller

Protocol:	Aruba GRE
Primary host:	192.0.2.2
Backup host:	192.0.2.4
Preemption:	Enabled
Hold time:	600 sec.
Fast failover:	Enabled
Reconnect user on failover:	Enabled
Reconnect time on failover:	60 sec.
Secs between test packets:	5
Max allowed test packet loss:	2
Per-AP tunnel:	Enabled

6. Click **Next** to continue.

In the CLI

To enable Aruba GRE tunnel:

```
(Instant AP)(config)# vpn gre-outside
(Instant AP)(config)# vpn primary <name/IP-address>
(Instant AP)(config)# vpn backup <<name/IP-address>>
(Instant AP)(config)# vpn fast-failover
(Instant AP)(config)# vpn hold-time <seconds>
(Instant AP)(config)# vpn preemption
(Instant AP)(config)# vpn monitor-pkt-send-freq <frequency>
(Instant AP)(config)# vpn monitor-pkt-lost-cnt <count>
(Instant AP)(config)# vpn reconnect-user-on-failover
(Instant AP)(config)# vpn reconnect-time-on-failover <down_time>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view VPN configuration details:

```
(Instant AP)# show vpn config
```

Configuring an L2TPv3 Tunnel

Some important points to note about L2TPv3 in the IAP context are as follows::

- Instant supports tunnel and session configuration, and uses Control Message Authentication (RFC 3931) for tunnel and session establishment. Each L2TPv3 tunnel supports one data connection and this connection is termed as an L2TPv3 session.
- Each IAP supports tunneling over User Datagram Protocol (UDP) only.

- If the primary LNS is down, it fails over to the backup LNS. L2TPv3 has one tunnel profile, and under this a primary peer and a backup peer are configured. If the primary tunnel creation fails or if the primary tunnel gets deleted, the backup starts. The following two failover modes are supported:
  - Preemptive: In this mode, if the primary comes up when the backup is active, the backup tunnel is deleted and the primary tunnel resumes as an active tunnel. If you configure the tunnel to be preemptive, and when the primary tunnel goes down, it starts the persistence timer which tries to bring up the primary tunnel.
  - Non-Preemptive: In this mode, when the backup tunnel is established after the primary tunnel goes down, it does not make the primary tunnel active again.

NOTE

L2TPV3 is not supported on IAP-205 devices.

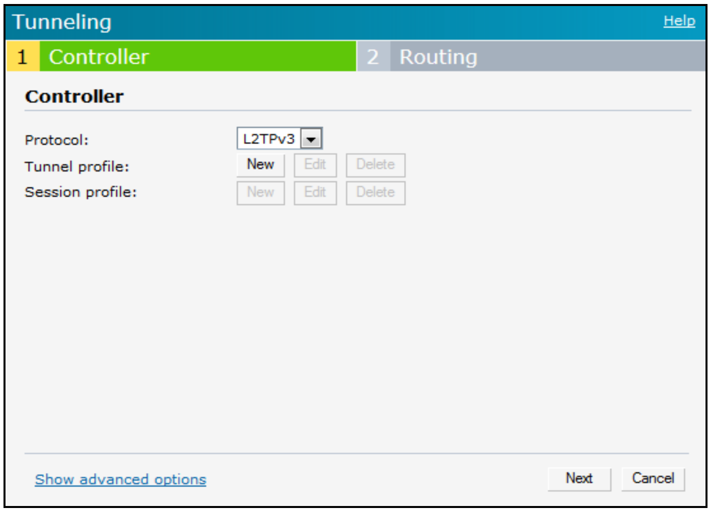
You can configure an L2TPv3 tunnel and session profiles through the Instant UI or the CLI.

In the Instant UI

To configure an L2TPv3 tunnel and session profile:

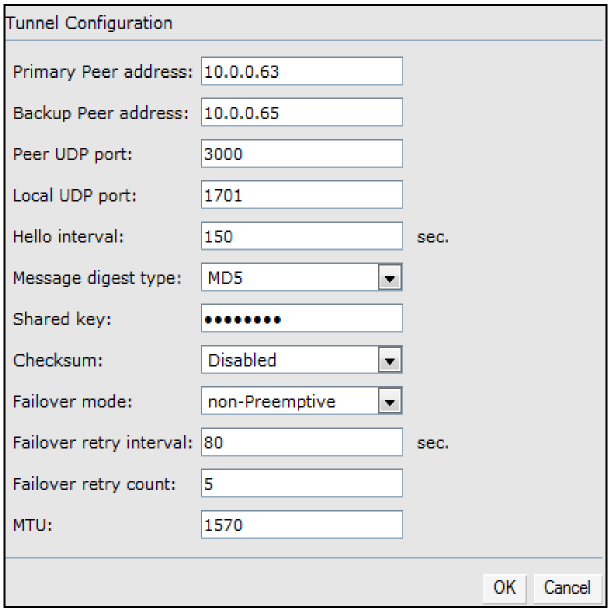
1. Click the **More > VPN** link located directly above the Search bar in the Instant UI. The **Tunneling** window is displayed.

Figure 54 *L2TPv3 Tunneling*



2. Select **L2TPv3** from the **Protocol** drop-down list.
3. To configure the tunnel profile:
   a. Click the **New** button.
   b. Enter the tunnel name to be used for tunnel creation.

Figure 55 *Tunnel Configuration*



Tunnel Configuration

Primary Peer address:	10.0.0.63	
Backup Peer address:	10.0.0.65	
Peer UDP port:	3000	
Local UDP port:	1701	
Hello interval:	150	sec.
Message digest type:	MD5	
Shared key:	••••••••	
Checksum:	Disabled	
Failover mode:	non-Preemptive	
Failover retry interval:	80	sec.
Failover retry count:	5	
MTU:	1570	

c. Enter the primary server IP address in the **Primary Peer address** text box.

d. Enter the remote end backup tunnel IP address in the **Backup Peer address** text box. This is an optional text box entry and is required only when backup server is configured.

e. Enter a port number in the **Peer UDP port** text box.

f. Enter the remote end UDP port number in the **Local UDP port** text box. The default value is 1701.

g. Enter the interval at which the hello packets are sent through the tunnel in the **Hello interval** text box. The default value is 60 seconds.

h. Select the message digest as MD5 or SHA to be used for message authentication from the Message digest type drop-down list.

i. Select **Disabled** from the **Checksum** drop-down list.

j. Enter a shared key for the message digest in the **Shared Key** text box. This key should match with the tunnel endpoint shared key.

k. If required, select the failover mode as Primary or Backup (when the backup server is available).

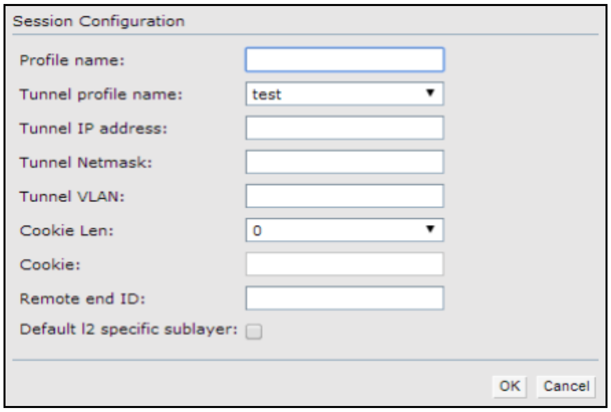
l. Specify a value for the tunnel MTU value if required. The default value is 1460.

m. Click **OK**.

4. Configure the session profile:

a. Enter the session name to be used for session creation.

Figure 56 *Session Configuration*



Session Configuration

Profile name:	
Tunnel profile name:	test
Tunnel IP address:	
Tunnel Netmask:	
Tunnel VLAN:	
Cookie Len:	0
Cookie:	
Remote end ID:	
Default l2 specific sublayer:	□

b. Enter the tunnel profile name where the session will be associated.

c. Configure the tunnel IP address with the corresponding network mask and VLAN ID. This is required to reach an IAP from a corporate network. For example, SNMP polling.

d. Select the cookie length and enter a cookie value corresponding to the length. By default, the cookie length is not set.

e. Specify the remote end ID.

f. If required, enable default l2 specific sublayer in the L2TPv3 session.

g. Click **OK**.

5. Click **Next** to continue.

In the CLI

To configure an L2TPv3 VPN tunnel profile:

```
(Instant AP)(config)# l2tpv3 tunnel <l2tpv3_tunnel_profile>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# primary peer-address <peer_ip_
addr_tunnel>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# backup peer-address <peer_ip_
addr_tunnel>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# checksum
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# failover-mode <mode>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# failover-retry-count <retry_
count>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# failover-retry-interval
<interval_in_sec>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# hello-timeout <interval_in_sec>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# local-port <local_udp_port>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# peer-port <peer_udp_port>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# message-digest-type <digest_algo>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# secret-key <key>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# mtu <tunnel_MTU>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_tunnel_profile>)# end
(Instant AP)# commit apply
```

To configure an L2TPv3 session profile:

```
(Instant AP)(config)# l2tpv3 session <l2tpv3_session_profile>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_session_profile>)# cookie len <len_of_cookie> value
<cookie_val>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_session_profile>)# l2tpv3 tunnel <l2tpv3_tunnel_
name_to_associate>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_session_profile>)# tunnel-ip <local_ip_addr_tunnel>
mask <tunnel_mask> vlan <tunnel_mgmt_vlan>
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_session_profile>)# default-l2-specific-sublayer
(Instant AP)(L2TPv3 Tunnel Profile <l2tpv3_session_profile>)# end
(Instant AP)# commit apply
```

Example

```
(Instant AP)(config)# l2tpv3 tunnel test_tunnel
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# primary peer-address 10.0.0.65
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# backup peer-address 10.0.0.63
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# no checksum
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# failover-mode non-preemptive
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# failover-retry-count 5
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# failover-retry-interval 80
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# hello-timeout 150
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# mtu 1570
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# peer-port 3000
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# secret-key test123
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# end
```

```
(Instant AP)# commit apply

(Instant AP)(config) # l2tpv3 session test_session
(Instant AP)(L2TPv3 Session Profile "test_session")# cookie len 4 value 12345678
(Instant AP)(L2TPv3 Session Profile "test_session")# l2tpv3 tunnel test_tunnel
(Instant AP)(L2TPv3 Session Profile "test_session")# tunnel-ip 1.1.1.1 mask 255.255.255.0 vlan
5
(Instant AP)(L2TPv3 Tunnel Profile "test_tunnel")# end
(Instant AP)# commit apply
```

To view L2TPv3 configuration:

```
(Instant AP)# show l2tpv3 config
L2TPV3 Tunnel configuration
---------------------------
Tunnel Profile  Primary Peer   Backup Peer   Peer UDP Port  Local UDP Port  Hello Interval
Host Name         MTU   Message Digest Type  secret Key                        Failover Mode
Failover Retry Count  Retry Interval  Checksum
--------------  -------------  ------------  -------------  --------------  --------------  --
-------         ---   ---------------  ----------                        -------------   -
-------------------  --------------  --------
test_tunnel     10.0.0.63      10.0.0.65     3000                1701              150
Instant-C4:42:98  1570       MD5                625beed39fa4ff3424edb3082ede48fa  non-
preemptive  5                     80              Disabled
L2TPV3 Session configuration
----------------------------
Session Name  Tunnel Name  Local tunnel IP  Tunnel Mask    Tunnel Vlan  Session Cookie Length
Session Cookie  Session Remote End ID
------------  -----------  ---------------  -----------    -----------  ---------------------
--------------  ---------------------
test_session               1.1.1.1          255.255.255.0  5            0
0               0
```

To view L2TPv3 global configuration:

```
(Instant AP)# show l2tpv3 global parameter

L2TPV3 Global configuration
---------------------------
Host Name
----------
Instant-C4:42:98
```

To view L2TPV3 session status:

```
(Instant AP)# show l2tpv3 session status
Session 1821009927 on tunnel 858508253:-
type: LAC Incoming Call, state: ESTABLISHED
created at:  Jul  2 04:58:45 2013
administrative name: 'test_session' (primary)
created by admin: YES, peer session id: 12382
session profile name: test_session_primary
data sequencing required: OFF
use data sequence numbers: OFF
Peer configuration data:-
data sequencing required: OFF
framing types:
data rx packets: 16, rx bytes: 1560, rx errors: 0 rx cookie error 0
data tx packets: 6, tx bytes: 588, tx errors: 0
```

To view L2TPV3 tunnel status:

```
(Instant AP)# show l2tpv3 tunnel status
```

```
Tunnel 858508253, from 10.13.11.29 to 10.13.11.157:-
state: ESTABLISHED
created at:  Jul  2 04:58:25 2013
administrative name: 'test_tunnel' (primary)
created by admin: YES, tunnel mode: LAC, persist: YES
local host name: Instant-C4:42:98
peer tunnel id: 1842732147, host name: aruba1600pop636635.hsbtst2.aus
UDP ports: local 1701, peer 3000
session limit: 0, session count: 1
tunnel profile: test_tunnel_primary, peer profile: default
session profile: default
hello timeout: 150, retry timeout: 80, idle timeout: 0
rx window size: 10, tx window size: 10, max retries: 5
use udp checksums: OFF
do pmtu discovery: OFF, mtu: 1460
trace flags: PROTOCOL FSM API AVPDATA FUNC XPRT DATA SYSTEM CLI
peer vendor name: Katalix Systems Ltd. Linux-2.6.32-358.2.1.el6.x86_64 (x86_64)
peer protocol version: 1.0, firmware 0
peer rx window size: 10
Transport status:-
ns/nr: 98/97, peer 98/96
cwnd: 10, ssthresh: 10, congpkt_acc: 9
Transport statistics:-
out-of-sequence control/data discards: 0/0
ACKs tx/txfail/rx: 0/0/96
retransmits: 0, duplicate pkt discards: 0, data pkt discards: 0
hellos tx/txfail/rx: 94/0/95
control rx packets: 193, rx bytes: 8506
control tx packets: 195, tx bytes: 8625
data rx packets: 0, rx bytes: 0, rx errors: 0
data tx packets: 6, tx bytes: 588, tx errors: 0
establish retries: 0
```

To view L2TPv3 tunnel config:

```
(Instant AP)# show l2tpv3 tunnel config
Tunnel profile test_tunnel_primary
l2tp host name: Instant-C4:42:98
local UDP port: 1701
peer IP address: 10.0.0.65
peer UDP port: 3000
hello timeout 150, retry timeout 80, idle timeout 0
rx window size 10, tx window size 10, max retries 5
use UDP checksums: OFF
do pmtu discovery: OFF, mtu: 1570
framing capability: SYNC ASYNC
bearer capability: DIGITAL ANALOG
use tiebreaker: OFF
peer profile: NOT SET
session profile: NOT SET
trace flags: PROTOCOL FSM API AVPDATA FUNC XPRT DATA SYSTEM CLI

Tunnel profile test_tunnel_backup
l2tp host name: aruba1600pop658509.hsb-dev4.aus
local UDP port: 1701
peer IP address: 10.13.11.157
peer UDP port: 1701
hello timeout 60, retry timeout 1, idle timeout 0
rx window size 10, tx window size 10, max retries 5
use UDP checksums: OFF
do pmtu discovery: OFF, mtu: 1460
framing capability: SYNC ASYNC
bearer capability: DIGITAL ANALOG
```

```
use tiebreaker: OFF
peer profile: NOT SET
session profile: NOT SET
trace flags: PROTOCOL FSM API AVPDATA FUNC XPRT DATA SYSTEM CLI
```

To view L2TPv3 system statistics:

```
(Instant AP)# show l2tpv3 system statistics
L2TP counters:-
Total messages sent: 99, received: 194, retransmitted: 0
illegal: 0, unsupported: 0, ignored AVPs: 0, vendor AVPs: 0
Setup failures: tunnels: 0, sessions: 0
Resource failures: control frames: 0, peers: 0
tunnels: 0, sessions: 0
Limit exceeded errors: tunnels: 0, sessions: 0
Frame errors: short frames: 0, wrong version frames: 0
unexpected data frames: 0, bad frames: 0
Internal: authentication failures: 0, message encode failures: 0
no matching tunnel discards: 0, mismatched tunnel ids: 0
no matching session_discards: 0, mismatched session ids: 0
total control frame send failures: 0, event queue fulls: 0
Message counters:-
Message RX Good RX Bad TX
ILLEGAL 0 0 0
SCCRQ 0 0 1
SCCRP 1 0 0
SCCCN 0 0 1
STOPCCN 0 0 0
RESERVED1 0 0 0
HELLO 95 0 95
OCRQ 0 0 0
OCRP 0 0 0
OCCN 0 0 0
ICRQ 0 0 1
ICRP 1 0 0
ICCN 0 0 1
RESERVED2 0 0 0
CDN 0 0 0
WEN 0 0 0
SLI 0 0 0
```

Configuring Routing Profiles

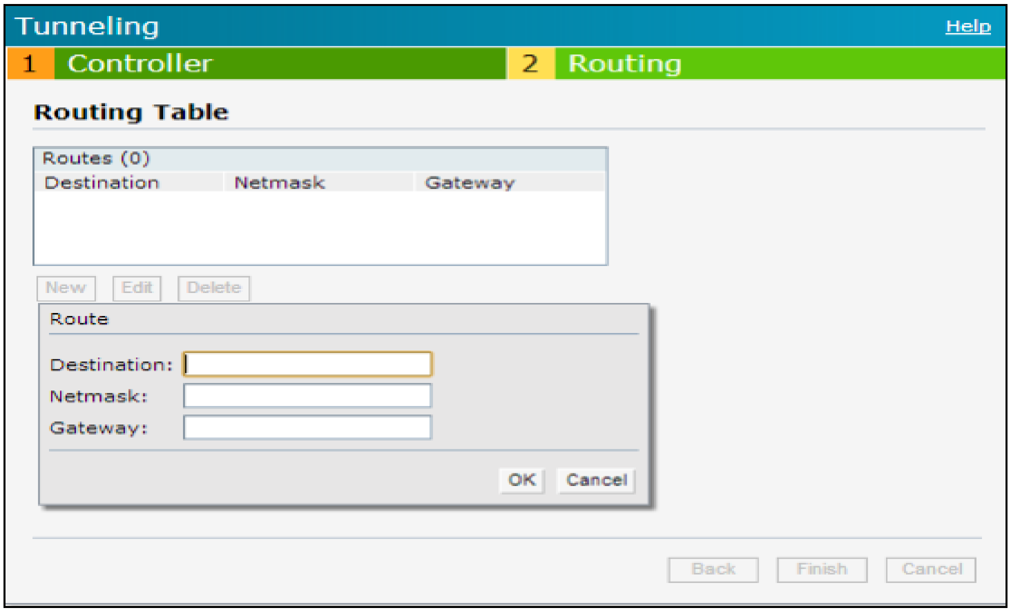
IAPs can terminate a single VPN connection on an Aruba Mobility Controller. The routing profile defines the corporate subnets which need to be tunneled through IPsec. You can configure routing profiles for policy based routing into the VPN tunnel using the Instant UI or the CLI.

In the Instant UI

To configure a routing profile:

1. Click **Routing** in the **Tunneling** window. The routing details are displayed.
2. Click **New**. The route parameters to configure are displayed.

Figure 57 *Tunneling— Routing*



3. Update the following parameters:
   - **Destination**— Specify the destination network that is reachable through the VPN tunnel. This defines the IP or subnet that must reach through the IPsec tunnel. Traffic to the IP or subnet defined here will be forwarded through the IPsec tunnel.
   - **Netmask**—Specify the subnet mask to the destination.
   - **Gateway**—Specify the gateway to which the traffic must be routed. This IP address must be the controller IP address on which the VPN connection is terminated. If you have a primary and backup host, configure two routes with the same destination and netmask, but ensure that the gateway is the primary controller IP for one route and the backup controller IP for the second route.
   - **Metric**—The default metric value is 15. Specify a metric value for the datapath route. When two routes or more routes with the same network destination are available for data forwarding, the route with the least metric value takes preference.
4. Repeat step 3 to create the required number of routing profiles.
5. Click **OK**.
6. Click **Finish**.

In the CLI

```
(Instant AP)(config)# routing-profile
(Instant AP)(Routing-profile)# route <destination> <mask> <gateway> {<metric>}
(Instant AP)(Routing-profile)# end
(Instant AP)# commit apply
```

NOTE

Routing profile is primarily used for IAP-VPN scenarios, to control which traffic should flow between the master IAP and the VPN tunnel, and which traffic should flow outside of the tunnel.

Chapter 19
IAP-VPN Deployment

This section provides the following information:

- Understanding IAP-VPN Architecture on page 241
- Configuring IAP and Controller for IAP-VPN Operations on page 244

Understanding IAP-VPN Architecture

The IAP-VPN architecture includes the following two components:

- IAPs at branch sites
- Controller at the datacenter

The master IAP at the branch site acts as the VPN endpoint and the controller at the datacenter acts as the VPN concentrator. When an IAP is set up for VPN, it forms an IPsec tunnel to the controller to secure sensitive corporate data. IPsec authentication and authorization between the controller and the IAPs are based on the RAP whitelist configured on the controller.

> NOTE
>
> Only the master IAP in an IAP cluster forms the VPN tunnel.

From the controller perspective, the master IAPs that form the VPN tunnel are considered as VPN clients. The controller terminates VPN tunnels and routes or switches the VPN traffic. The IAP cluster creates an IPsec or GRE VPN tunnel from the VC to a Mobility Controller in a branch office. The controller only acts as an IPsec or GRE VPN endpoint and it does not configure the IAP.

IAP-VPN Scalability Limits

The controller scalability in IAP-VPN architecture depends on factors such as IPsec tunnel limit, Branch ID limit, and datapath route table limit. The following table provides the IAP-VPN scalability information for various controller platforms:

Table 50: *IAP-VPN Scalability*

Platforms	Branches	Routes	L3 Mode Users	NAT Users	Total L2 Users
3200	1000	1000	N/A	N/A	64,000
3400	2000	2000			64,000
3600	8000	8000			64,000
M3	8000	8000			64,000
7210	8000	8000			64,000
7220	16,000	16,000			128,000
7240	32,000	32,000			128,000

- **Branches**—The number of IAP-VPN branches that can be terminated on a given controller platform.
- **Routes**—The number of L3 routes supported on the controller.
- **L3 mode and NAT mode users**—The number of trusted users supported on the controller. There is no scale impact on the controller. They are limited only by the number of clients supported per IAP.
- **L2 mode users**—The number of L2 mode users are limited to 128,000 for 7220 or 7240 Controllers and 64,000 across all platforms.

IAP-VPN Forwarding Modes

The forwarding modes determine whether the DHCP server and default gateway for clients reside in the branch or at the datacenter. These modes do not determine the firewall processing or traffic forwarding functionality. The VC enables different DHCP pools (various assignment modes) in addition to allocating IP subnets for each branch.

The VC allows different modes of forwarding traffic from the clients on a VLAN based on the DHCP scope configured on the IAP.

For the IAP-VPN deployments, the following forwarding modes are supported:

- Local mode
- L2 Switching mode
- L3 routing mode

The DHCP scopes associated with these forwarding modes are described in the following sections.

NOTE

Ensure that VLAN 1 is not configured for any of the DHCP scopes as it is reserved for a different purpose.

Local Mode

In this mode, the IAP cluster at that branch has a local subnet and the master IAP of the cluster acts as the DHCP server and gateway for clients. The local mode provides access to the corporate network using the inner IP of the IPsec tunnel. The network address for traffic destined to the corporate network is translated at the source with the inner IP of the IPsec tunnel and is forwarded through the IPsec tunnel. The traffic destined to the non-corporate network is translated using the IP address of the IAP and is forwarded through the uplink.

NOTE

When the local mode is used for forwarding client traffic, hosts on the corporate network cannot establish connections to the clients on the IAP, because the source addresses of the clients are translated.

Local, L2 Mode

In this mode, the IAP cluster at that branch has a local subnet and the master IAP of the cluster acts as the DHCP server. The default gateway is located outside the IAP and the network address for the client traffic is not translated at source. In the Local, L2 mode, access to the corporate network is supported only in a single IAP cluster. The traffic to the non-corporate network is locally bridged.

Local, L3 Mode

In this mode, the network address for traffic destined to the corporate network is translated at the source with the inner IP of the IPsec tunnel and is forwarded through the IPsec tunnel. The traffic destined to the non-corporate network is routed.

Distributed, L2 Mode

In this mode, the IAP assigns an IP address from the configured subnet and forwards traffic to both corporate and non-corporate destinations. Clients receive the corporate IP with VC as the DHCP server. The default gateway for the client still resides in the datacenter and hence this mode is an L2 extension of corporate VLAN to remote site. Either the controller or an upstream router can be the gateway for the clients. Client traffic destined to datacenter resources is forwarded by the master IAP (through the IPsec tunnel) to the client's default gateway in the datacenter.

When an IAP registers with the controller, the controller automatically adds the VPN tunnel associated to this IAP into the VLAN multicast table. This allows the clients connecting to the L2 mode VLAN to be part of the same L2 broadcast domain on the controller.

Distributed, L3 Mode

The Distributed, L3 mode contains all broadcast and multicast traffic to a branch. The Distributed, L3 mode reduces the cost and eliminates the complexity associated with the classic site-to-site VPN. However, this mode is very similar to a classic site-to-site IPsec VPN where two VPN endpoints connect individual networks together over a public network.

In Distributed, L3 mode, each branch location is assigned a dedicated subnet. The master IAP in the branch manages the dedicated subnet and acts as the DHCP server and gateway for clients. Client traffic destined to datacenter resources is routed to the controller through the IPsec tunnel, which then routes the traffic to the appropriate corporate destinations.

When an IAP registers with the controller, the controller adds a route to enable the routing of traffic from the corporate network to clients on this subnet in the branch.

Centralized, L2 Mode

The Centralized, L2 mode extends the corporate VLAN or broadcast domain to remote branches. The DHCP server and the gateway for the clients reside in the datacenter. Either the controller or an upstream router can be the gateway for the clients. For DHCP services in Centralized, L2 mode, Aruba recommends using an external DHCP server and not the DHCP server on the controller. Client traffic destined to datacenter resources is forwarded by the master IAP (through the IPsec tunnel) to the client's default gateway in the datacenter.

Centralized, L3 Mode

For Centralized, L3 clients, the VC acts as a DHCP relay agent that forwards the DHCP traffic to the DHCP server located behind the controller in the corporate network and reachable through the IPsec tunnel. The Centralized, L3 VLAN IP is used as the source IP. The IP address is obtained from the DHCP server.

DHCP Scope and VPN Forwarding Modes Mapping

The following table provides a summary of the DHCP scope and VPN forwarding modes mapping:

Table 51: *DHCP Scope and VPN Forwarding Modes Matrix*

Options	Local	Local, L2	Local, L3	Centralized, L2	Centralized, L3	Distributed, L2	Distributed, L3
DHCP server	VC	VC	VC	DHCP Server in the Datacenter	DHCP Server in the Datacenter and VC acts as a relay agent	VC	VC
Default Gateway for clients	VC	Default Gateway in the local network	VC	Controller or a router in the Datacenter	VC	Controller or a router in the Datacenter	VC
Corporate Traffic	Source-NAT is performed with inner IP of the IPsec tunnel	Not applicable	Source-NAT is performed with inner IP of the IPsec tunnel	L2 reachable	Routed	L2 reachable	Routed
Internet Traffic	Source-NAT is performed with local IP of the VC	Locally bridged	Routed	Source-NAT is performed with local IP of the VC	Source-NAT is performed with local IP of the VC	Source-NAT is performed with local IP of the VC	Source-NAT is performed with local IP of the VC
Branch access from datacenter	No	No	No	Yes	Yes	Yes	Yes

Configuring IAP and Controller for IAP-VPN Operations

This section describes the configuration procedures for the IAP and the controller to realize generic use cases. For information on specific deployment scenarios, see IAP-VPN Deployment Scenarios on page 402.

This section describes the configuration procedures to perform on the IAP for generic use cases. For information on specific deployment scenarios, see IAP-VPN Deployment Scenarios on page 402.

Configuring an IAP Network for IAP-VPN Operations

An IAP network requires the following configurations for IAP-VPN operations.

1. Defining the VPN Host Settings

2. Configuring Routing Profiles
3. Configuring DHCP Profiles
4. Configuring an SSID or Wired Port
5. Enabling Dynamic RADIUS Proxy
6. Configuring Enterprise Domains

Defining the VPN Host Settings

The VPN endpoint on which a master IAP terminates its VPN tunnel is considered as the host. A master IAP in an IAP network can be configured with a primary and backup host to provide VPN redundancy. You can define VPN host settings through **More > VPN > Controller** in the UI.

You can configure the following VPN profiles for the IAP-VPN operations. For more information, see Configuring a Tunnel from an IAP to a Mobility Controller on page 228.

- IPsec
- L2TPv3
- Manual GRE
- Aruba GRE

Configuring Routing Profiles

The routing profile on the IAP determines whether the traffic destined to a subnet must be tunneled through IPsec or bridged locally. If the routing profile is empty, the client traffic will always be bridged locally. For example, if the routing profile is configured to tunnel 10.0.0.0 /8, the traffic destined to 10.0.0.0 /8 will be forwarded through the IPsec tunnel and the traffic to all other destinations is bridged locally.

You can also configure a routing profile with 0.0.0.0 as gateway to allow both the client and IAP traffic to be routed through a non-tunnel route. If the gateway is in the same subnet as uplink IP address, it is used as a static gateway entry. A static route can be added to all master and slave IAPs for these destinations. The VPN traffic from the local subnet of IAP or the VC IP address in the local subnet is not routed to tunnel, but will be switched to the relevant VLAN. For example, when a 0.0.0.0/0.0.0.0 routing profile is defined, to bypass certain IPs, you can add a route to the IP by defining 0.0.0.0 as the destination, thereby forcing the traffic to be routed through the default gateway of the IAP.

You can configure routing profiles through **More > VPN > Controller** UI. For step-by-step procedural information on configuring routing profile, see Configuring Routing Profiles on page 239.

NOTE

The IAP network has only one active tunnel even when fast failover is enabled. At any given time, traffic can be tunneled only to one VPN host.

Configuring DHCP Profiles

You can create DHCP profiles to determine the IAP-VPN mode of operation. An IAP network can have multiple DHCP profiles configured for different modes of IAP-VPN. You can configure up to eight DHCP profiles. For more information on the IAP-VPN modes of operation, see IAP-VPN Forwarding Modes on page 242.

You can create any of the following types of DHCP profiles for the IAP-VPN operations:

- Local
- Local, L2
- Local, L3
- Distributed, L2
- Distributed, L3
- Centralized, L2

- Centralized, L3

For more information on configuring DHCP profiles, see Configuring DHCP Scopes on page 210.

> A Centralized, L2 or Distributed, L2 VLAN or subnet cannot be used to serve IAPs in a hierarchical mode of deployment. Ensure that the physical IP of the IAPs connecting to the master IAP in hierarchical mode of deployment is not on a VLAN or subnet that is in Centralized, L2 or Distributed, L2 mode of operation. For information on hierarchical mode of deployment, see Understanding Hierarchical Deployment on page 114.

Configuring an SSID or Wired Port

For a client to connect to the IAP-VPN network, an SSID or wired port profile on an IAP must be configured with appropriate IAP-VPN mode of operation. The VLAN configuration in an SSID or wired port profile determines whether an SSID or wired port is configured for the IAP-VPN operations.

To configure an SSID or wired port for a specific IAP-VPN mode, the VLAN ID defined in the SSID or wired port profile must match the VLAN ID defined in the DHCP profile configuration. If the VLAN assignment for an SSID or wired port profile is set to VC assigned, custom, or a static VLAN ID that does not match the VLAN ID configured in the DHCP profiles, the IAP-VPN operations are affected. For example, if a local DHCP profile is configured with a VLAN ID of 200, the VLAN configuration on the SSID must be set to a static VLAN ID 200.

> Ensure that the VLAN assignment for an SSID or wired port profile is not set to default as the VPN tunnel is not supported on the default VLAN.

For information on how to configure an SSID or wired port profile, see Wireless Network Profiles on page 80 and Configuring a Wired Profile on page 107, respectively.

Enabling Dynamic RADIUS Proxy

The RADIUS server can be deployed at different locations and VLANs. In most cases, a centralized RADIUS or local server is used to authenticate users. However, some user networks can use a local RADIUS server for employee authentication and a centralized RADIUS-based captive portal server for guest authentication. To ensure that the RADIUS traffic is routed to the required RADIUS server, the dynamic RADIUS proxy feature must be enabled. When enabled, dynamic RADIUS proxy ensures that all the RADIUS traffic is sourced from the VC IP or inner IP of the IAP IPsec tunnel depending on the RADIUS server IP and routing profile.

> Ensure that a static VC IP is configured before enabling dynamic RADIUS proxy in order to tunnel the RADIUS traffic to the central RADIUS server in the datacenter.

For information on enabling dynamic RADIUS proxy, see Configuring Dynamic RADIUS Proxy Parameters on page 162.

Configuring Enterprise Domains

By default, all the DNS requests from a client are forwarded to the client's DNS server. In a typical IAP deployment without VPN configuration, client DNS requests are resolved by the DNS server of clients. For the IAP-VPN scenario, the enterprise domain settings on the IAP are used to determine how client DNS requests are routed. For information on how to configure enterprise domains, see Configuring Enterprise Domains on page 195.

Configuring a Controller for IAP-VPN Operations

Aruba controllers provide an ability to terminate the IPsec and GRE VPN tunnels from the IAP and provide corporate connectivity to the branch network.

For IAP-VPN operations, ensure that the following configuration and verification procedures are completed on the controller:

- OSPF Configuration
- VPN Configuration
- Branch-ID Allocation
- Branch Status Verification

NOTE

This section describes the configuration procedures for the controller to realize generic use cases. For information on specific deployment scenarios, see IAP-VPN Deployment Scenarios on page 402.

NOTE

ArubaOS 6.3 or later version is recommended the controllers with IAP-VPN configuration. The IAP-VPN configuration is not supported on 600 Series controllers.

OSPF Configuration

Open Shortest Path First (OSPF) is a dynamic Interior Gateway routing Protocol (IGP) based on IETF RFC 2328. The premise of OSPF is that the shortest or fastest routing path is used. The implementation of OSPFv2 allows controllers to deploy effectively in a Layer 3 topology. The controllers can act as the default gateway for all clients and forward user packets to the upstream router.

Each IAP-VPN can be defined a separate subnet derived from the corporate intranet pool to allow IAP-VPN devices to work independently. For sample topology and configuration, refer to the *ArubaOS 6.5 User Guide*.

To redistribute IAP-VPN routes into the OSPF process:

```
(Instant AP)(config) # router ospf redistribute rapng-vpn
```

To verify if the redistribution of the IAP-VPN is enabled:

```
(host) #show ip ospf redistribute
```

To configure aggregate route for IAP-VPN routes:

```
(Instant AP) (config) # router ospf aggregate-route rapng-vpn
```

To view the aggregated routes for IAP-VPN routes:

```
(Instant AP) #show ip ospf rapng-vpn aggregate-routes
RAPNG VPN aggregate routes
--------------------------
Prefix Mask Contributing routes Cost
------ ---- ------------------- ----
201.201.200.0 255.255.252.0 5 268779624
100.100.2.0 255.255.255.0 1 10
```

To verify the details of a configured aggregated route:

```
(Instant AP) # show ip ospf rapng-vpn aggregated-routes <net> <mask>
(Instant AP) # show ip ospf rapng-vpn aggregate-routes 100.100.2.0 255.255.255.0
Contributing routes of RAPNG VPN aggregate route
------------------------------------------------
Prefix Mask Next-Hop Cost
------ ---- -------- ----
100.100.2.64 255.255.255.224 5.5.0.10 10
```

To view all the redistributed routes:

```
(Instant AP)# show ip ospf database
OSPF Database Table
-------------------
Area ID    LSA Type      Link ID        Adv Router     Age   Seq#          Checksum
-------    --------      -------        ----------     ---   ----          --------
0.0.0.15   ROUTER        9.9.9.9        9.9.9.9        159   0x80000016    0xee92
```

```
0.0.0.15   ROUTER        10.15.148.12   10.15.148.12   166   0x80000016   0x4c0d
0.0.0.15   NETWORK       10.15.148.12   10.15.148.12   167   0x80000001   0x9674
0.0.0.15   NSSA          12.12.2.0      9.9.9.9        29    0x80000003   0x7b54
0.0.0.15   NSSA          12.12.12.0     9.9.9.9        164   0x80000008   0x63a
0.0.0.15   NSSA          12.12.12.32    9.9.9.9        164   0x80000008   0x7b8
0.0.0.15   NSSA          50.40.40.0     9.9.9.9        164   0x80000007   0x8ed4
0.0.0.15   NSSA          51.41.41.128   9.9.9.9        164   0x80000007   0x68f6
0.0.0.15   NSSA          53.43.43.32    9.9.9.9        164   0x80000007   0x2633
0.0.0.15   NSSA          54.44.44.16    9.9.9.9        164   0x80000007   0x353
N/A        AS_EXTERNAL   12.12.2.0      9.9.9.9        29    0x80000003   0x8c06
N/A        AS_EXTERNAL   12.12.12.0     9.9.9.9        169   0x80000001   0x25e4
N/A        AS_EXTERNAL   12.12.12.32    9.9.9.9        169   0x80000001   0x2663
N/A        AS_EXTERNAL   50.40.40.0     9.9.9.9        169   0x80000001   0xab80
N/A        AS_EXTERNAL   51.41.41.128   9.9.9.9        169   0x80000001   0x85a2
N/A        AS_EXTERNAL   53.43.43.32    9.9.9.9        169   0x80000001   0x43de
N/A        AS_EXTERNAL   54.44.44.16    9.9.9.9        169   0x80000001   0x20fe
```

To verify if the redistributed routes are installed or not:

```
(Instant AP)# show ip route
Codes: C - connected, O - OSPF, R - RIP, S - static
M - mgmt, U - route usable, * - candidate default, V - RAPNG VPN
Gateway of last resort is Imported from DHCP to network 0.0.0.0 at cost 10
Gateway of last resort is Imported from CELL to network 0.0.0.0 at cost 10
Gateway of last resort is Imported from PPPOE to network 0.0.0.0 at cost 10
Gateway of last resort is 10.15.148.254 to network 0.0.0.0 at cost 1
S*    0.0.0.0/0  [1/0] via 10.15.148.254*
V    12.12.2.0/24 [10/0] ipsec map
V    12.12.12.0/25 [10/0] ipsec map
V    12.12.12.32/27 [10/0] ipsec map
V    50.40.40.0/24 [10/0] ipsec map
V    51.41.41.128/25 [10/0] ipsec map
V    53.43.43.32/27 [10/0] ipsec map
V    54.44.44.16/28 [10/0] ipsec map
C    9.9.9.0/24 is directly connected, VLAN9
C    10.15.148.0/24 is directly connected, VLAN1
C    43.43.43.0/24 is directly connected, VLAN132
C    42.42.42.0/24 is directly connected, VLAN123
C    44.44.44.0/24 is directly connected, VLAN125
C    182.82.82.12/32 is an ipsec map 10.15.149.69-182.82.82.12
C    182.82.82.14/32 is an ipsec map 10.17.87.126-182.82.82.14
```

VPN Configuration

The following VPN configuration steps on the controller enable the IAPs to terminate their VPN connection on the controller:

Whitelist Database Configuration

The whitelist database is a list of the MAC addresses of the IAPs that are allowed to establish VPN connections with the controller. This list can be either stored in the controller database or on an external server.

You can use the following CLI command to configure the whitelist database entries if the controller is acting as the whitelist database:

```
(host)# whitelist-db rap add mac-address 00:11:22:33:44:55 ap-group test
```

The **ap-group** parameter is not used for any configuration, but needs to be configured. The parameter can be any valid string.

If an external server is used as the location for the whitelist database, add the MAC addresses of the valid IAPs in the external database or external directory server and then configure a RADIUS server to authenticate the IAPs using the entries in the external database or external directory server.

If you are using the Windows 2003 server, perform the following steps to configure the external whitelist database on it. There are equivalent steps available for the Windows Server 2008 and other RADIUS servers.

1. Add the MAC addresses of all the IAPs in the Active Directory of the RADIUS server:
   a. Open the **Active Directory and Computers** window, add a new user and specify the MAC address (without the colon delimiter) of the IAP for the username and password, respectively.
   b. Right-click the user that you have just created and click **Properties**.
   c. On the **Dial-in** tab, select **Allow access** in the **Remote Access Permission** section and click **OK**.
   d. Repeat Step a through Step c for all IAPs.
2. Define the remote access policy in the Internet Authentication Service:
   a. In the **Internet Authentication Service** window, select **Remote Access Policies**.
   b. Launch the wizard to configure a new remote access policy.
   c. Define filters and select **grant remote access permission** in the **Permissions** window.
   d. Right-click the policy that you have just created and select **Properties**.
   e. In the **Settings** tab, select the policy condition, and click **Edit Profile...**.
   f. In the **Advanced** tab, select **Vendor Specific**, and click **Add** to add new vendor-specific attributes.
   g. Add new vendor-specific attributes and click **OK**.
   h. In the **IP** tab, provide the IP address of the IAP and click **OK**.

VPN Local Pool Configuration

The VPN local pool is used to assign an IP address to the IAP after successful XAUTH VPN.

```
(Instant AP) # ip local pool "rapngpool" <startip> <endip>
```

Role Assignment for the Authenticated IAPs

Define a role that includes an Source-NAT rule to allow connections to the RADIUS server and for the Dynamic RADIUS Proxy in the IAP to work. This role is assigned to IAPs after successful authentication.

```
(host) (config) #ip access-list session iaprole
(host) (config-sess-iaprole)#any host <radius-server-ip> any src-nat
(host) (config-sess-iaprole)#any any any permit
(host) (config-sess-iaprole)#!
(host) (config) #user-role iaprole
(host) (config-role) #session-acl iaprole
```

VPN Profile Configuration

The VPN profile configuration defines the server used to authenticate the IAP (internal or an external server) and the role assigned to the IAP after successful authentication.

```
(host) (config) #aaa authentication vpn default-iap
(host) (VPN Authentication Profile "default-iap") #server-group default
(host) (VPN Authentication Profile "default-iap") #default-role iaprole
```

Branch-ID Allocation

For branches deployed in Distributed, L3 and Distributed, L2 modes, the master IAP in the branch and the controller should agree upon a subnet/IP addresses to be used for DHCP services in the branch. The process or protocol used by the master IAP and the controller to determine the subnet/IP addresses used in a branch is called BID allocation. The BID allocation process is not essential for branches deployed in local or Centralized, L2 mode. The following are some of the key functions of the BID allocation process:

- Determines the IP addresses used in a branch for Distributed, L2 mode
- Determines the subnet used in a branch for Distributed, L3 mode
- Avoids IP address or subnet overlap (that is, avoids IP conflict)

- Ensures that a branch is allocated the same subnet or range of IP addresses irrespective of which IAP in the branch becomes the master in the IAP cluster

Branch Status Verification

To view the details of the branch information connected to the controller, execute the **show iap table** command.

Example

This example shows the details of the branches connected to the controller:

```
(host) #show iap table long

IAP Branch Table
----------------
Name             VC MAC Address     Status   Inner IP       Assigned Subnet  Assigned Vlan
----             --------------     ------   --------       ---------------  -------------
Tokyo-CB:D3:16   6c:f3:7f:cc:42:f8  DOWN     0.0.0.0
Paris-CB:D3:16   6c:f3:7f:cc:3d:04  UP       10.15.207.140  10.15.206.99/29  2
LA               6c:f3:7f:cc:42:25  UP       10.15.207.111  10.15.206.24/29  2
Munich           d8:c7:c8:cb:d3:16  DOWN     0.0.0.0
London-c0:e1     6c:f3:7f:c0:e1:b1  UP       10.15.207.120  10.15.206.64/29  2
Instant-CB:D3    6c:f3:7f:cc:42:1e  DOWN     0.0.0.0
Delhi            6c:f3:7f:cc:42:ca  DOWN     0.0.0.0
Singapore        6c:f3:7f:cc:42:cb  UP       10.15.207.122  10.15.206.120/29 2

Key        Bid(Subnet Name)
---        ----------------
b3c65c...
b3c65c...
b3c65c...  2(10.15.205.0-10.15.205.250,5),1(10.15.206.1-10.15.206.252,5)
a2a65c...  0
b3c65c...  7(10.15.205.0-10.15.205.250,5),8(10.15.206.1-10.15.206.252,5)
b3c65c...
b3c65c...  1(10.15.205.0-10.15.205.250,5),2(10.15.206.1-10.15.206.252,5)
b3c65c...  14(10.15.205.0-10.15.205.250,5),15(10.15.206.1-10.15.206.252,5)
```

The output of this command provides the following information:

Table 52: *Branch Details*

Parameter	Description
Name	Displays the name of the branch.
VC MAC Address	Displays the MAC address of the VC of the branch.
Status	Displays the current status of the branch (UP/DOWN).
Inner IP	Displays the internal VPN IP of the branch.
Assigned Subnet	Displays the subnet mask assigned to the branch.

Table 52: *Branch Details*

Parameter	Description
`Assigned Vlan`	Displays the VLAN ID assigned to the branch.
`Key`	Displays the key for the branch, which is unique to each branch.
`Bid(Subnet Name)`	Displays the Branch ID (BID) of the subnet. In the example above, the controller displays bid-per-subnet-per-branch i.e., for "LA" branch, BID "2" for the ip-range "10.15.205.0-10.15.205.250" with client count per branch "5"). If a branch has multiple subnets, it can have multiple BIDs. If a branch is in **UP** state and does not have a **Bid(Subnet Name)**, it means that the IAP is connected to a controller, which did not assign any BID for any subnet. In the above example, "Paris-CB:D3:16" branch is **UP** and does not have a **Bid(Subnet Name)**. This means that either the IAP is connected to a backup controller or it is connected to a primary controller without any Distributed, L2 or Distributed, L3 subnets.

NOTE

The **show iap table** command output does not display the **Key** and **Bid(Subnet Name)** details.

Chapter 20
Adaptive Radio Management

This chapter provides the following information:

- ARM Overview on page 252
- Configuring ARM Features on an IAP on page 253
- Configuring Radio Settings on page 259

ARM Overview

Adaptive Radio Management (ARM) is a radio frequency management technology that optimizes WLAN performance even in networks with the highest traffic by dynamically and intelligently choosing the best 802.11 channel and transmitting power for each IAP in its current RF environment. ARM works with all standard clients, across all operating systems, while remaining in compliance with the IEEE 802.11 standards. It does not require any proprietary client software to achieve its performance goals. ARM ensures low-latency roaming, consistently high performance, and maximum client compatibility in a multi-channel environment. By ensuring a fair distribution of the available Wi-Fi bandwidth to mobile devices, ARM ensures that data, voice, and video applications have sufficient network resources at all times. ARM allows mixed 802.11a, b, g, n, and ac client types to interoperate at the highest performance levels.

Channel or Power Assignment

The channel or power assignment feature automatically assigns channel and power settings for all the IAPs in the network according to changes in the RF environment. This feature automates many setup tasks during network installation and the ongoing operations when RF conditions change.

Voice Aware Scanning

The Voice Aware scanning feature prevents an IAP supporting an active voice call from scanning for other channels in the RF spectrum and allows the IAP to resume scanning when there are no active voice calls. This significantly improves the voice quality when a call is in progress and simultaneously delivers the automated RF management functions. By default, this feature is enabled.

Load Aware Scanning

The Load Aware Scanning feature dynamically adjusts scanning function to maintain uninterrupted data transfer on resource-intensive systems when the network traffic exceeds a predefined threshold. The IAPs resume complete monitoring scans when the traffic drops to the normal levels. By default, this feature is enabled.

Monitoring the Network with ARM

When ARM is enabled, an IAP dynamically scans all 802.11 channels within its 802.11 regulatory domain at regular intervals and sends reports to a VC on network (WLAN) coverage, interference, and intrusion detection.

ARM Metrics

ARM computes coverage and interference metrics for each valid channel and chooses the best performing channel and transmit power settings for each IAP RF environment. Each IAP gathers other metrics on its ARM-assigned channel to provide a snapshot of the current RF health state.

Configuring ARM Features on an IAP

This section describes the following procedures for configuring ARM features:

- Band Steering on page 253
- Airtime Fairness Mode on page 254
- Client Match on page 254
- Access Point Control on page 256

Band Steering

The band steering feature assigns the dual-band capable clients to the 5 GHz band on dual-band IAPs. This feature reduces co-channel interference and increases available bandwidth for dual-band clients, because there are more channels on the 5 GHz band than that on the 2.4 GHz band. You can configure band steering parameters through the Instant UI or the CLI.

In the Instant UI

To configure band steering:

1. In the **RF > ARM > Show advanced options** tab view, configure the following parameters:

Table 53: *Band Steering Mode—Configuration Parameters*

Parameter	Description
Prefer 5 GHz	Select this option to use band steering in the 5 GHz mode. On selecting this, the IAP steers the client to the 5 GHz band (if the client is 5 GHz-capable), but allows the client connection on the 2.4 GHz band if the client persistently attempts for 2.4 GHz association.
Force 5 GHz	Select this option to enforce 5 GHz band steering mode on the IAPs.
Balance Bands	Select this option to allow the IAP to balance the clients across the two radios to best utilize the available 2.4 GHz bandwidth. This feature takes into account the fact that the 5 GHz band has more channels than the 2.4 GHz band, and that the 5 GHz channels operate in 40 MHz, while the 2.4 GHz band operates in 20 MHz.
Disabled	Select this option if you want to allow the clients to select the band to use.

2. Click **OK**.

In the CLI

To configure band steering:

```
(Instant AP)(config)# arm
(Instant AP)(ARM)# band-steering-mode {<Prefer 5 GHz>| <Force 5 GHz>|<Balance
Bands>|<Disabled>}
(Instant AP)(ARM)# end
(Instant AP)# commit apply
```

Airtime Fairness Mode

The airtime fairness feature provides equal access to all clients on the wireless medium, regardless of client type, capability, or operating system, thus delivering uniform performance to all clients. This feature prevents the clients from monopolizing resources. You can configure airtime fairness mode parameters through the Instant UI or the CLI.

In the Instant UI

1. For **Airtime fairness mode** configuration, specify any of the following values under the **RF > ARM > Show advanced options** tab:

Table 54: *Airtime Fairness Mode—Configuration Parameters*

Parameter	Description
Default Access	Select this option to provide access based on client requests. When **Air Time Fairness** is set to default access, per-user and per-SSID bandwidth limits are not enforced.
Fair Access	Select this option to allocate Airtime evenly across all the clients.
Preferred Access	Select this option to set a preference where 802.11n clients are assigned more airtime than 802.11a/11g. The 802.11a/11g clients get more airtime than 802.11b. The ratio is 16:4:1.

2. Click **OK**.

In the CLI

```
(Instant AP)(config)# arm
(Instant AP)(ARM)# air-time-fairness-mode {<Default Access>| <Fair Access> | <Preferred
Access>
(Instant AP)(ARM)# end
(Instant AP)# commit apply
```

Client Match

The ARM client match feature continually monitors a client's RF neighborhood to provide ongoing client band steering and load balancing, and enhanced IAP reassignment for roaming mobile clients. This feature supersedes the legacy band steering and spectrum load balancing features, which unlike client match, do not trigger IAP changes for clients already associated to an IAP. In addition to this, the Client Match feature provides the smartphone handoff assist function which helps smartphones to switch between 3G and 4G networks when the Wi-Fi connectivity is poor. The IAP monitors the Received Signal Strength Indicator (RSSI) of the smartphone and checks if it remains under the threshold connectivity strength for a certain duration and deauthenticates the client.

NOTE

Legacy 802.11a/b/g access points do not support the client match feature. When client match is enabled on 802.11n-capable access points, the client match feature overrides any settings configured for the legacy band steering, station handoff assist, or load balancing feature. 802.11ac-capable access points do not support the legacy band steering, station handoff assist, or load balancing settings; so these access points must be managed using client match.

When the client match feature is enabled on an IAP, the IAP measures the RF health of its associated clients. In the current release, the client match feature is supported only within an IAP cluster. If any of the following trigger conditions is met, clients are moved from one IAP to another for better performance and client experience:

- Dynamic Load Balancing—Client match balances clients across IAPs on different channels, based on the client load on the IAPs and the signal to noise ration (SNR) levels the client detects from an underutilized IAP. If an IAP radio can support additional clients, the IAP will participate in client match load balancing and clients can be directed to that IAP radio, subject to the predefined SNR thresholds. For better load balancing, clients are steered from busy channels to idle channels.
- Sticky Clients—The client match feature also helps mobile clients that tend to stay associated to an IAP despite low signal levels. IAPs using client match continually monitor the client's RSSI as the client roams between IAPs, and move the client to an IAP when a better radio match can be found. This prevents mobile clients from remaining associated to the IAPs with less than ideal RSSI, which can cause poor connectivity and reduce performance for other clients associated with that IAP.
- Band Steering—IAPs using the client match feature monitor the RSSI for clients that advertise a dual-band capability. If a client is currently associated to a 2.4 GHz radio and the IAP detects that the client has a good RSSI from the 5 GHz radio, the IAP steers the client to the 5 GHz radio, as long as the 5 GHz RSSI is not significantly worse than the 2.4 GHz RSSI, and the IAP retains a suitable distribution of clients on each of its radios.
- Channel Utilization—Based on the percentage of channel utilization, clients are steered from a busy channel to an idle channel.
- Client Capability Match—Based on the client capability match, clients are steered to appropriate channel, for example, HT20, HT40, or VHT80.

NOTE

Starting from the Instant 6.3.1.1-4.0 release, spectrum load balancing is integrated with the client match feature. Client match allows the IAPs in a cluster to be divided into several logical IAP RF neighborhood called domains, which share the same clients. The VC determines the distribution of clients and balances client load across channels, regardless of whether the IAP is responding to the probe requests of wireless clients.

You can configure client match parameters in the Instant UI or the CLI. When client match is enabled, the dashboard in the main window displays the **Client Match** link on selecting an IAP in the **Access Points** tab or a client in the **Clients** tab. Clicking this link provides a graphical representation of radio map view of an IAP and the client distribution on an IAP radio. For more information, see Client Match on page 50.

In the Instant UI

1. For client match configuration, specify the following parameters in the **RF > ARM > Show advanced options** tab:

Table 55: *Client Match Configuration Parameters*

Parameter	Description
Client match	Select **Enabled** to enable the **Client match** feature on IAPs. When enabled, client count will be balanced among all the channels in the same band. For more information, see ARM Overview on page 252. By default, the client match feature is disabled. **NOTE:** When client match is enabled, ensure that Scanning is enabled.
CM calculating interval	Specify a value for calculating the interval of Client match. The value specified for **CM calculating interval** determines the interval at which client match is calculated. The interval is specified in seconds and the default value is 30 seconds. You can specify a value within the range of 10–600.
CM neighbor matching %	Specify a value for **CM neighbor matching %**. This number takes into account the least similarity percentage to be considered as in the same virtual RF neighborhood of client match. You can specify a percentage value within the range of 20–100. The default value is 75%.
CM threshold	Specify a value for **CM threshold**. This number takes acceptance client count difference among all the channels of client match into account. When the client load on an IAP reaches or exceeds the threshold, client match is enabled on that IAP. You can specify a value within range of 1–255. The default value is 2.
SLB mode	Select a mode from the **SLB mode** drop-down list. The SLB mode determines the balancing strategy for client match. The following options are available: ● Channel ● Radio ● Channel + Radio

2. Click **OK**.

In the CLI

```
(Instant AP)(config)# arm
(Instant AP)(ARM)# client-match calc-interval <seconds>
(Instant AP)(ARM)# client-match calc-threshold <threshold>
(Instant AP)(ARM)# client-match nb-matching <percentage>
(Instant AP)(ARM)# client-match slb-mode 1
(Instant AP)(ARM)# end
(Instant AP)# commit apply
```

Access Point Control

You can configure access point control parameters through the Instant UI or the CLI.

In the Instant UI

1. For **Access Point Control**, specify the following parameters in the **RF > ARM > Show advanced options** tab:

Table 56: *Access Point Control—Configuration Parameters*

Parameter	Description
Customize Valid Channels	Select this check box to customize valid channels for 2.4 GHz and 5 GHz. By default, the IAP uses valid channels as defined by the Country Code (regulatory domain). On selecting the **Customize Valid Channels** check box, a list of valid channels for both 2.4 GHz and 5 GHz are displayed. The valid channel customization feature is disabled by default.
Minimum Transmit Power	Specify the minimum transmission power. The value specified for **Minimum Transmit Power** indicates the minimum Effective Isotropic Radiated Power (EIRP) that can range from 3 dBm to 33 dBm in 3 dBm increments. If the minimum transmission EIRP setting configured on an IAP is not supported by the IAP model, this value is reduced to the highest supported power setting. The default value for minimum transmit power is 18 dBm.
Maximum Transmit Power	Specify the maximum transmission power. The value specified for **Maximum Transmit Power** indicates the maximum Effective Isotropic Radiated Power (EIRP) that can range from 3 dBm to 33 dBm in 3 dBm increments. If the maximum transmission EIRP configured on an IAP is not supported by the IAP model, the value is reduced to the highest supported power setting. The default value for maximum transmit power is 127 dBm.
Client aware	When **Enabled**, ARM does not change channels for the IAPs with active clients, except for high-priority events such as RADAR or excessive noise. This feature must be enabled in most deployments for a stable WLAN. If the Client Aware mode is **Disabled**, the IAP may change to a more optimal channel, that may disrupt the current client traffic for a while. The Client aware option is **Enabled** by default. **NOTE:** When Client aware is disabled, channels can be changed even when the clients are active on a BSSID.
Scanning	Select **Enabled** so that the IAP dynamically scans all 802.11 channels within its 802.11 regulatory domain at regular intervals and reports to the IAP. This scanning report includes WLAN coverage, interference, and intrusion detection data. **NOTE:** For client match configuration, ensure that scanning is enabled.
Wide Channel Bands	Select a band to allow the IAPs to be placed in 40 MHz (wide band) channels. The **Wide Channel Bands** allows administrators to configure 40 MHz channels in the 2.4 GHz and 5 GHz bands. 40 MHz channels are two 20 MHz adjacent channels that are bonded together. A 40 MHz channel effectively doubles the frequency bandwidth available for data transmission.
80 MHz Support	Enables or disables the use of 80 MHz channels on IAPs. This feature allows ARM to assign 80 MHz channels on IAPs with 5 GHz radios, which support a very high throughput. This setting is enabled by default. **NOTE:** Only the IAPs that support 802.11ac can be configured with 80 MHz channels.

2. Reboot the IAP.

3. Click **OK**.

In the CLI

To configure access point control parameters:

```
(Instant AP)(config)# arm
(Instant AP)(ARM)# a-channels <5GHz-channels>
(Instant AP)(ARM)# min-tx-power <power>
(Instant AP)(ARM)# max-tx-power <power>
(Instant AP)(ARM)# client-aware
(Instant AP)(ARM)# wide-bands {<5GHz>|<2GHz>|<All>|<None>}
(Instant AP)(ARM)# scanning
(Instant AP)(ARM)# 80mhz-support
(Instant AP)(ARM)# end
(Instant AP)# commit apply
```

Verifying ARM Configuration

To view ARM configuration:

```
(Instant AP)# show arm config

Minimum Transmit Power            :18
Maximum Transmit Power            :127
Band Steering Mode       :prefer-5ghz
Client Aware             :enable
Scanning                 :enable
Wide Channel Bands       :5ghz
80Mhz Support            :enable
Air Time Fairness Mode   :fair-access
Client Match             :disable
CM NB Matching Percent   :75
CM Calculating Interval  :30
CM SLB Threshold         :2
CM SLB Balancing Mode    :channel based
CM max client match req  :5
CM max adoption          :5
Custom Channels          :No
2.4 GHz Channels
----------------
Channel  Status
-------  ------
1        enable
2        disable
3        disable
4        disable
5        disable
6        enable
7        disable
8        disable
9        disable
10       disable
11       enable
12       disable
13       disable
1+       enable
2+       disable
3+       disable
4+       disable
5+       disable
6+       disable
7+       enable
```

```
5.0 GHz Channels
----------------
Channel  Status
-------  ------
36       enable
40       enable
44       enable
48       enable
52       enable
56       enable
60       enable
64       enable
149      enable
153      enable
157      enable
161      enable
165      enable
36+      enable
44+      enable
52+      disable
60+      disable
149+     enable
157+     enable
36E      enable
52E      enable
149E     enable
```

Client Match for Access Points in a Zone

When Client match is enabled, the decision to move a client from the home IAP to a target IAP is made at the radio level. However, this proves inefficient when client match is enabled on an IAP or SSID operating in a specific zone, it could result in the client being moved to a target IAP that does not have the same zone specific SSID as the home IAP.

Starting from Instant 6.5.1.0-4.3.1.0, the decision to move a client from a home IAP to a target IAP will be made at the SSID level instead of the radio level, by adding the SSID name to the client match radio database. Client Match will check if the same SSID (zone specific SSID on Home IAP) is available on the target IAP before it moves the client. This ensures that client match works as expected when zone settings are configured on the IAP.

Additionally, the maximum clients threshold and the current associated client number of the SSID is added to the client match radio database to prevent the clients from being moved to an SSID whose associated client number is already reached its limit.

You can use the following commands to view the SSID details stored in client match:

The **show ap client-match-ssid-table** command displays the client match SSID table for the current IAP and its neighboring IAPs.

The **show ap client-match-ssid-table radio-mac <mac>** command displays the client match SSID table for a specific IAP denoted by its mac address.

Configuring Radio Settings

You can configure 2.4 GHz and 5 GHz radio settings for an IAP either using the Instant UI or the CLI.

In the Instant UI

To configure radio settings:

1. Click the **RF** link located directly above the Search bar of the Instant main window.

2. Click **Show advanced options**. The advanced options are displayed.
3. Click the **Radio** tab.
4. Under the channel 2.4.GHz or 5 GHz, or both, configure the following parameters.

Table 57: *Radio Configuration Parameters*

Parameter	Description
Legacy only	Select **Enabled** to run the radio in non-802.11n mode. This option is set to **Disabled** by default.
802.11d / 802.11h	Select **Enabled** to allow the radio to advertise its 802.11d (Country Information) and 802.11h (Transmit Power Control) capabilities. This option is set to **Disabled** by default.
Beacon interval	Enter the Beacon period for the IAP in milliseconds. This indicates how often the 802.11 beacon management frames are transmitted by the access point. You can specify a value within the range of 60-500. The default value is 100 milliseconds.
Interference immunity level	Select to increase the immunity level to improve performance in high-interference environments. The default immunity level is 2. ● **Level 0**—no ANI adaptation. ● **Level 1**—Noise immunity only. This level enables power-based packet detection by controlling the amount of power increase that makes a radio aware that it has received a packet. ● **Level 2**—Noise and spur immunity. This level also controls the detection of OFDM packets, and is the default setting for the Noise Immunity feature. ● **Level 3**—Level 2 settings and weak OFDM immunity. This level minimizes false detects on the radio due to interference, but may also reduce radio sensitivity. This level is recommended for environments with a high-level of interference related to 2.4 GHz appliances such as cordless phones. ● **Level 4**—Level 3 settings, and FIR immunity. At this level, the IAP adjusts its sensitivity to in-band power, which can improve performance in environments with high and constant levels of noise interference. ● **Level 5**—The IAP completely disables PHY error reporting, improving performance by eliminating the time the IAP would spend on PHY processing. **NOTE:** Increasing the immunity level makes the IAP to lose a small amount of range.
Channel switch announcement count.	Specify the count to indicate the number of channel switching announcements that must be sent before switching to a new channel. This allows associated clients to recover gracefully from a channel change.

Table 57: *Radio Configuration Parameters*

Parameter	Description
Background spectrum monitoring	Select **Enabled** to allow the IAPs in access mode to continue with normal access service to clients, while performing additional function of monitoring RF interference (from both neighboring IAPs and non Wi-Fi sources such as, microwaves and cordless phones) on the channel they are currently serving clients.
Customize ARM power range	Select the check box and select a minimum (**Min Power**) and maximum (**Max Power**) power range value for the 2.4 GHz and 5 GHz band frequencies. The default value is 3 dBm. Unlike the configuration in the ARM profile, the transmit power of all radios in the Radio profile do not share the same configuration.
Very high throughput	Ensure that this check box is selected to enable very high throughput (VHT) on 802.11ac devices with 5 GHz radio. If VHT is enabled for the 5 GHz radio profile on an IAP, it is automatically enabled for all SSIDs configured on an IAP. By default, VHT is enabled on all SSIDs. If you want the 802.11ac IAPs to function as 802.11n IAPs, clear the check box to disable VHT on these devices.

5. Click **OK**.

In the CLI

To configure 2.4 GHz radio settings:

```
(Instant AP)(config)# rf dot11g-radio-profile
(Instant AP)(RF dot11g Radio Profile)# beacon-interval <milliseconds>
(Instant AP)(RF dot11g Radio Profile)# legacy-mode
(Instant AP)(RF dot11g Radio Profile)# spectrum-monitor
(Instant AP)(RF dot11g Radio Profile)# dot11h
(Instant AP)(RF dot11g Radio Profile)# interference-immunity <level>
(Instant AP)(RF dot11g Radio Profile)# csa-count <count>
(Instant AP)(RF dot11g Radio Profile)# max-distance <count>
(Instant AP)(RF dot11g Radio Profile)# max-tx-power <db>
(Instant AP)(RF dot11g Radio Profile)# min-tx-power <db>
(Instant AP)(RF dot11g Radio Profile)# end
(Instant AP)# commit apply
```

To configure 5 GHz radio settings:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# beacon-interval <milliseconds>
(Instant AP)(RF dot11a Radio Profile)# legacy-mode
(Instant AP)(RF dot11a Radio Profile)# spectrum-monitor
(Instant AP)(RF dot11a Radio Profile)# spectrum-band <type>
(Instant AP)(RF dot11a Radio Profile)# dot11h
(Instant AP)(RF dot11a Radio Profile)# interference-immunity <level>
(Instant AP)(RF dot11a Radio Profile)# max-distance <count>
(Instant AP)(RF dot11a Radio Profile)# max-tx-power <db>
(Instant AP)(RF dot11a Radio Profile)# min-tx-power <db>
(Instant AP)(RF dot11a Radio Profile)# csa-count <count>
(Instant AP)(RF dot11a Radio Profile)# end
(Instant AP)# commit apply
```

To disable VHT on a 5 GHz radio profile:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# very-high-throughput-disable
```

```
(Instant AP)(RF dot11a Radio Profile)# end
(Instant AP)# commit apply
```

To view the radio configuration:

```
(Instant AP)# show radio config

2.4 GHz:
Legacy Mode:enable
Beacon Interval:100
802.11d/802.11h:enable
Interference Immunity Level:2
Channel Switch Announcement Count:0
MAX Distance:600
Channel Reuse Type:disable
Channel Reuse Threshold:0
Background Spectrum Monitor:disable

5.0 GHz:
Legacy Mode:enable
Beacon Interval:100
802.11d/802.11h:enable
Interference Immunity Level:2
Channel Switch Announcement Count:2
MAX Distance:600
Channel Reuse Type:disable
Channel Reuse Threshold:0
Background Spectrum Monitor:disable
Standalone Spectrum Band:5ghz-upper
```

Configuring Cell Size Reduction using the CLI

The Cell Size Reduction feature allows you to manage dense deployments and to increase overall system performance and capacity by shrinking an IAPs receive coverage area, thereby minimizing co-channel interference and optimizing channel reuse.

The default 0 dB reduction allows the radio to retain its current default Rx sensitivity value.

Values from 1 dB–55 dB reduce the power level that the radio can hear by that amount. If you configure this feature to use a non-default value, you must also reduce the radio’s transmission (Tx) power to match its new received (Rx) power level. Failure to match a device’s Tx power level to its Rx power level can result in a configuration that allows the radio to send messages to a device that it cannot hear.

To configure Cell Size Reduction for 2.4 GHz radio profile in the CLI:

```
(Instant AP)(config)# rf dot11g-radio-profile
(Instant AP)(RF dot11g Radio Profile)# cell-size-reduction <reduction>
(Instant AP)(RF dot11g Radio Profile)# end
(Instant AP)# commit apply
```

To configure Cell Size Reduction for 5 GHz radio profile in the CLI:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# cell-size-reduction <reduction>
(Instant AP)(RF dot11a Radio Profile)# end
(Instant AP)# commit apply
```

ARM Channel Selection using the CLI

Starting from Instant 6.5.0.0-4.3.0.0, IAPs can search for a new environment in a short span of time, so that the ARM is triggered to perform frequent scanning and selection of a valid channel for transmission.

By default, the ARM is triggered to scan all the channels every 10 seconds, and select the best channel for transmission. But when the IAP is in a new environment, ARM is triggered to perform frequent scanning of the non-DFS channels every 200 milliseconds, and select the best available channel for transmission. The **ap-frequent-scan** command is introduced in the CLI to enable the IAPs to trigger frequent scanning of transmission signals on a radio profile.

NOTE

Wireless connection is affected for a few seconds when the frequent scanning of non-DFS channels is ongoing. The connection is re-established after the ARM selects a valid channel. Typically, a frequent scanning session lasts for less than 10 seconds.

Perform the following checks before scanning:

- The DFS channels must be skipped (this is done to avoid delays in scanning).
- The IAP must be on stand-alone mode.
- The **client-aware** parameter must be disabled in the ARM profile.

In the CLI

The following example triggers ARM scanning on a 2.4 GHz frequency band radio profile:

```
(Instant AP)# ap-frequent-scan 2.4
```

To verify the status of ARM scanning:

```
(Instant AP)# show ap debug am-config
```

This chapter provides the following information:

Deep Packet Inspection

AppRF is Aruba's custom-built Layer 7 firewall capability. It consists of an onboard deep packet inspection and a cloud-based Web Policy Enforcement (WPE) service that allows creating firewall policies based on types of application. The WPE capabilities require the IAP to have a WPE subscription. For more information on subscription, contact the Aruba Sales Team.

IAPs with DPI capability analyze data packets to identify applications in use and allow you to create access rules to determine client access to applications, application categories, web categories, and website URLs based on web reputation. You can also define traffic-shaping policies such as bandwidth control and QoS per application for client roles. For example, you can block bandwidth-monopolizing applications on a guest role within an enterprise.

The AppRF feature provides application visibility for analyzing client traffic flow. IAPs support the power of both in-device packet flow identification and dynamically updated cloud-based web categorization.

Enabling Application Visibility

Enabling AppRF visibility allows you to view the AppRF statistics for an IAP or the clients associated with an IAP. Full URL visibility for HTTP sessions fed to Analytics and Location Engine (ALE) is exposed as northbound APIs which can be consumed by URL analytical engines for advanced client URL data mining and analytics.

You can enable AppRF visibility by using the Instant UI or the CLI.

In the Instant UI

To enable AppRF:

1. Navigate to **System > General**.
2. Select **All** from the **AppRF visibility** drop-down list to view both application and web categories charts or either **App** or **WebCC** to view their DPI graphs separately.
3. Click **OK**.

In the CLI

To enable AppRF visibility:

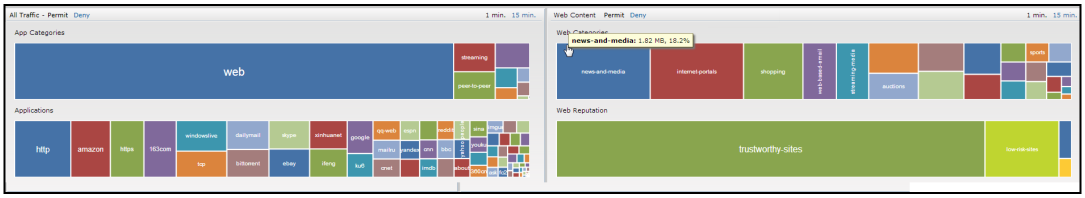
```
(Instant AP)(config)# dpi [app|webcc]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Application Visibility

The AppRF graphs are based on Deep Packet Inspection (DPI) application and Web Policy Enforcement (WPE) service, which provide application traffic summary for the client devices associated with an IAP. The **AppRF** link above the activity panel of the dashboard is displayed only if **AppRF visibility** is enabled in the **System** window.

The following figure provides a view of the AppRF dashboard:

Figure 58 *AppRF Dashboard*



The AppRF dashboard presents four different graph areas with data graphs on all client traffic and content filters based on App Category, Web Category, and Web Reputation. Click each category to view the real-time client traffic data or usage trend in the last 15 minutes or 1 minute.

The **permit** and **deny** monitoring tabs in the All Traffic and Web Content sections provide enforcement visibility support.

- **Permit** represents the allowed or permitted traffic on the IAP.
- **Deny** represents all the blocked URLs and traffic .

Application Categories Chart

The application categories chart displays details on the client traffic towards the application categories. By clicking the rectangle area, you can view the following graphs, and toggle between the chart and list views.

Figure 59 *Application Categories Chart: Client View*

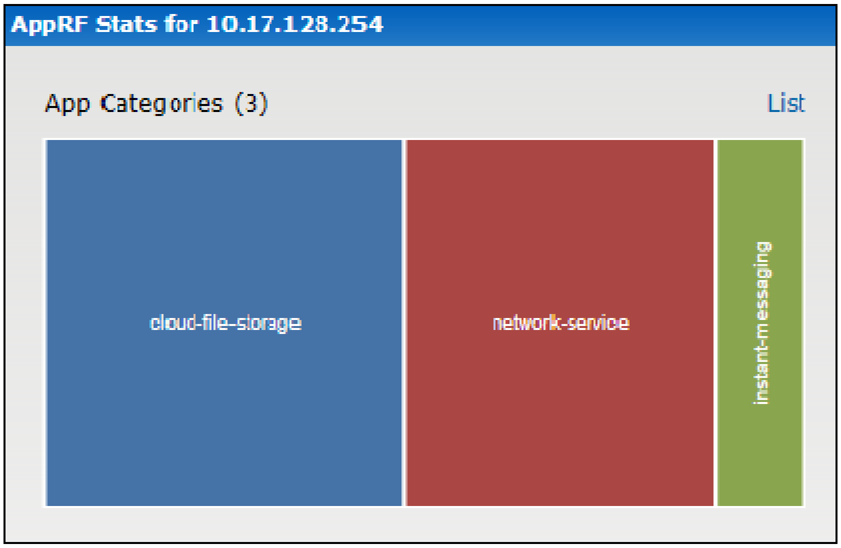
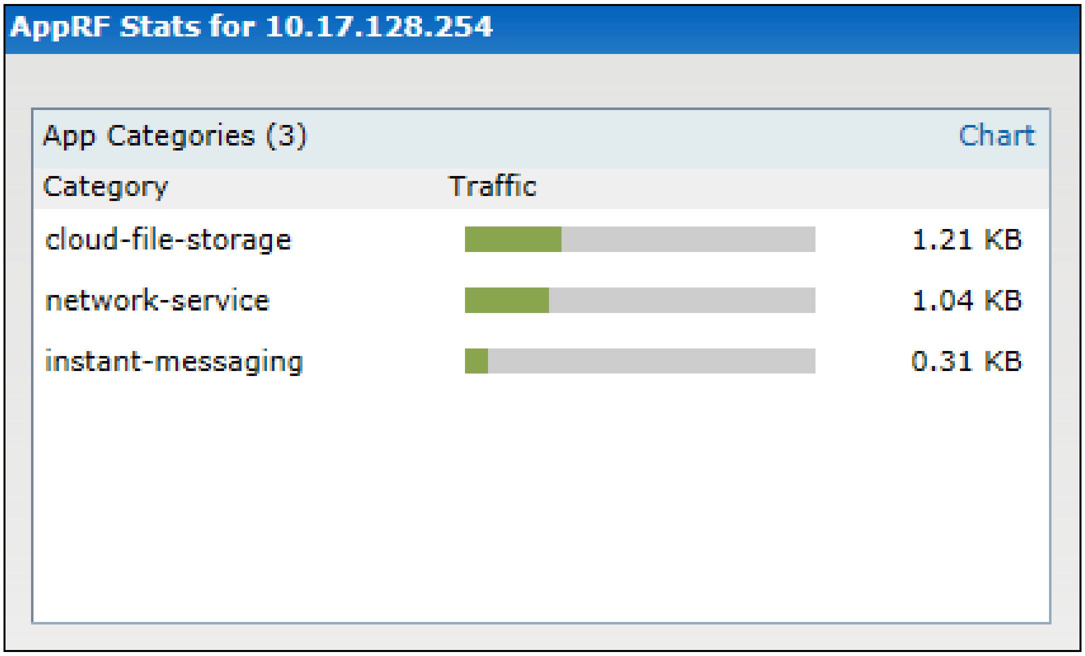


Figure 60 *Application Categories List: Client View*

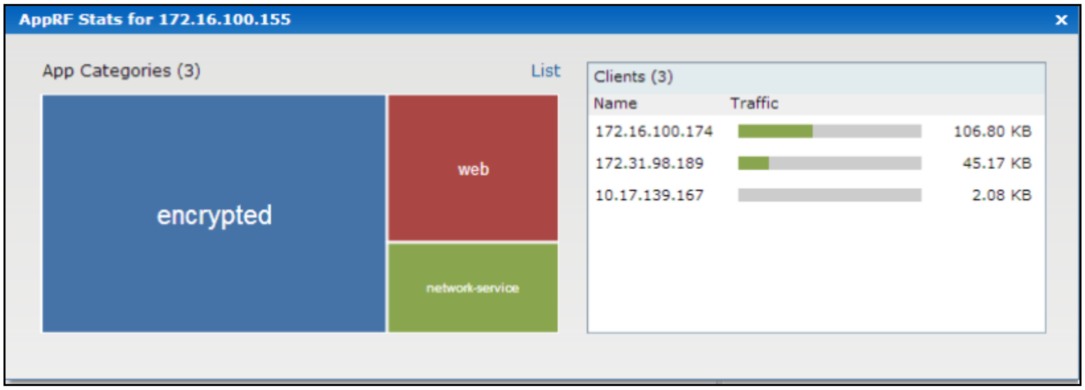


AppRF Stats for 10.17.128.254

App Categories (3) Chart

Category	Traffic	
cloud-file-storage		1.21 KB
network-service		1.04 KB
instant-messaging		0.31 KB

Figure 61 *Application Categories Chart: IAP View*



Clients (3)

Name	Traffic	
172.16.100.174		106.80 KB
172.31.98.189		45.17 KB
10.17.139.167		2.08 KB

Applications Chart

The applications chart displays details on the client traffic towards the applications. By clicking the rectangular area, you can view the following graphs, and toggle between the chart and list views.

Figure 62 *Applications Chart: Client View*

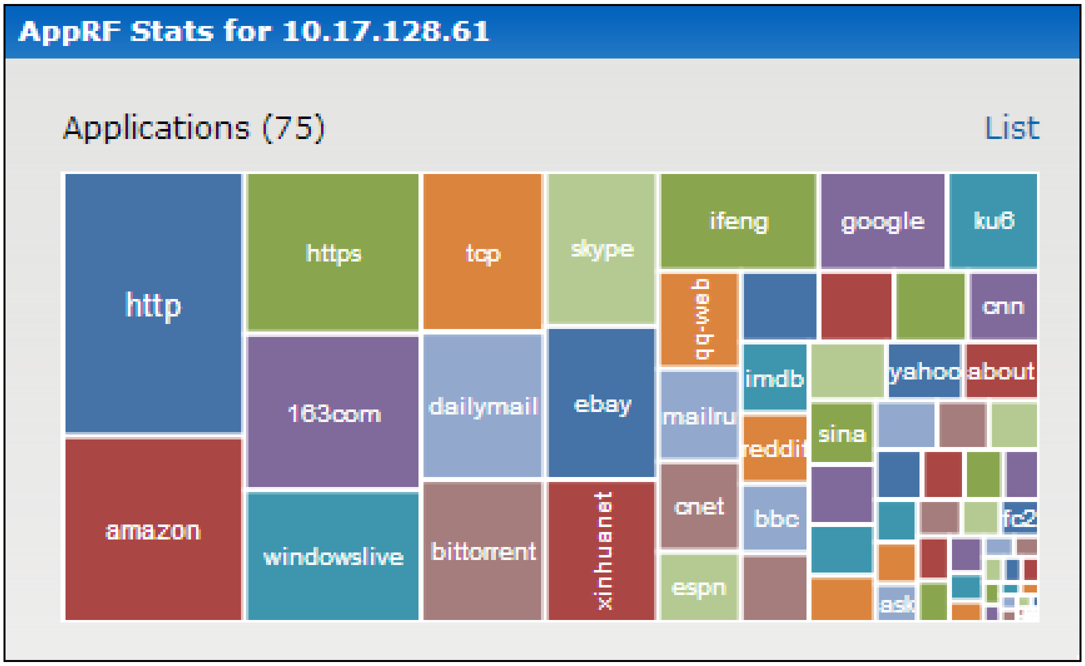
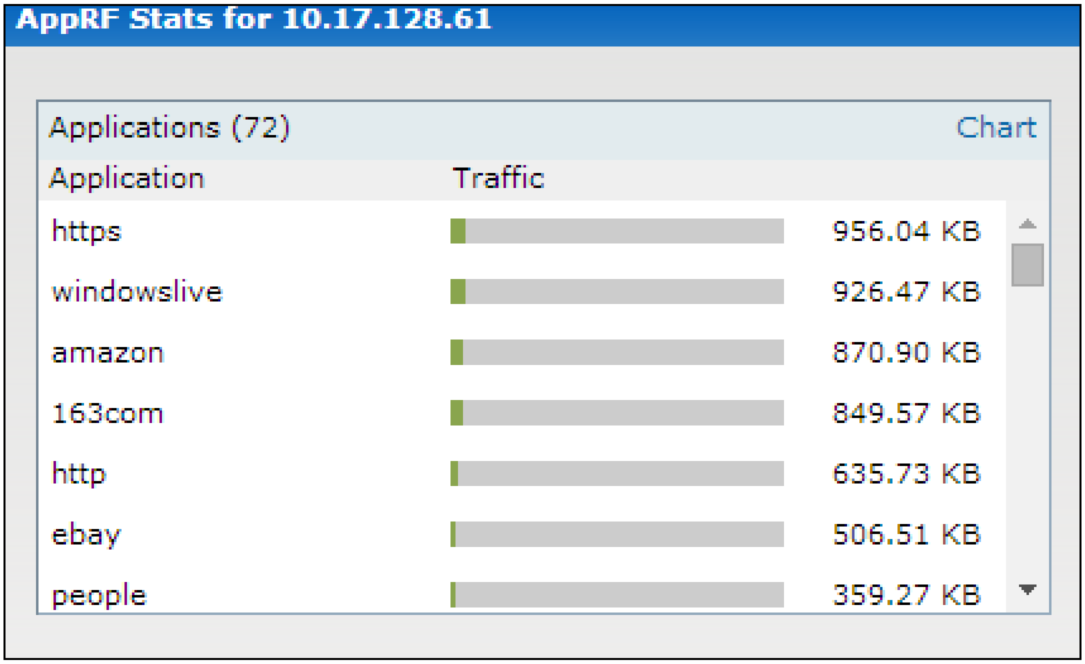


Figure 63 *Applications List: Client View*

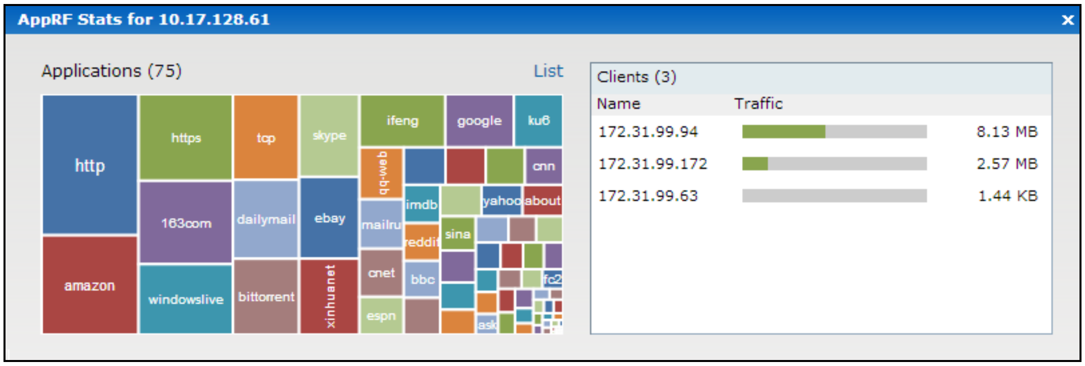


AppRF Stats for 10.17.128.61

Applications (72) Chart

Application	Traffic
https	956.04 KB
windowslive	926.47 KB
amazon	870.90 KB
163com	849.57 KB
http	635.73 KB
ebay	506.51 KB
people	359.27 KB

Figure 64 *Application Chart: Access Point View*



AppRF Stats for 10.17.128.61

Applications (75) List

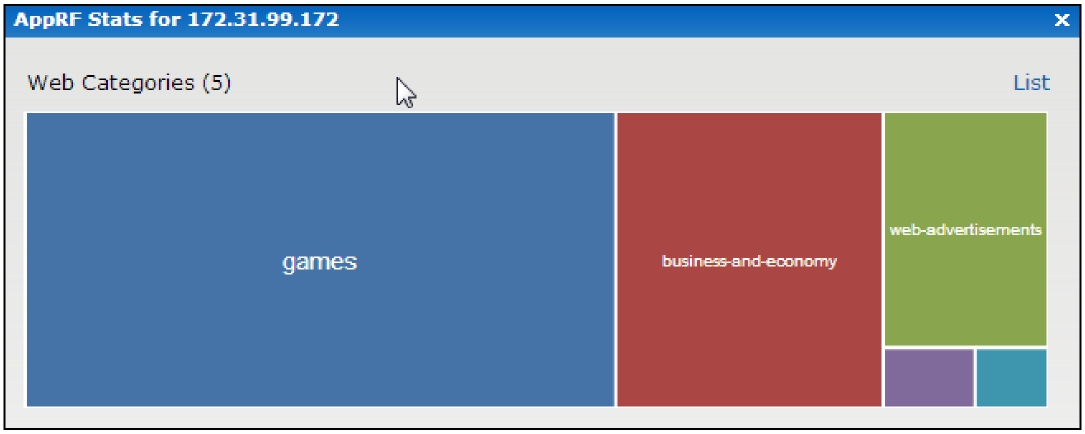
Clients (3)

Name	Traffic	
172.31.99.94		8.13 MB
172.31.99.172		2.57 MB
172.31.99.63		1.44 KB

Web Categories Charts

The web categories chart displays details about the client traffic to the web categories. By clicking the rectangle area, you can view the following graphs, and toggle between the chart and list views.

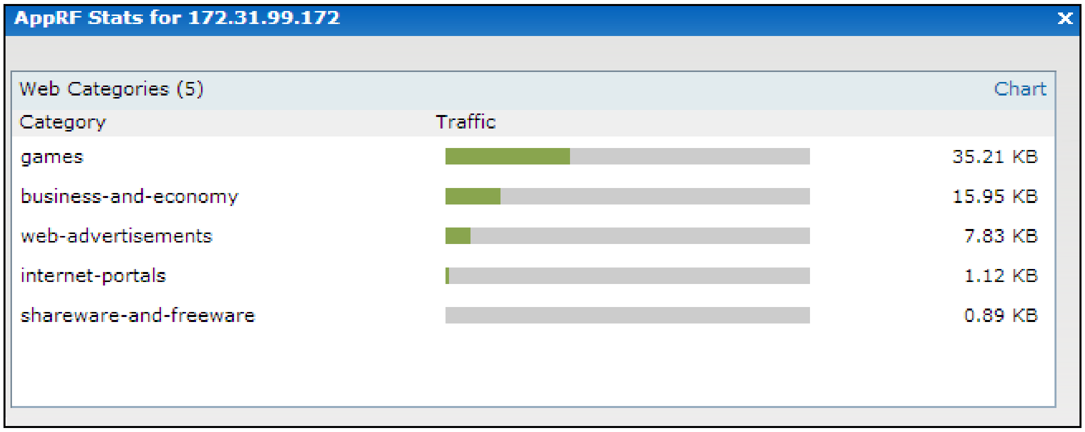
Figure 65 *Web Categories Chart: Client View*



AppRF Stats for 172.31.99.172

Web Categories (5) List

Figure 66 *Web Categories List: Client View*

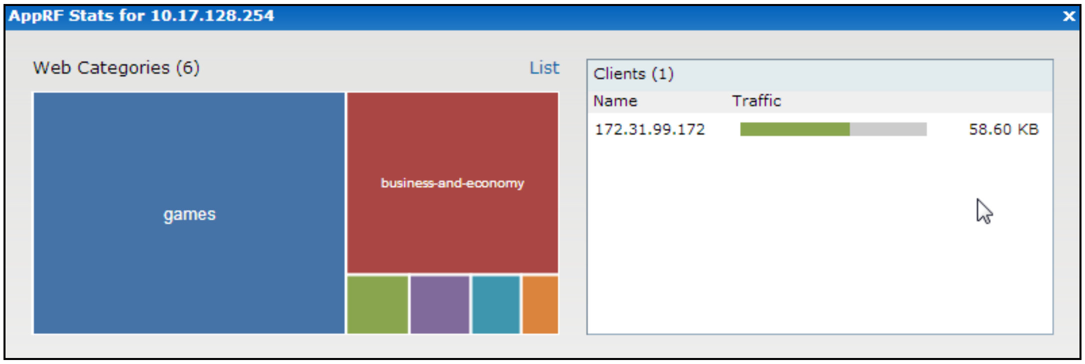


AppRF Stats for 172.31.99.172

Web Categories (5) Chart

Category	Traffic	
games		35.21 KB
business-and-economy		15.95 KB
web-advertisements		7.83 KB
internet-portals		1.12 KB
shareware-and-freeware		0.89 KB

Figure 67 *Web Categories Chart: Access Point View*



AppRF Stats for 10.17.128.254

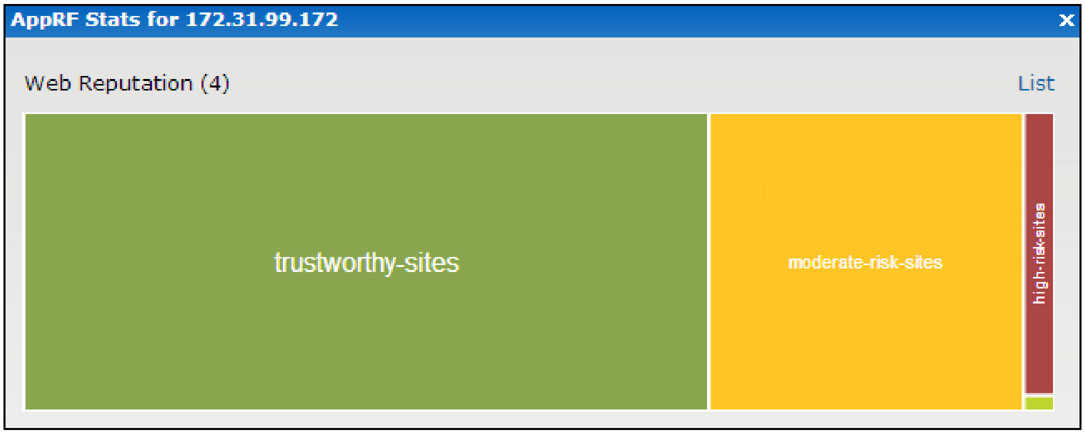
Clients (1)

Name	Traffic	
172.31.99.172		58.60 KB

Web Reputation Charts

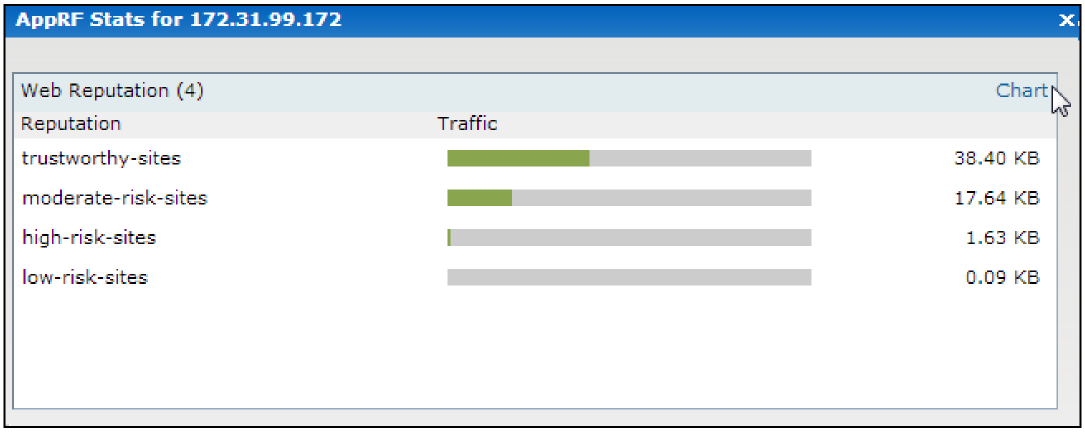
The web reputation chart displays details about the client traffic to the URLs that are assigned security ratings. By clicking in the rectangle area, you can view the following graphs, and toggle between the chart and list views.

Figure 68 *Web Reputation Chart: Client View*



AppRF Stats for 172.31.99.172

Figure 69 *Web Reputation List: Client View*

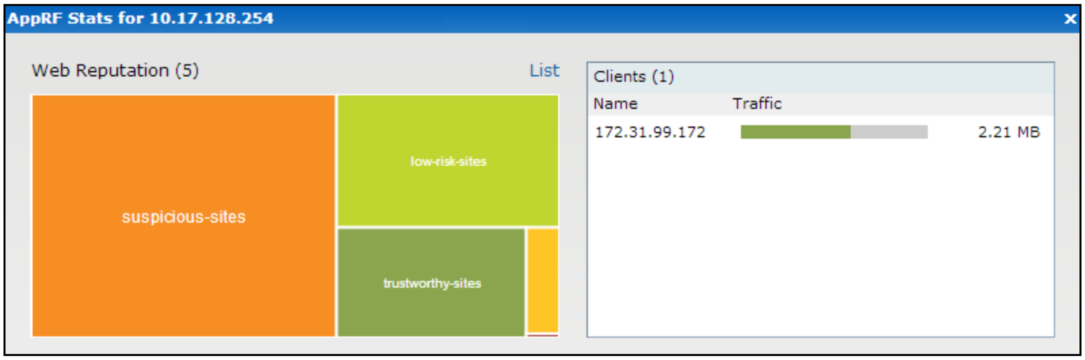


AppRF Stats for 172.31.99.172

Web Reputation (4) Chart

Reputation	Traffic	
trustworthy-sites		38.40 KB
moderate-risk-sites		17.64 KB
high-risk-sites		1.63 KB
low-risk-sites		0.09 KB

Figure 70 *Web Reputation Chart: IAP View*



Name	Traffic
172.31.99.172	2.21 MB

Enabling URL Visibility

Enabling URL visibility allows the IAP to extract the full URL information of the HTTP and HTTPS sessions and periodically log them on the ALE server. Full URL visibility for HTTP sessions fed to ALE are exposed as Northbound APIs, and are used by URL analytical engines for advanced client URL data mining and analysis.

You can enable URL visibility by using the Instant UI or the CLI:

In the Instant UI

To enable URL visibility:

1. Navigate to **System > General**.
2. Select **Enabled** from the **URL visibility** drop-down list.
3. Click **OK**.

In the CLI

To enable URL visibility:

```
(Instant AP)(config)# url-visibility
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring ACL Rules for Application and Application Categories

This section describes the procedure for configuring access rules based on application and application categories. The Application and Application rules utilize the onboard DPI engine.

- For information on configuring access rules to control access to network services, see Configuring ACL Rules for Network Services on page 181.
- For information on configuring access rules based on web categories and web reputation, see Configuring Web Policy Enforcement Service on page 273.

In the Instant UI

To configure ACL rules for a user role:

1. Navigate to the **Security > Roles** tab. The **Roles** tab contents are displayed.

   You can also configure access rules for a wired or wireless client by using:

   a. The WLAN wizard (**Network > WLAN SSID > Edit > Edit WLAN > Access**) or

   b. The Wired profile (**More > Wired > Edit > Edit Wired Network > Access**) window.
2. Select the role for which you want to configure the access rules.

3. In the **Access rules** section, click **New** to add a new rule. The **New Rule** window is displayed.
4. Ensure that the rule type is set to **Access Control**.
5. To configure access to applications or application category, select a service category from the following list:
   - Application
   - Application category
6. Based on the selected service category, configure the following parameters:

Table 58: *Access Rule Configuration Parameters*

Service Category	Description
Application	Select the applications to which you want to allow or deny access.
Application category	Select any of the following application categories to which you want to allow or deny access: - antivirus - authentication - cloud-file-storage - collaboration - encrypted - enterprise-apps - gaming - im-file-transfer - instant-messaging - mail-protocols - mobile-app-store - network-service - peer-to-peer - social-networking - standard - streaming - thin-client - tunneling - unified-communications - web - Webmail
Application Throttling	Application throttling allows you to set a bandwidth limit for an application, application category, web category, or for sites based on their web reputation. For example, you can limit the bandwidth rate for video streaming applications such as YouTube or Netflix, or assign a low bandwidth to high-risk sites. If your IAP model does not support configuring access rules based on application or application category, you can create a rule based on web category or website reputation and assign bandwidth rates. To specify a bandwidth limit:

Table 58: *Access Rule Configuration Parameters*

Service Category	Description
	1. Select the **Application Throttling** check box. 2. Specify the downstream and upstream rates in Kbps.
Action	Select any of following actions: - Select **Allow** to allow access to users based on the access rule. - Select **Deny** to deny access to users based on the access rule. - Select **Destination-NAT** to allow changes to destination IP address. - Select **Source-NAT** to allow changes to the source IP address. The destination-NAT and source-NAT actions apply only to the network services rules.
Destination	Select a destination option for the access rules for network services, applications, and application categories. You can allow or deny access to any the following destinations based on your requirements. - **to all destinations**—Access is allowed or denied to all destinations. - **to a particular server**—Access is allowed or denied to a particular server. After selecting this option, specify the IP address of the destination server. - **except to a particular server**—Access is allowed or denied to servers other than the specified server. After selecting this option, specify the IP address of the destination server. - **to a network**—Access is allowed or denied to a network. After selecting this option, specify the IP address and netmask for the destination network. - **except to a network**—Access is allowed or denied to networks other than the specified network. After selecting this option, specify the IP address and netmask of the destination network. - **to domain name**—Access is allowed or denied to the specified domains. After selecting this option, specify the domain name in the **Domain Name** text box. - **to master IP**—Access is allowed or denied to the master IP address.
Log	Select this check box to create a log entry when this rule is triggered. Instant supports firewall-based logging function. Firewall logs on the IAPs are generated as security logs.
Blacklist	Select the **Blacklist** check box to blacklist the client when this rule is triggered. The blacklisting lasts for the duration specified in **Auth failure blacklist time** on the Blacklisting tab of the **Security** window. For more information, see Blacklisting Clients on page 175.

Table 58: *Access Rule Configuration Parameters*

Service Category	Description
Disable scanning	Select **Disable scanning** check box to disable ARM scanning when this rule is triggered. The selection of the **Disable scanning** applies only if ARM scanning is enabled. For more information, see Configuring Radio Settings on page 259.
DSCP tag	Select the **DSCP tag** check box to specify a DSCP value to prioritize traffic when this rule is triggered. Specify a value within the range of 0–63. To assign a higher priority, specify a higher value.
802.1p priority	Select the **802.1p priority** check box to specify an 802.1p priority. Specify a value between 0 and 7. To assign a higher priority, specify a higher value.

3. Click **OK** and then click **Finish**.

In the CLI

To configure access rules:

```
(Instant AP)(config)# wlan access-rule <access-rule-name>
(Instant AP)(Access Rule <Name>)#rule <dest> <mask> <match/invert> {app <app> {permit|deny}
|appcategory <appgrp>}[<option1....option9>]
(Instant AP)(Access Rule <Name>)# end
(Instant AP)# commit apply
```

Example

The following CLI example shows hoe to configure employee access rules:

```
(Instant AP)(config)# wlan access-rule employee
(Instant AP)(Access Rule "employee")# rule any any match app uoutube permit throttle-
downstream 256 throttle-up 256
(Instant AP)(Access Rule "employee")# rule any any match appcategory collaboration permit
(Instant AP)(Access Rule "employee")# end
(Instant AP)# commit apply
```

Configuring Web Policy Enforcement Service

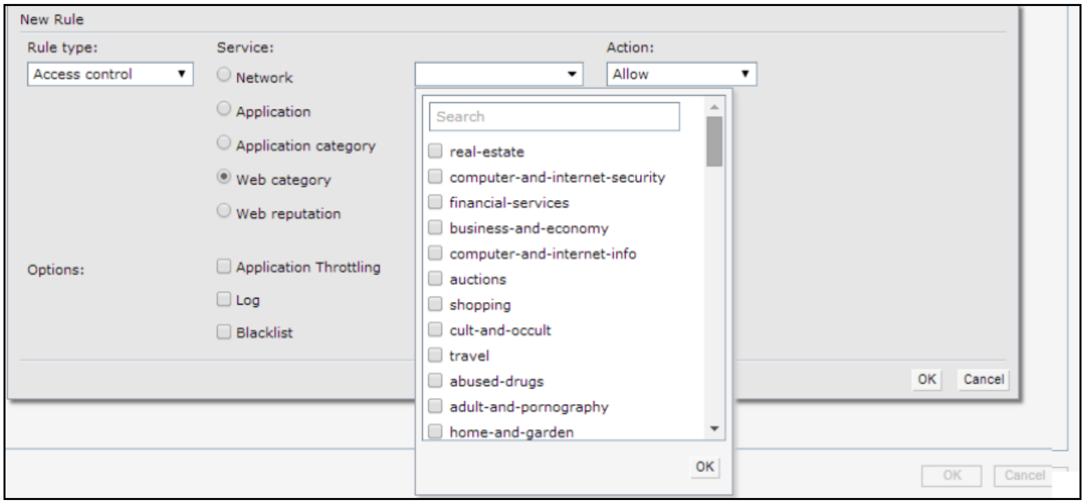
You can configure the WPE service on an IAP to block certain categories of websites based on your organization specifications by defining ACL rules by using the Instant UI or the CLI.

In the Instant UI

To configure WPE service:

1. Navigate to **Security > Roles**.
2. Select any WLAN SSID or wired profile role, and click **New** in the Access Rules section.
3. Select the rule type as **Access Control**.
4. To set an access policy based on the web category:
   a. Under **Service**, select **Web category** and expand the **Web categories** drop-down list.

Figure 71 *Web Policy Enforcement*



New Rule

Rule type: Access control ▾

Service:
- ○ Network
- ○ Application
- ○ Application category
- ● Web category
- ○ Web reputation

Action: Allow ▾

Search
- □ real-estate
- □ computer-and-internet-security
- □ financial-services
- □ business-and-economy
- □ computer-and-internet-info
- □ auctions
- □ shopping
- □ cult-and-occult
- □ travel
- □ abused-drugs
- □ adult-and-pornography
- □ home-and-garden

Options:
- □ Application Throttling
- □ Log
- □ Blacklist

b. Select the categories to which you want to deny or allow access. You can also search for a web category and select the required option.

c. From the **Action** drop-down list, select **Allow** or **Deny** as required.

d. Click **OK**.

5. To filter access based on the security ratings of the website:

a. Select **Web reputation** under **Service**.

b. Move the slider to the required security rating level. Move the slider to select a specific web reputation value to deny access to websites with a reputation value lower than or equal to the configured value or to permit access to websites with a reputation value higher than or equal to the configured value. The following options are available:

- Trustworthy—These are well known sites with strong security practices and may not expose the user to security risks. There is a very low probability that the user will be exposed to malicious links or payloads.
- Low risk—These are benign sites and may not expose the user to security risks. There is a low probability that the user will be exposed to malicious links or payloads.
- Moderate risk—These are generally benign sites, but may pose a security risk. There is some probability that the user will be exposed to malicious links or payloads.
- Suspicious—These are suspicious sites. There is a higher than average probability that the user will be exposed to malicious links or payloads.
- High risk—These are high-risk sites. There is a high probability that the user will be exposed to malicious links or payloads.

c. From the **Action** drop-down list, select **Allow** or **Deny** as required.

NOTE

For a complete list of categories and information about each of these categories, visit the BrightCloud® Security Services web page at http://www.brightcloud.com/tools/change-request-url-ip.php.

6. To set a bandwidth limit based on web category or web reputation score, select **Application Throttling** check box and specify the downstream and upstream rates in Kbps. For example, you can set a higher bandwidth for trusted sites and a low bandwidth rate for high-risk sites.

7. If required, select the following check boxes :

- Log
- Blacklist
- Disable scanning

- DSCP tag
- 802.1p priority

8. Click **OK** on the **Roles** tab to save the changes to the role for which you defined ACL rules.

In the CLI

To control access based on web categories and security ratings:

```
(Instant AP)(config)# wlan access-rule <access_rule>
(Instant AP)(Access Rule "<access-rule>")# rule <dest> <mask> <match> webcategory <webgrp>
{permit | deny}[<option1....option9>]
(Instant AP)(Access Rule "<access-rule>")# rule <dest> <mask> <match> webreputation <webrep>
{permit | deny}[<option1....option9>]
(Instant AP)(Access Rule "<access-rule>")# end
(Instant AP)# commit apply
```

Example

The following CLI example shows how to set access rules based on the web category and the web reputation:

```
(Instant AP)(config)# wlan access-rule URLFilter
(Instant AP)(Access Rule "URLFilter")# rule any any match webcategory gambling deny
(Instant AP)(Access Rule "URLFilter")# rule any any match webcategory training-and-tools
permit
(Instant AP)(Access Rule "URLFilter")# rule any any match webreputation suspicious-sites deny
(Instant AP)(Access Rule "URLFilter")# end
(Instant AP)# commit apply
```

Chapter 22 Voice and Video

This chapter explains the steps required to configure voice and video services on an IAP for Voice over IP (VoIP) devices, Session Initiation Protocol (SIP), Spectralink Voice Priority (SVP), H323, SCCP, Vocera, and Alcatel NOE phones, clients running Microsoft OCS, and Apple devices running the Facetime application.

This section includes the following topics:

- Wi-Fi Multimedia Traffic Management on page 276
- Media Classification for Voice and Video Calls on page 279
- Enabling Enhanced Voice Call Tracking on page 280

Wi-Fi Multimedia Traffic Management

Wi-Fi Multimedia (WMM) is a Wi-Fi Alliance specification based on the IEEE 802.11e wireless Quality of Service (QoS) standard. WMM works with 802.11a, 802.11b, 802.11g, and 802.11n physical layer standards.

WMM supports the following access categories (ACs):

- Voice
- Video
- Best effort
- Background

The following table shows the mapping of the WMM access categories to 802.1p priority values. The 802.1p priority value is contained in a two-byte QoS control field in the WMM data frame.

Table 59: *WMM AC to 802.1p Priority Mapping*

802.1p Priority	WMM Access Category
1	Background
2	
0	Best effort
3	
4	Video
5	
6	Voice
7	

In a non-WMM or hybrid environment, where some clients are not WMM-capable, you can configure an SSID with higher values for best effort and voice ACs, to allocate a higher bandwidth to clients transmitting best effort and voice traffic.

Configuring WMM for Wireless Clients

You can configure WMM for wireless clients by using the UI or the CLI.

In the Instant UI

To configure the WMM for wireless clients:

1. Navigate to the WLAN wizard.
   a. Click **Networks > New** or
   b. Click **Networks**, and select the **WLAN SSID > edit**.
2. Click **Show advanced options** under **WLAN Settings**.
3. Specify a percentage value for the following WMM access categories in the corresponding **Share** text box. You can allocate a higher bandwidth for voice and video traffic than that for other types of traffic based on the network profile.
   - **Background WMM**—Allocates bandwidth for background traffic such as file downloads or print jobs.
   - **Best effort WMM**—Allocates bandwidth or best effort traffic such as traffic from legacy devices or traffic from applications or devices that do not support QoS.
   - **Video WMM**—Allocates bandwidth for video traffic generated from video streaming.
   - **Voice WMM**—Allocates bandwidth for voice traffic generated from the incoming and outgoing voice communication.
4. Click **Next** and complete the configuration as required.

In the CLI

Configuring WMM for wireless clients:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# wmm-background-share <share>
(Instant AP)(SSID Profile <name>)# wmm-best-effort-share <share>
(Instant AP)(SSID Profile <name>)# wmm-video-share <share>
(Instant AP)(SSID Profile <name>)# wmm-voice-share <share>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Mapping WMM ACs and DSCP Tags

The IEEE 802.11e standard defines the mapping between WMM ACs and Differentiated Services Code Point (DSCP) tags. You can customize the mapping values between WMM ACs and DSCP tags to prioritize various traffic types and apply these changes to a WMM-enabled SSID profile.

DSCP classifies packets based on network policies and rules. The following table shows the default WMM AC to DSCP mappings and the recommended WMM AC to DSCP mappings.

Table 60: *WMM AC-DSCP Mapping*

DSCP Value	WMM Access Category
8	Background
16	
0	Best effort
24	

Table 60: *WMM AC-DSCP Mapping*

DSCP Value	WMM Access Category
32	Video
40	
48	Voice
56	

By customizing WMM AC mappings, all packets received are matched against the entries in the mapping table and prioritized accordingly. The mapping table contains information for upstream (client to IAP) and downstream (IAP to client) traffic.

You can configure different WMM to DSCP mapping values for each WMM AC when configuring an SSID profile by using the Instant UI or the CLI.

In the Instant UI

To configure DSCP mapping values:

1. Navigate to the WLAN wizard.
   1. Click **Network > New** or
   2. Click **Network**, and select the **WLAN SSID > edit**.
2. Click **Show advanced options** under **WLAN Settings**.
3. Specify the appropriate DSCP mapping value within a range of 0–63 for the following access categories in the **DSCP mapping** text box:
   - **Background WMM**—DSCP mapping for the background traffic.
   - **Best effort WMM**—DSCP mapping for the best-effort traffic.
   - **Video WMM**—DSCP mapping for the video traffic.
   - **Voice WMM**—DSCP mapping for the voice traffic.
4. Click **Next** and complete the configuration as required.

In the CLI

Configuring DSCP settings on an SSID:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# wmm-background-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-best-effort-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-video-dscp <dscp>
(Instant AP)(SSID Profile <name>)# wmm-voice-dscp <dscp>
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

You can configure up to 8 DSCP mappings values within the range of 0-63. You can also configure a combination of multiple values separated by a comma, for example, **wmm-voice-dscp 46,44,42,41**.

Configuring WMM U-APSD

To extend the battery life and enable power saving on WLAN clients, IAPs support Unscheduled Automatic Power Save Delivery (U-APSD) for the clients that support WMM. The U-APSD or the WMM Power Save feature is enabled by default on all SSIDs. When configured, U-APSD enables a client station to retrieve the unicast QoS traffic buffered in the IAP by sending trigger frames. During the association or reassociation with the IAP, the station indicates the WMM Access Categories for which U-APSD is enabled. In the current release, IAPs support U-APSD on all WMM ACs.

To disable U-APSD on an SSID:

```
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
(Instant AP)(SSID Profile "<ssid_profile>")# wmm-uapsd-disable
(Instant AP)(SSID Profile "<ssid_profile>")# end
(Instant AP)# commit apply
```

To re-enable U-APSD on an SSID:

```
(Instant AP)(config)# wlan ssid-profile <ssid_profile>
(Instant AP)(SSID Profile "<ssid_profile>")# no wmm-uapsd-disable
(Instant AP)(SSID Profile "<ssid_profile>")# end
(Instant AP)# commit apply
```

Media Classification for Voice and Video Calls

Instant supports the following media classification types:

- Classify Media Flag
- STUN Based Media Classification

Classify Media Flag

Voice and video devices use a signaling protocol to establish, control, and terminate voice and video calls. These control or signaling sessions are usually permitted using predefined ACLs. If the control signaling packets are encrypted, the IAP cannot determine the dynamic ports that are used for voice or video traffic. In these cases, the IAP has to use an ACL with the classify-media option enabled to identify the voice or video flow based on a deep packet inspection and analysis of the actual traffic. Instant identifies and prioritizes voice and video traffic from applications such as Skype for Business, Apple Facetime, and Jabber.

Skype for Business uses Session Initiation Protocol (SIP) over TLS or HTTPS to establish, control, and terminate voice and video calls. Apple Facetime uses Extensible Messaging and Presence Protocol (XMPP) over TLS or HTTPS for these functions.

The following CLI example shows the media classification for VoIP calls:

```
(Instant AP)(config)# wlan access-rule example_s4b_test
(Instant AP)(example_s4b_test)# rule alias <domain_name_for_S4B_server> match tcp 443 443
permit log classify-media
(Instant AP)(example_s4b_test)# rule any any match tcp 5060 5060 permit log classify-media
(Instant AP)(example_s4b_test)# rule any any match tcp 5061 5061 permit log classify-media
(Instant AP)(example_s4b_test)# rule any any match tcp 5223 5223 permit log classify-media
(Instant AP)(example_s4b_test)# rule any any match any any any permit
(Instant AP)(example_s4b_test)# end
(Instant AP)# commit apply
```

STUN Based Media Classification

STUN based media classification requires the ACLs permitting signaling sessions without the **classify-media** flag. However, it requires an implicit deny firewall rule for User Datagram Protocol (UDP) to be activated. All other traffic that should be allowed in the network must be explicitly configured using ACL rules.The IAP automatically allows firewall sessions for voice and video calls made from Skype for Business and Apple Facetime. For all other S4B and Facetime applications like desktop sharing and file transfer, the corresponding ports must be explicitly opened by using ACL rules.

Before media transmission, a VOIP client initiates a Session Traversal Utilities for NAT (STUN) connectivity check. Sessions created by STUN are subjected to media classification that classifies the media as Real-time Transport Protocol (RTP) or non-RTP. The firewall automatically allows the RTP session on the IAP and denies the non-RTP sessions.

The following CLI example shows the STUN based media classification for Skype for Business:

```
(Instant AP)(config)#wlan access-rule example_s4b_test
(Instant AP)(example_s4b_test)# rule alias <domain_name_for_S4B_server> match tcp 443 443
permit
(Instant AP)(example_s4b_test)# rule any any match tcp 5223 5223 permit
(Instant AP)(example_s4b_test)# rule any any match tcp 5061 5061 permit
(Instant AP)(example_s4b_test)# rule any any match any any any deny
(Instant AP)(example_s4b_test)# end
(Instant AP)# commit apply
```

NOTE

The Type of Service (ToS) values for calls prioritized using the above mentioned media classification types will always carry a ToS of 40 fora voice session and 48 for a video session.

Enabling Enhanced Voice Call Tracking

Aruba Instant provides seamless support for tracking VoIP calls in the network by using SNMP to send the location details of the caller to the third-party server. This feature is currently applied for tracking Emergency 911 (E911) VoIP calls.

The Master IAP identifies the location from where the VoIP call was placed and sends the details of the location to the third-party SNMP server. You must configure the third-party server as an SNMP host and enable SNMP traps to activate the voice call tracking feature on the IAP. For more information on configuring a third-party server as an SNMP host, see Configuring SNMP on page 366.

The Master IAP will send the WLSXIAPVOICECLIENTLOCATIONUPDATE SNMP trap under the following scenarios:

- The VoIP call is successful.
- The VoIP client roams from one IAP to another during an active call, the Master IAP will identify the VoIP client and send out the WLSXIAPVOICECLIENTLOCATIONUPDATE trap to the emergency call server.

NOTE

The trap sending feature is not supported for L3 mobility.

The WLSXIAPVOICECLIENTLOCATIONUPDATE trap contains the following information:

Table 61: *SNMP Trap Details for VoIP Calls*

Parameter	Description
wlsxTrapVcIpAddress	IP address of the VoIP client.
wlsxTrapVcMacAddress	MAC address of the VoIP client.
wlsxTrapAPMacAddress	MAC address of the IAP which generated the trap.
wlsxTrapAPName	Name of the IAP which generated the trap.

SNMP GET

In order to find the location of a particular emergency caller, the third-party SNMP server sends a query to the Master IAP using SNMP GET. The Master IAP responds back to the SNMP server with the location (IAP Name) of the VoIP caller. Following are the key parameters in the response sent by the Master IAP:

- VoIP Client IP Address
- VoIP Client MAC Address
- IAP MAC Address
- IAP Name

Chapter 23
Services

This chapter provides information on how to configure the following services on an IAP:

Configuring AirGroup

AirGroup provides a unique enterprise-class capability that leverages zero configuration networking to enable AirGroup services from mobile devices efficiently. Zero configuration networking enables service discovery, address assignment, and name resolution for desktop computers, mobile devices, and network services. It is designed for flat, single-subnet IP networks such as wireless networking at home. The users can register their personal devices and define a group of users who can share the registered devices. Administrators can register and manage an organization's shared devices such as printers and grant global access to each device, or restrict access according to the username, role, or user location.

In large universities and enterprise networks, it is common for devices to connect to the network across VLANs. As a result, user devices on a specific VLAN cannot discover a service that resides on another VLAN. As the addresses used by the protocol are link-scope multicast addresses, each query or advertisement can only be forwarded on its respective VLAN, but not across different VLANs. Broadcast and multicast traffic are usually filtered out from a wireless LAN network to preserve the airtime and battery life. This inhibits the performance of AirGroup services that rely on multicast traffic. Aruba addresses this challenge with AirGroup technology.

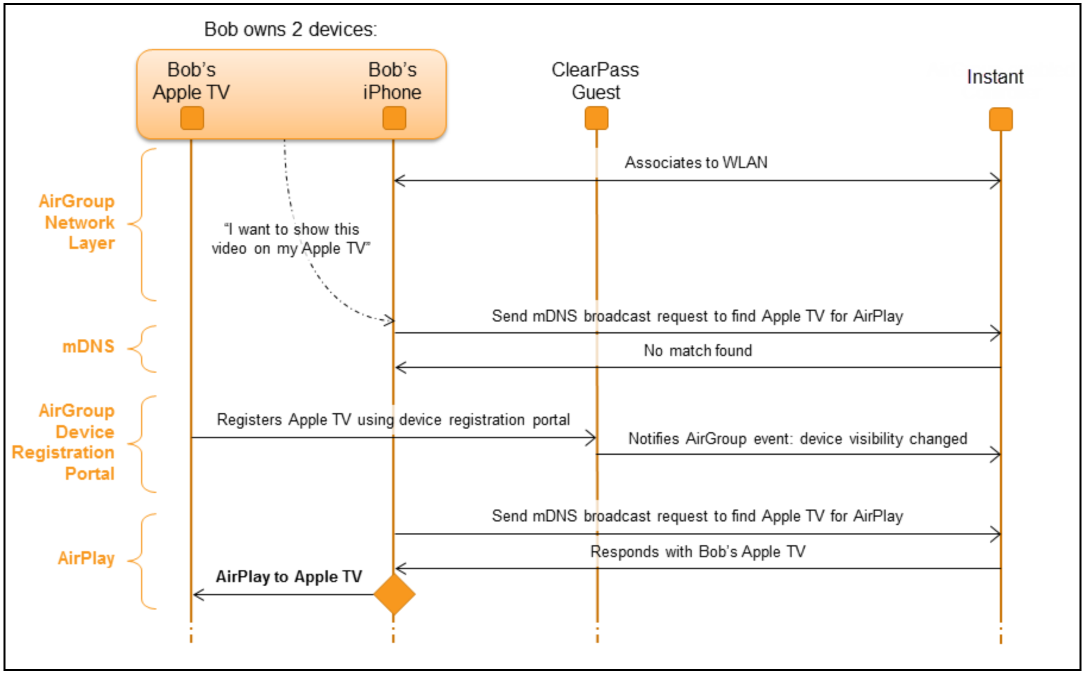
The distributed AirGroup architecture allows each IAP to handle multicast DNS (mDNS) and Digital Living Network Alliance (DLNA) queries and responses individually instead of overloading a VC with these tasks. This results in a scalable AirGroup solution.

The AirGroup solution supports both wired and wireless devices. An AirGroup device can be registered by an administrator or a guest user.

1. The AirGroup administrator gives an end user the AirGroup operator role, which authorizes the user to register the client devices on the ClearPass Policy Manager platform.
2. IAPs maintain information for all AirGroup services. IAP queries ClearPass Policy Manager to map each device’s access privileges to the available services and responds to the query made by a device based on contextual data such as user role, username, and location.

The following figure illustrates how AirGroup enables personal sharing of Apple devices:

Figure 72 *AirGroup Enables Personal Device Sharing*


Bob owns 2 devices:
Bob's Apple TV
Bob's iPhone
ClearPass Guest
Instant
AirGroup Network Layer
Associates to WLAN
"I want to show this video on my Apple TV"
mDNS
Send mDNS broadcast request to find Apple TV for AirPlay
No match found
AirGroup Device Registration Portal
Registers Apple TV using device registration portal
Notifies AirGroup event: device visibility changed
AirPlay
Send mDNS broadcast request to find Apple TV for AirPlay
Responds with Bob's Apple TV
AirPlay to Apple TV

NOTE

AirGroup is not supported on 3G and PPPoE uplinks.

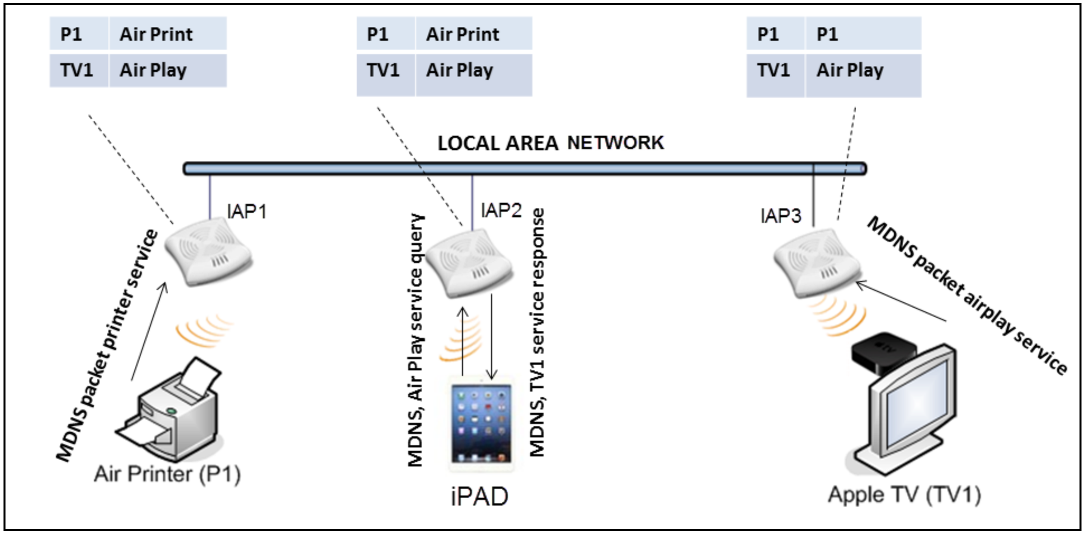
Multicast DNS and Bonjour® Services

Bonjour is the trade name for the zero configuration implementation introduced by Apple. It is supported by most of the Apple product lines, including the Mac OS X operating system, iPhone, iPod Touch, iPad, Apple TV, and AirPort Express. Apple AirPlay and AirPrint services are based on the Bonjour protocol and are essential services in campus Wi-Fi networks.

Bonjour can be installed on computers running Microsoft Windows® and is supported by the new network-capable printers. Bonjour is also included with popular software programs such as Apple iTunes, Safari, and iPhoto. Bonjour uses multicast DNS (mDNS) to locate devices and the services offered by these devices.

As shown in the following figure, the IAP1 discovers AirPrint (P1) and IAP3 discovers Apple TV (TV1). IAP1 advertises information about its connected P1 device to the other IAPs that is IAP2 and IAP3. Similarly, IAP3 advertises TV1 device to IAP1 and IAP2. This type of distributed architecture allows any IAP to respond to its connected devices locally. In this example, the iPad connected to IAP2 obtains direct response from the same IAP about the other Bonjour-enabled services in the network.

Figure 73 *Bonjour Services and AirGroup Architecture*



For a list of supported Bonjour services, see AirGroup Services on page 286.

DLNA UPnP Support

In addition to the mDNS protocol, IAPs now support Universal Plug and Play (UPnP), and DLNA-enabled devices. DLNA is a network standard derived from UPnP, which enables devices to discover the services available in a network. DLNA also provides the ability to share data between the Windows or Android-based multimedia devices. All the features and policies applicable to mDNS are extended to DLNA to ensure full interoperability between compliant devices.

In a UPnP-based scenario, the following types of devices are available in a network:

- Controlled devices (servers)
- Control points (clients)

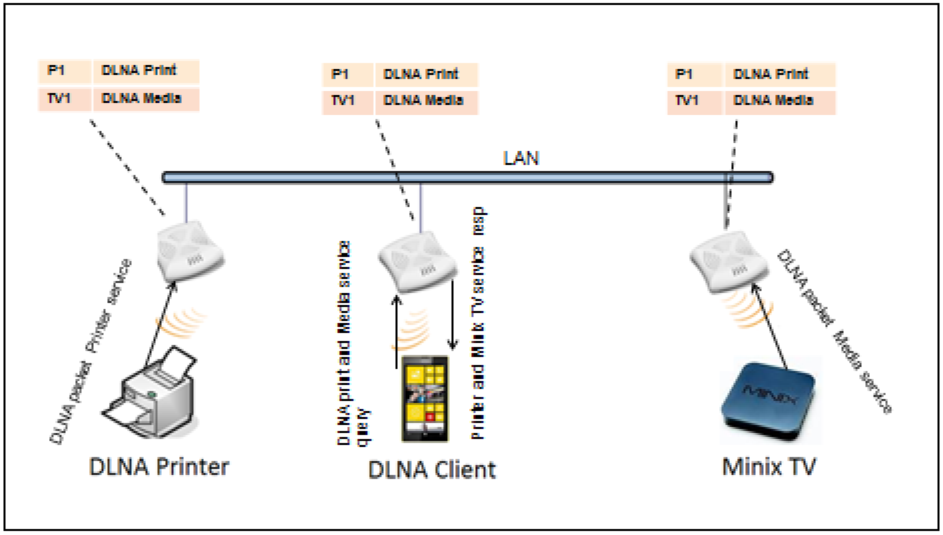
When a controlled device joins a network and acquires IP address, it multicasts a number of discovery messages for advertising itself, its embedded devices, and services. On the other hand, when a control point joins a network, it may multicast a search discovery message for finding interesting devices and services. The devices listening on the multicast address respond if they match the search criteria in the search message.

In a single IAP network, the IAP maintains a cache table containing the list of discovered services in the network. The IAP also enforces native policies such as disallowing roles and VLANs and the policies defined on ClearPass Policy Manager to determine the devices or services that are allowed and can be discovered in the network. Whenever a search request comes, the IAP looks up its cache table and filters the cached data, based on configured policies, then builds a search response, and unicasts it to the requesting device.

In an IAP cluster, the IAPs maintain a list of associated UPnP devices and allow the discovery of the associated devices.

The following figure illustrates DLNA UPnP Services and AirGroup Architecture.

Figure 74 *DLNA UPnP Services and AirGroup Architecture*


P1
DLNA Print
TV1
DLNA Media
P1
DLNA Print
TV1
DLNA Media
P1
DLNA Print
TV1
DLNA Media
LAN
DLNA packet Printer service
DLNA print and Media service query
Printer and Minix TV service resp
DLNA packet Media service
MINIX
DLNA Printer
DLNA Client
Minix TV

For a list of supported DLNA services, see AirGroup Services on page 286.

AirGroup Features

AirGroup supports the following features:

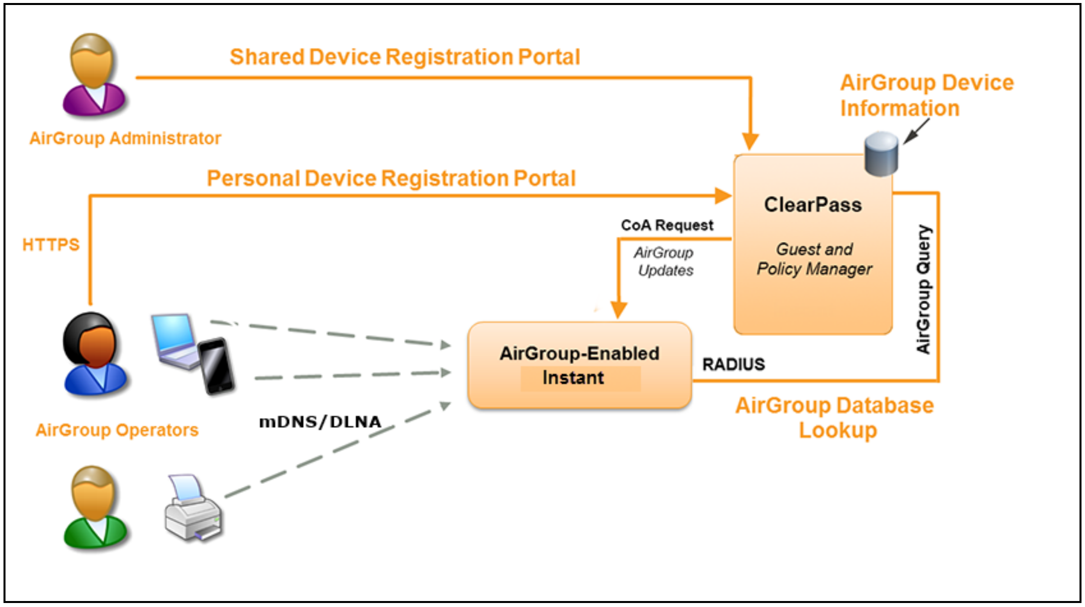
- Sends unicast responses to mDNS or DLNA queries and reduces the traffic footprint.
- Ensures cross-VLAN visibility and availability of AirGroup devices and services.
- Allows or blocks AirGroup services for all users.
- Allows or blocks AirGroup services based on user roles.
- Allows or blocks AirGroup services based on VLANs.
- Matches devices to their closest services such as printers.

AirGroup also enables context awareness for services across the network:

- AirGroup is aware of personal and shared devices. For example, an Apple TV in a dorm room can be associated with the student who owns it or an Apple TV in a meeting room or a printer in a supply room that is available to certain users, such as the marketing department.
- AirGroup is aware of the location of services when ClearPass Policy Manager support is enabled. For example, depending on the proximity, a user would be presented with the closest printer instead of all the printers in the building.
- When configured, AirGroup enables a client to perform a location-based discovery. For example, when a client roams from one Instant cluster to another, it can discover devices available in the new cluster to which the client is currently connected.

The following figure shows an example of a higher-education environment with shared, local, and personal services available to mobile devices.

Figure 75 *AirGroup in a Higher-Education Environment*



NOTE

When AirGroup discovers a new device, it interacts with ClearPass Policy Manager to obtain the shared attributes such as shared location and role. However, the current versions of IAPs do not support the enforcement of shared location policy.

AirGroup Services

AirGroup supports zero configuration services. The services are preconfigured and are available as part of the factory default configuration. The administrator can also enable or disable any or all services by using the Instant UI or the CLI.

The following services are available for IAP clients:

- AirPlay™—Apple® AirPlay allows wireless streaming of music, video, and slide shows from your iOS device to Apple TV® and other devices that support the AirPlay feature.
- AirPrint™—Apple AirPrint allows you to print from an iPad®, iPhone®, or iPod® Touch directly to any AirPrint-compatible printers.
- iTunes—The iTunes service is used by iTunes Wi-Fi sync and iTunes home-sharing applications across all Apple devices.
- RemoteMgmt—The RemoteMgmt service allows remote login, remote management, and FTP utilities on Apple devices.
- Sharing—The Sharing service allows applications such as disk sharing and file sharing among Apple devices.
- Chat—The iChat® (Instant Messenger) application on Apple devices uses this service.
- ChromeCast—The ChromeCast service allows you to use a ChromeCast device to play audio or video content on a high-definition television by streaming content through Wi-Fi from the Internet or local network.
- DLNA Media—Applications such as Windows Media Player use this service to browse and play media content on a remote device.
- DLNA Print—This service is used by printers that support DLNA.

NOTE

In the Instant 6.4.0.2-4.1.0.0 release, it is recommended to have a maximum of upto 80 AirGroup servers in the network.

For more information on configuring AirGroup services, see Configuring AirGroup and AirGroup Services on an IAP on page 288.

AirGroup Components

AirGroup leverages key elements of the Aruba solution portfolio including operating system software for Instant, ClearPass Policy Manager, and the VLAN-based or role-based filtering options offered by the AirGroup services. The components that make up the AirGroup solution include the Instant, ClearPass Policy Manager, and ClearPass Guest. The version requirements are described in the following table:

Table 62: *Instant, ClearPass Policy Manager, and ClearPass Guest Requirements*

Component	Minimum Version for mDNS Services	Minimum Version for DLNA Services
Instant	Instant 6.2.0.0-3.2.0.0	Instant 6.4.0.2-4.1.0.0
ClearPass Policy Manager software	ClearPass Policy Manager 5.2	ClearPass Policy Manager 6.2
ClearPass Guest Services plugin	ClearPass Guest 6.2.0	ClearPass Guest 6.3.0

> Starting from ClearPass Policy Managerversion 6.0, the ClearPass Guest and the AirGroup Services plug-in are integrated into a single platform.

AirGroup maintains seamless connectivity between clients and services across VLANs and SSIDs. The following table summarizes the filtering options supported by Instant:

Table 63: *AirGroup Filtering Options*

Features	Instant Deployment Models	
	Integrated with ClearPass Guest	**Integrated with ClearPass Policy Manager**
Allow mDNS and DLNA traffic to propagate across subnets/VLANs	Yes	Yes
Limit mDNS and DLNA traffic on the network	Yes	Yes
VLAN-based AirGroup service policy enforcement	Yes	Yes
User-role-based AirGroup service policy enforcement	Yes	Yes
Portal to self-register personal devices	No	Yes
Device-owner-based policy enforcement	No	Yes
Shared user-list-based policy enforcement	No	Yes
Shared role-list based-policy enforcement	No	Yes

ClearPass Policy Manager and ClearPass Guest Features

ClearPass Policy Manager and ClearPass Guest support the following features:

- Registration portal for WLAN users to register their personal devices.
- Registration portal for WLAN administrators to register shared devices.
- Operator-defined *personal* AirGroup to specify a list of other users who can share devices with the operator.
- Administrator-defined username, user role, and location attributes for shared devices.

Configuring AirGroup and AirGroup Services on an IAP

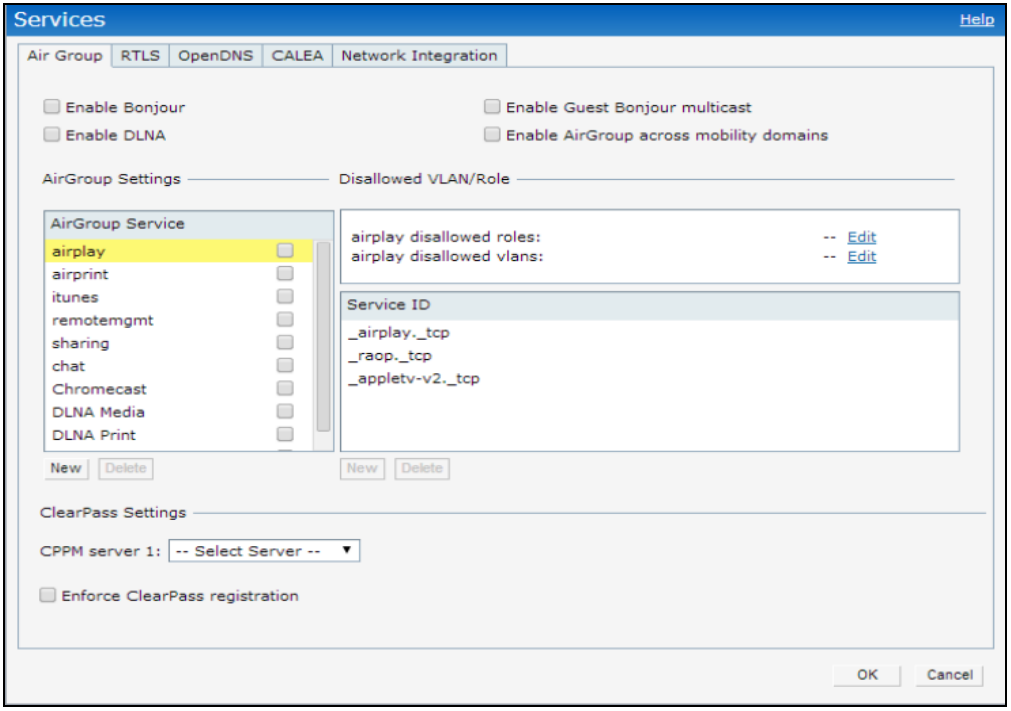
You can configure AirGroup services by using the Instant UI or the CLI.

In the Instant UI

To enable AirGroup and its services:

1. Click the **More > Services** link on the Instant main window.
2. Click the **Air Group** tab.

Figure 76 *AirGroup Configuration*



□ Enable Bonjour

□ Enable DLNA

□ Enable Guest Bonjour multicast

□ Enable AirGroup across mobility domains

AirGroup Settings

AirGroup Service	
airplay	□
airprint	□
itunes	□
remotemgmt	□
sharing	□
chat	□
Chromecast	□
DLNA Media	□
DLNA Print	□

Disallowed VLAN/Role

airplay disallowed roles: -- Edit
airplay disallowed vlans: -- Edit

Service ID
_airplay._tcp
_raop._tcp
_appletv-v2._tcp

ClearPass Settings

CPPM server 1: -- Select Server --

□ Enforce ClearPass registration

3. To enable support for Bonjour services, select the **Enable Bonjour** check box and select the AirGroup services related to Bonjour as required.
4. To enable DLNA support, select the **Enable DLNA** check box and select the DLNA services.
5. To allow the users to use Bonjour services enabled in a guest VLAN, select **Enable Guest Bonjour multicast**. When this check box is enabled, the Bonjour devices are visible only in the guest VLAN and AirGroup will not discover or enforce policies in guest VLAN.
6. Select the **Enable Air Group across mobility domains** check box to enable inter-cluster mobility. When enabled, the IAP shares the mDNS database information with the other clusters. The DNS records in the VC can be shared with all the VC configured for L3 Mobility.

   By default, this feature is disabled. To define clusters, go to the **System > L3 Mobility** tab.

7. Ensure that the required AirGroup services are selected. To add any service, click **New** and add. To allow all services, select **allowall**. If a custom service is added, you can add a corresponding service ID by clicking **New** under **Service ID**.

NOTE

If an IAP is upgraded to the current release with the **Bonjour** check box enabled, ensure that the corresponding Bonjour services are selected.

Instant supports the use of up to 6 custom services.

8. Based on the services configured, you can block any user roles from accessing an AirGroup service and restrict the AirGroup servers connected to a specific set of VLANs from being discovered . The user roles and VLANs marked as disallowed are prevented from accessing the corresponding AirGroup service. You can create a list of disallowed user roles and VLANs for all AirGroup services configured on the IAP. For example, If the AirPlay service is selected, the **edit** links for the **airplay disallowed roles** and **airplay disallowed vlans** are displayed. Similarly, if sharing service is selected, the **edit** links for the **sharing disallowed roles** and **sharing disallowed vlans** are displayed.
   - To block user roles from accessing an AirGroup service, click the corresponding **edit** link and select the user roles for which you want to restrict access. By default, an AirGroup service is accessible by all user roles configured in your IAP cluster.
   - To block VLANs from allowing access to an AirGroup service, click the corresponding **edit** link and select the VLANs to exclude. By default, the AirGroup services are accessible by users or devices in all VLANs configured in your IAP cluster.
9. **ClearPass Settings**—Use this section to configure the ClearPass Policy Manager server, CoA server, and enforce ClearPass registering.
   - **CPPM server 1**—Indicates the ClearPass Policy Manager server information for AirGroup policy.
   - **Enforce ClearPass registering**—When enabled, only devices registered with ClearPass Policy Manager will be discovered by Bonjour devices, based on the ClearPass Policy Manager policy.

In the CLI

To configure AirGroup:

```
(Instant AP)(config)# airgroup
(Instant AP)(airgroup)# enable [dlna-only | mdns-only]
(Instant AP)(airgroup)# cppm enforce-registration
(Instant AP)(airgroup)# cppm-server <server>
(Instant AP)(airgroup)# cppm-query-interval <interval>
(Instant AP)(airgroup)# disallow-vlan <vlan-ID>
(Instant AP)(airgroup)# enable-guest-multicast
(Instant AP)(airgroup)# multi-swarm
(Instant AP)(airgroup)# end
(Instant AP)# commit apply
```

To enable DLNA support:

```
(Instant AP)(config)# airgroup
(Instant AP)(airgroup)# enable dlna-only
(Instant AP)(airgroup)# end
(Instant AP)# commit apply
```

To enable support for Bonjour services:

```
(Instant AP)(config)# airgroup
(Instant AP)(config)# enable mdns-only
(Instant AP)(airgroup)# end
(Instant AP)# commit apply
```

To configure AirGroup services:

```
(Instant AP)(config)# airgroupservice <airgroup-service>
```

```
(Instant AP)(airgroup-service)# id <airgroupservice-ID>
(Instant AP)(airgroup-service)# description <text>
(Instant AP)(airgroup-service)# disallow-role <role>
(Instant AP)(airgroup-service)# disallow-vlan <vlan-ID>
(Instant AP)(airgroup-service)# end
(Instant AP)# commit apply
```

To verify the AirGroup configuration status:

```
(Instant AP)# show airgroup status
```

Configuring AirGroup and ClearPass Policy Manager Interface in Instant

Configure the Instant and ClearPass Policy Manager interface to allow an AirGroup IAP and ClearPass Policy Manager to exchange information regarding device sharing, and location. The configuration options define the RADIUS server that is used by the AirGroup RADIUS client.

The AirGroup configuration with ClearPass Policy Manager involves the following steps:

1. Create a RADIUS Server
2. Assigning a Server to AirGroup
3. Configuring ClearPass Policy Manager to Enforce Registration
4. Configuring Change of Authorization (CoA)

Creating a RADIUS Server

You can create a RADIUS server in the **Air Group** window. Navigate to **Services > AirGroup > Clear Pass Settings > CPPM server 1 >** and select **New** from the drop-down list.

You can configure an external RADIUS Security window. For more information on configuring ClearPass Policy Manager server, see Configuring an External Server for Authentication on page 155.

Assigning a Server to AirGroup

To associate the ClearPass Policy Manager server with AirGroup, select the ClearPass Policy Manager server from the **CPPM Server 1** drop-down list.

NOTE

If two ClearPass Policy Manager servers are configured, the CPPM server 1 acts as a primary server and the CPPM server 2 acts as a backup server.

After the configuration is complete, this particular server will be displayed in the CoA server option. To view this server go to **Services > AirGroup > ClearPass Settings > CoA server**.

Configuring ClearPass Policy Manager to Enforce Registration

When ClearPass Policy Manager registration is enforced, the devices registered with ClearPass Policy Manager will be discovered by Bonjour devices, based on the ClearPass Policy Manager policy.

Configuring Change of Authorization (CoA)

When a RADIUS server is configured with Change of Authorization (CoA) with the ClearPass Policy Manager server, the guest users are allowed to register their devices. For more information on configuring RADIUS server with CoA , see Configuring an External Server for Authentication on page 155.

NOTE

You can also create a **CoA only server** in the **Services > AirGroup > Clear Pass Settings > CoA server** window.

Configuring an IAP for RTLS Support

Instant supports the real-time tracking of devices when integrated with the AMP or a third-party Real Time Location Server such as Aeroscout Real Time Location Server. With the help of the RTLS, the devices can be monitored in real time or through history.

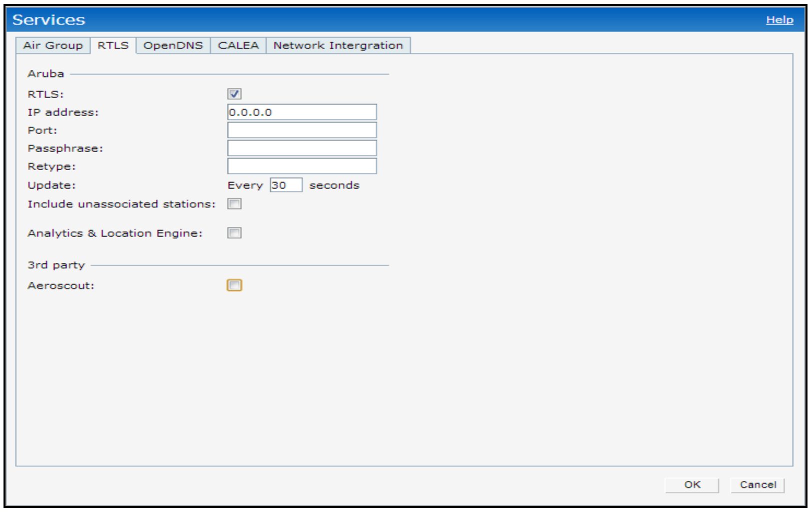
You can configure RTLS by using the Instant UI or the CLI.

In the Instant UI

To configure Aruba RTLS:

1. Click the **More > Services** link on the Instant main window.
2. In the **Services** section, click the **RTLS** tab.
3. Under **Aruba**, select the **RTLS** check box to integrate Instant with the AMP or Ekahau Real Time Location Server. The following figure shows the contents of the **RTLS** tab.

Figure 77 *RTLS Window*



Aruba

RTLS: ☑

IP address: 0.0.0.0

Port:

Passphrase:

Retype:

Update: Every 30 seconds

Include unassociated stations: □

Analytics & Location Engine: □

3rd party

Aeroscout: □

4. Specify the IP address and port to which the location reports must be sent.
5. Specify the shared secret key in the **Passphrase** text box.
6. In the **Update** text box, specify the frequency at which the VC can send updates to the server. You can specify a value within the range of 5-3600 seconds. The default value is 5 seconds.
7. Select the **Include unassociated stations** check box to send reports to the RTLS server about the stations that are not associated to any IAP.
8. Click **OK**.

To configure third-party RTLS such as Aeroscout:

1. Select the **Aeroscout** check box to send the RFID tag information to an AeroScout RTLS.
2. Specify the IP address and port number of the AeroScout server to which location reports must be sent.
3. Select the **Include unassociated stations** check box to send reports on the stations that are not associated to any IAP to the Aeroscout RTLS server.
4. Click **OK**.

In the CLI

To configure AirWave RTLS:

```
(Instant AP)(config)# airwave-rtls <IP-address> <port> <passphrase> <seconds> include-unassoc-
sta
(Instant AP)(config)# end
```

```
(Instant AP)# commit apply
```

To configure Aeroscout RTLS:

```
(Instant AP)(config)# aeroscout-rtls <IP-address> <port> include-unassoc-sta
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring an IAP for Analytics and Location Engine Support

The Analytics and Location Engine (ALE) is designed to gather client information from the network, process it, and share it through a standard API. The client information gathered by ALE can be used for business purposes by analyzing a client's Internet behavior such as shopping preferences.

ALE includes a location engine that calculates the associated and unassociated device location every 30 seconds by default. For every device on the network, ALE provides the following information through the Northbound API:

- Client username
- IP address
- MAC address
- Device type
- Application firewall data showing the destinations and applications used by associated devices
- Current location
- Historical location

ALE requires the IAP placement data to be able to calculate location for the devices in a network.

ALE with Instant

The Instant 6.3.1.1-4.0 release supports Analytics and Location Engine (ALE). The ALE server acts as a primary interface to all third-party applications and the IAP sends client information and all status information to the ALE server.

To integrate IAP with ALE, the ALE server address must be configured on an IAP. If the ALE sever is configured with a host name, the VC performs a mutual certificated-based authentication with the ALE server before sending any information.

Enabling ALE Support on an IAP

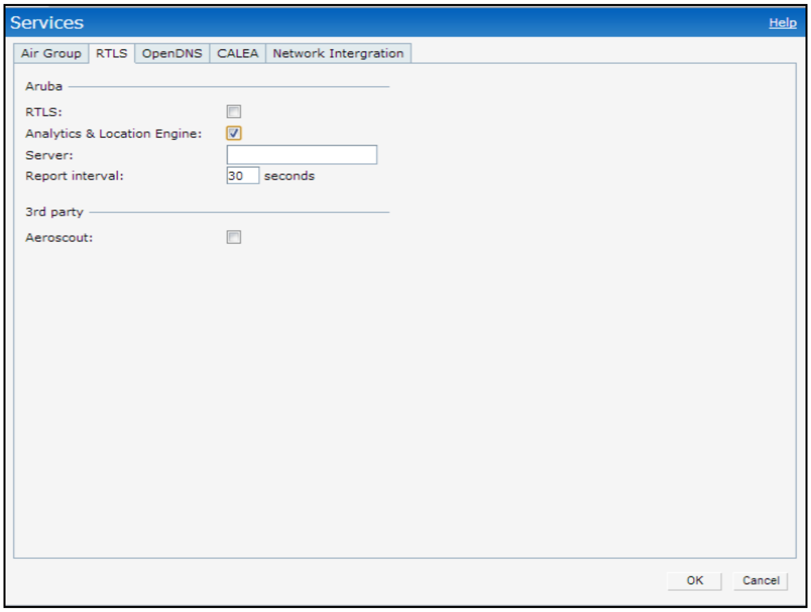
You can configure an IAP for ALE support by using the Instant UI or the CLI.

In the Instant UI

Configuring ALE support:

1. Click **More > Services**.
2. Click the **RTLS** tab.
3. Select the **Analytics & Location Engine** check box.

Figure 78 *Services Window—ALE Integration*



Aruba

RTLS: □

Analytics & Location Engine: ☑

Server:

Report interval: 30 seconds

3rd party

Aeroscout: □

4. In the **Server** text box, specify the ALE server name or IP address.
5. In the **Report interval** text box, specify the reporting interval within the range of 6–60 seconds. The IAP sends messages to the ALE server at the specified interval. The default interval is 30 seconds.
6. Click **OK**.

In the CLI

To enable IAP integration with the ALE server:

```
(Instant AP)(config)# ale-server <server-name | IP-address>
(Instant AP)(config)# ale-report-interval <seconds>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Verifying ALE Configuration on an IAP

To view the configuration details:

```
(Instant AP)# show ale config
```

To verify the configuration status:

```
(Instant AP)# show ale status
```

Managing BLE Beacons

In Instant 6.4.3.4-4.2.1.0, IAPs support Aruba Bluetooth Low Energy (BLE) devices, such as BT-100 and BT-105, which are used for location tracking and proximity detection. The BLE devices can be connected to an IAP and are monitored or managed by a cloud-based Beacon Management Console (BMC). The BLE Beacon Management feature allows you to configure parameters for managing the BLE beacons and establishing secure communication with the Beacon Management Console (BMC). You can also configure the BLE operation modes that determine the functions of the built-in BLE chip in the IAP.

NOTE

The BLE beacon management and BLE operation mode feature is supported only on IAP-334/335, IAP-314/315, IAP-324/325, IAP-224/225, IAP-205H, and IAP-214/215 devices.

You can configure BLE operation modes and enable the BLE Beacon Management feature by using the Instant UI or the CLI.

In the Instant UI

Configuring BLE mode:

1. Click **More > Services**.
2. Click the **RTLS** tab. The tab details are displayed.
3. To manage the BLE devices using BMC, select **Manage BLE Beacons**.
4. Enter the authorization token. The authorization token is a text string of 1–255 characters used by the BLE devices in the HTTPS header when communicating with the BMC. This token is unique for each deployment.
5. In **Endpoint URL**, enter the URL of the server to which the BLE sends the monitoring data.
6. Select any of the following options from **Operation Mode** drop-down list:

Table 64: *BLE Operation Modes*

Mode	Description
Beaconing	The built-in BLE chip of the IAP functions as an iBeacon combined with the beacon management functionality.
Disabled	The built-in BLE chip of the IAP is turned off. The BLE operation mode is set to **Disabled** by default.
DynamicConsole	The built-in BLE chip of the IAP functions in the beaconing mode and dynamically enables access to IAP console over BLE when the link to the Local Management Switch (LMS) is lost.
PersistentConsole	The built-in BLE chip of the IAP provides access to the IAP console over BLE and also operates in the **Beaconing** mode.

7. Click **OK**.

In the CLI

To enable BLE beacon management:

```
(Instant AP)(config)# ble config <token> <url>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To configure a BLE operation mode:

```
(Instant AP)(config)# ble mode <opmode>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view the BLE configuration details:

```
(Instant AP)# show ble-config
```

Clarity Live

IAP provides support for Inline Monitoring support using Clarity Live to identify client connectivity issues and sends user debug data to AirWave. The client connectivity issues can be a problem with the client, Radius Authentication, DHCP, DNS, or it can be delay in the network. Clarity Live is used to identify the root cause of the problem, this feature can be used.

Inline Monitoring

This functionality of Clarity Live helps diagnose client connectivity issues. It provides the network administrator or engineers with more information regarding the exact stage at which the client connectivity fails or provides data where the dhcp or radius server is slow.

The IAP collects all information related to user transitions like association, authentication, and dhcp. Then, the IAP sends these records to a management server like AirWave. The management server analyzes the data and concludes which dhcp or radius server was not working efficiently causing user connectivity issues. This enhancement allows the management server to isolate WLAN issues caused by external servers such as dhcp or radius.

HTTPS is the data transport protocol used to communicate basic statistics or state changes to AirWave. Inline Monitoring makes use of HTTPS to send the statistics to AirWave too.

The following events are used by IAP to send inline monitoring (Clarity Live) updates to AirWave:

- Authentication Failure Events
- DHCP Failure Events
- DNS Failure Events
- STA Failure Events

Authentication Failure Events

The statistics or updates shared as part of this event are related to the management frame. These frames are processed by STM and are collected in the user space.

You can configure an IAP to generate statistics for Authentication Failure Events by using the Instant UI or the CLI.

In the Instant UI

To enable Clarity Live for generating statistics for Authentication Failure Events:

1. Click **More > Services**.
2. Click **Clarity**. The configuration options for the Clarity group are displayed.
3. Select the **Inline Auth stats** checkbox to enable the IAP to generate statistics and update messages for Authentication Failure Events.
4. Click **OK.**

In the Instant CLI

To configure statistics for Authentication Failure Events using the CLI:

```
(Instant AP)(config)# clarity
(Instant AP)(clarity)# inline-auth-stats
(Instant AP)(config)# end
(Instant AP)# commit apply
```

DHCP Failure Events

In scenarios where the DHCP does not respond, information about the failure of the event can be collected by the IAP with the help of Clarity Live and sent to AirWave. This functionality receives client DHCP transactions from the control plane.

You can configure an IAP to generate statistics for DHCP Failure Events by using the Instant UI or the CLI:

In the Instant UI:

To enable statistics for DHCP Failure Events, using the UI:

1. Click **More > Services**.
2. Click **Clarity**. The configuration options for the Clarity group are displayed.
3. Select the **Inline DHCP stats** checkbox to enable the IAP to generate statistics and update messages for DHCP Failure Events.
4. Click **OK.**

In the CLI:

To enable statistics for DHCP Failure Events, using the CLI:

```
(Instant AP)(config)# clarity
(Instant AP)(clarity)# inline-dhcp-stats
(Instant AP)(config)# end
(Instant AP)# commit apply
```

DNS Failure Events

The IAP measures the responsiveness of each DNS server with the help of Clarity Live. The monitoring includes minimum, maximum, and average response time of each DNS server. A maximum of 16 DNS servers can be monitored at a time and a maximum of 16 DNS server entries are made in the DNS table. If there are no queries from a particular DNS server for a long period of time, the DNS server entry can be removed and replaced with a new DNS server entry. The statistical data collected for the DNS server will be pushed to AirWave before the entry is replaced by a new DNS entry.

In the Instant UI:

To enable statistics for DNS Failure Events, using the UI:

1. Click **More > Services**.
2. Click **Clarity**. The configuration options for the Clarity group are displayed.
3. Select the **Inline DNS stats** checkbox to enable the IAP to generate statistics and update messages for DNS Failure Events.
4. Click **OK.**

In the CLI:

To enable statistics for DNS Failure Events, using the CLI:

```
(Instant AP)(config)# clarity
(Instant AP)(clarity)# inline-dns-stats
(Instant AP)(config)# end
(Instant AP)# commit apply
```

STA Failure Events

The station passive monitor statistic is generated when enabled on the IAP. The IAP gernerate the data periodically for every 60 seconds and sends it to AirWave.

In the Instant UI:

To enable statistics for STA Failure Events, using the UI:

1. Click **More > Services**.
2. Click **Clarity**. The configuration options for the Clarity group are displayed.
3. Select the **Inline STA stats** checkbox to enable the IAP to generate statistics and update messages for STA Failure Events.
4. Click **OK.**

In the CLI:

To enable statistics for STA Failure Events, using the CLI:

```
(Instant AP)(config)# clarity
(Instant AP)(clarity)# inline-sta-stats
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Verify Clarity Configuration on IAP

The following command is used to view the status of the Inline Monitoring events:

```
(Instant AP)# show clarity config
```

The following command is used to view the history of the authentication events:

```
(Instant AP)# show clarity history auth
```

The following command is used to view the history of the DHCP events:

```
(Instant AP)# show clarity history dhcp
```

The following command is used to view the history of the DNS events:

```
(Instant AP)# show clarity history dns
```

Configuring OpenDNS Credentials

When configured, the OpenDNS credentials are used by Instant to access OpenDNS to provide enterprise level content filtering. You can configure OpenDNS credentials by using the Instant UI or the CLI.

In the Instant UI

To configure OpenDNS credentials:

1. Click **More > Services > OpenDNS**.
2. Enter the **Username** and **Password** to enable access to OpenDNS.
3. Click **OK** to apply the changes.

In the CLI

To configure OpenDNS credentials:

```
(Instant AP)(config)# opendns <username> <password>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Integrating an IAP with Palo Alto Networks Firewall

Palo Alto Networks (PAN) next-generation firewall offers contextual security for all users for safe enabling of applications. A simple firewall beyond basic IP address or TCP port numbers only provides a subset of the enhanced security required for enterprises to secure their networks. In the context of businesses using social networking sites, legacy firewalls are not able to differentiate valid authorized users from casual social networking users.

The Palo Alto next-generation firewall is based on user ID, which provides many methods for connecting the users to sources of identity information and associating them with firewall policy rules. For example, it provides an option to gather user information from Active Directory or Lightweight Directory Access Protocol (LDAP) server.

Integration with Instant

The functionality provided by the PAN firewall based on user ID requires the collection of information from the network. IAP maintains the network (such as mapping IP address) and user information for its clients in the network and can provide the required information for the user ID on PAN firewall. Before sending the user-ID mapping information to the PAN firewall, the IAP must retrieve an API key that will be used for authentication for all APIs.

IAP provides the User ID mapping information to the PAN firewall for integration. The client user id for authentication will not be sent to the PAN firewall unless it has a domain prefix. The IAP checks for the domain information in the client username for all login and logout requests sent to the PAN firewall. If the user id already has a domain prefix, IAP forwards the request to the PAN firewall. Otherwise, the static client domain configured in the PAN firewall profile will be prefixed to the user id and then sent to the PAN firewall.

IAP and PAN firewall integration can be seamless with the XML-API that is available with PAN-OS 5.0 or later.

To integrate an IAP with PAN user ID, a global profile is added. This profile can be configured on an IAP with PAN firewall information such as IP address, port, username, password, firewall-enabled or firewall-disabled status.

The IAP sends messages to PAN based on the type of authentication and client status:

- After a client completes the authentication and is assigned an IP address, IAP sends the **login** message.
- After a client is disconnected or dissociated from the IAP, the IAP sends a **logout** message.

Configuring an IAP for PAN integration

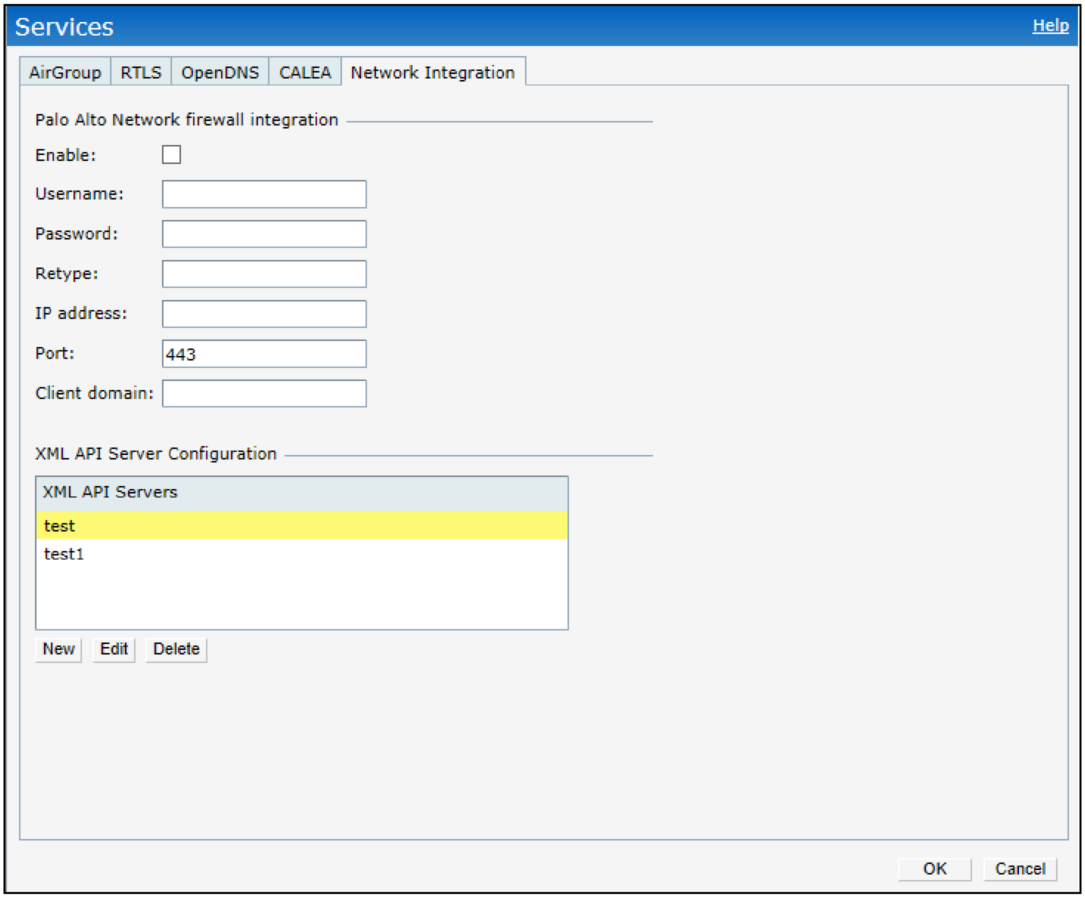
You can configure an IAP for PAN firewall integration by using the Instant UI or the CLI.

In the Instant UI

To configure PAN firewall integration in an IAP:

1. Click **More > Services**.
2. Click **Network Integration**. The PAN firewall configuration options are displayed.

Figure 79 *Services Window: Network Integration Tab*



Palo Alto Network firewall integration

Enable: □

Username:

Password:

Retype:

IP address:

Port: 443

Client domain:

XML API Server Configuration

XML API Servers
test
test1

3. Select the **Enable** check box to enable PAN firewall.
4. Provide the user credentials of the PAN firewall administrator in the **Username** and **Password** text boxes.
5. Enter the PAN firewall IP address.
6. Enter the port number within the range of 1–65,535. The default port is 443.
7. Specify the static **Client Domain** to be mapped to the client User IDs that do not have a domain name of its own.
8. Click **OK**.

In the CLI

To enable PAN firewall integration with the IAP:

```
(Instant AP)(config)# firewall-external-enforcement pan
(Instant AP)(firewall-external-enforcement pan)# enable
(Instant AP)(firewall-external-enforcement pan)# domain-name <name>
(Instant AP)(firewall-external-enforcement pan)# ip <ip-address>
(Instant AP)(firewall-external-enforcement pan)# port <port>
(Instant AP)(firewall-external-enforcement pan)# user <name> <password>
(Instant AP)(firewall-external-enforcement pan)# end
(Instant AP)# commit apply
```

Integrating an IAP with an XML API Interface

The XML API interface provides options to create and execute user management operations seamlessly on behalf of the clients or users.

Integration with Instant

The XML API interface allows you to send specific XML commands to an IAP from an external server. These XML commands can be used to customize IAP client entries. You can use the XML API interface to add, delete, authenticate, query, or blacklist a user or a client.

NOTE

The user authentication is supported only for users authenticated by captive portal authentication and not for the dot1x-authentication users.

The user add operation performed by the XML API interface is only used to modify the role of an existing user and not to create a new user.

You can now use HTTP or HTTPS to post commands to IAP. The communication process using the XML API Interface is as follows:

- An API command is issued in XML format from the server to the VC.
- The VC processes the XML request and identifies where the client is and sends the command to the correct slave IAP.
- Once the operation is completed, VC sends the XML response to the XML server.
- Users can use the response and take appropriate action to suit their requirements. The response from the VC is returned using the predefined formats.

Configuring an IAP for XML API integration

You can configure an IAP for XML API integration by using the Instant UI or the CLI. IAP supports the configuration of up to 8 XML API server entries.

In the Instant UI

Enabling XML API server entries:

1. Click **More > Services**.
2. Click **Network Integration**. The XML API Server configuration parameters are displayed.
3. Enter a name for the XML API Server in the **Name** text box.
4. Enter the subnet of the XML API Server in the **Subnet** text box.
5. Enter the subnet mask of the XML API Server in the **Mask** text box.
6. Enter a passcode in the **Passphrase** text box, to enable authorized access to the XML API Server.
7. Re-enter the passcode in the **Retype** box.
8. To add multiple entries, repeat the procedure.
9. Click **OK**.
10. To edit or delete the server entries, use the **Edit** and **Delete** buttons, respectively.

In the CLI

To enable XML API integration with the IAP:

```
(Instant AP)(config)# xml-api-server <xml_api_server_profile>
(Instant AP)(xml-api-server <profile-name>)# ip <subnet> [mask <mask>]
(Instant AP)(xml-api-server)# key <key>
(Instant AP)(xml-api-server)# end
(Instant AP)# commit apply
```

Creating an XML API Request

You can now create an XML request with an appropriate authentication command and send it to the VC through HTTPS post. The format of the URL to send the XML request is:

```
https://<virtualcontroller-ip/auth/command.xml>
```

- **virtualcontroller-ip**: The IP address of the VC that will receive the XML API request
- **command.xml** : The XML request that contains the XML API command.

The format of the XML API request is:

```
xml=<aruba command="<XML API command>">
<options>Value</options>
...
<options>Value</options>
</aruba>
```

You can specify any of the following commands in the XML request:

Table 65: *XML API Command*

Parameter	Description
user_add	If the user entry is already present in the user table, the command will modify the entry with the values defined in the XML request. For an existing user, this command will update any value that is supplied, with an exception of IP and MAC address. Session time-out is only applicable to captive portal users.
user_delete	This command deletes an existing user from the user table of the VC. **NOTE:** Do not use the **user_delete** command if the intention is to clear the association from the VC user table. If the client is dual-stack, it re-inherits the authentication state from the IPv6 address. If not dual-stack, the client reverts to the initial role.
user_authenticate	This command authenticates against the server group defined in the captive portal profile. This is only applicable to captive portal users.
user_blacklist	This command blacklists a user from connecting to your network. This command uses the default blacklist timeout of 3600 seconds. There is no corresponding clear command.
user_query	This command fetches the status and details of a user connected to your network. A dual-stack client can be queried by any of its IPv4 or IPv6 addresses, but only the queried IP address is displayed in the output.

Each XML API command requires certain mandatory options to successfully execute the task. The list of all available options are:

Table 66: *XML API Command Options*

Parameter	Description	Range / Defaults
ipaddr	IP address of the user in IPv4 or IPv6 format.	—
macaddr	MAC address of the user in aa:bb:cc:dd:ee:ff format.	Enter MAC address with colon.
user	Name of the user.	64-character string
role	This option is used to change the role of an existing user. This option applies to user_add and user_delete commands only.	64-character string

Parameter	Description	Range / Defaults
password	The password of the user for authentication.	—
session_timeout	The role will be changed to a pre-auto role after session timeout.	—
authentication	Authentication method used to authenticate the message and the sender. You can use any of MD5, SHA-1 or clear text methods of authentication. This option is ignored if shared secret is not configured. It is, however, mandatory if it is configured.	
key	This is the encoded MD5/SHA-1 hash of shared secret or plain text shared secret. This option is ignored if shared secret is not configured on the switch. The actual MD5/SHA-1 hash is 16/20 bytes and consists of binary data. It must be encoded as an ASCII-based HEX string before sending. It must be present when the VC is configured with an xml API key for the server. Encoded hash length is 32/40 bytes for MD5/SHA-1.	
version	The version of the XML API interface available in the VC. This is mandatory in all XML API requests.	Current version is XML API 1.0

CALEA Integration and Lawful Intercept Compliance

Lawful Intercept (LI) allows the Law Enforcement Agencies (LEA) to perform an authorized electronic surveillance. Depending on the country of operation, the service providers (SPs) are required to support LI in their respective networks.

In the United States, SPs are required to ensure LI compliance based on Communications Assistance for Law Enforcement Act (CALEA) specifications.

Instant supports CALEA integration in a hierarchical and flat topology, mesh IAP network, the wired and wireless networks.

NOTE

Enable this feature only if lawful interception is authorized by a law enforcement agency.

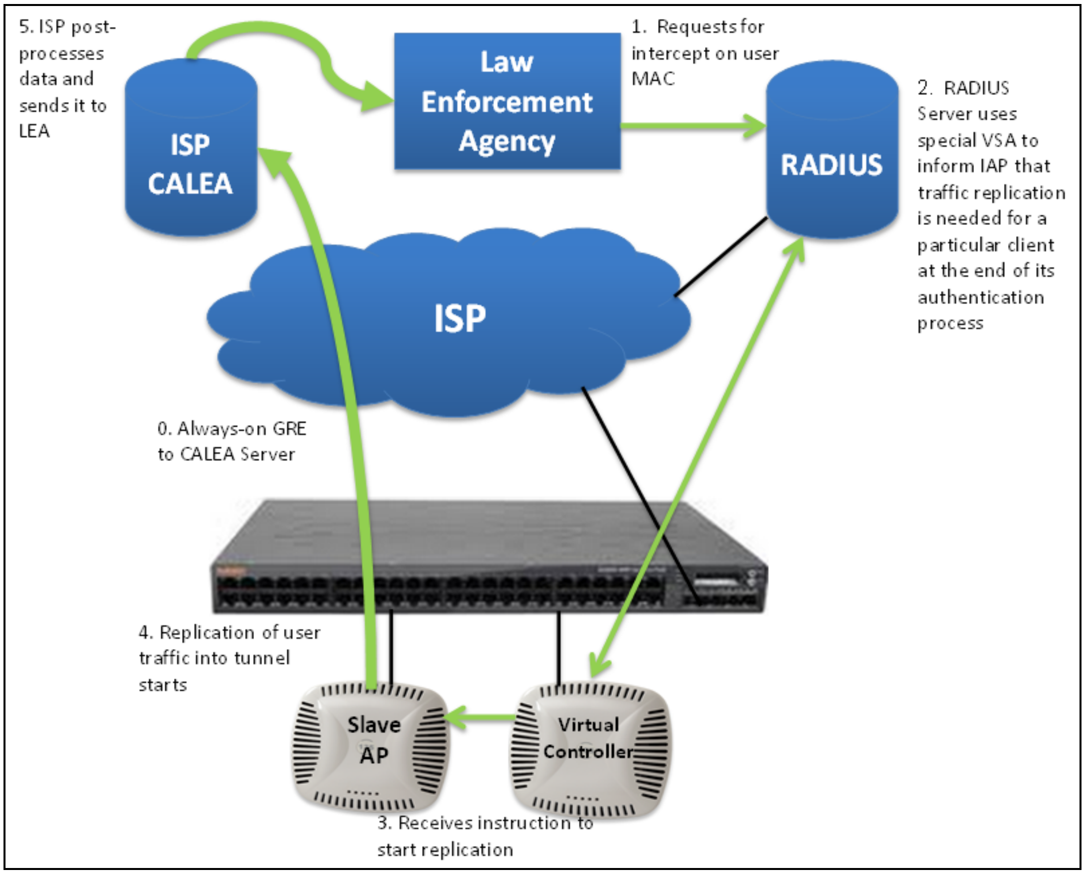
CALEA Server Integration

To support CALEA integration and ensure LI compliance, you can configure the IAPs to replicate a specific or selected client traffic and send it to a remote CALEA server.

Traffic Flow from IAP to CALEA Server

You can configure an IAP to send GRE-encapsulated packets to the CALEA server and replicate client traffic within the GRE tunnel. Each IAP sends GRE encapsulated packets only for its associated or connected clients. The following figure illustrates the traffic flow from the IAP to the CALEA server.

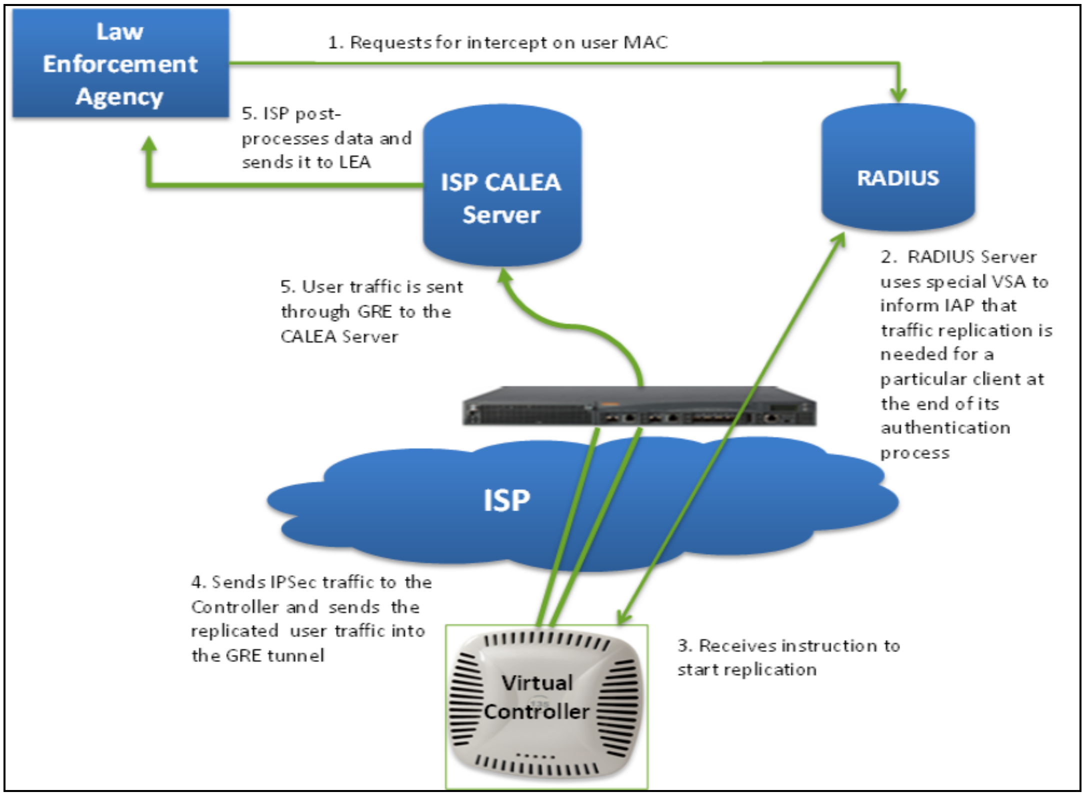
Figure 80 *IAP to CALEA Server*


5. ISP post-processes data and sends it to LEA
Law Enforcement Agency
1. Requests for intercept on user MAC
ISP CALEA
RADIUS
2. RADIUS Server uses special VSA to inform IAP that traffic replication is needed for a particular client at the end of its authentication process
ISP
0. Always-on GRE to CALEA Server
4. Replication of user traffic into tunnel starts
Slave AP
Virtual Controller
3. Receives instruction to start replication

Traffic Flow from IAP to CALEA Server through VPN

You can also deploy the CALEA server with the controller and configure an additional IPsec tunnel for corporate access. When CALEA server is configured with the controller, the client traffic is replicated by the slave IAP and client data is encapsulated by GRE on slave, and routed to the master IAP. The master IAP sends the IPsec client traffic to the controller. The controller handles the IPsec client traffic while GRE data is routed to the CALEA server. The following figure illustrates the traffic flow from IAP to the CALEA server through VPN.

Figure 81 *IAP to CALEA Server through VPN*


Law Enforcement Agency
1. Requests for intercept on user MAC
5. ISP post-processes data and sends it to LEA
ISP CALEA Server
RADIUS
5. User traffic is sent through GRE to the CALEA Server
2. RADIUS Server uses special VSA to inform IAP that traffic replication is needed for a particular client at the end of its authentication process
ISP
4. Sends IPSec traffic to the Controller and sends the replicated user traffic into the GRE tunnel
Virtual Controller
3. Receives instruction to start replication

Ensure that IPsec tunnel is configured if the client data has to be routed to the ISP or CALEA server through VPN. For more information on configuring IPsec, see Configuring an IPsec Tunnel on page 229.

Client Traffic Replication

Client traffic is replicated in the following ways:

- Through RADIUS VSA—In this method, the client traffic is replicated by using the RADIUS VSA to assign clients to a CALEA-related user role. To enable role assignment to clients, you need to create a user role and a CALEA access rule, and then assign the CALEA rule to the user role. Whenever a client that is configured to use a CALEA rule connects, a replication role is assigned.
- Through Change of Authorization (CoA)—In this method, a user session can start without replication. When the network administrator triggers a CoA from the RADIUS server, the user session is replicated. The replication is stopped when the user disconnects or by sending a CoA to change the replication role.

As the client information is shared between multiple IAPs in a cluster, the replication rules persist when clients roam within the cluster.

Configuring an IAP for CALEA Integration

To enable CALEA server integration, perform the following steps:

1. Create a CALEA profile.
2. If a replication role must be assigned through the RADIUS VSA, create an access rule and assign the access rule to a WLAN SSID or wired profile.
3. Verify the configuration.

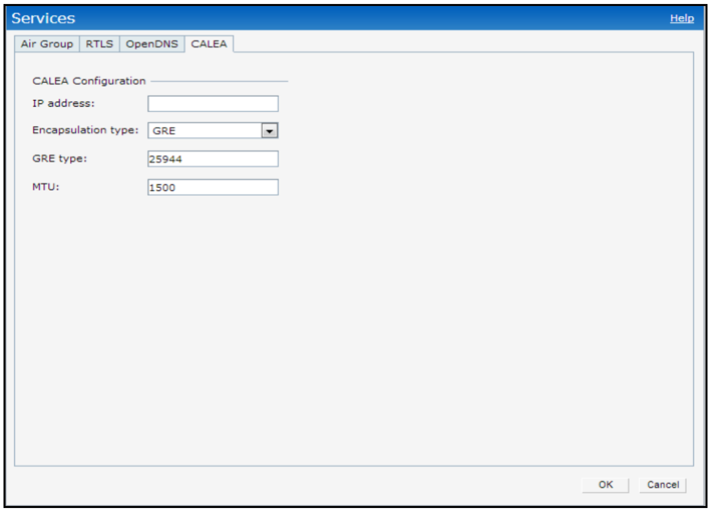
Creating a CALEA Profile

You can create a CALEA profile by using the Instant UI or the CLI.

In the Instant UI

To configure a CALEA profile:

1. Click **More > Services** link on the Instant main window.
2. In the Services section, click **CALEA**. The **CALEA** tab details are displayed.



CALEA Configuration

IP address:

Encapsulation type: GRE

GRE type: 25944

MTU: 1500

3. Specify the following parameters:
   - **IP address**—Specify the IP address of the CALEA server.
   - **Encapsulation type**—Select the encapsulation type. The current release of Instant supports GRE only.
   - **GRE type**—Specify the GRE type.
   - **MTU**—Specify a size for the maximum transmission unit (MTU) within the range of 68–1500. After GRE encapsulation, if packet length exceeds the configured MTU, IP fragmentation occurs. The default MTU size is 1500.
4. Click **OK**.

In the CLI

To create a CALEA profile:

```
(Instant AP)(config)# calea
(Instant AP)(calea)# ip <IP-address>
(Instant AP)(calea)# ip mtu <size>
(Instant AP)(calea)# encapsulation-type <gre>
(Instant AP)(calea)# gre-type <type>
(Instant AP)(calea)# end
(Instant AP)# commit apply
```

Creating an Access Rule for CALEA

You can create an access rule for CALEA by using the Instant UI or the CLI.

In the Instant UI

To create an access rule:

1. To add the CALEA access rule to an existing profile:
   a. Select an existing wireless (**Network > edit**) or,
   b. Select a Wired (**More > Wired > Edit**) profile.
2. To add the access rule to a new profile:
   a. Click **New** under the **Network** tab and create a WLAN profile or,
   a. Click **More > Wired > New** and create a wired port profile.

3. On the **Access** tab, select the role for which you want create the access rule.
4. Under **Access Rules**, click **New**.
5. In the **New Rule** window that is displayed, select **CALEA**.
6. Click **OK**.
7. Create a role assignment rule if required.
8. Click **Finish**.

In the CLI

To create a CALEA access rule:

```
(Instant AP)(config)# wlan access-rule <name>
(Instant AP)(Access Rule <name>)# calea
(Instant AP)(Access Rule <name>)# end
(Instant AP)# commit apply
```

To assign the CALEA rule to a user role:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# set-role <attribute>{{equals | not-equals | starts-with|
ends-with | contains}<operator><role> | value-of}
(Instant AP)(SSID Profile <name>)# end
(Instant AP)(SSID Profile <name>)# commit apply
```

To associate the access rule with a wired profile:

```
(Instant AP)(config)# wired-port-profile <name>
(Instant AP)(Wired ap profile <name>)# access-rule-name <name>
(Instant AP)(Wired ap profile <name>)# end
(Instant AP)# commit apply
```

Verifying the configuration

To verify the CALEA configuration:

```
(Instant AP)# show calea config
```

To view the tunnel encapsulation statistics:

```
(Instant AP)# show calea statistics
```

Example

To enable CALEA integration:

```
(Instant AP)(config)# calea
(Instant AP)(calea)# ip 192.0.2.7
(Instant AP)(calea)# ip mtu 1500
(Instant AP)(calea)# encapsulation-type GRE
(Instant AP)(calea)# gre-type 255
(Instant AP)(calea)# end
```

To enable a CALE access rule:

```
(Instant AP)(config)# wlan access-rule ProfileCalea
(Instant AP)(Access Rule "ProfileCalea")# calea
(Instant AP)(Access Rule "ProfileCalea")# end
(Instant AP)# commit apply
```

To assign the CALEA rule to user role:

```
(Instant AP)(config)# wlan ssid-profile Calea-Test
(Instant AP)(SSID Profile"Calea-Test")# enable
(Instant AP)(SSID Profile"Calea-Test")# index 0
(Instant AP)(SSID Profile"Calea-Test")# type employee
(Instant AP)(SSID Profile"Calea-Test")# essid QA-Calea-Test
(Instant AP)(SSID Profile"Calea-Test")# opmode wpa2-aes
(Instant AP)(SSID Profile"Calea-Test")# max-authentication-failures 0
```

```
(Instant AP)(SSID Profile"Calea-Test")# auth-server server1
(Instant AP)(SSID Profile"Calea-Test")# set-role Filter-Id equals 123456 calea-test
(Instant AP)(SSID Profile"Calea-Test")# rf-band 5.0
(Instant AP)(SSID Profile"Calea-Test")# captive-portal disable
(Instant AP)(SSID Profile"Calea-Test")# dtim-period 1
(Instant AP)(SSID Profile"Calea-Test")# inactivity-timeout 1000
(Instant AP)(SSID Profile"Calea-Test")# broadcast-filter none
(Instant AP)(SSID Profile"Calea-Test")# dmo-channel-utilization-threshold 90
(Instant AP)(SSID Profile"Calea-Test")# local-probe-req-thresh 0
(Instant AP)(SSID Profile"Calea-Test")# max-clients-threshold 64
(Instant AP)(SSID Profile"Calea-Test")# end
(Instant AP)(SSID Profile"Calea-Test")# commit apply
```

To verify the configuration:

```
(Instant AP)# show calea config

calea-ip :10.0.0.5
encapsulation-type :gre
gre-type :25944
ip mtu : 150
```

To view the tunnel encapsulation statistics:

```
(Instant AP)# show calea statistics

Rt resolve fail : 0
Dst resolve fail: 0
Alloc failure : 0
Fragged packets : 0
Jumbo packets : 263
Total Tx fail : 0
Total Tx ok : 263
```

Chapter 24
Cluster Security

This chapter describes cluster security and the procedure for configuring cluster security DTLS for secure communication. It includes the following topics:

Overview

Cluster security is a communication protocol that secures control plane messages between Instant access points. Control plane messages such as configuration, cluster join, and other messages distributed between the devices in a cluster are secured using this protocol. Cluster security operates on the UDP port 4434 and uses DTLS protocol to secure messages.

Cluster Security Using DTLS

Cluster security provides secure communication using Datagram Transport Layer Security (DTLS). A DTLS connection is established between the IAPs communicating with each other in the cluster. Following are some of the advantages of using DTLS for cluster security:

- Mutual authentication is done between the IAPs in a cluster using device certificate.
- Peer MAC address validation against **AP whitelist** can be enabled in the configuration.
- Control plane messages between cluster members are transmitted securely using the DTLS connection established.

NOTE

If auto-join is enabled, backward compatibility and recovery of IAPs is allowed on ARUBA UDP port 8211. Messages required for image synchronization and cluster security DTLS state synchronization are the only messages allowed.

If auto-join is disabled, the MAC address of a peer IAP is verified against the **AP whitelist** during device certificate validation.

Locked Mode Slave IAP

A slave IAP with non-factory default configuration is considered to be in locked mode of operation. These slave IAPs will not be able to join the existing non-DTLS cluster as backward compatibility and recovery is not allowed.

To recover the slave IAPs in locked mode:

- Execute the **disable-cluster-security-dtls** action command on the slave IAP , or
- Factory reset the slave IAP.

Enabling Cluster Security

You can enable cluster security using the Instant UI or the CLI. Ensure that the following pre-requisites are satisfied:

Pre-requisites

1. NTP server must be reachable—If internet is reachable, pool.ntp.org will be used by default, otherwise a static NTP server needs to be configured.
2. UDP port 4434 should be permitted.

In the Instant UI

To enable cluster security:

1. Navigate to **System > General** .
2. Select **Enabled** from the **Cluster security** drop-down list.
3. Click **OK**.

Reboot all the IAPs in the swarm for the configuration to take effect.

In the CLI:

To enable cluster security:

```
(Instant AP)(config)# cluster-security
(Instant AP)(cluster-security)# dtls
(Instant AP)(cluster-security)# end
(Instant AP)# commit apply
```

To disable cluster security DTLS:

```
(Instant AP)(config)# cluster-security
(Instant AP)(cluster-security)# no dtls
(Instant AP)(cluster-security)# end
(Instant AP)# commit apply
```

To change per module logging level of cluster security:

```
(Instant AP)# cluster-security logging module <module_name> log-level <level>
```

To set individual log level for each module:

```
(Instant AP)# cluster-security logging module <module_name> log-level-individual <level>
```

After enabling or disabling the cluster security option, ensure that the Config Sync Status is TRUE in the output of the show summary command, before rebooting the cluster.

Cluster security is not supported for L3 mobility.

Cluster Security Debugging Logs

Cluster security logging is organized into modules based on functionality. The following are the core modules which are useful and should be used for debugging:

peer—The peer module is used to log connection initiation, renegotiation, collision and active connection updates. The log-level should be set to **debug** level while debugging any issues.

conn—The connection module is used to log connection creation, establishment, data transfer and maintenance updates. The log-level should be set to **debug** level for debugging DTLS connection issues.

mcap—The module capture module is used to log messages sent and received to the socket. Set log-level to **debug** to log only control messages. Set log-level to **debug1** to log control and data messages.

The following command can be used to set per module logging level:

```
(Instant AP)# cluster-security logging module <module_name> log-level <level>
```

Once the log-level is set, logs can be viewed using:

```
(Instant AP)# show log papi-handler
```

Verifying the Configuration

The following show commands can be used to view the cluster security configuration:

To view current cluster security Configuration and running state

```
(Instant AP)# show cluster-security
```

To view the cluster security statistics:

```
(Instant AP)# show cluster-security stats
```

To view the cluster security connection table:

```
(Instant AP)# show cluster-security connections
```

To view the cluster security peers:

```
(Instant AP)# show cluster-security peers
```

To view the message handler process logs:

```
(Instant AP) # show log papi-handler <count>
```

This chapter provides information on managing and monitoring IAPs from the following management servers:

- Managing an IAP from AirWave on page 311
- Managing IAP from Aruba Central on page 320

Managing an IAP from AirWave

AirWave is a powerful platform and easy-to-use network operations system that manages Aruba wireless, wired, and remote access networks, as well as wired and wireless infrastructures from a wide range of third-party manufacturers. With its easy-to-use interface, AirWave provides real-time monitoring, proactive alerts, historical reporting, as well as fast and efficient troubleshooting. It also offers tools that manage RF coverage, strengthen wireless security, and demonstrate regulatory compliance.

The IAPs communicate with AirWave using the HTTPS protocol. This allows an AirWave server to be deployed in the cloud across a NAT device, such as a router.

The AirWave features available in the Instant network are described in the following sections:

Image Management

AirWave allows you to manage firmware updates on WLAN devices by defining a minimum acceptable firmware version for each make and model of a device. It remotely distributes the firmware image to the WLAN devices that require updates, and it schedules the firmware updates such that updating is completed without requiring you to manually monitor the devices.

The following models can be used to upgrade the firmware:

- Automatic—In this model, the VC periodically checks for newer updates from a configured URL and automatically initiates upgrade of the network.
- Manual—In this model, the user can manually start a firmware upgrade for each VC or set the desired firmware preference per group of devices.

Resetting an IAP

An IAP device can be reset through AirWave in the **Managed** mode:

1. In the **Modify Devices** section, select the IAP devices you want to reset to factory-default by selecting the check box beside it.
2. From the **Change Device Group Folder** drop-down list, select **Factory Reset selected devices**.
3. Click the **Factory Reset** tab.

NOTE

On resetting the IAP device from AirWave, all the configuration values will be set to default except for the **per-ap-settings** and **VC Key** value.

IAP and Client Monitoring

AirWave allows you to find any IAP or client on the wireless network and to see real-time monitoring views. These monitoring views can be used to aggregate critical information and high-end monitoring information.

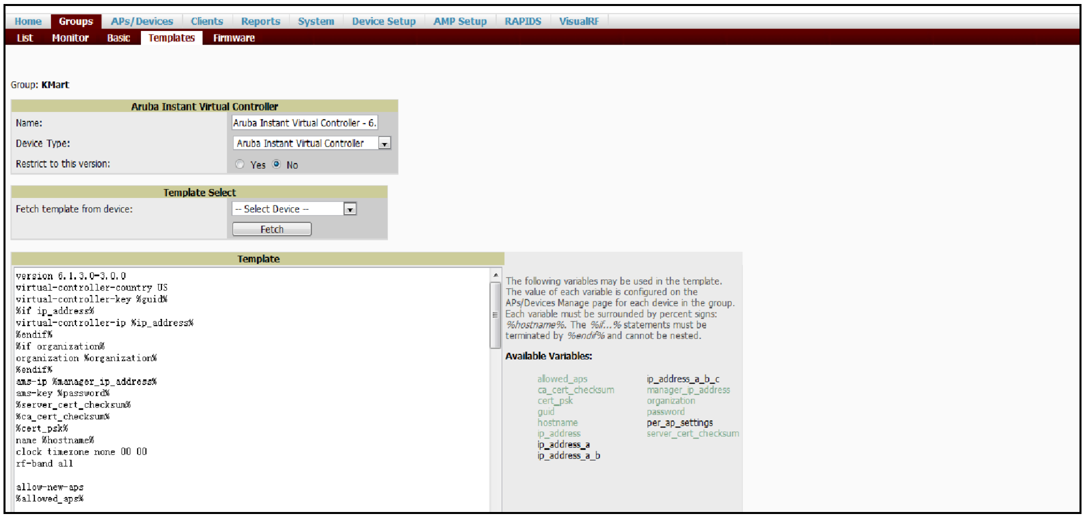
In the AirWave User Interface (UI), you can select either **Manage Read/Write** or **Monitor-only+Firmware Upgrades** as management modes. When the AirWave Management level is set to **Manage Read/Write**, the Instant UI is in read-only mode. When the AirWave Management level is set to **Monitor-only+Firmware Upgrades**, the Instant UI changes to the read-write mode.

With the latest version of AirWave, a new option in the AMP is available to put the IAP in config-only mode. In this mode, the IAP will receive the firmware upgrades and configurations, but will not send any statistics for monitoring. The load is reduced on IAP and AirWave and this assists in scaling AirWave effectively.

Template-Based Configuration

AirWave automatically creates a configuration template based on any of the existing IAPs, and it applies that template across the network as shown in the following figure. It audits every device on an ongoing basis to ensure that configurations never vary from the enterprise policies. It alerts you whenever a violation is detected and automatically repairs the incorrectly configured devices.

Figure 82 *Template-Based Configuration*



Group: **KMart**

Aruba Instant Virtual Controller

Name:	Aruba Instant Virtual Controller - 6.
Device Type:	Aruba Instant Virtual Controller
Restrict to this version:	○ Yes ● No

Template Select

Fetch template from device: -- Select Device --

Template

```
version 6.1.3.0-3.0.0
virtual-controller-country US
virtual-controller-key %guid%
%if ip_address%
virtual-controller-ip %ip_address%
%endif%
%if organization%
organization %organization%
%endif%
ams-ip %manager_ip_address%
ams-key %password%
%server_cert_checksum%
%ca_cert_checksum%
%cert_psk%
name %hostname%
clock timezone none 00 00
rf-band all

allow-new-aps
%allowed_aps%
```

The following variables may be used in the template. The value of each variable is configured on the APs/Devices Manage page for each device in the group. Each variable must be surrounded by percent signs: *%hostname%*. The *%if...%* statements must be terminated by *%endif%* and cannot be nested.

Available Variables:

allowed_aps
ca_cert_checksum
cert_psk
guid
hostname
ip_address
ip_address_a
ip_address_a_b
ip_address_a_b_c
manager_ip_address
organization
password
per_ap_settings
server_cert_checksum

Trending Reports

AirWave saves up to 14 months of actionable information, including network performance data and user roaming patterns, so you can analyze how network usage and performance trends have changed over time. It also provides detailed capacity reports with which you can plan the capacity and appropriate strategies for your organization.

Intrusion Detection System (IDS)

AirWave provides advanced, rules-based rogue classification. It automatically detects rogue IAPs irrespective of their location in the network and prevents authorized IAPs from being detected as rogue IAPs. It tracks and correlates the IDS events to provide a complete picture of network security.

Wireless Intrusion Detection System (WIDS) Event Reporting to AirWave

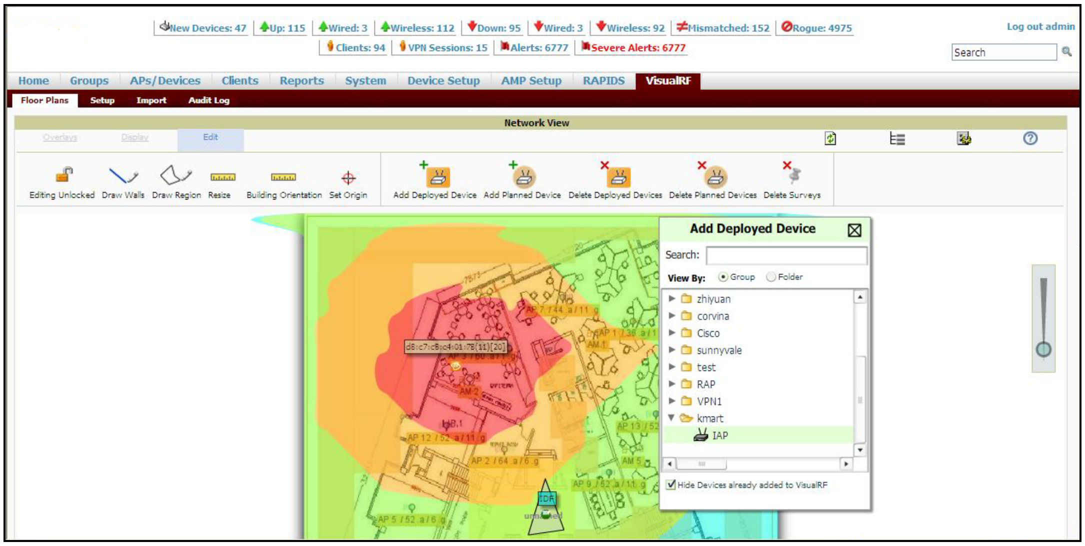
AirWave supports Wireless Intrusion Detection System (WIDS) Event Reporting, which is provided by Instant. This includes WIDS classification integration with the Rogue Access Point Detection Software (RAPIDS) module. RAPIDS is a powerful and easy-to-use tool for automatic detection of unauthorized wireless devices. It supports multiple methods of rogue detection and uses authorized wireless IAPs to report other devices within range.

The WIDS report cites the number of IDS events for devices that have experienced the most instances in the prior 24 hours and provides links to support additional analysis or configuration in response.

RF Visualization Support for Instant

AirWave supports RF visualization for Instant. The VisualRF module provides a real-time picture of the actual radio environment of your wireless network and the ability to plan the wireless coverage of new sites. VisualRF uses sophisticated RF fingerprinting to accurately display coverage patterns and calculate the location of every Instant device in range. VisualRF provides graphical access to floor plans, client location, and RF visualization for floors, buildings, and campuses that host your network.

Figure 83 *Adding an IAP in VisualRF*



PSK-Based and Certificate-Based Authentication

On the DHCP server, two formats for option 43 are supported:

- **<organization>,<ams-ip>,<ams-key>**—If you select this format, the IAP authenticates the AMP server using the Pre-Shared Key (PSK) login process.
- **<organization>,<ams-domain>**—If you select this format, the IAP resolves the AirWave domain name into one or two IP addresses as AirWave Primary or AirWave Backup, and then IAP starts a certificate-based authentication with AMP server, instead of the PSK login. When the AMP domain name is used, the IAP performs certificate-based authentication with the AMP server. The IAP initiates a Secure Socket Layer (SSL) connection with the AirWave server. The AirWave server verifies the signature and public key certificate from the IAP. If the signature matches, the AirWave responds to the IAP with the login request.

Configurable Port for IAP and AirWave Management Server Communication

You can now customize the port number of the AMP server through the **server_host:server_port** format, for example, **amp.aruba.com:4343**.

The following example shows how to configure the port number of the AMP server:

```
24:de:c6:cf:63:60 (config) # ams-ip 10.65.182.15:65535
24:de:c6:cf:63:60 (config) # end
24:de:c6:cf:63:60# commit apply
```

Configuring Organization String

The Organization string is a set of colon-separated strings created by the AirWave administrator to accurately represent the deployment of each IAP. This string is defined by the installation personnel on the site.

You can use any of the following strings:

- AMP Role—"Org Admin" (initially disabled)
- AMP User—"Org Admin" (assigned to the role "Org Admin")
- Folder—"Org" (under the Top folder in AMP)
- Configuration Group—"Org"

You can also assign additional strings to create a hierarchy of subfolders under the folder named "Org". For example:

  - subfolder1 for a folder under the "Org" folder
  - subfolder2 for a folder under subfolder1

Shared Key

The Shared Secret key is an optional key used by the administrator to manually authorize the first VC for an organization. Any string is acceptable.

Configuring AirWave Information

You can configure AirWave information by using the Instant UI or the CLI.

In the Instant UI

To configure AirWave information:

1. Click the AirWave **Set Up Now** link of the main window. The **System** window is displayed with the AirWave parameters on the **Admin** tab.
2. Enter the name of your organization in the **Organization name** text box. The name defined for the organization is displayed under the **Groups** tab in the AirWave UI.
3. Enter the IP address or domain name of the AirWave server in the **AirWave server** text box.
4. Enter the IP address or domain name of a backup AirWave server in the **AirWave backup server** text box. The backup server provides connectivity when the primary server is down. If the IAP cannot send data to the primary server, the VC switches to the backup server automatically.
5. Enter the shared key in the **Shared key** text box and reconfirm. This shared key is used for configuring the first IAP in the Instant network.
6. Click **OK**.

In the CLI

To configure AirWave information:

```
(Instant AP)(config)# organization <name>
(Instant AP)(config)# ams-ip <IP-address or domain name>
(Instant AP)(config)# ams-backup-ip <IP-address or domain name>
(Instant AP)(config)# ams-key <key>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Configuring for AirWave Discovery Through DHCP

The AirWave can be discovered through the DHCP server. You can configure this only if AirWave was not configured earlier or if you have deleted the precedent configuration.

On the DHCP server, the format for option 60 is " **InstantAP**", and the two formats for option 43 are "**<organization>,<ams-ip>,<ams-key>**" and "**<organization>,<ams-domain>**" .

If you use the **<organization>,<ams-ip>,<ams-key>** format, the PSK-based authentication is used to access the AMP server.

If you use the **<organization>,<ams-domain>** format, the IAP resolves the domain name into two IP addresses—AirWave Primary and AirWave Backup—and then the IAP starts a certificate-based authentication with AMP server, instead of the PSK login.

NOTE

For option 43, when you choose to enter the domain name, the IP address and key are not available.

Enabling DNS-Based Discovery of the Provisioning AMP Server

IAPs can now automatically discover the provisioning AMP server if the DHCP option 43 and Activate cannot perform zero-touch provisioning (ZTP)and transfer the AirWave configuration to the IAP.

When a domain option **xxx** is included in the DHCP configuration, the IAP will search the DNS server records for **aruba-airwave.xxx**. When there is no domain option, the IAP will search only the server records for **aruba-airwave**.

NOTE

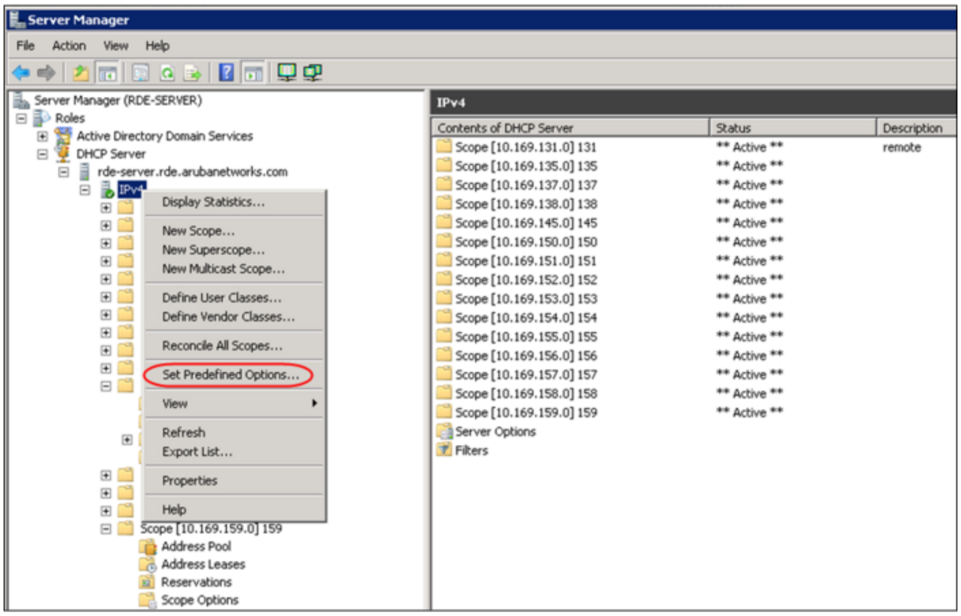
To enable IAPs to automatically discover the AMP server, create a DNS record for **aruba-airwave.xxx** or **aruba-airwave** in the DNS server. To use this feature on the AirWave side, enable certificate-based login. For information on how to enable certificate-based login, see PSK-Based and Certificate-Based Authentication on page 313.

Standard DHCP Options 60 and 43 on Windows Server 2008

In networks that are not using DHCP options 60 and 43, it is easy to use the standard DHCP options 60 and 43 for an IAP or AP. For APs, these options can be used to indicate the master controller or the local controller. For IAPs, these options can be used to define the AirWave IP, group, password, and domain name.

1. From a server running Windows Server 2008, navigate to **Server Manager > Roles > DHCP sever > domain > DHCP Server > IPv4**.
2. Right-click **IPv4** and select **Set Predefined Options.**

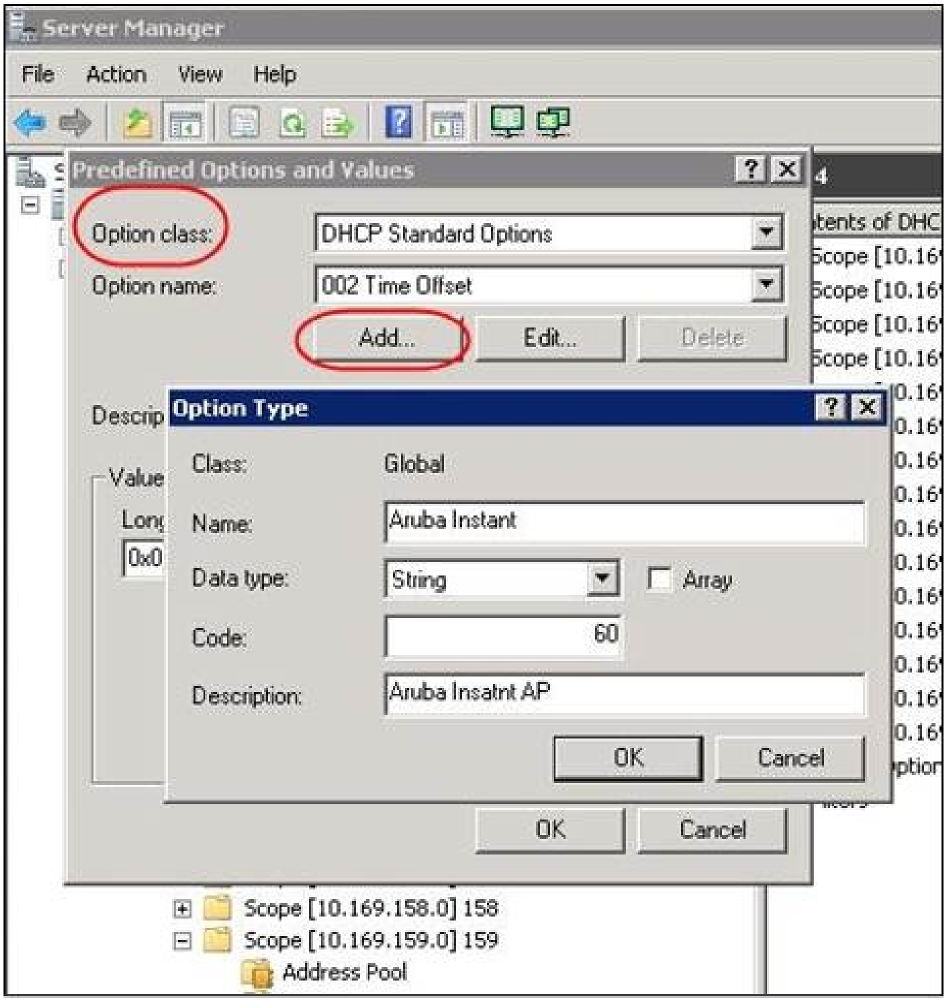
Figure 84 *Instant and DHCP options for AirWave: Set Predefined Options*



Contents of DHCP Server	Status	Description
Scope [10.169.131.0] 131	** Active **	remote
Scope [10.169.135.0] 135	** Active **	
Scope [10.169.137.0] 137	** Active **	
Scope [10.169.138.0] 138	** Active **	
Scope [10.169.145.0] 145	** Active **	
Scope [10.169.150.0] 150	** Active **	
Scope [10.169.151.0] 151	** Active **	
Scope [10.169.152.0] 152	** Active **	
Scope [10.169.153.0] 153	** Active **	
Scope [10.169.154.0] 154	** Active **	
Scope [10.169.155.0] 155	** Active **	
Scope [10.169.156.0] 156	** Active **	
Scope [10.169.157.0] 157	** Active **	
Scope [10.169.158.0] 158	** Active **	
Scope [10.169.159.0] 159	** Active **	
Server Options		
Filters		

3. Select **DHCP Standard Options** in the **Option class** drop-down list and then click **Add**.
4. Enter the following information:
   - Name—Instant
   - Data Type—String
   - Code—60
   - Description—Instant AP

Figure 85 *Instant and DHCP options for AirWave: Predefined Options and Values*



Option class: DHCP Standard Options

Option name: 002 Time Offset

Class: Global

Name: Aruba Instant

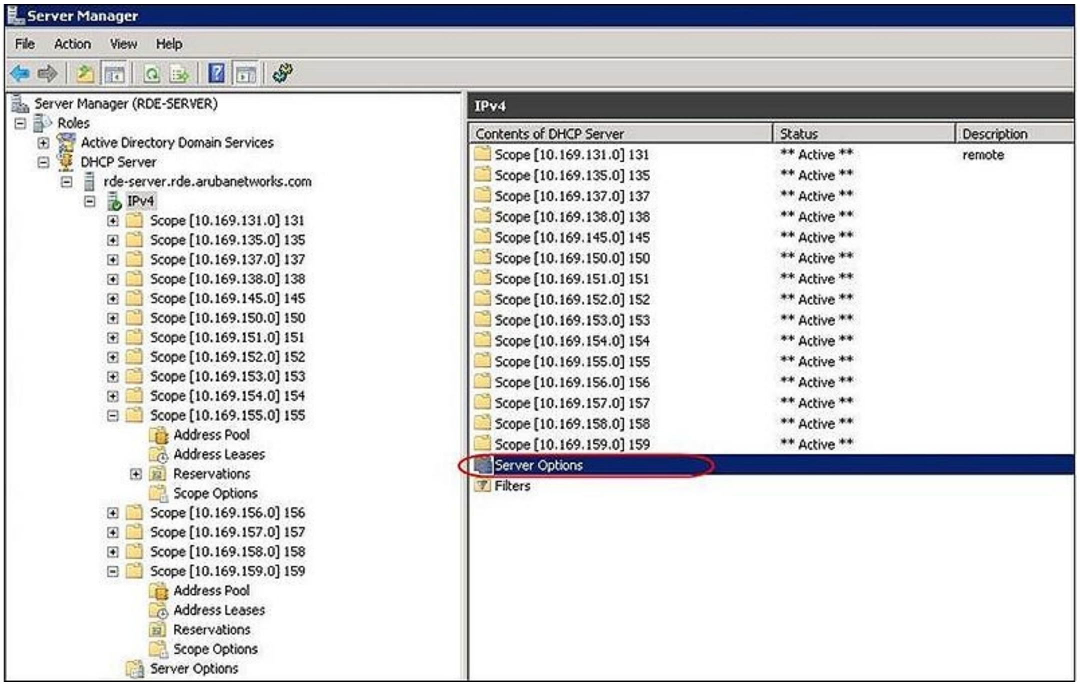
Data type: String □ Array

Code: 60

Description: Aruba Insatnt AP

5. Navigate to **Server Manager** and select **Server Options** in the **IPv4** window. (This sets the value globally. Use options on a per-scope basis to override the global options.)
6. Right-click **Server Options** and select the configuration options.

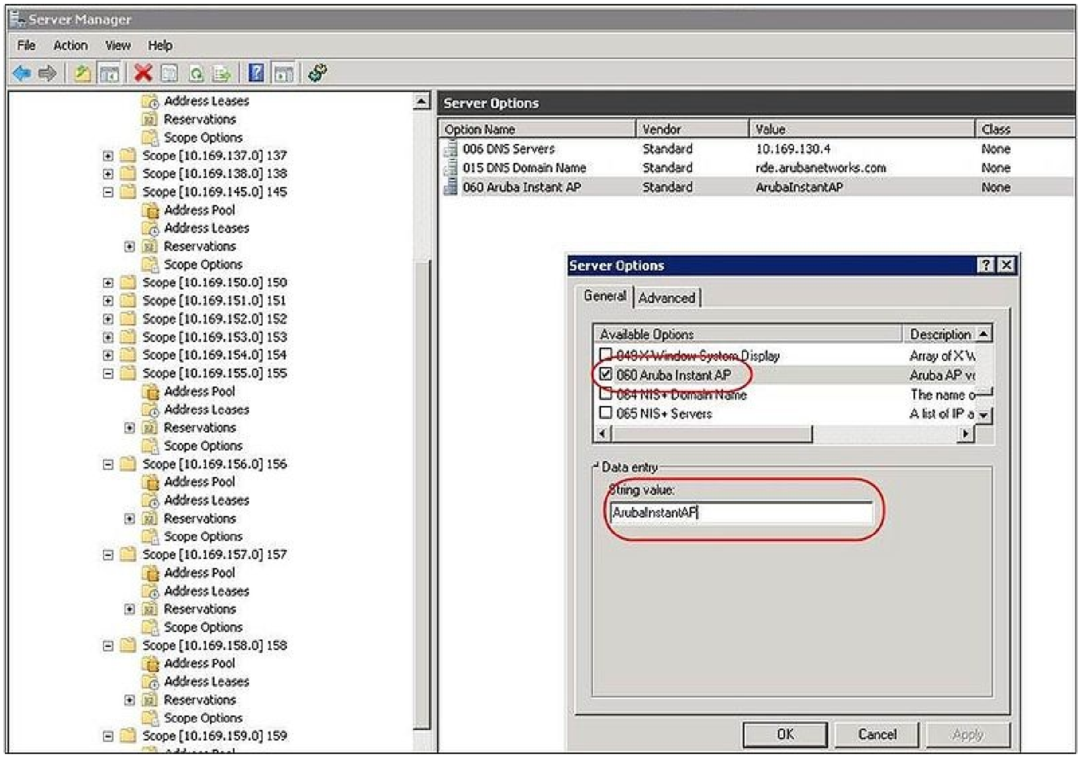
Figure 86 *Instant and DHCP options for AirWave: Server Options*



Contents of DHCP Server	Status	Description
Scope [10.169.131.0] 131	** Active **	remote
Scope [10.169.135.0] 135	** Active **	
Scope [10.169.137.0] 137	** Active **	
Scope [10.169.138.0] 138	** Active **	
Scope [10.169.145.0] 145	** Active **	
Scope [10.169.150.0] 150	** Active **	
Scope [10.169.151.0] 151	** Active **	
Scope [10.169.152.0] 152	** Active **	
Scope [10.169.153.0] 153	** Active **	
Scope [10.169.154.0] 154	** Active **	
Scope [10.169.155.0] 155	** Active **	
Scope [10.169.156.0] 156	** Active **	
Scope [10.169.157.0] 157	** Active **	
Scope [10.169.158.0] 158	** Active **	
Scope [10.169.159.0] 159	** Active **	
Server Options		
Filters		

7. Select **060 Aruba Instant AP** in the **Server Options** window and enter **ArubaInstantAP** in the **String value** text box.

Figure 87 *Instant and DHCP options for AirWave—060 IAP in Server Options*



Option Name	Vendor	Value	Class
006 DNS Servers	Standard	10.169.130.4	None
015 DNS Domain Name	Standard	rde.arubanetworks.com	None
060 Aruba Instant AP	Standard	ArubaInstantAP	None

Available Options	Description
□ ~~049 X Window System~~ Display	Array of X W
☑ 060 Aruba Instant AP	Aruba AP v
□ ~~064 NIS+ Domain Name~~	The name o
□ 065 NIS+ Servers	A list of IP a

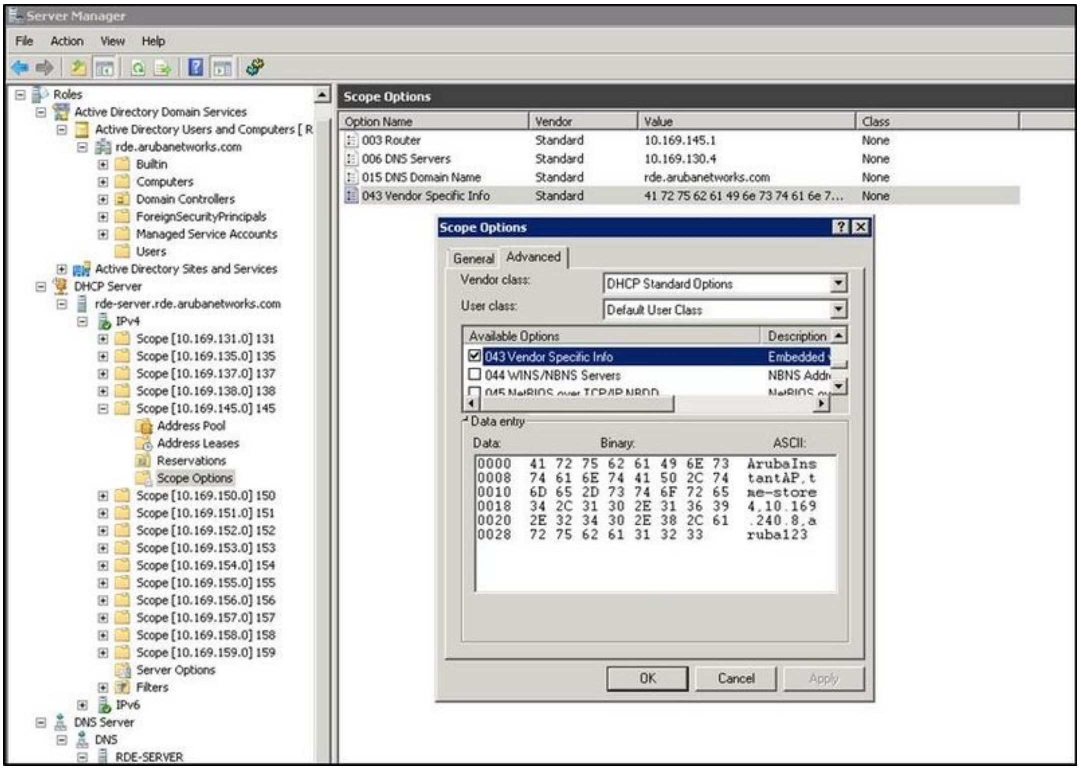
Data entry

String value: ArubaInstantAP

8. Select **043 Vendor Specific Info** and enter a value for either of the following in the ASCII text box:

- **airwave-orgn, airwave-ip, airwave-key**; for example: Aruba,192.0.2.20, 12344567
- **airwave-orgn, airwave-domain**; for example: Aruba, aruba.support.com

Figure 88 *Instant and DHCP options for—043 Vendor-Specific Info*



Scope Options

Option Name	Vendor	Value	Class
003 Router	Standard	10.169.145.1	None
006 DNS Servers	Standard	10.169.130.4	None
015 DNS Domain Name	Standard	rde.arubanetworks.com	None
043 Vendor Specific Info	Standard	41 72 75 62 61 49 6e 73 74 61 6e 7...	None

Scope Options

General | Advanced

Vendor class: DHCP Standard Options

User class: Default User Class

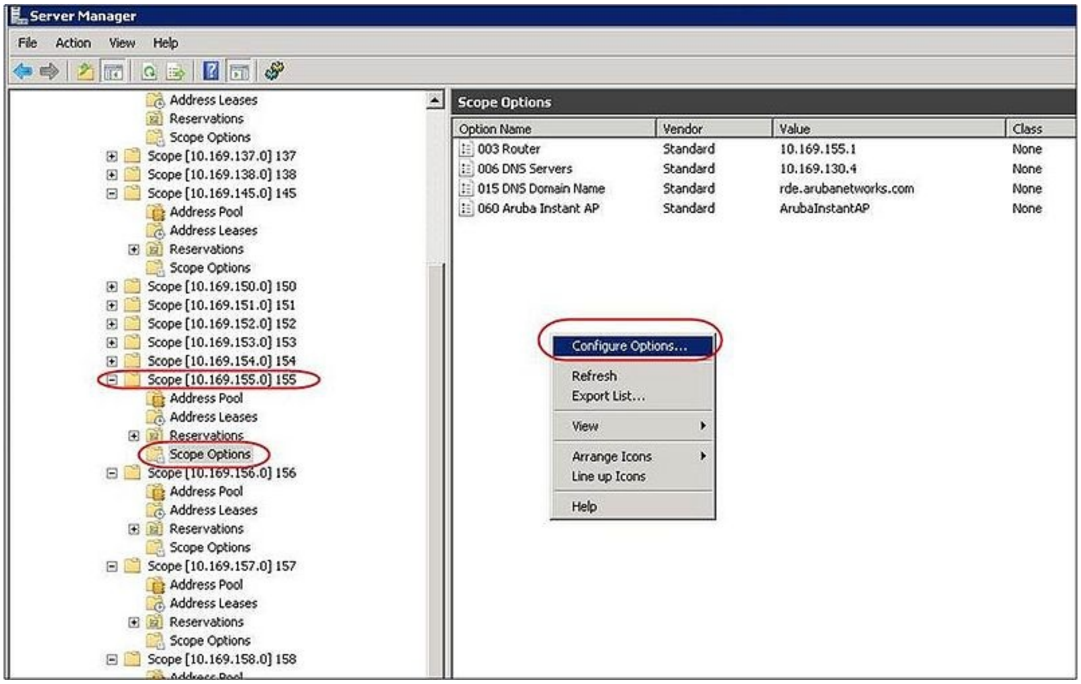
Available Options	Description
☑ 043 Vendor Specific Info	Embedded
□ 044 WINS/NBNS Servers	NBNS Addr
□ 045 NetBIOS over TCP/IP NBDD	NetBIOS ov

Data entry

```
Data:         Binary:                    ASCII:
0000   41 72 75 62 61 49 6E 73   ArubaIns
0008   74 61 6E 74 41 50 2C 74   tantAP,t
0010   6D 65 2D 73 74 6F 72 65   me-store
0018   34 2C 31 30 2E 31 36 39   4,10.169
0020   2E 32 34 30 2E 38 2C 61   .240.8,a
0028   72 75 62 61 31 32 33      ruba123
```

This creates DHCP options 60 and 43 on a global basis. You can do the same on a per-scope basis. The per-scope option overrides the global option.

Figure 89 *Instant and DHCP options for AirWave: Scope Options*



Scope Options

Option Name	Vendor	Value	Class
003 Router	Standard	10.169.155.1	None
006 DNS Servers	Standard	10.169.130.4	None
015 DNS Domain Name	Standard	rde.arubanetworks.com	None
060 Aruba Instant AP	Standard	ArubaInstantAP	None

Alternate Method for Defining Vendor-Specific DHCP Options

This section describes how to add vendor-specific DHCP options for IAPs in a network that already uses DHCP options 60 and 43 for other services. Some networks use DHCP standard options 60 and 43 to provide the DHCP clients information about certain services such as PXE. In such an environment, the standard DHCP options 60 and 43 cannot be used for IAPs.

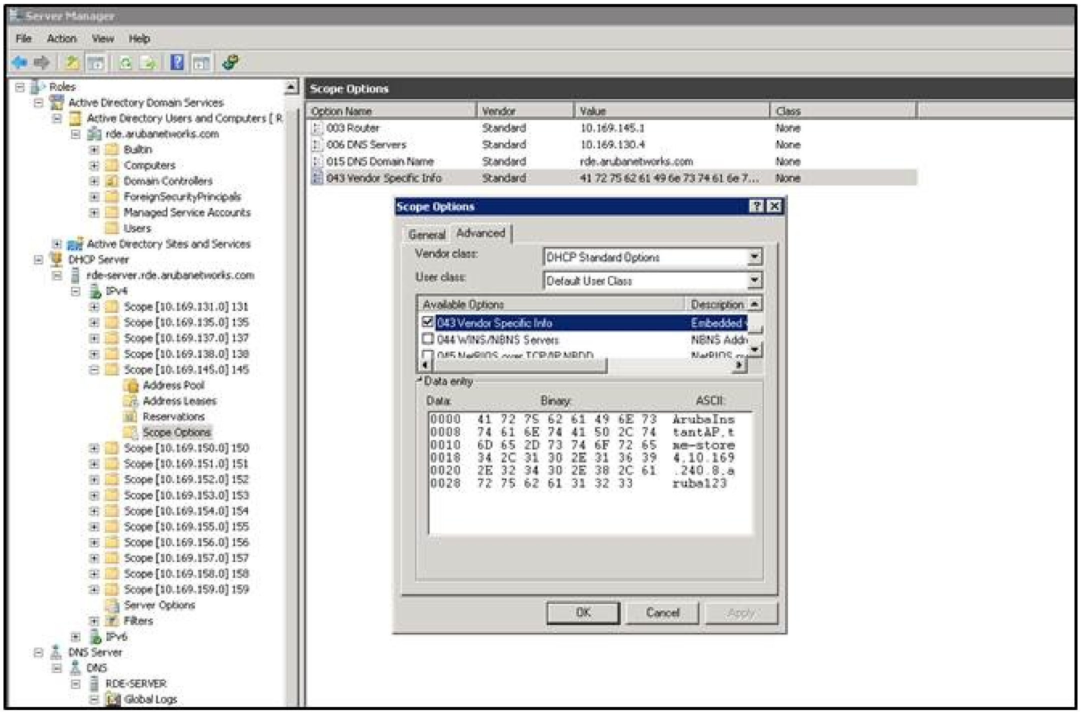
This method describes how to set up a DHCP server to send option 43 with AirWave information to the IAP. This section assumes that option 43 is sent per scope, because option 60 is being shared by other devices as well.

NOTE

The DHCP scope must be specific to Instant, and the PXE devices that use options 60 and 43 must not connect to the subnet defined by this scope. This is because you can specify only one option 43 for a scope, and if other devices that use option 43 connect to this subnet, they are presented with the information specific to the IAP.

1. In Windows Server 2008, navigate to **Server Manager > Roles > DHCP Server > Domain DHCP Server > IPv4**.
2. Select a scope [subnet]. Scope [10.169.145.0]145 is selected in the example shown in the figure below.
3. Right-click and select **Advanced,** and then specify the following options:
   - Vendor class—DHCP Standard Options
   - User class—Default User Class
   - Available options—Select 043 Vendor-Specific Info
   - String Value—ArubaInstantAP, tme-store4, 10.169.240.8, Aruba123 (which is the IAP description, organization string, AirWave IP address or domain name, Pre-shared key, for AirWave)

Figure 90 *Vendor-Specific DHCP options*



Scope Options

Option Name	Vendor	Value	Class
003 Router	Standard	10.169.145.1	None
006 DNS Servers	Standard	10.169.130.4	None
015 DNS Domain Name	Standard	rde.arubanetworks.com	None
043 Vendor Specific Info	Standard	41 72 75 62 61 49 6e 73 74 61 6e 7...	None

Vendor class: DHCP Standard Options

User class: Default User Class

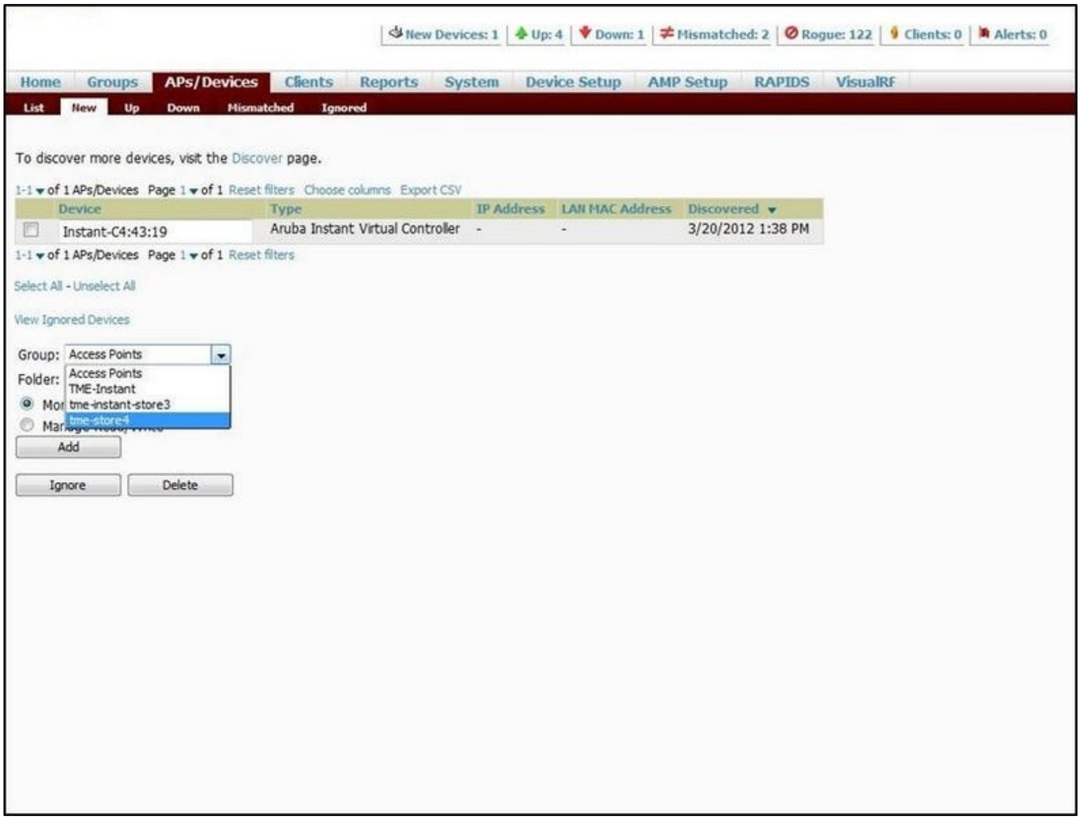
☑ 043 Vendor Specific Info — Embedded

Data entry

```
Data:          Binary:                    ASCII:
0000   41 72 75 62 61 49 6E 73   ArubaIns
0008   74 61 6E 74 41 50 2C 74   tantAP,t
0010   6D 65 2D 73 74 6F 72 65   me-store
0018   34 2C 31 30 2E 31 36 39   4,10.169
0020   2E 32 34 30 2E 38 2C 61   .240.8,a
0028   72 75 62 61 31 32 33      ruba123
```

Upon completion, the IAP shows up as a new device in AirWave, and a new group called **tme-store4** is created. Navigate to **APs/Devices > New > Group** to view this group.

Figure 91 *AirWave—New Group*



To discover more devices, visit the Discover page.

1-1 of 1 APs/Devices Page 1 of 1 Reset filters Choose columns Export CSV

	Device	Type	IP Address	LAN MAC Address	Discovered
□	Instant-C4:43:19	Aruba Instant Virtual Controller	-	-	3/20/2012 1:38 PM

1-1 of 1 APs/Devices Page 1 of 1 Reset filters

Group: Access Points

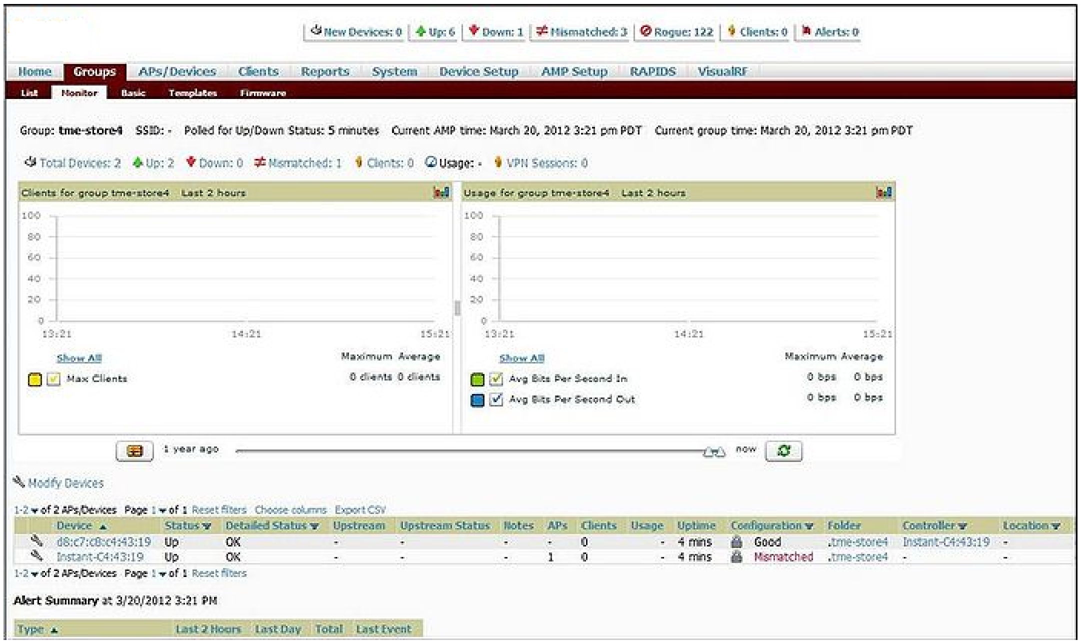
Folder:

Access Points
TME-Instant
tme-instant-store3
tme-store4

● Mon

○ Man

Figure 92 *AirWave—Monitor*



Group: tme-store4 SSID: - Polled for Up/Down Status: 5 minutes Current AMP time: March 20, 2012 3:21 pm PDT Current group time: March 20, 2012 3:21 pm PDT

Total Devices: 2 Up: 2 Down: 0 Mismatched: 1 Clients: 0 Usage: - VPN Sessions: 0

	Maximum	Average
🟨 ☑ Max Clients	0 clients	0 clients

	Maximum	Average
🟩 ☑ Avg Bits Per Second In	0 bps	0 bps
🟦 ☑ Avg Bits Per Second Out	0 bps	0 bps

1-2 of 2 APs/Devices Page 1 of 1 Reset filters Choose columns Export CSV

Device	Status	Detailed Status	Upstream	Upstream Status	Notes	APs	Clients	Usage	Uptime	Configuration	Folder	Controller	Location
d8:c7:c8:c4:43:19	Up	OK	-	-	-	-	0	-	4 mins	Good	.tme-store4	Instant-C4:43:19	-
Instant-C4:43:19	Up	OK	-	-	-	1	0	-	4 mins	Mismatched	.tme-store4	-	-

1-2 of 2 APs/Devices Page 1 of 1 Reset filters

Alert Summary at 3/20/2012 3:21 PM

Type	Last 2 Hours	Last Day	Total	Last Event

Managing IAP from Aruba Central

The Aruba Central user interface provides a standard web-based interface that allows you to configure and monitor multiple Aruba Instant networks from anywhere with a connection to the Internet. Central supports all the IAPs running Instant 6.2.1.0-3.3.0.0 or later versions.

Using Central, individual users can manage their own wireless network. This user interface is accessible through a standard web browser and can be launched using various browsers. Aruba Central uses a secure HTTPs connection and provides a strong mutual authentication mechanism using certificates for all communication with IAPs. These certificates ensure the highest level of protection.

Provisioning an IAP using Central

After you subscribe and register an IAP, log in to the Central dashboard to manage your IAP using the following URL:

http://www.arubanetworks.com/iap-motd

The Central UI is categorized into the following sections:

1. Monitoring
2. Configuration
3. Reporting
4. Maintenance

These sections are layered under groups. The configuration details of the IAPs are defined at a group level. Any IAP joining a group inherits the configuration defined for the group. After you create a group, navigate to the Wireless Configuration section and create a new SSID. Aruba Central supports zero-touch provisioning, which allows the network administrators to configure the IAPs even before the hardware arrives.

After you turn on the IAP and connect to the uplink port, the IAP is displayed under the default group in the Aruba Central UI. You can choose to move the IAP to a different group that you created. The configuration defined in this group is automatically applied to the IAP.

Maintaining the Subscription List

Aruba Central maintains a subscription list for the IAPs. If an IAP is not included in this list, Central identifies it as an unauthorized IAP and prevents it from joining the network. The service providers use Aruba Central to track the subscription of each IAP based on its serial number and MAC address.

The following types of subscription status are listed for the IAPs:

- Active—Central allows the IAP to join the network.
- Expired—Central denies the IAP from joining the network.

NOTE

If the status of a master IAP changes from active to expired, the VC is set to factory defaults and it reboots.

If the status of a slave IAP changes from active to expired, the VC sets the slave IAP to factory defaults and reboots the IAP.

- Unknown—Central does not allow the IAP to join the network. However, it gives an option to retry the connection.

The list maintained by Aruba Central is different from the list maintained by the end users. Therefore, Central can prevent an IAP from joining the network when the subscription expires, even if the IAP is present in the subscription list maintained by the end user.

NOTE

The subscription list is dynamic and gets updated each time an IAP is included in Central.

Firmware Maintenance

For a multiclass IAP network, ensure that the IAP can download software images from the Aruba Cloud-Based Image Service. You may also need to configure HTTP proxy settings on the IAP if they are required for Internet access in your network. For more information about image upgrade and HTTP proxy configuration, see sections Image Management Using Cloud Server on page 354 and Configuring HTTP Proxy on an IAP on page 354.

This chapter provides the following information:

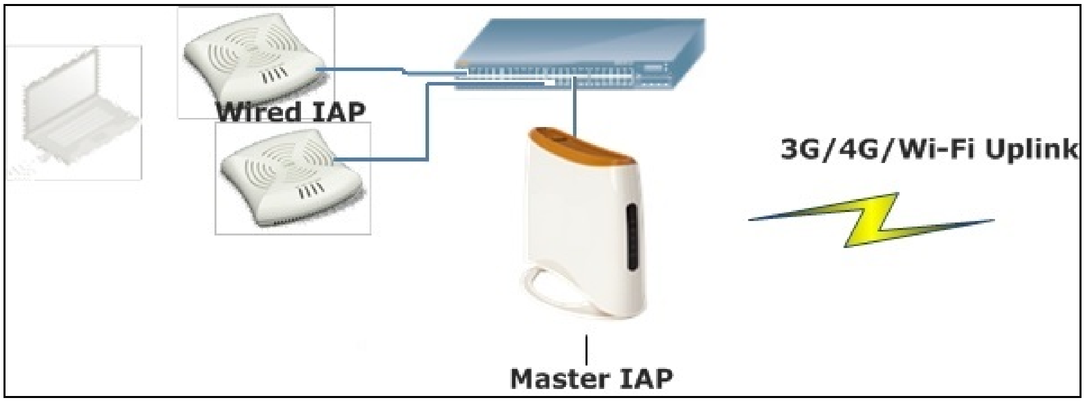
- Uplink Interfaces on page 323
- Uplink Preferences and Switching on page 328

Uplink Interfaces

Instant network supports Ethernet, 3G and 4G USB modems, and the Wi-Fi uplink to provide access to the corporate Instant network. The 3G/4G USB modems and the Wi-Fi uplink can be used to extend the connectivity to places where an Ethernet uplink cannot be configured. It also provides a reliable backup link for the Ethernet-based Instant network.

The following figure illustrates a scenario in which the IAPs join the VC as slave IAPs through a wired or mesh Wi-Fi uplink:

Figure 93 *Uplink Types*



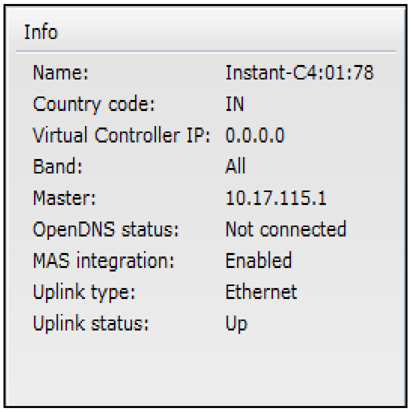
The following types of uplinks are supported on Instant:

- Ethernet Uplink
- Cellular Uplink
- Wi-Fi Uplink

Ethernet Uplink

The Eth0 port on an IAP is enabled as an uplink port by default. You can view the type of uplink and the status of uplink of an IAPin the **Info** tab on selecting a client.

Figure 94 *Uplink Status*



Info

Name:	Instant-C4:01:78
Country code:	IN
Virtual Controller IP:	0.0.0.0
Band:	All
Master:	10.17.115.1
OpenDNS status:	Not connected
MAS integration:	Enabled
Uplink type:	Ethernet
Uplink status:	Up

Ethernet uplink supports the following types of configuration in this Instant release.

- PPPoE
- DHCP
- Static IP

You can use PPPoE for your uplink connectivity in both IAP and IAP-VPN deployments. PPPoE is supported only in a single IAP deployment.

NOTE

Uplink redundancy with the PPPoE link is not supported.

When the Ethernet link is up, it is used as a PPPoE or DHCP uplink. After the PPPoE settings are configured, PPPoE has the highest priority for the uplink connections. The IAP can establish a PPPoE session with a PPPoE server at the ISP and get authenticated using Password Authentication Protocol (PAP) or the Challenge Handshake Authentication Protocol (CHAP). Depending upon the request from the PPPoE server, either the PAP or the CHAP credentials are used for authentication. After configuring PPPoE, reboot the IAP for the configuration to take effect. The PPPoE connection is dialed after the IAP comes up. The PPPoE configuration is checked during IAP boot and if the configuration is correct, Ethernet is used for the uplink connection.

NOTE

When PPPoE is used, do not configure Dynamic RADIUS Proxy and IP address of the VC. An SSID created with default VLAN is not supported with PPPoE uplink.

You can also configure an alternate Ethernet uplink to enable uplink failover when an Ethernet port fails.

Configuring PPPoE Uplink Profile

You can configure PPPoE settings from the Instant UI or the CLI.

In the Instant UI

Configuring PPPoE settings:

1. Click the **System** link on the Instant main window.
2. In the **System** section, click the **Show advanced options** link.
3. Perform the following steps in the **PPPoE** section in the **Uplink** tab:
   a. Enter the PPPoE service name provided by your service provider in the **Service name** text box.
   b. Enter the secret key used for Challenge Handshake Authentication Protocol (CHAP) authentication in the **CHAP secret** and **Retype** text boxes. You can use a maximum of 34 characters for the CHAP secret key.
   c. Enter the username for the PPPoE connection in the **User** text box.

d. Enter a password for the PPPoE connection and confirm the password in the **Password** and **Retype** text boxes.

4. Select a value from the **Local interface** drop-down list to set a local interface for the PPPoE uplink connections. The selected DHCP scope will be used as a local interface on the PPPoE interface and the Local, L3 DHCP gateway IP address as its local IP address. When configured, the local interface acts as an unnumbered PPPoE interface and allows the entire Local, L3 DHCP subnet to be allocated to clients.

NOTE

The options in the **Local interface** drop-down list are displayed only if a Local, L3 DHCP scope is configured on the IAP.

5. Click **OK**.
6. Reboot the IAP for the configuration to take effect.

In the CLI

To configure a PPPoE uplink connection:

```
(Instant AP)(config) # pppoe-uplink-profile
(Instant AP)(pppoe-uplink-profile)# pppoe-svcname <service-name>
(Instant AP)(pppoe-uplink-profile)# pppoe-username <username>
(Instant AP)(pppoe-uplink-profile)# pppoe-passwd <password>
(Instant AP)(pppoe-uplink-profile)# pppoe-chapsecret <password>
(Instant AP)(pppoe-uplink-profile)# pppoe-unnumbered-local-l3-dhcp-profile <dhcp-profile>
(Instant AP)(pppoe-uplink-profile)# end
(Instant AP)# commit apply
```

To view the PPPoE configuration:

```
(Instant AP)# show pppoe config

PPPoE Configuration
-------------------
Type Value
---- -----
User testUser
Password 3c28ec1b82d3eef0e65371da2f39c4d49803e5b2bc88be0c
Service name internet03
CHAP secret 8e87644deda9364100719e017f88ebce
Unnumbered dhcp profile dhcpProfile1
```

To view the PPPoE status:

```
(Instant AP)# show pppoe status

pppoe uplink state:Suppressed.
```

Cellular Uplink

Instant supports the use of 3G and 4G USB modems to provide the Internet backhaul to an Instant network. The 3G or 4G USB modems can be used to extend client connectivity to places where an Ethernet uplink cannot be configured. This enables the IAPs to automatically choose the available network in a specific region.

NOTE

RAP-155/155P devices do not support the high-speed option (HSO) module.

NOTE

When UML290 runs in auto-detect mode, the modem can switch from 4G network to 3G network or vice-versa based on the signal strength. To configure the UML290 for the 3G network only, manually set the USB type to **pantech-3g**. To configure the UML290 for the 4G network only, manually set the 4G USB type to **pantech-lte**.

Configuring Cellular Uplink Profiles

You can configure 3G or 4G uplinks by using the Instant UI or the CLI.

In the Instant UI

To configure 3G/4G uplinks:

1. Click the **System** link on the Instant main window.
2. In the **System** window, click the **show advanced settings** link.
3. Click the **Uplink** tab.
4. To configure a 3G or 4G uplink, select the **Country** and **ISP**.
5. Click **OK**.
6. Reboot the IAP for changes to take effect.

In the CLI

To configure 3G/4G uplink manually:

```
(Instant AP)(config) # cellular-uplink-profile
(Instant AP)(cellular-uplink-profile)# usb-type <3G-usb-type>
(Instant AP)(cellular-uplink-profile)# 4g-usb-type <4g-usb>
(Instant AP)(cellular-uplink-profile)# modem-country <country>
(Instant AP)(cellular-uplink-profile)# modem-isp <service-provider-name>
(Instant AP)(cellular-uplink-profile)# usb-auth-type <usb-authentication_type>
(Instant AP)(cellular-uplink-profile)# usb-user <username>
(Instant AP)(cellular-uplink-profile)# usb-passwd <password>
(Instant AP)(cellular-uplink-profile)# usb-dev <device-ID>
(Instant AP)(cellular-uplink-profile)# usb-tty <tty-port>
(Instant AP)(cellular-uplink-profile)# usb-init <Initialization-parameter>
(Instant AP)(cellular-uplink-profile)# usb-dial <dial-parameter>
(Instant AP)(cellular-uplink-profile)# usb-modeswitch <usb-modem>
(Instant AP)(cellular-uplink-profile)# end
(Instant AP)# commit apply
```

To switch a modem from the storage mode to modem mode:

```
(Instant AP)(cellular-uplink-profile)# usb-modeswitch <usb-modem>
```

To view the cellular configuration:

```
(Instant AP)# show cellular config
```

Managing Cellular SIM PIN

IAPs now support the Subscriber Identity Module (SIM) Personal Identification Number (PIN) management functions such as locking, unlocking, and renewing the SIM PIN of the 3G/4G modems. In the current release, these functions can be configured only through the IAP CLI.

To prevent any fradulent use of 3G/4G modems connected to an IAP, you can enable locking of the SIM PIN of the modems. When enabled, if an incorrect PIN code is provided in the three consecutive attempts, the SIM PIN is locked. To unlock the PIN, the users must use the Personal Unblocking Code (PUK) code provided by your ISP.

NOTE

After enabling SIM PIN lock, reboot the IAP to apply the SIM PIN lock configuration changes.

To enable SIM PIN lock:

```
(Instant AP)# pin-enable <pin_current_used>
```

To disable SIM PIN locking:

```
(Instant AP)# no pin-enable <pin_current_used>
```

To unlock a PIN with the PUK code provided by the operator:

```
(Instant AP)# pin-puk <pin_puk> <pin_new>
```

To renew the PIN:

```
(Instant AP)# pin-renew <pin_current> <pin_new>
```

Wi-Fi Uplink

The Wi-Fi uplink is supported on all the IAP models, except for the 802.11ac IAP models (IAP-2xx Series access points). However only the master IAP uses this uplink. The Wi-Fi allows uplink to open, PSK-CCMP, and PSK-TKIP SSIDs.

- For single-radio IAPs, the radio serves wireless clients and the Wi-Fi uplink.
- For dual-radio IAPs, both radios can be used to serve clients but only one of them can be used for the Wi-Fi uplink.

NOTE

When the Wi-Fi uplink is in use, the client IP is assigned by the internal DHCP server.

Configuring a Wi-Fi Uplink Profile

The following configuration conditions apply to the Wi-Fi uplink:

- To bind or unbind the Wi-Fi uplink on the 5 GHz band, reboot the IAP.
- If the Wi-Fi uplink is used on the 5 GHz band, mesh is disabled. The two links are mutually exclusive.
- For IAPs to connect to an ArubaOS-based WLAN using Wi-Fi uplink, the controller must run ArubaOS 6.2.1.0 or later.

In the Instant UI

To provision an IAP with the Wi-Fi uplink:

1. If you are configuring a Wi-Fi uplink after restoring factory settings on an IAP, connect the IAP to an Ethernet cable to allow the IAP to get the IP address. Otherwise, go to step 2.
2. Click the **System** link on the Instant main window.
3. In the **System** section, click the **Show advanced options** link. The advanced options are displayed.
4. Click the **Uplink** tab.
5. Under **Wi-Fi**, enter the name of the wireless network that is used for the Wi-Fi uplink in the **Name (SSID)** text box.
6. Select the type of key for uplink encryption and authentication from the **Key management** drop-down list. If the uplink wireless router uses mixed encryption, WPA-2 is recommended for the Wi-Fi uplink.
7. Select the band in which the VC currently operates, from the **band** drop-down list. The following options are available:
   - 2.4 GHz (default)
   - 5 GHz
8. Select a passphrase format from the **Passphrase format** drop-down list. The following options are available:
   - 8–63 alphanumeric characters
   - 64 hexadecimal characters

NOTE

Ensure that the hexadecimal password string is exactly 64 digits in length.

9. Enter a Pre-Shared Key (PSK) passphrase in the **Passphrase** text box and click **OK**.

10. Navigate to **System > General > Show Advanced Options** view and set the **Extended SSID** parameter to **Disabled**.
11. Reboot the IAP to apply the changes. After the IAP reboot, the Wi-Fi and mesh links are automatically enabled.

In the CLI

To configure Wi-Fi uplink on an IAP:

```
(Instant AP)(config) # wlan sta-profile
(Instant AP)(sta uplink)# cipher-suite<clear | wpa-tkip-psk | wpa2-ccmp-psk>
(Instant AP)(sta uplink)# essid <essid>
(Instant AP)(sta uplink)# uplink-band <band>
(Instant AP)(sta uplink)# wpa-passphrase <key>
(Instant AP)(sta uplink)# end
(Instant AP)# commit apply
```

To view the W-Fi uplink status in the CLI:

```
(Instant AP)# show wifi-uplink status
configured :NO
```

To view the configuration status in the CLI:

```
(Instant AP)# show wifi-uplink config

ESSID :
Cipher Suite :
Passphrase :
Band :

(Instant AP)# show wifi-uplink auth log

----------------------------------------------------------------------
wifi uplink auth configuration:
----------------------------------------------------------------------
----------------------------------------------------------------------
wifi uplink auth log:
----------------------------------------------------------------------
[1116]2000-01-01 00:00:45.625: Global control interface '/tmp/supp_gbl'
```

Uplink Preferences and Switching

This topic describes the following procedures:

- Enforcing Uplinks on page 328
- Setting an Uplink Priority on page 329
- Enabling Uplink Preemption on page 329
- Switching Uplinks Based on VPN and Internet Availability on page 330
- Viewing Uplink Status and Configuration on page 332

Enforcing Uplinks

The following configuration conditions apply to the uplink enforcement:

- When an uplink is enforced, the IAP uses the specified uplink as the primary uplink regardless of uplink preemption configuration and the current uplink status.
- When an uplink is enforced and multiple Ethernet ports are configured ,and if the uplink is enabled on the wired profiles, the IAP tries to find an alternate Ethernet link based on the priority configured.

- When no uplink is enforced and preemption is not enabled, and if the current uplink fails, the IAP tries to find an available uplink based on the priority configured. The uplink with the highest priority is used as the primary uplink. For example, if Wi-Fi-sta has the highest priority, it is used as the primary uplink.
- When no uplink is enforced and preemption is enabled, and if the current uplink fails, the IAP tries to find an available uplink based on the priority configured. If current uplink is active, the IAP periodically tries to use a higher-priority uplink and switches to the higher-priority uplink even if the current uplink is active.

You can enforce a specific uplink on an IAP by using the Instant UI or the CLI.

In the Instant UI

To enforce an uplink:

1. Click the **System > show advanced settings > Uplink**. The **Uplink** tab contents are displayed.
2. Under **Management**, select the type of uplink from the **Enforce Uplink** drop-down list. If Ethernet uplink is selected, the **Port** text box is displayed.
3. Specify the Ethernet interface port number.
4. Click **OK**. The selected uplink is enforced on the IAP.

In the CLI

To enforce an uplink:

```
(Instant AP)(config)# uplink
(Instant AP)(uplink)# enforce {cellular|ethernet | wifi | none}
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

Setting an Uplink Priority

You can set an uplink priority by using the Instant UI or the CLI.

In the Instant UI

Setting an uplink priority:

1. Click **System > show advanced settings > Uplink** .
2. Under **Uplink Priority List**, select the uplink, and click the icons in the **Uplink Priority List** section, to increase or decrease the priority. By default, the Eth0 uplink is set as a high-priority uplink.
3. Click **OK**. The selected uplink is prioritized over other uplinks.

In the CLI

Setting an uplink priority:

```
(Instant AP)(config)# uplink
(Instant AP)(uplink)# uplink-priority {cellular <priority> | ethernet <priority> | [port
<Interface-number> <priority>] | wifi <priority>}
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

Setting an Ethernet uplink priority :

```
(Instant AP)(uplink)# uplink-priority ethernet port 0 1
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

Enabling Uplink Preemption

The following configuration conditions apply to uplink preemption:

- Preemption can be enabled only when no uplink is enforced.

- When preemption is disabled and the current uplink goes down, the IAP tries to find an available uplink based on the uplink priority configuration.
- When preemption is enabled and if the current uplink is active, the IAP periodically tries to use a higher-priority uplink, and switches to a higher-priority uplink even if the current uplink is active.

You can enable uplink preemption by using Instant UI or the CLI.

In the Instant UI

To enable uplink preemption:

1. Click **System > show advanced settings > Uplink**. The **Uplink** tab contents are displayed.
2. Under **Management**, ensure that the **Enforce Uplink** is set to none.
3. Select **Enabled** from the **Pre-emption** drop-down list.
4. Click **OK**.

In the CLI

To configure uplink preemption:

```
(Instant AP)(config)# uplink
(Instant AP)(uplink)# preemption
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

Switching Uplinks Based on VPN and Internet Availability

The default priority for uplink switchover is Ethernet and then 3G/4G. The IAP can switch to the lower-priority uplink if the current uplink is down.

Switching Uplinks Based on VPN Status

Instant supports switching uplinks based on the VPN status when deploying multiple uplinks (Ethernet, 3G/4G, and Wi-Fi). When VPN is used with multiple backhaul options, the IAP switches to an uplink connection based on the VPN connection status, instead of only using the Ethernet or the physical backhaul link.

The following configuration conditions apply to uplink switching:

- If the current uplink is Ethernet and the VPN connection is down, the IAP tries to reconnect to VPN. The retry time depends on the fast failover configuration and the primary or backup VPN tunnel. If this fails, the IAP waits for the VPN failover timeout and selects a different uplink such as 3G/4G or Wi-Fi.
- If the current uplink is 3G or Wi-Fi, and Ethernet has a physical link, the IAP periodically suspends user traffic to try and connect to the VPN on the Ethernet. If the IAP succeeds, the IAP switches to Ethernet. If the IAP does not succeed, it restores the VPN connection to the current uplink.

Uplink switching based on VPN status is automatically enabled if VPN is configured on the IAP. However, you can specify the duration in the **VPN failover timeout** text box to wait for an uplink switch. By default, this duration is set to 180 seconds. The IAP monitors the VPN status and when the VPN connection is not available for 3 minutes, the uplink switches to another available connection (if a low-priority uplink is detected and the uplink preference is set to none). When **VPN failover timeout** is set to 0, uplink does not switch over.

When uplink switching based on the Internet availability is enabled, the uplink switching based on VPN failover is automatically disabled.

Switching Uplinks Based on Internet Availability

You can configure Instant to switch uplinks based on Internet availability.

When the uplink switchover based on Internet availability is enabled, the IAP continuously sends Internet Control Management Protocol (ICMP) packets to some well-known Internet servers. If the request is timed out due to a bad uplink connection or uplink interface failure, and the public Internet is not reachable from the current uplink, the IAP switches to a different connection.

You can set preferences for uplink switching by using the Instant UI and the CLI.

In the Instant UI

To configure uplink switching:

1. Click **System > show advanced settings > Uplink**. The **Uplink** tab contents are displayed.
2. Under **Management**, configure the following parameters:
   - **VPN failover timeout**—To configure uplink switching based on VPN status, specify the duration to wait for an uplink switch. The default duration is set to 180 seconds.
   - **Internet failover**—To configure uplink switching based on Internet availability, perform the following steps:
     a. Select **Enabled** from the **Internet failover** drop-down list.
     b. Specify the required values for the following parameters:
        - **Max allowed test packet loss**—The maximum number of ICMP test packets that are allowed to be lost to determine if the IAP must switch to a different uplink connection. You can specify a value within the range of 1–1000.
        - **Secs between test packets**—The frequency at which ICMP test packets are sent. You can specify a value within the range of 1–3600 seconds.
        - **Internet check timeout**—Internet check timeout is the duration for the test packet timeout. You can specify a value within the range of 0–3600 seconds and the default value is 10 seconds.
   - **Internet failover IP**—To configure an IP address to which the IAP must send IAP packets and verify if the Internet is reachable when the uplink is down. By default, the master IAP sends the ICMP packets to 8.8.8.8 IP address only if the out-of-service operation based on Internet availability (internet-down state) is configured on the SSID.
3. Click **OK**.

NOTE

When **Internet failover** is enabled, the IAP ignores the VPN status, although uplink switching based on VPN status is enabled.

In the CLI

To enable uplink switching based on VPN status:

```
(Instant AP)(config)# uplink
(Instant AP)(uplink)# failover-vpn-timeout <seconds>
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

To enable uplink switching based on Internet availability:

```
(Instant AP)(config)# uplink
(Instant AP)(uplink)# failover-internet
(Instant AP)(uplink)# failover-internet-ip <ip>
(Instant AP)(uplink)# failover-internet-pkt-lost-cnt <count>
(Instant AP)(uplink)# failover-internet-pkt-send-freq <frequency>
(Instant AP)(uplink)# end
(Instant AP)# commit apply
```

Viewing Uplink Status and Configuration

To view the uplink status:

```
(Instant AP)# show uplink status
Uplink preemption             :enable
Uplink preemption interval    :600
Uplink enforce                :none
Ethernet uplink eth0        :DHCP
Uplink Table
------------
Type      State  Priority  In Use
----      -----  --------  ------
eth0      UP     2         Yes
Wifi-sta  INIT   1         No
3G/4G     INIT   3         No
Internet failover             :enable
Internet failover IP          :192.2.0.1
Max allowed test packet loss  :10
Secs between test packets     :30
VPN failover timeout (secs)   :180
Internet check timeout (secs) :10
ICMP pkt sent        :1
ICMP pkt lost        :1
Continuous pkt lost  :1
VPN down time        :0
AP1X type:NONE
Certification type:NONE
Validate server:NONE
```

To view the uplink configuration in the CLI:

```
(Instant AP)# show uplink config
Uplink preemption             :enable
Uplink preemption interval    :600
Uplink enforce                :none
Ethernet uplink eth0        :DHCP
Internet failover             :disable
Max allowed test packet loss  :10
Secs between test packets     :30
VPN failover timeout (secs)   :180
Internet check timeout (secs) :10
Secs between test packets   :30
```

Chapter 27
Intrusion Detection

The Intrusion Detection System (IDS) is a feature that monitors the network for the presence of unauthorized IAPs and clients. It also logs information about the unauthorized IAPs and clients, and generates reports based on the logged information.

The IDS feature in the Instant network enables you to detect rogue IAPs, interfering IAPs, and other devices that can potentially disrupt network operations.

This chapter describes the following procedures:

- Detecting and Classifying Rogue IAPs on page 333
- OS Fingerprinting on page 333
- Configuring Wireless Intrusion Protection and Detection Levels on page 334
- Configuring IDS on page 339

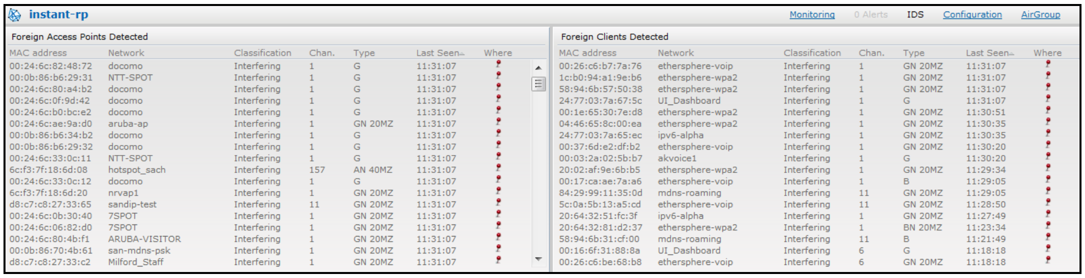
Detecting and Classifying Rogue IAPs

A rogue IAP is an unauthorized IAP plugged into the wired side of the network.

An interfering IAP is an IAP seen in the RF environment but it is not connected to the wired network. While the interfering IAP can potentially cause RF interference, it is not considered a direct security threat, because it is not connected to the wired network. However, an interfering IAP may be reclassified as a rogue IAP.

To detect the rogue IAPs, click the **IDS** link in the Instant main window. The built-in IDS scans for access points that are not controlled by the VC. These are listed and classified as either Interfering or Rogue, depending on whether they are on a foreign network or your network.

Figure 95 *Intrusion Detection*



Foreign Access Points Detected

MAC address	Network	Classification	Chan.	Type	Last Seen	Where
00:24:6c:82:48:72	docomo	Interfering	1	G	11:31:07	📍
00:0b:86:b6:29:31	NTT-SPOT	Interfering	1	G	11:31:07	📍
00:24:6c:80:a4:b2	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:0f:9d:42	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:b0:bc:e2	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:ae:9a:d0	aruba-ap	Interfering	1	GN 20MZ	11:31:07	📍
00:0b:86:b6:34:b2	docomo	Interfering	1	G	11:31:07	📍
00:0b:86:b6:29:32	docomo	Interfering	1	G	11:31:07	📍
00:24:6c:33:0c:11	NTT-SPOT	Interfering	1	G	11:31:07	📍
6c:f3:7f:18:6d:08	hotspot_sach	Interfering	157	AN 40MZ	11:31:07	📍
00:24:6c:33:0c:12	docomo	Interfering	1	G	11:31:07	📍
6c:f3:7f:18:6d:20	nrvap1	Interfering	1	GN 20MZ	11:31:07	📍
d8:c7:c8:27:33:65	sandip-test	Interfering	11	GN 20MZ	11:31:07	📍
00:24:6c:0b:30:40	7SPOT	Interfering	1	GN 20MZ	11:31:07	📍
00:24:6c:06:82:d0	7SPOT	Interfering	1	GN 20MZ	11:31:07	📍
00:24:6c:80:4b:f1	ARUBA-VISITOR	Interfering	1	GN 20MZ	11:31:07	📍
00:0b:86:70:4b:61	san-mdns-psk	Interfering	1	GN 20MZ	11:31:07	📍
d8:c7:c8:27:33:c2	Milford_Staff	Interfering	1	GN 20MZ	11:31:07	📍

Foreign Clients Detected

MAC address	Network	Classification	Chan.	Type	Last Seen	Where
00:26:c6:b7:7a:76	ethersphere-voip	Interfering	1	GN 20MZ	11:31:07	📍
1c:b0:94:a1:9e:b6	ethersphere-wpa2	Interfering	1	GN 20MZ	11:31:07	📍
58:94:6b:57:50:38	ethersphere-wpa2	Interfering	1	GN 20MZ	11:31:07	📍
24:77:03:7a:67:5c	UI_Dashboard	Interfering	1	G	11:31:07	📍
00:1e:65:30:7e:d8	ethersphere-wpa2	Interfering	1	GN 20MZ	11:30:51	📍
04:46:65:8c:00:ea	ethersphere-wpa2	Interfering	1	GN 20MZ	11:30:35	📍
24:77:03:7a:65:ec	ipv6-alpha	Interfering	1	GN 20MZ	11:30:35	📍
00:37:6d:e2:df:b2	ethersphere-voip	Interfering	1	GN 20MZ	11:30:20	📍
00:03:2a:02:5b:b7	akvoice1	Interfering	1	G	11:30:20	📍
20:02:af:9e:6b:b5	ethersphere-wpa2	Interfering	1	GN 20MZ	11:29:34	📍
00:17:ca:ae:7a:a6	ethersphere-voip	Interfering	1	B	11:29:05	📍
84:29:99:11:35:0d	mdns-roaming	Interfering	11	GN 20MZ	11:29:05	📍
5c:0a:5b:13:a5:cd	ethersphere-voip	Interfering	11	GN 20MZ	11:28:50	📍
20:64:32:51:fc:3f	ipv6-alpha	Interfering	1	GN 20MZ	11:27:49	📍
20:64:32:81:d2:37	ethersphere-wpa2	Interfering	1	BN 20MZ	11:23:34	📍
58:94:6b:31:cf:00	mdns-roaming	Interfering	11	B	11:21:49	📍
00:16:6f:31:88:8a	UI_Dashboard	Interfering	6	G	11:18:18	📍
00:26:c6:be:68:b8	ethersphere-voip	Interfering	6	GN 20MZ	11:18:18	📍

OS Fingerprinting

The OS Fingerprinting feature gathers information about the client that is connected to the Instant network to find the operating system that the client is running on. The following is a list of advantages of this feature:

- Identifying rogue clients—Helps to identify clients that are running on forbidden operating systems.
- Identifying outdated operating systems—Helps to locate outdated and unexpected OS in the company network.
- Locating and patching vulnerable operating systems—Assists in locating and patching specific operating system versions on the network that have known vulnerabilities, thereby securing the company network.

OS Fingerprinting is enabled in the Instant network by default. The following operating systems are identified by Instant:

- Windows 7
- Windows Vista
- Windows Server
- Windows XP
- Windows ME
- OS-X
- iPhone
- iOS
- Android
- Blackberry
- Linux

Configuring Wireless Intrusion Protection and Detection Levels

WIP offers a wide selection of intrusion detection and protection features to protect the network against wireless threats.

Like most other security-related features of the Instant network, the WIP can be configured on the IAP.

You can configure the following options:

- **Infrastructure Detection Policies**—Specifies the policy for detecting wireless attacks on access points.
- **Client Detection Policies**—Specifies the policy for detecting wireless attacks on clients.
- **Infrastructure Protection Policies**—Specifies the policy for protecting access points from wireless attacks.
- **Client Protection Policies**—Specifies the policy for protecting clients from wireless attacks.
- **Containment Methods**—Prevents unauthorized stations from connecting to your Instant network.

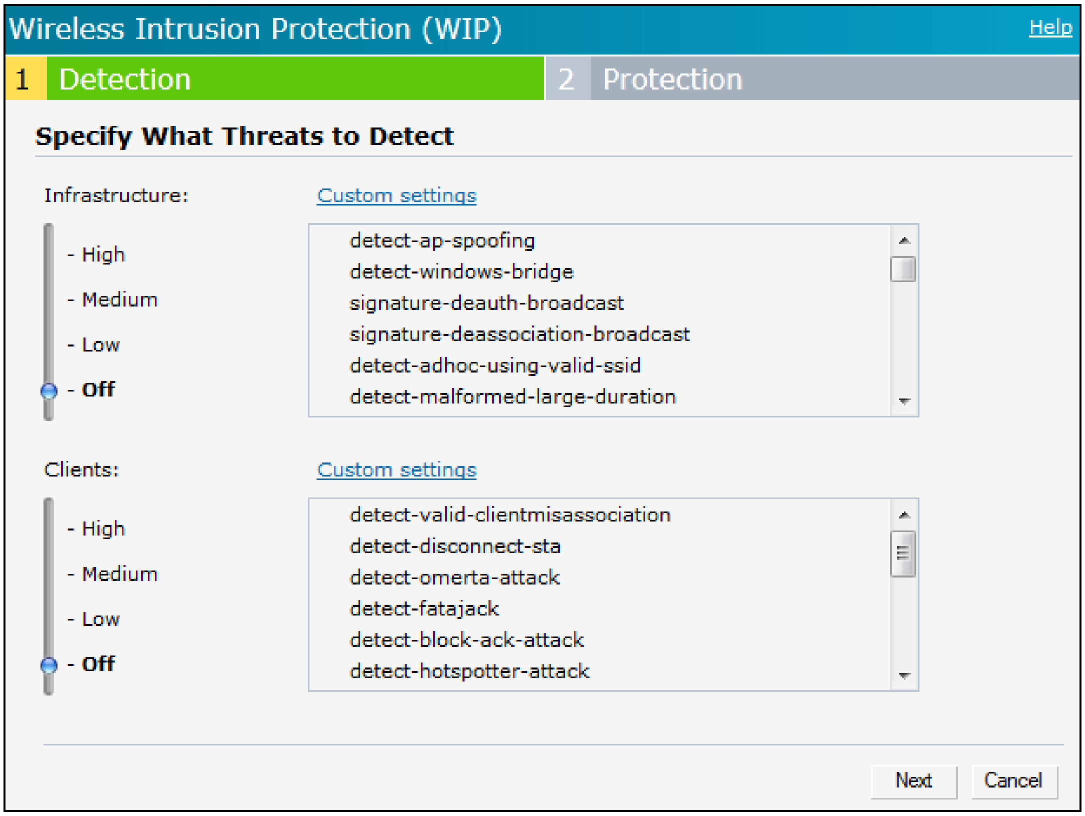
Each of these options contains several default levels that enable different sets of policies. An administrator can customize, enable, or disable these options accordingly.

The detection levels can be configured using the **IDS** window. To view the IDS window, click **More > IDS** link on the Instant main window.

The following levels of detection can be configured in the WIP Detection page:

- Off
- Low
- Medium
- High

Figure 96 *Wireless Intrusion Detection*



Wireless Intrusion Protection (WIP)

Specify What Threats to Detect

Infrastructure:

- detect-ap-spoofing
- detect-windows-bridge
- signature-deauth-broadcast
- signature-deassociation-broadcast
- detect-adhoc-using-valid-ssid
- detect-malformed-large-duration

Clients:

- detect-valid-clientmisassociation
- detect-disconnect-sta
- detect-omerta-attack
- detect-fatajack
- detect-block-ack-attack
- detect-hotspotter-attack

The following table describes the detection policies enabled in the Infrastructure Detection **Custom settings** text box:

Table 67: *Infrastructure Detection Policies*

Detection Level	Detection Policy
Off	Rogue Classification
Low	● Detect IAP Spoofing ● Detect Windows Bridge ● IDS Signature—Deauthentication Broadcast ● IDS Signature—Deassociation Broadcast
Medium	● Detect ad hoc networks using VALID SSID—Valid SSID list is autoconfigured based on Instant IAP configuration ● Detect Malformed Frame—Large Duration
High	● Detect IAP Impersonation ● Detect ad hoc Networks ● Detect Valid SSID Misuse ● Detect Wireless Bridge ● Detect 802.11 40 MHz intolerance settings ● Detect Active 802.11n Greenfield Mode

Table 67: *Infrastructure Detection Policies*

Detection Level	Detection Policy
	• Detect IAP Flood Attack • Detect Client Flood Attack • Detect Bad WEP • Detect CTS Rate Anomaly • Detect RTS Rate Anomaly • Detect Invalid Address Combination • Detect Malformed Frame—HT IE • Detect Malformed Frame—Association Request • Detect Malformed Frame—Auth • Detect Overflow IE • Detect Overflow EAPOL Key • Detect Beacon Wrong Channel • Detect devices with invalid MAC OUI

The following table describes the detection policies enabled in the Client Detection **Custom settings** text box.

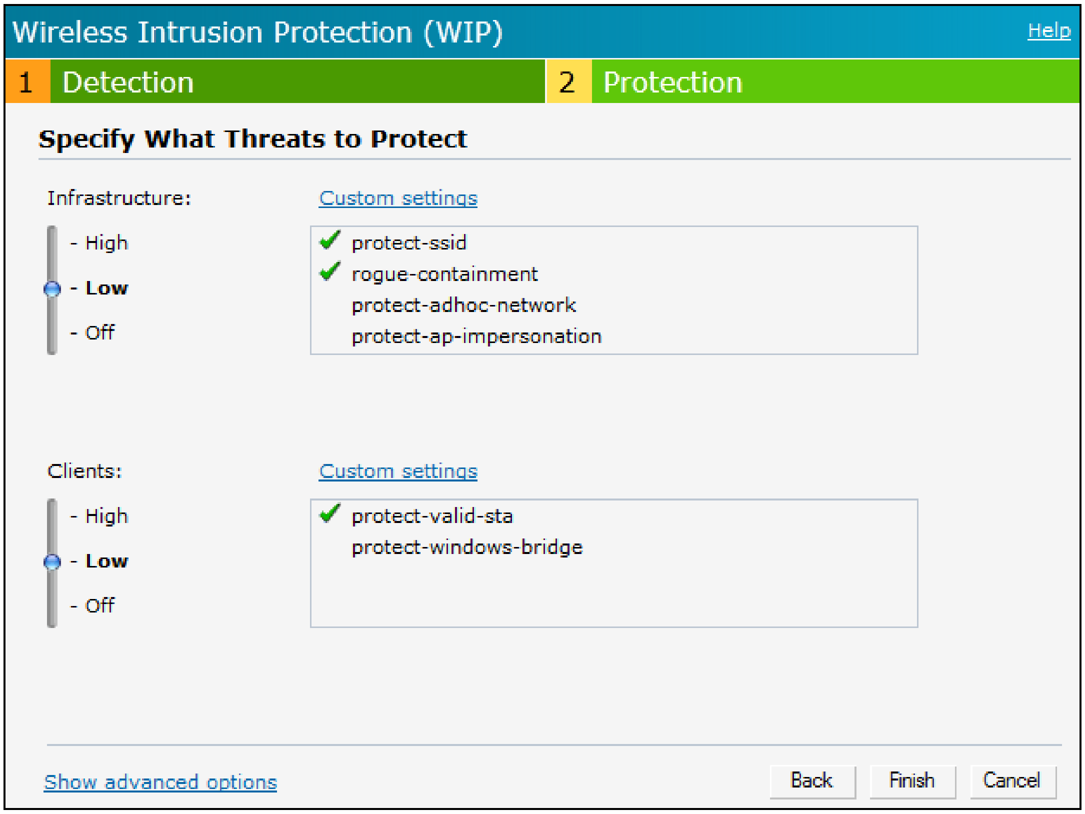
Table 68: *Client Detection Policies*

Detection Level	Detection Policy
Off	All detection policies are disabled.
Low	• Detect Valid Station Misassociation
Medium	• Detect Disconnect Station Attack • Detect Omerta Attack • Detect FATA-Jack Attack • Detect Block ACK DOS • Detect Hotspotter Attack • Detect unencrypted Valid Client • Detect Power Save DOS Attack
High	• Detect EAP Rate Anomaly • Detect Rate Anomaly • Detect Chop Chop Attack • Detect TKIP Replay Attack • IDS Signature—Air Jack • IDS Signature—ASLEAP

The following levels of detection can be configured in the WIP Protection page:

- Off
- Low
- High

Figure 97 *Wireless Intrusion Protection*



Wireless Intrusion Protection (WIP)

Specify What Threats to Protect

Infrastructure: - Low

- ✓ protect-ssid
- ✓ rogue-containment
- protect-adhoc-network
- protect-ap-impersonation

Clients: - Low

- ✓ protect-valid-sta
- protect-windows-bridge

The following table describes the protection policies that are enabled in the Infrastructure Protection **Custom settings** text box:

Table 69: *Infrastructure Protection Policies*

Protection Level	Protection Policy
Off	All protection policies are disabled
Low	• Protect SSID—Valid SSID list should be auto-derived from Instant configuration • Rogue Containment
High	• Protect from ad hoc Networks • Protect IAP Impersonation

The following table describes the detection policies that are enabled in the Client Protection **Custom settings** text box:

Table 70: *Client Protection Policies*

Protection Level	Protection Policy
Off	All protection policies are disabled
Low	Protect Valid Station
High	Protect Windows Bridge

Containment Methods

You can enable wired and wireless containments to prevent unauthorized stations from connecting to your Instant network.

Instant supports the following types of containment mechanisms:

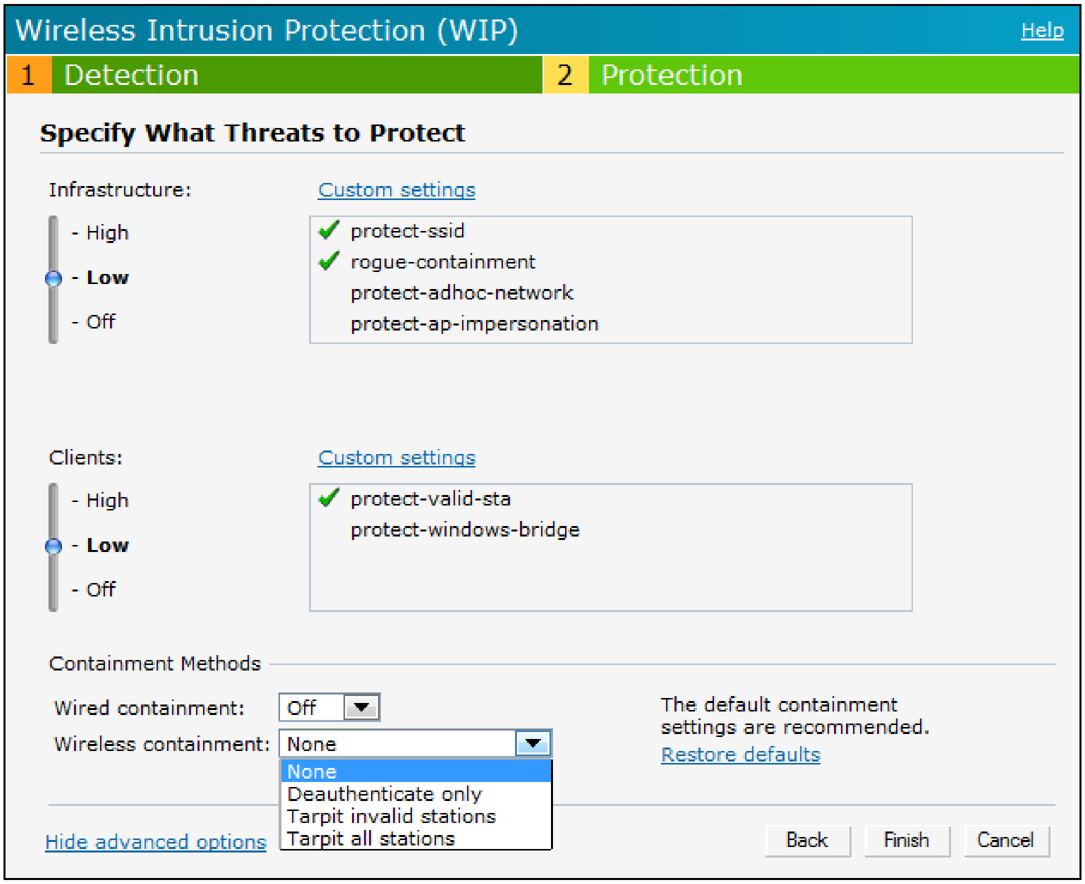
- Wired containment—When enabled, IAPs generate ARP packets on the wired network to contain wireless attacks.
  - wired-containment-ap-adj-mac—Enables a wired containment to Rogue IAPs whose wired interface MAC address is offset by one from its BSSID.
  - wired-containment-susp-l3-rogue—Enables the users to identify and contain an IAP with a preset MAC address that is different from the BSSID of the IAP, if the MAC address that the IAP provides is offset by one character from its wired MAC address.

NOTE

Enable the **wired-containment-susp-l3-rogue** parameter only when a specific containment is required, to avoid a false alarm.

- Wireless containment—When enabled, the system attempts to disconnect all clients that are connected or attempting to connect to the identified Access Point.
  - None—Disables all the containment mechanisms.
  - Deauthenticate only—With deauthentication containment, the Access Point or client is contained by disrupting the client association on the wireless interface.
  - Tarpit containment—With Tarpit containment, the Access Point is contained by luring clients that are attempting to associate with it to a tarpit. The tarpit can be on the same channel or a different channel as the Access Point being contained.

Figure 98 *Containment Methods*



Wireless Intrusion Protection (WIP)

Specify What Threats to Protect

Infrastructure: Low

- ✓ protect-ssid
- ✓ rogue-containment
- protect-adhoc-network
- protect-ap-impersonation

Clients: Low

- ✓ protect-valid-sta
- protect-windows-bridge

Containment Methods

Wired containment: Off

Wireless containment: None

The default containment settings are recommended.

Configuring IDS

The IDS policy for IAPs can be created using the CLI.

To configure IDS using CLI:

```
(Instant AP)(config)# ids
(Instant AP)(IDS)# infrastructure-detection-level <type>
(Instant AP)(IDS)# client-detection-level <type>
(Instant AP)(IDS)# infrastructure-protection-level <type>
(Instant AP)(IDS)# client-protection-level <type>
(Instant AP)(IDS)# wireless-containment <type>
(Instant AP)(IDS)# wired-containment
(Instant AP)(IDS)# wired-containment-ap-adj-mac
(Instant AP)(IDS)# wired-containment-susp-l3-rogue
(Instant AP)(IDS)# detect-ap-spoofing
(Instant AP)(IDS)# detect-windows-bridge
(Instant AP)(IDS)# signature-deauth-broadcast
(Instant AP)(IDS)# signature-deassociation-broadcast
(Instant AP)(IDS)# detect-adhoc-using-valid-ssid
(Instant AP)(IDS)# detect-malformed-large-duration
(Instant AP)(IDS)# detect-ap-impersonation
(Instant AP)(IDS)# detect-adhoc-network
(Instant AP)(IDS)# detect-valid-ssid-misuse
(Instant AP)(IDS)# detect-wireless-bridge
(Instant AP)(IDS)# detect-ht-40mhz-intolerance
(Instant AP)(IDS)# detect-ht-greenfield
(Instant AP)(IDS)# detect-ap-flood
(Instant AP)(IDS)# detect-client-flood
(Instant AP)(IDS)# detect-bad-wep
(Instant AP)(IDS)# detect-cts-rate-anomaly
(Instant AP)(IDS)# detect-rts-rate-anomaly
(Instant AP)(IDS)# detect-invalid-addresscombination
(Instant AP)(IDS)# detect-malformed-htie
(Instant AP)(IDS)# detect-malformed-assoc-req
(Instant AP)(IDS)# detect-malformed-frame-auth
(Instant AP)(IDS)# detect-overflow-ie
(Instant AP)(IDS)# detect-overflow-eapol-key
(Instant AP)(IDS)# detect-beacon-wrong-channel
(Instant AP)(IDS)# detect-invalid-mac-oui
(Instant AP)(IDS)# detect-valid-clientmisassociation
(Instant AP)(IDS)# detect-disconnect-sta
(Instant AP)(IDS)# detect-omerta-attack
(Instant AP)(IDS)# detect-fatajack
(Instant AP)(IDS)# detect-block-ack-attack
(Instant AP)(IDS)# detect-hotspotter-attack
(Instant AP)(IDS)# detect-unencrypted-valid
(Instant AP)(IDS)# detect-power-save-dos-attack
(Instant AP)(IDS)# detect-eap-rate-anomaly
(Instant AP)(IDS)# detect-rate-anomalies
(Instant AP)(IDS)# detect-chopchop-attack
(Instant AP)(IDS)# detect-tkip-replay-attack
(Instant AP)(IDS)# signature-airjack
(Instant AP)(IDS)# signature-asleap
(Instant AP)(IDS)# protect-ssid
(Instant AP)(IDS)# rogue-containment
(Instant AP)(IDS)# protect-adhoc-network
(Instant AP)(IDS)# protect-ap-impersonation
(Instant AP)(IDS)# protect-valid-sta
(Instant AP)(IDS)# protect-windows-bridge
(Instant AP)(IDS)# end
(Instant AP)# commit apply
```

This chapter provides the following information:

- Mesh Network Overview on page 340
- Setting up Instant Mesh Network on page 341
- Configuring Wired Bridging on Ethernet 0 for Mesh Point on page 341

Mesh Network Overview

The Instant secure enterprise mesh solution is an effective way to expand network coverage for outdoor and indoor enterprise environments without any wires. As traffic traverses across mesh IAPs, the mesh network automatically reconfigures around broken or blocked paths. This self-healing feature provides increased reliability and redundancy and allows the network to continue operation even when an IAP stops functioning or if a connection fails.

Mesh IAPs

Mesh network requires at least one valid uplink (wired or 3G) connection. Any provisioned IAP that has a valid uplink (wired or 3G) functions as a mesh portal, and the IAP without an Ethernet link functions as a mesh point. The mesh portal can also act as a VC. Mesh portals and mesh points are also known as mesh nodes, a generic term used to describe IAPs configured for mesh.

If two IAPs have valid uplink connections, there is redundancy in the mesh network, and most mesh points try to mesh directly with one of the two portals. However, depending on the actual deployment and RF environment, some mesh points may mesh through other intermediate mesh points.

In an Instant mesh network, the maximum hop count is two nodes (point > point > portal) and the maximum number of mesh points per mesh portal is eight.

Mesh IAPs detect the environment when they boot up, locate and associate with their nearest neighbor, to determine the best path to the mesh portal.

Instant mesh functionality is supported only on dual-radio IAPs. On dual-radio IAPs, the 2.4 GHz radio is always used for client traffic, while the 5 GHz radio is always used for both mesh-backhaul and client traffic.

NOTE

Mesh service is automatically enabled on 802.11a band for dual-radio IAP only, and this is not configurable.

For IAP-RW variants, the mesh network must be provisioned for the first time by plugging into the wired network. After that, mesh works on IAP-RWs like any other regulatory domain.

Mesh Portals

A mesh portal (MPP) is a gateway between the wireless mesh network and the enterprise wired LAN. The mesh roles are automatically assigned based on the IAP configuration. A mesh network could have multiple mesh portals to support redundant mesh paths (mesh links between neighboring mesh points that establish the best path to the mesh portal) from the wireless mesh network to the wired LAN.

The mesh portal broadcasts a mesh services set identifier (MSSID/ mesh cluster name) to advertise the mesh network service to other mesh points in that Instant network. This is not configurable and is transparent to the user. The mesh points authenticate to the mesh portal and establish a link that is secured using Advanced Encryption Standard (AES) encryption.

NOTE

The mesh portal reboots after 5 minutes when it loses its uplink connectivity to a wired network.

Mesh Points

The mesh point establishes an all-wireless path to the mesh portal. The mesh point provides traditional WLAN services such as client connectivity, intrusion detection system (IDS) capabilities, user role association, and Quality of Service (QoS) for LAN-to-mesh communication to clients and performs mesh backhaul/network connectivity.

NOTE

A mesh point also supports LAN bridging. You can connect any wired device to the downlink port of the mesh point. In the case of single Ethernet port platforms such as IAP-105, you can convert the Eth0 uplink port to a downlink port by enabling **Eth0 Bridging**. For additional information, see Configuring Wired Bridging on Ethernet 0 for Mesh Point on page 341.

Setting up Instant Mesh Network

Starting from Instant 6.4.0.2-4.1.0.0 release, mesh functionality is disabled by default, because of which over-the-air provisioning of mesh IAPs is not supported.

To provision IAPs as mesh IAPs:

1. Connect the IAPs to a wired switch.
2. Ensure that the VC key is synchronized and the country code is configured.
3. Ensure that a valid SSID is configured on the IAP.
4. If the IAP has a factory default SSID (Instant SSID), delete the SSID.
5. If an extended SSID (ESSID) is enabled on the VC, disable it and reboot the IAP cluster.
6. Disconnect the IAPs that you want to deploy as mesh points from the switch, and place the IAPs at a remote location. The IAPs come up without any wired uplink connection and function as mesh points. The IAPs with valid uplink connections function as mesh portals.

NOTE

Instant does not support the topology in which the IAPs are connected to the downlink Ethernet port of a mesh point.

Configuring Wired Bridging on Ethernet 0 for Mesh Point

Instant supports wired bridging on the Enet0 port of an IAP. If IAP is configured to function as a mesh point, you can configure wired bridging.

NOTE

Enabling wired bridging on this port of an IAP makes the port available as a downlink wired bridge and allows client access through the port.

NOTE

When using 3G uplink, the wired port will be used as downlink.

You can configure support for wired bridging on the Enet0 port of an IAP by using the Instant UI or the CLI.

In the Instant UI

To configure Ethernet bridging:

1. On the **Access Points** tab, click the IAP to modify.
2. Click the **edit** link.
3. Click the **Uplink** tab.
4. Select **Enable** from the **Eth0 Bridging** drop-down list.
5. Click **OK**.
6. Reboot the IAP.

In the CLI

To configure Ethernet bridging:

```
(Instant AP)# enet0-bridging
```

NOTE

Make the necessary changes to the wired-profile when eth0 is used as the downlink port. For more information, see Configuring a Wired Profile on page 107.

Chapter 29
Mobility and Client Management

This chapter provides the following information:

- Layer-3 Mobility Overview on page 343
- Configuring L3-Mobility on page 344

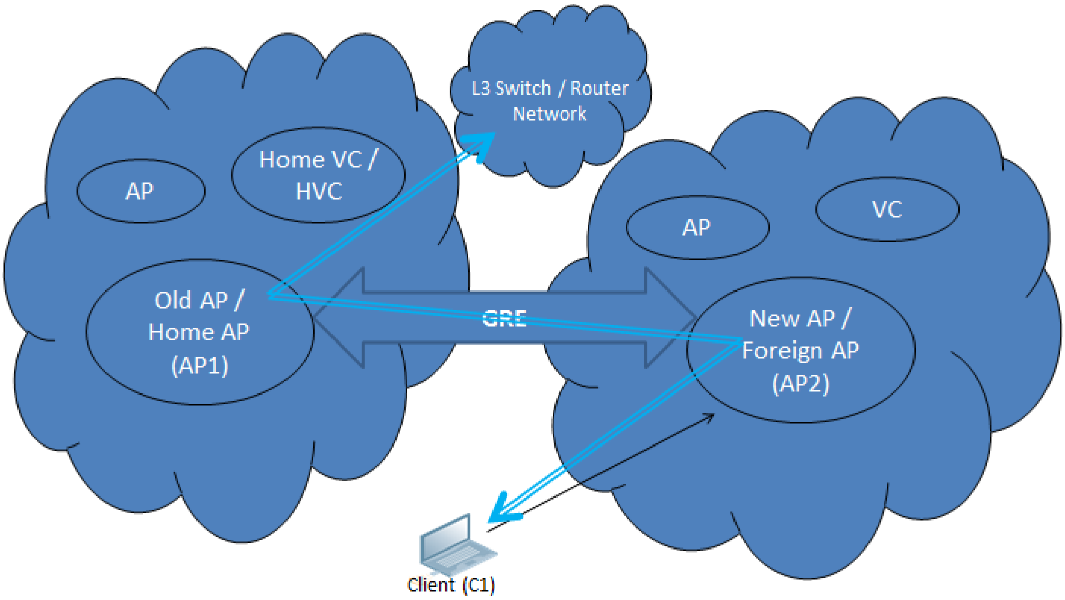
Layer-3 Mobility Overview

IAPs form a single Instant network when they are in the same Layer-2 (L2) domain. As the number of clients increase, multiple subnets are required to avoid broadcast overhead. In such a scenario, a client must be allowed to roam away from the Instant network to which it first connected (home network) to another network supporting the same WLAN access parameters (foreign network) and continue its existing sessions.

Layer-3 (L3) mobility allows a client to roam without losing its IP address and sessions. If WLAN access parameters are the same across these networks, clients connected to IAPs in a given Instant network can roam to IAPs in a foreign Instant network and continue their existing sessions. Clients roaming across these networks are able to continue using their IP addresses after roaming. You can configure a list of VC IP addresses across which L3 mobility is supported.

The Aruba Instant Layer-3 mobility solution defines a Mobility Domain as a set of Instant networks, with the same WLAN access parameters, across which client roaming is supported. The Instant network to which the client first connects is called its home network. When the client roams to a foreign network, an IAP in the home network (home IAP) anchors all traffic to or from this client. The IAP to which the client is connected in the foreign network (foreign IAP) tunnels all client traffic to or from the home IAP through a GRE tunnel.

Figure 99 *Routing of traffic when the client is away from its home network*



When a client first connects to an Instant network, a message is sent to all configured VC IP addresses to see if this is an L3 roamed client. On receiving an acknowledgement from any of the configured VC IP addresses, the client is identified as an L3 roamed client. If the IAP has no GRE tunnel to this home network, a new tunnel is formed to an IAP (home IAP) from the client's home network.

Each foreign IAP has only one home IAP per Instant network to avoid duplication of broadcast traffic. Separate GRE tunnels are created for each foreign IAP-home IAP pair. If a peer IAP is a foreign IAP for one client and a home IAP for another, two separate GRE tunnels are used to handle L3 roaming traffic between these IAPs.

If client subnet discovery fails on association due to some reason, the foreign IAP identifies its subnet when it sends out the first L3 packet. If the subnet is not a local subnet and belongs to another Instant network, the client is treated as an L3 roamed client and all its traffic is forwarded to the home network through a GRE tunnel.

Configuring L3-Mobility

To configure a mobility domain, you have to specify the list of all Instant networks that form the mobility domain. To allow clients to roam seamlessly among all the IAPs, specify the VC IP for each foreign subnet. You may include the local Instant or VC IP address, so that the same configuration can be used across all Instant networks in the mobility domain.

It is recommended that you configure all client subnets in the mobility domain.

When the client subnets are configured, note the following scenarios:

- If a client is from a local subnet, it is identified as a local client. When a local client starts using the IP address, L3 roaming is terminated.
- If the client is from a foreign subnet, it is identified as a foreign client. When a foreign client starts using the IP address, L3 roaming is set up.

Home Agent Load Balancing

Home Agent Load Balancing is required in large networks where multiple tunnels might terminate on a single border or lobby IAP and overload it. When load balancing is enabled, the VC assigns the home IAP for roamed clients by applying a *round robin* policy. With this policy, the load for the IAPs acting as Home Agents for roamed clients is uniformly distributed across the IAP cluster.

Configuring a Mobility Domain for Instant

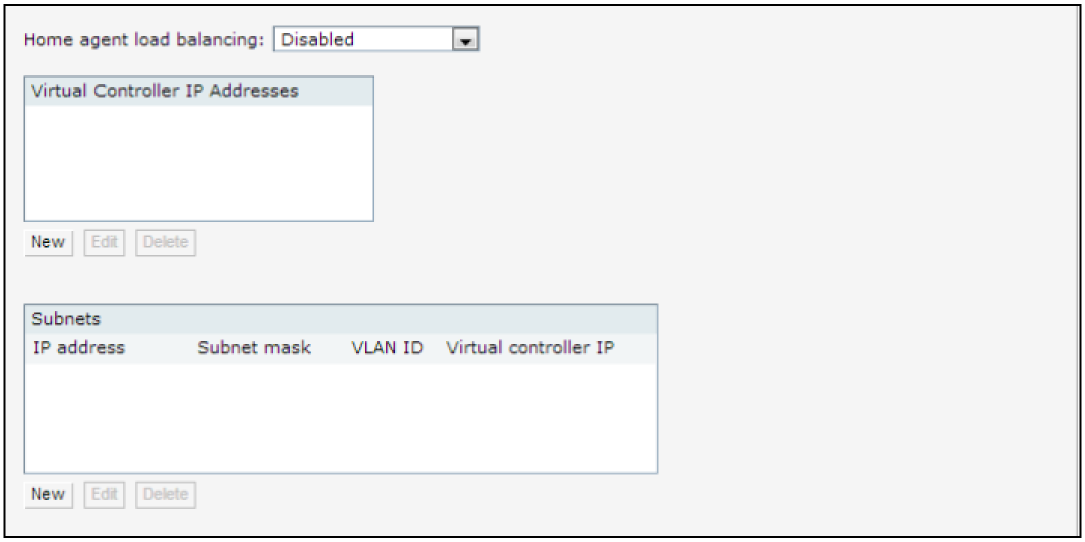
You can configure L3 mobility domain by using the Instant UI or the CLI.

In the Instant UI

To configure a mobility domain:

1. Click the **System** link on the Instant main window.
2. In the **Services** section, click the **Show advanced options** link. The advanced options are displayed.
3. Click **L3 Mobility**. The L3 Mobility window is displayed.

Figure 100 *L3 Mobility Window*



Home agent load balancing: Disabled

IP address	Subnet mask	VLAN ID	Virtual controller IP

4. Select **Enabled** from the **Home agent load balancing** drop-down list. By default, home agent load balancing is disabled.
5. Click **New** in the **Virtual Controller IP Addresses** section, add the IP address of a VC that is part of the mobility domain, and click **OK**.
6. Repeat Steps 2 to 5, to add the IP addresses of all VC that form the L3 mobility domain.
7. Click **New** in the **Subnets** section and specify the following:
   a. Enter the client subnet in the **IP address** text box.
   b. Enter the mask in the **Subnet mask** text box.
   c. Enter the VLAN ID of the home network in the **VLAN ID** text box.
   d. Enter the home VC IP address for this subnet in the **Virtual controller IP** text box.
8. Click **OK**.

In the CLI

To configure a mobility domain:

```
(Instant AP)(config)# l3-mobility
(Instant AP)(L3-mobility)# home-agent-load-balancing
(Instant AP)(L3-mobility)# virtual-controller <IP-address>
(Instant AP)(L3-mobility)# subnet <IP-address> <subnet-mask> <VLAN-ID> <virtual-controller-IP-
address>
(Instant AP)(L3-mobility)# end
(Instant AP)# commit apply
```

Chapter 30
Spectrum Monitor

This chapter provides the following information:

- Understanding Spectrum Data on page 346
- Configuring Spectrum Monitors and Hybrid IAPs on page 352

Understanding Spectrum Data

Wireless networks operate in environments with electrical and radio frequency devices that can interfere with network communications. Microwave ovens, cordless phones, and even adjacent Wi-Fi networks are all potential sources of continuous or intermittent interference. The spectrum monitor software modules on IAPs can examine the radio frequency (RF) environment in which the Wi-Fi network is operating, identify interference, and classify its sources. An analysis of the results can then be used to quickly isolate issues associated with packet transmission, channel quality, and traffic congestion caused by contention with other devices operating in the same band or channel.

Spectrum monitors (SMs) are IAP radios that gather spectrum data but do not service clients. Each SM scans and analyzes the spectrum band used by the SM's radio (2.4 GHz or 5 GHz). An IAP radio in hybrid IAP mode continues to serve clients as an access point while it analyzes spectrum analysis data for the channel the radio uses to serve clients. You can record data for both types of spectrum monitor devices. However, the recorded spectrum is not reported to the VC. A spectrum alert is sent to the VC when a non-Wi-Fi interference device is detected.

The spectrum monitor is fully supported on all IAPs/RAPs with a few exceptions:

- RAP-155 does not support Spectrum from Instant 6.3.1.1-4.0.0.0 release.
- IAP-105 supports the dedicated Spectrum mode, but not the Hybrid Spectrum mode.
- RAP3 do not support Spectrum display in the Instant UI.

The spectrum data is collected by each IAP spectrum monitor and hybrid IAP. The spectrum data is not reported to the VC. The **Spectrum** link is visible in the UI (Access Point view) only if you have enabled the Spectrum Monitoring feature.

You can view the following spectrum data in the UI:

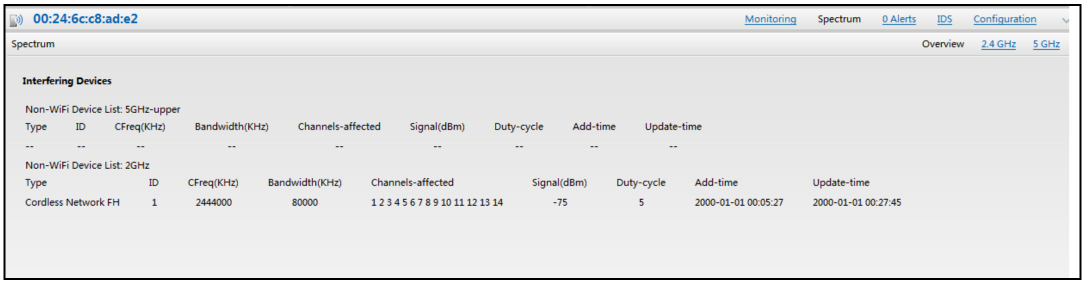
- Device List
- Non-Wi-Fi Interferers
- Channel Metrics
- Channel Details
- Spectrum Alerts

Device List

The device list consists of a device summary table and channel information for active non-Wi-Fi devices currently seen by a spectrum monitor or hybrid IAP radio.

To view the device list, click **Spectrum** in the dashboard. The following figure shows an example of the device list details.

Figure 101 *Device List*



Interfering Devices

Non-WiFi Device List: 5GHz-upper

Type	ID	CFreq(KHz)	Bandwidth(KHz)	Channels-affected	Signal(dBm)	Duty-cycle	Add-time	Update-time
--	--	--	--	--	--	--	--	--

Non-WiFi Device List: 2GHz

Type	ID	CFreq(KHz)	Bandwidth(KHz)	Channels-affected	Signal(dBm)	Duty-cycle	Add-time	Update-time
Cordless Network FH	1	2444000	80000	1 2 3 4 5 6 7 8 9 10 11 12 13 14	-75	5	2000-01-01 00:05:27	2000-01-01 00:27:45

Table 71 shows the device details that are displayed:

Table 71: *Device Summary and Channel Information*

Column	Description
Type	Device type. This parameter can be any of the following: ● Audio FF (fixed frequency) ● Bluetooth ● Cordless base FH (frequency hopper) ● Cordless phone FF (fixed frequency) ● Cordless network FH (frequency hopper) ● Generic FF (fixed frequency) ● Generic FH (frequency hopper) ● Generic interferer ● Microwave ● Microwave inverter ● Video ● Xbox **NOTE:** For additional details about non-Wi-Fi device types shown in this table, see Non-Wi-Fi Interferer Types.
ID	ID number assigned to the device by the spectrum monitor or hybrid IAP radio. Spectrum monitors and hybrid IAPs assign a unique spectrum ID per device type.
Cfreq	Center frequency of the signal sent from the device.
Bandwidth	Channel bandwidth used by the device.
Channels-affected	Radio channels affected by the wireless device.
Signal-strength	Strength of the signal sent from the device, represented in dBm.

Table 71: *Device Summary and Channel Information*

Column	Description
Duty-cycle	Device duty cycle. This value represents the percent of time the device broadcasts a signal.
Add-time	Time at which the device was first detected.
Update-time	Time at which the device's status was updated.

Non-Wi-Fi Interferers

The following table describes each type of non-Wi-Fi interferer detected by the Spectrum Monitor feature:

Table 72: *Non-Wi-Fi Interferer Types*

Non Wi-Fi Interferer	Description
Bluetooth	Any device that uses the Bluetooth protocol to communicate in the 2.4 GHz band is classified as a *Bluetooth* device. Bluetooth uses a frequency hopping protocol.
Fixed Frequency (Audio)	Some audio devices such as wireless speakers and microphones also use fixed frequency to continuously transmit audio. These devices are classified as *Fixed Frequency (Audio)*.
Fixed Frequency (Cordless Phones)	Some cordless phones use a fixed frequency to transmit data (much like the fixed frequency video devices). These devices are classified as *Fixed Frequency (Cordless Phones)*.
Fixed Frequency (Video)	Video transmitters that continuously transmit video on a single frequency are classified as *Fixed Frequency (Video)*. These devices typically have close to a 100% duty cycle. These types of devices may be used for video surveillance, TV or other video distribution, and similar applications.
Fixed Frequency (Other)	All other fixed frequency devices that do not fall into any of the above categories are classified as *Fixed Frequency (Other)*. Note that the RF signatures of the fixed frequency audio, video, and cordless phone devices are very similar and that some of these devices may be occasionally classified as *Fixed Frequency (Other)*.
Frequency Hopper (Cordless Base)	Frequency hopping cordless phone base units transmit periodic beacon-like frames at all times. When the handsets are not transmitting (that is, when there are no active phone calls), the cordless base is classified as *Frequency Hopper (Cordless Base)*.
Frequency Hopper (Cordless Network)	When there is an active phone call and one or more handsets are part of the phone conversation, the device is classified as *Frequency Hopper (Cordless Network)*. Cordless phones may operate in 2.4 GHz or 5 GHz bands. Some phones use both 2.4 GHz and 5 GHz bands (for example, 5 GHz for Base-to-handset and 2.4 GHz for Handset-to-base). These phones may be classified as unique Frequency Hopper devices on both bands.

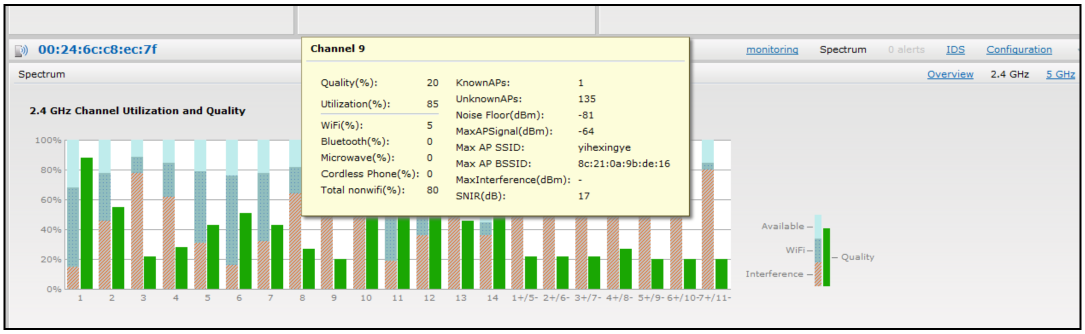
Table 72: *Non-Wi-Fi Interferer Types*

Non Wi-Fi Interferer	Description
Frequency Hopper (Xbox)	The Microsoft Xbox device uses a frequency hopping protocol in the 2.4 GHz band. These devices are classified as *Frequency Hopper (Xbox)*.
Frequency Hopper (Other)	When the classifier detects a frequency hopper that does not fall into any of the prior categories, it is classified as *Frequency Hopper (Other)*. Some examples include IEEE 802.11 FHSS devices, game consoles, and cordless/hands-free devices that do not use one of the known cordless phone protocols.
Microwave	Common residential microwave ovens with a single magnetron are classified as a *Microwave*. These types of microwave ovens may be used in cafeterias, break rooms, dormitories, and similar environments. Some industrial, healthcare, or manufacturing environments may also have other equipment that functions like a microwave and may also be classified as a Microwave device.
Microwave (Inverter)	Some newer-model microwave ovens have the inverter technology to control the power output and these microwave ovens may have a duty cycle close to 100%. These microwave ovens are classified as *Microwave (Inverter)*. Dual-magnetron industrial microwave ovens with higher duty cycle may also be classified as *Microwave (Inverter)*. There may be other equipment that functions like inverter microwaves in some industrial, healthcare, or manufacturing environments. Those devices may also be classified as *Microwave (Inverter)*.
Generic Interferer	Any non-frequency hopping device that does not fall into any of the prior categories described in this table is classified as a *Generic Interferer*. For example, a Microwave-like device that does not operate in the known operating frequencies used by the Microwave ovens may be classified as a *Generic Interferer*. Similarly wide-band interfering devices may be classified as *Generic Interferers*.

Channel Details

When you move the mouse over a channel, the channel details or the summary of the 2.4 GHz and 5 GHz channels as detected by a spectrum monitor are displayed. You can view the aggregate data for each channel seen by the spectrum monitor radio, including the maximum IAP power, interference, and the signal-to-noise-and-interference Ratio (SNIR). SNIR is the ratio of signal strength to the combined levels of interference and noise on that channel. Spectrum monitors display spectrum data of all channels in the selected band, and hybrid IAPs display data for the channel they are monitoring.

Figure 102 *Channel Details*



Channel 9

Quality(%):	20	KnownAPs:	1
Utilization(%):	85	UnknownAPs:	135
WiFi(%):	5	Noise Floor(dBm):	-81
Bluetooth(%):	0	MaxAPSignal(dBm):	-64
Microwave(%):	0	Max AP SSID:	yihexingye
Cordless Phone(%):	0	Max AP BSSID:	8c:21:0a:9b:de:16
Total nonwifi(%):	80	MaxInterference(dBm):	-
		SNIR(dB):	17

Channel Details Information shows the information that you can view in the Channel Details graph.

Table 73: *Channel Details Information*

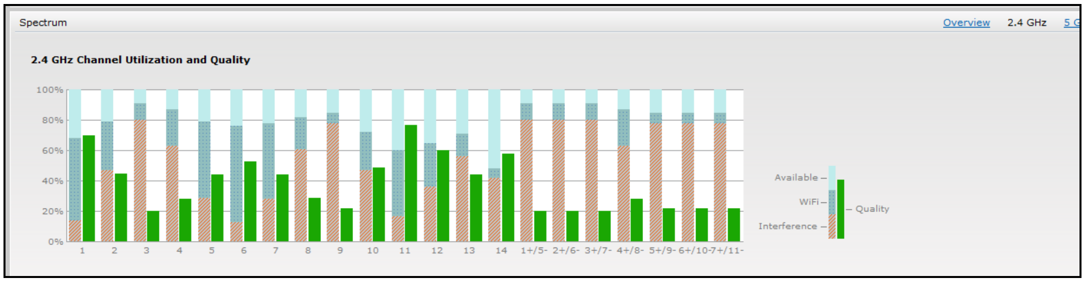
Column	Description
Channel	An 802.11a or 802.11g radio channel.
Quality(%)	Current relative quality of the channel.
Utilization(%)	The percentage of the channel being used.
Wi-Fi (%)	The percentage of the channel currently being used by Wi-Fi devices.
Type	Device type.
Total nonwifi (%)	The percentage of the channel currently being used by non-Wi-Fi devices.
Known IAPs	Number of valid IAPs identified on the radio channel.
UnKnown IAPs	Number of invalid or rogue IAPs identified on the radio channel.
Channel Util (%)	Percentage of the channel currently in use.
Max IAP Signal (dBm)	Signal strength of the IAP that has the maximum signal strength on a channel.
Max Interference (dBm)	Signal strength of the non-Wi-Fi device that has the highest signal strength.
SNIR (dB)	The ratio of signal strength to the combined levels of interference and noise on that channel. This value is calculated by determining the maximum noise-floor and interference-signal levels, and then calculating how strong the desired signal is above this maximum.

Channel Metrics

The channel metrics graph displays channel quality, availability, and utilization metrics as seen by a spectrum monitor or hybrid IAP. You can view the channel utilization data based on 2 GHz and 5 GHz radio channels. The percentage of each channel that is currently being used by Wi-Fi devices, and the percentage of each channel being used by non-Wi-Fi devices and 802.11 adjacent channel interference (ACI). This chart shows the channel availability, the percentage of each channel that is available for use, and the current relative quality of selected channels in the 2.4 GHz or 5 GHz radio bands. While spectrum monitors can display data for all channels in their selected band, hybrid IAPs display data for a single monitored channel.

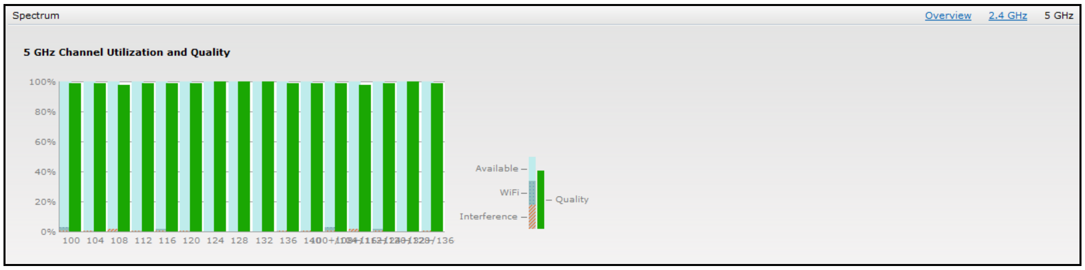
To view this graph, click **2.4 GHz** in the **Spectrum** section of the dashboard.

Figure 103 *Channel Metrics for the 2.4 GHz Radio Channel*



To view this graph, click **5 GHz** in the **Spectrum** section of the dashboard.

Figure 104 *Channel Metrics for the 5 GHz Radio Channel*



Channel Metrics shows the information displayed in the Channel Metrics graph.

Table 74: *Channel Metrics*

Column	Description
Channel	A 2.4 GHz or 5 GHz radio channel.
Quality(%)	Current relative quality of selected channels in the 2.4 GHz or 5 GHz radio bands, as determined by the percentage of packet retries, the current noise floor, and the duty cycle for non-Wi-Fi devices on that channel.
Availability(%)	The percentage of the channel currently available for use.
Utilization(%)	The percentage of the channel being used.
WiFi Util(%)	The percentage of the channel currently being used by Wi-Fi devices.
Interference Util(%)	The percentage of the channel currently being used by non-Wi-Fi interference plus Wi-Fi adjacent channel interference (ACI)

Spectrum Alerts

When a new non-Wi-Fi device is found, an alert is reported to the VC. The spectrum alert messages include the device ID, device type, IP address of the spectrum monitor or hybrid IAP, and the timestamp. VC reports the detailed device information to AMP.

Configuring Spectrum Monitors and Hybrid IAPs

An IAP can be provisioned to function as a spectrum monitor or as a hybrid IAP. The radios on groups of IAPs can be converted to dedicated spectrum monitors or hybrid IAPs through the IAP group's 802.11a and 802.11g radio profiles.

Converting an IAP to a Hybrid IAP

You can convert all IAPs in an Instant network into hybrid IAPs by selecting the **Background Spectrum Monitoring** option in the 802.11a and 802.11g radio profiles of an IAP. IAPs in **Access** mode continue to provide normal access service to clients, while providing the additional function of monitoring RF interference. If any IAP in the Instant network does not support the Spectrum Monitoring feature, that IAP continues to function as a standard IAP, rather than a hybrid IAP. By default, the background spectrum monitoring option is disabled.

In the hybrid mode, spectrum monitoring is performed only on the home channel. In other words, if the IAP-channel width is 80 Mhz, spectrum monitoring is performed for 80 Mhz. If the channel width is 40, spectrum monitoring is performed for 40 MHz channel. In a dedicated air monitor mode, IAPs perform spectrum monitoring on all channels.

You can convert IAPs in an Instant network to hybrid mode by using the Instant UI or the CLI.

In the Instant UI

To convert an IAP to a hybrid IAP:

1. Click the **RF** link on the Instant main window.
2. In the **RF** section, click **Show advanced options** to view the **Radio** tab.
3. To enable a spectrum monitor on the 802.11g radio band, in the 2.4 GHz radio profile, select **Enabled** from the **Background Spectrum Monitoring** drop-down list.
4. To enable a spectrum monitor on the 802.11a radio band, in the 5 GHz radio profile, select **Enabled** from the **Background Spectrum Monitoring** drop-down list.
5. Click **OK**.

In the CLI

To configure 2.4 GHz radio settings:

```
(Instant AP)(config)# rf dot11g-radio-profile
(Instant AP)(RF dot11g Radio Profile)# spectrum-monitor
```

To configure 5 GHz radio settings:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# spectrum-monitor
```

Converting an IAP to a Spectrum Monitor

In spectrum mode, spectrum monitoring is performed on entire bands and the IAP functions as a dedicated full-spectrum RF monitor, scanning all channels to detect interference, whether from the neighboring IAPs or from non-Wi-Fi devices such as microwaves and cordless phones.

By default, spectrum monitoring is performed on a higher band of the 5 GHz radio.

You can configure an IAP to function as a stand-alone spectrum monitor by using the Instant UI or the CLI.

In the Instant UI

To convert an IAP to a spectrum monitor:

1. In the **Access Points** tab, click the IAP that you want to convert to a spectrum monitor.
2. Click the **edit** link.

3. Click the **Radio** tab.
4. From the **Access Mode** drop-down list, select **Spectrum Monitor**.
5. Click **OK**.
6. Reboot the IAP for the changes to take effect.
7. To enable spectrum monitoring for any other band for the 5 GHz radio:
   a. Click the **RF** link on the Instantmain window.
   b. In the **RF** section, click **Show advanced options** to view the **Radio** tab.
   c. For the 5 GHz radio, specify the spectrum band you want that radio to monitor by selecting **Lower**, **Middle**, or **Higher** from the **Standalone spectrum band** drop-down list.
   d. Click **OK**.

In the CLI

To convert an IAP to a spectrum monitor:

```
(Instant AP)# wifi0-mode {<access> | <monitor> | <spectrum-monitor>}
(Instant AP)# wifi1-mode {<access> | <monitor> | <spectrum-monitor>}
```

To enable spectrum monitoring for any other band for the 5 GHz radio:

```
(Instant AP)(config)# rf dot11a-radio-profile
(Instant AP)(RF dot11a Radio Profile)# spectrum-band <type>
```

To view the radio configuration:

```
(Instant AP)# show radio config
2.4 GHz:
Legacy Mode:disable
Beacon Interval:100
802.11d/802.11h:disable
Interference Immunity Level:2
Channel Switch Announcement Count:0
Channel Reuse Type:disable
Channel Reuse Threshold:0
Background Spectrum Monitor:disable

5.0 GHz:
Legacy Mode:disable
Beacon Interval:100
802.11d/802.11h:disable
Interference Immunity Level:2
Channel Switch Announcement Count:0
Channel Reuse Type:disable
Channel Reuse Threshold:0
Background Spectrum Monitor:disable
Standalone Spectrum Band:5ghz-upper
```

Chapter 31
IAP Maintenance

This section provides information on the following procedures:

- Upgrading an IAP on page 354
- Backing up and Restoring IAP Configuration Data on page 357
- Converting an IAP to a Remote AP and Campus AP on page 358
- Resetting a Remote AP or Campus AP to an IAP on page 364
- Rebooting the IAP on page 364

Upgrading an IAP

While upgrading an IAP, you can use the image check feature to allow the IAP to find new software image versions available on a cloud-based image server hosted and maintained by Aruba Networks. The location of the image server is fixed and cannot be changed by the user. The image server is loaded with the latest versions of the Instant software.

Upgrading an IAP and Image Server

Instant supports mixed IAP-class Instant deployment with all IAPs as part of the same VC cluster.

Image Management Using AirWave

If the multiclass IAP network is managed by AirWave, image upgrades can only be done through the AirWave UI. The IAP images for different classes must be uploaded on the AMP server. When new IAPs joining the network need to synchronize their software with the version running on the VC, and if the new IAP belongs to a different class, the image file for the new IAP is provided by AirWave. If AirWave does not have the appropriate image file, the new IAP will not be able to join the network.

NOTE

The VC communicates with the AirWave server if AirWave is configured. If AirWave is not configured on the IAP, the image is requested from the Image server.

Image Management Using Cloud Server

If the multiclass IAP network is not managed by AirWave, image upgrades can be done through the Cloud-Based Image Check feature. When a new IAP joining the network needs to synchronize its software version with the version on the VC and if the new IAP belongs to a different class, the image file for the new IAP is provided by the cloud server.

Configuring HTTP Proxy on an IAP

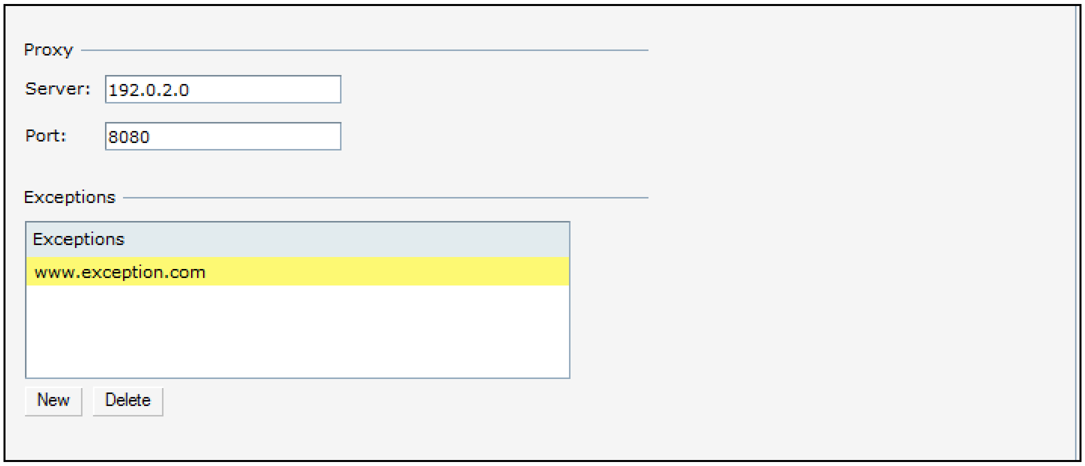
If your network requires a proxy server for Internet access, ensure that you configure the HTTP proxy on the IAP to download the image from the cloud server. After setting up the HTTP proxy settings, the IAP connects to the Activate server, AMP, Central, or OpenDNS server through a secure HTTP connection. You can also exempt certain applications from using the HTTP proxy (configured on an IAP) by providing their host name or IP address under exceptions.

In the Instant UI

To configure the HTTP proxy settings:

1. Navigate to **System > Proxy**. The **Proxy** configuration window is displayed.

Figure 105 *Proxy Configuration Window*



Proxy

Server: 192.0.2.0

Port: 8080

Exceptions

Exceptions
www.exception.com

2. Enter the HTTP proxy server IP address in the **Server** text box.
3. Enter the port number in the **Port** text box.
4. If you do not want the HTTP proxy to be applied for a particular host, click **New** to enter that IP address or domain name of that host in the **Exceptions** section.

In the CLI

To configure the HTTP proxy settings:

```
(Instant AP)(config)# proxy server 192.0.2.1 8080
(Instant AP)(config)# proxy exception 192.0.2.2
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Upgrading an IAP Using Automatic Image Check

You can upgrade an IAP by using the Automatic Image Check feature. The automatic image checks are performed once, as soon as the IAP boots up and every week thereafter.

If the image check locates a new version of the Instant software on the image server, the **New version available** link is displayed on the Instant main window.

NOTE

If AirWave is configured, the automatic image check is disabled.

To check for a new version on the image server in the cloud:

1. Go to **Maintenance > Automatic > Check for New Version**. After the image check is completed, one of the following messages is displayed:
   - No new version available—If there is no new version available.
   - Image server timed out—Connection or session between the image server and the IAP is timed out.
   - Image server failure—If the image server does not respond.
   - A new image version found—If a new image version is found.
2. If a new version is found, the **Upgrade Now** button becomes available and the version number is displayed.
3. Click **Upgrade Now**.

   The IAP downloads the image from the server, saves it to flash, and reboots. Depending on the progress and success of the upgrade, one of the following messages is displayed:
   - Upgrading—While image upgrading is in progress.

- Upgrade successful—When the upgrading is successful.
- Upgrade failed—When the upgrading fails.

If the upgrade fails and an error message is displayed, retry upgrading the IAP.

Upgrading to a New Version Manually

If the Automatic Image Check feature is disabled, you can obtain an image file from a local file system or from a TFTP or HTTP URL.

To manually check for a new firmware image version and obtain an image file:

1. Navigate to **Maintenance > Firmware**.
2. Under **Manual** section, perform the following steps:

- Select the **Image file** option. This method is only available for single-class IAPs.

  The following examples describe the image file format for different IAP models:
  - For IAP-334/335—ArubaInstant_Lupus_6.5.1.0-4.3.1.0.0_xxxx
  - For IAP-314/315 and IAP-324/325—ArubaInstant_Hercules_6.5.1.0-4.3.1.0.0_xxxx
  - For IAP-224/225, IAP-228, IAP-214/215, IAP-274/275, IAP-277—ArubaInstant_Centaurus_6.5.1.0-4.3.1.0.0_xxxx
  - For IAP-204/205 and IAP-205H—ArubaInstant_Taurus_6.5.1.0-4.3.1.0.0_xxxx
  - For RAP-155/155P—ArubaInstant_Aries_6.5.1.0-4.3.1.0.0_xxxx
  - For RAP-108/109, IAP-103, and IAP-114/115—ArubaInstant_Pegasus_6.5.1.0-4.3.1.0.0_xxxx
- Select the **Image URL** option. Select this option to obtain an image file from a TFTP, FTP, or HTTP URL.
  - HTTP - http://<IP-address>/<image-file>. For example, http://<IP-address>/ArubaInstant_Hercules_6.5.1.0-4.3.1.0.0_xxxx
  - TFTP - tftp://<IP-address>/<image-file>. For example, tftp://<IP-address>/ArubaInstant_Hercules_6.5.1.0-4.3.1.0.0_xxxx
  - FTP - ftp://<IP-address>/<image-file>. For example, ftp://<IP-address>/ArubaInstant_Hercules_6.5.1.0-4.3.1.0.0_xxxx

3. Clear the **Reboot all APs after upgrade** check box if required. The **Reboot all APs after upgrade** check box is selected by default to allow the IAPs to reboot automatically after a successful upgrade. To reboot the IAP at a later time, clear the **Reboot all APs after upgrade** check box.
4. Click **Upgrade Now** to upgrade the IAP to the newer version.

Upgrading an Image Using CLI

To upgrade an image using a HTTP, TFTP, or FTP URL:

```
(Instant AP)# upgrade-image <ftp/tftp/http-URL>
```

To upgrade an image without rebooting the IAP:

```
(Instant AP)# upgrade-image2-no-reboot <ftp/tftp/http-URL>
```

To view the upgrade information:

```
(Instant AP)# show upgrade info

Image Upgrade Progress
----------------------
Mac                IP Address   AP Class  Status    Image Info  Error Detail
---                ---------    --------  ------    ----------  ------------
d8:c7:c8:c4:42:98  10.17.101.1  Hercules  image-ok  image file  none
Auto reboot        :enable
Use external URL   :disable
```

Backing up and Restoring IAP Configuration Data

You can back up the IAP configuration data and restore the configuration when required.

Viewing Current Configuration

To view the current configuration on the IAP:

- In the UI, navigate to **Maintenance > Configuration > Current Configuration**.
- In the CLI, enter the following command at the command prompt:

  ```
  (Instant AP)# show running-config
  ```

Backing up Configuration Data

To back up the IAP configuration data:

1. Navigate to the **Maintenance > Configuration** page.
2. Click **Backup Configuration**.
3. Click **Continue** to confirm the backup. The *instant.cfg* containing the IAP configuration data is saved in your local file system.
4. To view the configuration that is backed up by the IAP, enter the following command at the command prompt:

```
(Instant AP)# show backup-config
```

Restoring Configuration

To restore configuration:

1. Navigate to the **Maintenance > Configuration** page.
2. Click **Restore Configuration**.
3. Click **Browse** to browse your local system and select the configuration file.
4. Click **Restore Now**.
5. Click **Restore Configuration** to confirm restoration. The configuration is restored and the IAP reboots to load the new configuration.

```
(Instant AP)(config)# copy config tftp://x.x.x.x/confgi.cfg
```

Converting an IAP to a Remote AP and Campus AP

This section provides the following information:

- Regulatory Domain Restrictions for IAP to RAP or CAP Conversion on page 358
- Converting an IAP to a Remote AP on page 360
- Converting an IAP to a Campus AP on page 363
- Converting an IAP to Stand-Alone Mode on page 363
- Converting an IAP using CLI on page 364

Regulatory Domain Restrictions for IAP to RAP or CAP Conversion

You can provision an IAP as a Campus AP or a Remote AP in a controller-based network. Before converting an IAP, ensure that there is a regulatory domain match between the IAP and the controller.

The following table describes the regulatory domain restrictions that apply for the IAP-to-ArubaOS AP conversion:

Table 75: *IAP-to-ArubaOS Conversion*

IAP Variant	IAP Regulatory Domain	Controller Regulatory Domain			ArubaOS release
		US	Unrestricted	IL	
IAP-314/315 IAP-334/335	US	Y	X	X	ArubaOS 6.5.0.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
IAP-324/325	US	Y	X	X	ArubaOS 6.4.4.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
IAP-277	US	Y	X	X	ArubaOS 6.4.3.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
IAP-228	US	Y	X	X	ArubaOS 6.4.3.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	

Table 75: *IAP-to-ArubaOS Conversion*

IAP Variant	IAP Regulatory Domain	Controller Regulatory Domain			ArubaOS release
		US	Unrestricted	IL	
IAP-205H	US	Y	X	X	ArubaOS 6.4.3.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-21x	US	Y	X	X	ArubaOS 6.4.2.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-205	US	Y	X	X	ArubaOS 6.4.1.0 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-274/275	US	Y	X	X	ArubaOS 6.4 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-103H	US	Y	X	X	ArubaOS 6.4 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	

Table 75: *IAP-to-ArubaOS Conversion*

IAP Variant	IAP Regulatory Domain	Controller Regulatory Domain			ArubaOS release
		US	Unrestricted	IL	
IAP-114/115	US	Y	X	X	ArubaOS 6.3.1.3 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-22x	US	Y	X	X	ArubaOS 6.3.1.3 or later
	RW	X	Y	Y	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-11x and IAP-22x	US	Y	X	X	ArubaOS 6.3.1.0, ArubaOS 6.3.1.1, and ArubaOS 6.3.1.2
	RW	X	X	X	
	JP	X	Y	X	
	IL	X	X	Y	
IAP-22x	US	Y	X	X	ArubaOS 6.3.0
	RW/JP/IL	X	X	X	
All other IAPs	US	Y	X	X	Versions prior to ArubaOS 6.3.0, ArubaOS 6.3.x.x, ArubaOS 6.4, and ArubaOS 6.4.x.x
	Unrestricted	X	Y	X	
	IL	X	X	Y	
	JP	X	Y	X	

Converting an IAP to a Remote AP

For converting an IAP to a Remote AP, the VC sends the Remote AP convert command to all the other IAPs. The VC, along with the slave IAPs, sets a VPN tunnel to the remote controller, and downloads the firmware through FTP. The VC uses IPsec to communicate to the Mobility Controller over the Internet.

- If the IAP obtains AirWave information through DHCP (Option 43 and Option 60), it establishes an HTTPS connection to the AirWave server, downloads the configuration, and operates in the IAP mode.
- If the IAP does not get AirWave information through DHCP provisioning, it tries provisioning through the Activate server in the cloud by sending a serial number MAC address. If an entry for the IAP is present in

Activate and is provisioned as an IAP > Remote AP, Activate responds with mobility controller IP address, IAP group, and IAP type. The IAP then contacts the controller, establishes certificate-based secure communication, and obtains configuration and image from the controller. The IAP reboots and comes up as a Remote AP. The IAP then establishes an IPsec connection with the controller and begins operating in the Remote AP mode.

- If an IAP entry is present in Activate and a provisioning rule is configured to return the IP address or host name of the AirWave server, the IAP downloads configuration from AirWave and operates in the IAP mode.
- If there is no response from Activate, the access point comes up with default configuration and operates in the IAP mode.

NOTE

A mesh point cannot be converted to Remote AP, because mesh access points do not support VPN connection.

An IAP can be converted to a Campus AP and Remote AP only if the controller is running ArubaOS 6.1.4 or later versions:

The following table describes the supported IAP platforms and minimal ArubaOS version required for the Campus AP or Remote AP conversion.

Table 76: *IAP Platforms and Minimum ArubaOS Versions for IAP-to-Remote AP Conversion*

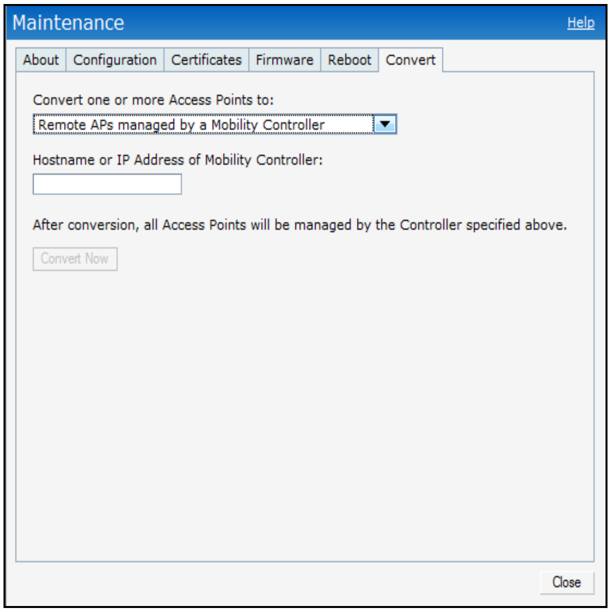
IAP Platform	ArubaOS Release	Instant Release
IAP-314/315 IAP-334/335	ArubaOS 6.5.0.0 or later versions	Instant 4.3.0 or later versions
IAP-324/325	ArubaOS 6.4.4.0 or later versions	Instant 4.2.2 or later versions
IAP-205H IAP-228 IAP-277	ArubaOS 6.4.3.1 or later versions	Instant 4.2 or later versions
IAP-214/215	ArubaOS 6.4.2.0 or later versions	Instant 4.1.1 or later versions
IAP-204/205	ArubaOS 6.4.1.0 or later versions	Instant 4.1.1 or later versions
IAP-274/275	ArubaOS 6.4 or later versions	Instant 4.1 or later versions
IAP-103	ArubaOS 6.4 or later versions	Instant 4.1 or later versions
IAP-114/115	ArubaOS 6.3.1.1 or later versions	Instant 4.0 or later versions

IAP Platform	ArubaOS Release	Instant Release
IAP-224/225	ArubaOS 6.3.1.1 or later versions	Instant 4.0 or later versions
RAP-155/155P	ArubaOS 6.3.0 or later versions	Instant 3.3 or later versions
RAP-108/109	ArubaOS 6.2.0.0 or later versions	Instant 3.2 or later versions

To convert an IAP to a Remote AP:

1. Click **Maintenance** in the Instant main window.
2. Click the **Convert** tab. The **Convert** tab contents are displayed.

Figure 106 *Maintenance—Convert Tab*



Maintenance

Convert one or more Access Points to:

Remote APs managed by a Mobility Controller

Hostname or IP Address of Mobility Controller:

After conversion, all Access Points will be managed by the Controller specified above.

3. Select **Remote APs managed by a Mobility Controller** from the drop-down list.
4. Enter the host name (fully qualified domain name) or the IP address of the controller in the **Hostname or IP Address of Mobility Controller** text box. Contact your local network administrator to obtain the IP address.

NOTE

Ensure that the Mobility Controller IP address is reachable by the IAPs.

5. Click **Convert Now** to complete the conversion. The IAP reboots and begins operating in the Remote AP mode.
6. After conversion, the IAP is managed by the mobility controller.

NOTE

For IAPs to function as Remote APs, configure the IAP in the Remote AP whitelist and enable the FTP service on the controller.

NOTE

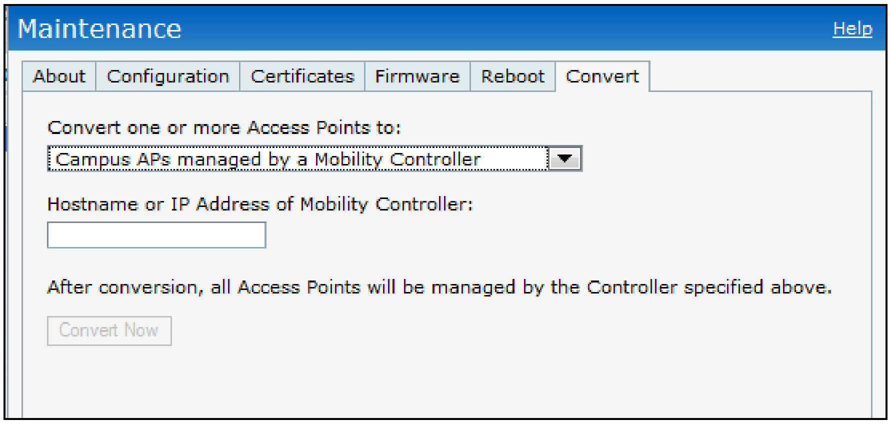
If the VPN setup fails and an error message is displayed, click **OK**, copy the error logs, and share them with your local administrator.

Converting an IAP to a Campus AP

To convert an IAP to a Campus AP:

1. Click **Maintenance** in the Instant main window.
2. Click the **Convert** tab. The **Convert** tab contents are displayed.

Figure 107 *Converting an IAP to Campus AP*



Convert one or more Access Points to:

Campus APs managed by a Mobility Controller

Hostname or IP Address of Mobility Controller:

After conversion, all Access Points will be managed by the Controller specified above.

3. Select **Campus APs managed by a Mobility Controller** from the drop-down list.
4. Enter the host name, Fully Qualified Domain Name (FQDN), or the IP address of the controller in the **Hostname or IP Address of Mobility Controller** text box. Contact your local administrator to obtain these details.
5. Click **Convert Now** to complete the conversion.

Converting an IAP to Stand-Alone Mode

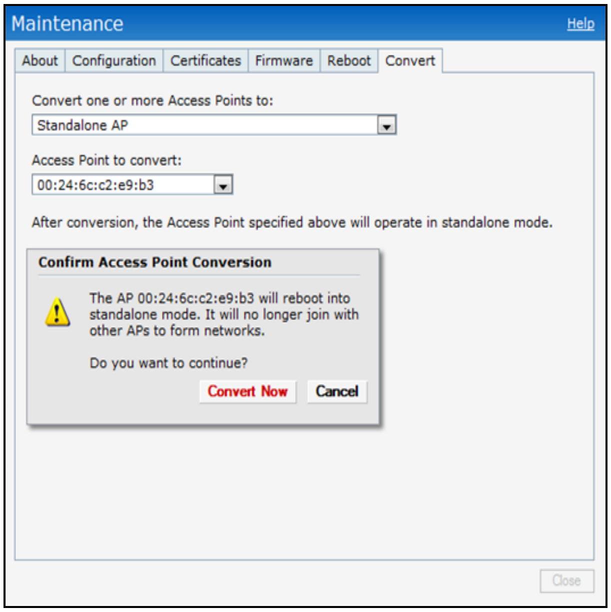
This feature allows you to deploy an IAP as an autonomous IAP, which is a separate entity from the existing VC cluster in the Layer 2 domain.

When an IAP is converted to function in stand-alone mode, it cannot join a cluster of IAPs even if the IAP is in the same VLAN. If the IAP is in the cluster mode, it can form a cluster with other VC IAPs in the same VLAN.

To deploy an IAP as a stand-alone or autonomous IAP:

1. Click **Maintenance** in the Instant main window.
2. Click the **Convert** tab. The **Convert** tab contents are displayed.

Figure 108 *Stand-Alone IAP Conversion*



Convert one or more Access Points to: Standalone AP

Access Point to convert: 00:24:6c:c2:e9:b3

After conversion, the Access Point specified above will operate in standalone mode.

Confirm Access Point Conversion

The AP 00:24:6c:c2:e9:b3 will reboot into standalone mode. It will no longer join with other APs to form networks.

Do you want to continue?

3. Select **Standalone AP** from the drop-down list.
4. Select the Access Point from the **Access Point to Convert** drop-down list.
5. Click **Convert Now** to complete the conversion. The IAP now operates in the stand-alone mode.

Converting an IAP using CLI

To convert an IAP to a remote AP or campus AP:

```
(Instant AP)# convert-aos-ap <mode> <controller-IP-address>
```

To convert an IAP to a stand-alone IAP or to provision an IAP in the cluster mode:

```
(Instant AP)# swarm-mode <mode>
```

Resetting a Remote AP or Campus AP to an IAP

The reset knob located on the rear of an IAP can be used to reset the IAP to factory default settings.

To reset an IAP, perform the following steps:

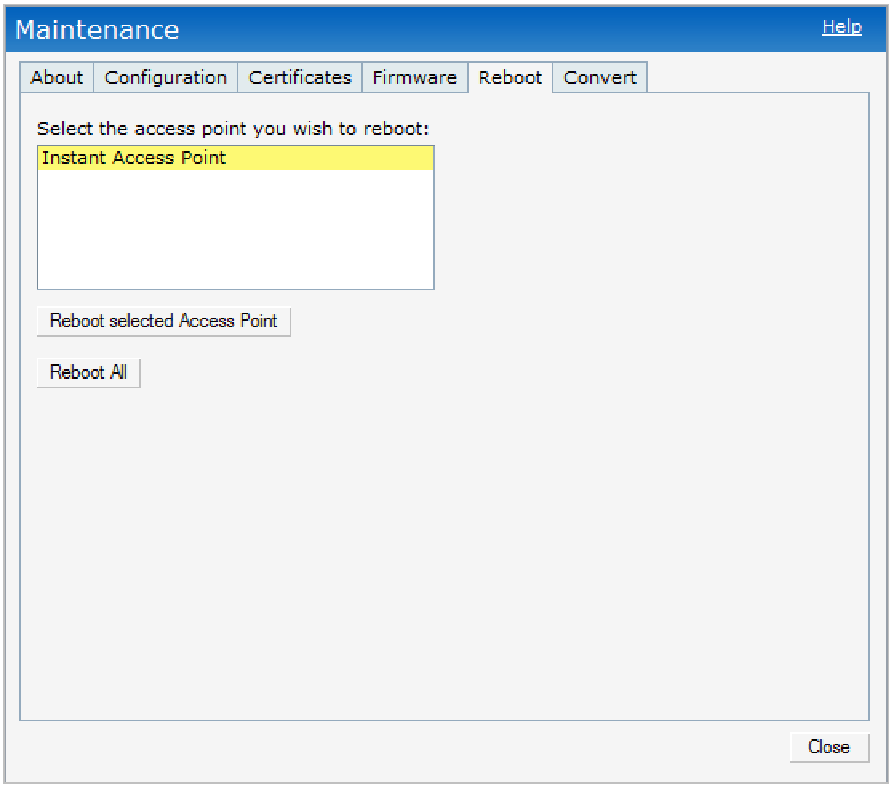
1. Turn off the IAP.
2. Press and hold the reset knob using a small and narrow object such as a paperclip.
3. Turn on the IAP without releasing the reset knob. The power LED flashes within 5 seconds indicating that the reset is completed.
4. Release the reset knob. The IAP reboots with the factory default settings.

Rebooting the IAP

If you encounter any problem with the IAPs, you can reboot all IAPs or a selected IAP in a network using the Instant UI. To reboot an IAP:

1. Click **Maintenance** in the Instant main window.
2. Click the **Reboot** tab.

Figure 109 *Rebooting the IAP*



Select the access point you wish to reboot:

Instant Access Point

3. In the IAP list, select the IAP that you want to reboot and click **Reboot selected Access Point**. To reboot all the IAPs in the network, click **Reboot All.**
4. The **Confirm Reboot for AP** message is displayed. Click **Reboot Now** to proceed. The **Reboot in Progress** message is displayed indicating that the reboot is in progress. The **Reboot Successful** message is displayed after the process is complete. If the system fails to boot, the **Unable to contact Access Points after reboot was initiated** message is displayed.
5. Click **OK**.

Chapter 32
Monitoring Devices and Logs

This chapter describes the following topics:

- Configuring SNMP on page 366
- Configuring a Syslog Server on page 370
- Configuring TFTP Dump Server on page 371
- Running Debug Commands on page 372
- Uplink Bandwidth Monitoring on page 376

Configuring SNMP

This section provides the following information:

- SNMP Parameters for IAP on page 366
- Configuring SNMP on page 367
- Configuring SNMP Traps on page 369

SNMP Parameters for IAP

Instant supports SNMPv1, SNMPv2, and SNMPv3 for reporting purposes only. An IAP cannot use Simple Network Management Protocol (SNMP) to set values in an Aruba system.

You can configure the following parameters for an IAP:

Table 77: *SNMP Parameters for IAP*

Parameter	Description
Community Strings for SNMPV1 and SNMPV2	An SNMP community string is a text string that acts as a password, and is used to authenticate messages sent between the VC and the SNMP agent.
If you are using SNMPv3 to obtain values from the IAP, you can configure the following parameters:	
Name	A string representing the name of the user.
Authentication Protocol	An indication of whether messages sent on behalf of this user can be authenticated, and if so, the type of authentication protocol used. This can take one of the two values: ● MD5—HMAC-MD5-96 Digest Authentication Protocol ● SHA—HMAC-SHA-96 Digest Authentication Protocol

Table 77: *SNMP Parameters for IAP*

Parameter	Description
Authentication protocol password	If messages sent on behalf of this user can be authenticated, a (private) authentication key is used with the authentication protocol. This is a string password for MD5 or SHA based on the conditions mentioned above.
Privacy protocol	An indication of whether messages sent on behalf of this user can be protected from disclosure, and if so, the type of privacy protocol that is used. This takes the value DES (CBC-DES Symmetric Encryption).
Privacy protocol password	If messages sent on behalf of this user can be encrypted/decrypted with DES, the (private) privacy key with the privacy protocol is used.

Configuring SNMP

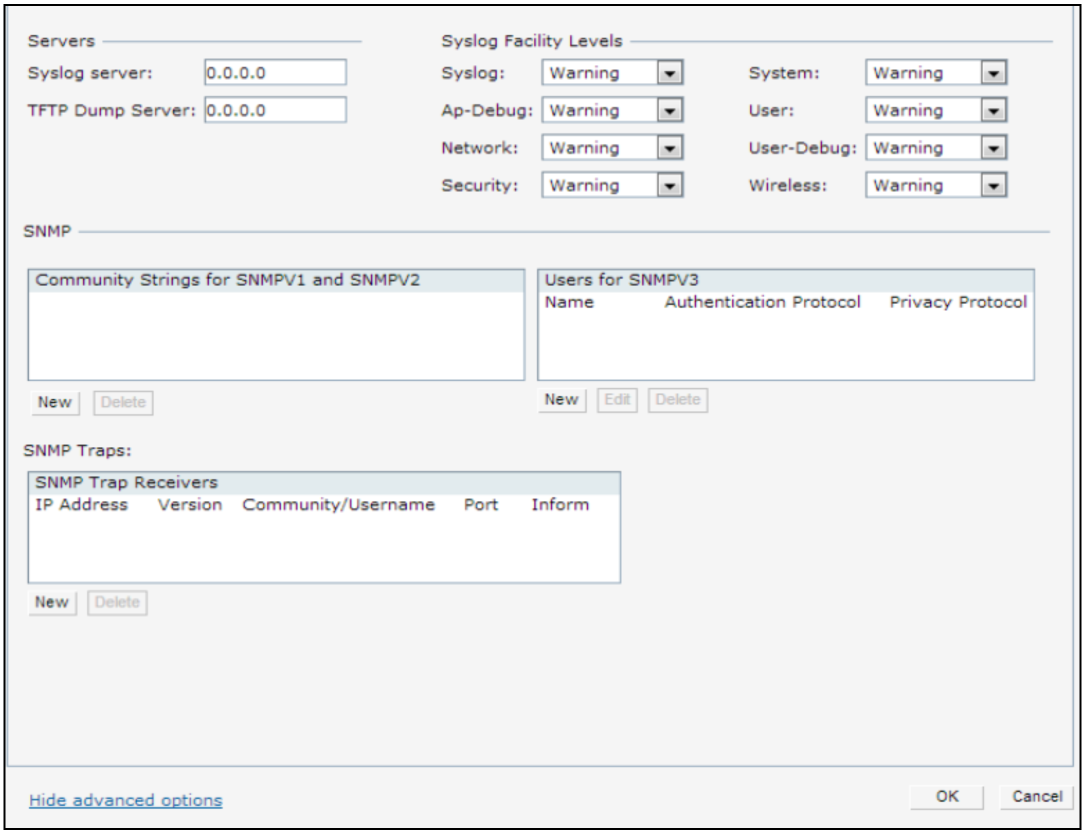
This section describes the procedure for configuring SNMPv1, SNMPv2, and SNMPv3 community strings by using the Instant UI or the CLI.

Creating Community Strings for SNMPv1 and SNMPv2 Using Instant UI

To create community strings for SNMPv1 and SNMPv2:

1. Click the **System** link on the Instant main window.
2. In the **System** window that is displayed, click the **Monitoring** tab.

Figure 110 *Monitoring Tab: SNMP Configuration Parameters*



Servers

Syslog server: 0.0.0.0

TFTP Dump Server: 0.0.0.0

Syslog Facility Levels

Syslog:	Warning	System:	Warning
Ap-Debug:	Warning	User:	Warning
Network:	Warning	User-Debug:	Warning
Security:	Warning	Wireless:	Warning

SNMP

Community Strings for SNMPV1 and SNMPV2

Users for SNMPV3

Name	Authentication Protocol	Privacy Protocol

SNMP Traps:

SNMP Trap Receivers

IP Address	Version	Community/Username	Port	Inform

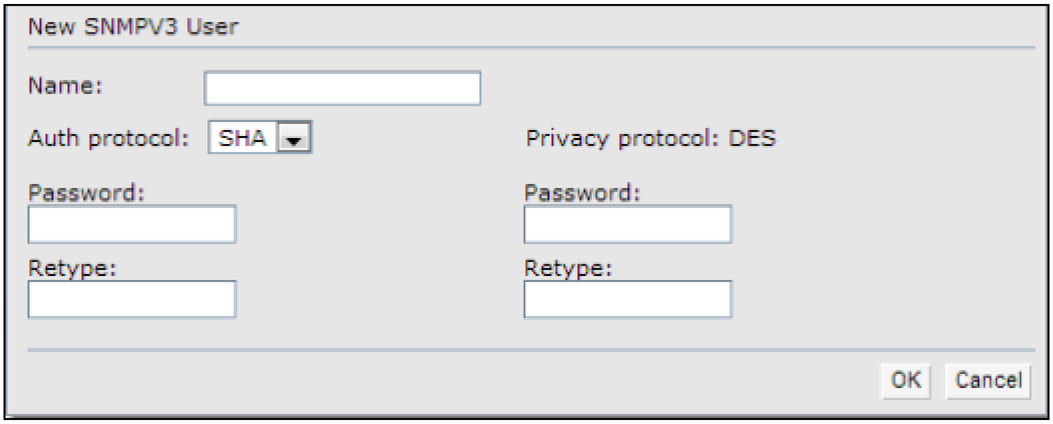
3. Click **New** under the **Community Strings for SNMPv1 and SNMPv2** box.
4. Enter the string in the **New Community String** text box.
5. Click **OK**.
6. To delete a community string, select the string, and click **Delete**.

Creating Community Strings for SNMPv3 Using Instant UI

To create community strings for SNMPv3:

1. Click the **System** link on the Instant main window.
2. In the **System** window that is displayed, click the **Monitoring** tab.
3. Click **New** under the **Users for SNMPV3** box.

Figure 111 *SNMPv3 User*



4. Enter the name of the user in the **Name** text box.
5. Select the type of authentication protocol from the **Auth protocol** drop-down list.
6. Enter the authentication password in the **Password** text box and retype the password in the **Retype** text box.
7. Select the type of privacy protocol from the **Privacy protocol** drop-down list.
8. Enter the privacy protocol password in the **Password** text box and retype the password in the **Retype** text box.
9. Click **OK**.
10. To edit the details for a particular user, select the user and click **Edit**.
11. To delete a particular user, select the user and click **Delete**.

Configuring SNMP Community Strings in the CLI

To configure an SNMP engine ID and host:

```
(Instant AP)(config)# snmp-server engine-id <engine-ID>
(Instant AP)(config)# host <ipaddr> version {1 <name> udp-port <port>}|{2c|3 <name> [inform]
[udp-port <port>]}
```

To configure SNMPv1 and SNMPv2 community strings:

```
(Instant AP)(config)# snmp-server community <password>
```

To configure SNMPv3 community strings:

```
(Instant AP)(config)# snmp-server user <name> <auth-protocol> <password> <privacy-protocol>
<password>
```

To view SNMP configuration:

```
(Instant AP)# show snmp-configuration
```

```
Engine ID:D8C7C8C44298
Community Strings
-----------------
Name
----
SNMPv3 Users
------------
Name Authentication Type Encryption Type
---- ------------------- ---------------
SNMP Trap Hosts
---------------
IP Address Version Name Port Inform
---------- ------- ---- ---- ------
```

Configuring SNMP Traps

Instant supports the configuration of external trap receivers. Only the IAP acting as the VC generates traps. The traps for IAP cluster are generated with VC IP as the source IP, if VC IP is configured. The Object Identifier (OID) of the traps is 1.3.6.1.4.1.14823.2.3.3.1.200.2.X.

You can configure SNMP traps by using the Instant UI or the CLI.

In the Instant UI

To configure an SNMP trap receiver:

1. Navigate to **System > Show advanced options > Monitoring**.
2. Under **SNMP Traps**, enter a name in the **SNMP Engine ID** text box. It indicates the name of the SNMP agent on the IAP. The SNMPv3 agent has an engine ID that uniquely identifies the agent in the device and is unique to that internal network.
3. Click **New** and update the following information:
   - **IP Address**—Enter the **IP Address** of the new SNMP Trap receiver.
   - **Version**—Select the SNMP version— **v1, v2c, v3** from the drop-down list. The version specifies the format of traps generated by the access point.
   - **Community/Username**—Specify the community string for SNMPv1 and SNMPv2c traps and a username for SNMPv3 traps.
   - **Port**—Enter the port to which the traps are sent. The default value is 162.
   - **Inform**—When enabled, traps are sent as SNMP INFORM messages. It is applicable to SNMPv3 only. The default value is **Yes**.
4. Click **OK** to view the trap receiver information in the **SNMP Trap Receivers** window.

In the CLI

To configure SNMP traps:

```
(Instant AP)(config)# snmp-server host <IP-address> {version 1 | version 2 | version 3} <name>
udp-port <port> inform
(Instant AP)(config)# end
(Instant AP)# commit apply
```

NOTE

Instant supports SNMP Management Information Bases (MIBs) along with Aruba-MIBs. For information about MIBs and SNMP traps, refer to the *Aruba Instant 6.5.1.0-4.3.1.0 MIB Reference Guide*.

Configuring a Syslog Server

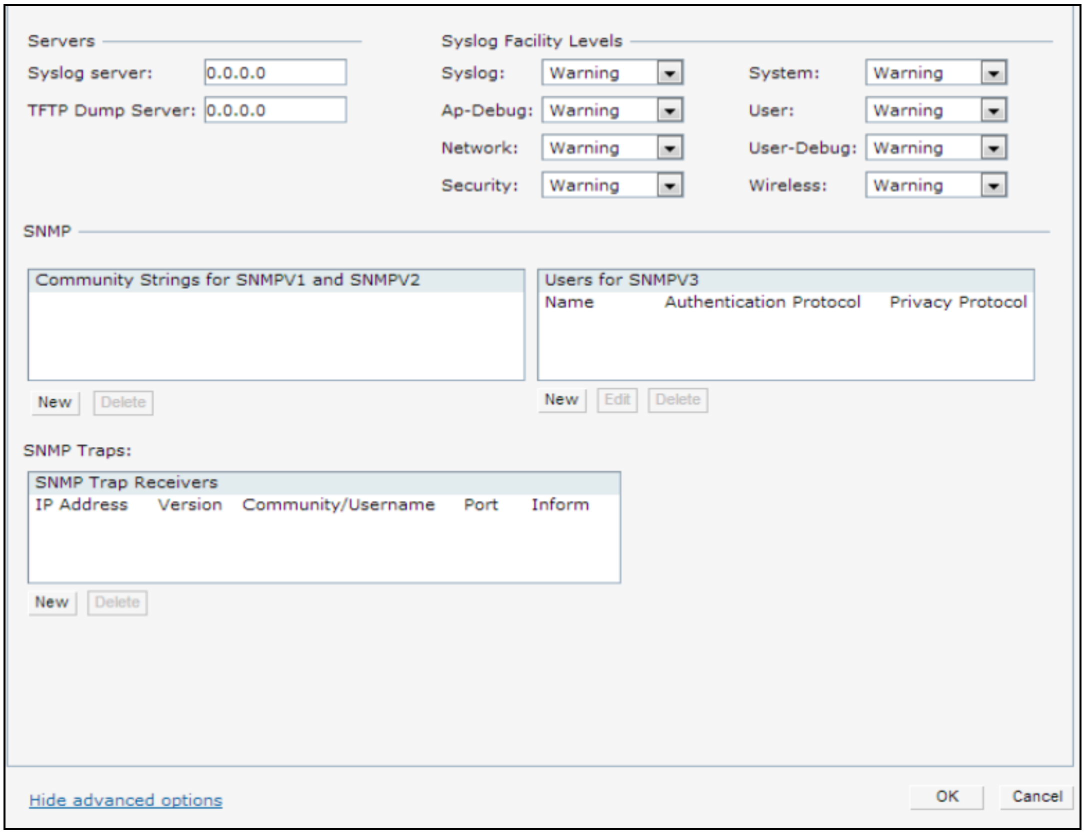
You can specify a syslog server for sending syslog messages to the external servers by using the Instant UI or the CLI.

In the Instant UI

To configure a Syslog server and Syslog facility levels:

1. In the Instant main window, click the **System** link.
2. Click **Show advanced options** to display the advanced options.
3. Click the **Monitoring** tab.

Figure 112 *Syslog Server*



Servers

Syslog server: 0.0.0.0

TFTP Dump Server: 0.0.0.0

Syslog Facility Levels

Syslog:	Warning	System:	Warning
Ap-Debug:	Warning	User:	Warning
Network:	Warning	User-Debug:	Warning
Security:	Warning	Wireless:	Warning

4. In the **Syslog server** text box, enter the IP address of the server to which you want to send system logs.

NOTE

The syslog source address is sent individually by the IAPs in the cluster and never the VC IP. Even the master IAP sends the syslog source address from its actual IP address.

5. Select the required values to configure syslog facility levels. Syslog Facility is an information field associated with a syslog message. It is an application or operating system component that generates a log message. The following seven facilities are supported by Syslog:

- **AP-Debug**—Detailed log about the IAP device.
- **Network**—Log about change of network; for example, when a new IAP is added to a network.
- **Security**—Log about network security; for example, when a client connects using wrong password.
- **System**—Log about configuration and system status.
- **User**—Important logs about client.
- **User-Debug**—Detailed logs about client debugging.

- **Wireless**—Log about radio.

The following table describes the logging levels in order of severity, from the most to the least severe.

Table 78: *Logging Levels*

Logging Level	Description
Emergency	Panic conditions that occur when the system becomes unusable.
Alert	Any condition requiring immediate attention and correction.
Critical	Any critical conditions such as a hard drive error.
Errors	Error conditions.
Warning	Warning messages.
Notice	Significant events of a noncritical and normal nature. The default value for all Syslog facilities.
Informational	Messages of general interest to system users.
Debug	Messages containing information useful for debugging.

6. Click **OK**.

In the CLI

To configure a syslog server:

```
(Instant AP)(config)# syslog-server <IP-address>
```

To configure syslog facility levels:

```
(Instant AP)(config)# syslog-level <logging-level>[ap-debug |network |security |system |user |
user-debug | wireless]
(Instant AP)(config)# end
(Instant AP)# commit apply
```

To view syslog logging levels:

```
(Instant AP)# show syslog-level

Logging Level
-------------
Facility Level
-------- -----
ap-debug warn
network warn
security warn
system warn
user warn
user-debug warn
wireless error
```

Configuring TFTP Dump Server

You can configure a TFTP server for storing core dump files by using the Instant UI or the CLI.

In the Instant UI

To configure a TFTP server:

1. In the Instant main window, click the **System** link.
2. Click **Show advanced options** to display the advanced options.
3. Click the **Monitoring** tab.
4. Enter the IP address of the TFTP server in the **TFTP Dump Server** text box.
5. Click **OK**.

In the CLI

To configure a TFTP server:

```
(Instant AP)(config)# tftp-dump-server <IP-address>
(Instant AP)(config)# end
(Instant AP)# commit apply
```

Running Debug Commands

To run the debugging commands from the UI:

1. Navigate to **More > Support** on the Instant main window.
2. Select the required option from the **Command** drop-down list.
3. Select **All Access Points** or **Instant Access Point(VC)** from the **Target** drop-down list.
4. Click **Run**. When you run debug commands and click **Save**, the output of all the selected commands is displayed in a single page.

The **Support** window allows you to run commands for each access point and VC in a cluster. For a complete list of commands supported in a particular release train, execute the **show support-commands** command at the IAP CLI. The output of this command displays the list of support commands that you can run through the UI and the corresponding CLI commands. For more information on these commands, refer to the respective command page in the *Aruba Instant 6.5.0.0-4.3.0.0 CLI Reference Guide*.

```
(Instant AP) # show support-commands
Support Commands
----------------
Description                         Command Name
-----------                         ------------
AP Tech Support Dump                show tech-support
AP Tech Support Dump Supplemental   show tech-support supplemental
AP Provisioning Status              show activate status
AP 3G/4G Status                     show cellular status
AP 802.1X Statistics                show ap debug dot1x-statistics
AP Access Rule Table                show access-rule-all
AP Inbound Firewall Rules           show inbound-firewall-rules
AP Active                           show aps
AP AirGroup Cache                   show airgroup cache entries
AP AirGroup CPPM Entries            show airgroup cppm entries
AP AirGroup CPPM Servers            show airgroup cppm server
AP AirGroup Debug Statistics        show airgroup debug statistics
AP AirGroup Servers                 show airgroup servers verbose
AP AirGroup User                    show airgroup users verbose
AP ALE Configuration                show ale config
AP ALE Status                       show ale status
AP Allowed Channels                 show ap allowed-channels
AP Allowed MAX-EIRP                 show ap allowed-max-EIRP
AP All Supported Timezones          show clock timezone all
AP ARM Bandwidth Management         show ap arm bandwidth-management
AP ARM Channels                          show arm-channels
AP ARM Configuration                     show arm config
AP ARM History                           show ap arm history
AP ARM Neighbors                         show ap arm neighbors
AP ARM RF Summary                        show ap arm rf-summary
AP ARM Scan Times                        show ap arm scan-times
AP ARP Table                             show arp
AP Association Table                     show ap association
AP Authentication Frames                 show ap debug auth-trace-buf
AP Auth-Survivability Cache              show auth-survivability cached-info
AP Auth-Survivability Debug Log          show auth-survivability debug-log
AP BSSID Table                           show ap bss-table
AP Captive Portal Domains                show captive-portal-domains
AP Captive Portal Auto White List        show captive-portal auto-white-list
AP Client Match Status                   show ap debug client-match
AP Client Match History                  show ap client-match-history
AP Client Match Action                   show ap client-match-actions
AP Client Match Live                     show ap client-match-live
AP Client Match Triggers                 show ap client-match-triggers
AP Client Table                          show ap debug client-table
AP Client View                           show ap client-view
AP Country Codes                         show country-codes
AP CPU Details                           show cpu details
AP CPU Utilization                       show cpu
AP Crash Info                            show ap debug crash-info
AP Current Time                          show clock
AP Current Timezone                      show clock timezone
AP Datapath ACL Table Allocation         show datapath acl-allocation
AP Datapath ACL Tables                   show datapath acl-all
AP Datapath Bridge Table                 show datapath bridge
AP Datapath DMO session                  show datapath dmo-session
AP Datapath DMO station                  show datapath dmo-station
AP Datapath Dns Id Map                   show datapath dns-id-map
AP Datapath Multicast Table              show datapath mcast
AP Datapath Nat Pool                     show datapath nat-pool
AP Datapath Route Table                  show datapath route
AP Datapath Session Table                show datapath session
AP Datapath DPI Session Table            show datapath session dpi
AP Datapath DPI Session Table Verbose    show datapath session dpi verbose
AP Datapath Statistics                   show datapath statistics
AP Datapath User Table                   show datapath user
AP Datapath VLAN Table                   show datapath vlan
AP DPI Debug statistics                  show dpi debug statistics
AP Daylight Saving Time                  show clock summer-time
AP Derivation Rules                      show derivation-rules
AP Driver Configuration                  show ap debug driver-config
AP Election Statistics                   show election statistics
AP External Captive Portal Status        show external-captive-portal
AP Environment Variable                  show ap-env
AP ESSID Table                           show network
AP Flash Configuration                   show ap flash-config
AP IGMP Group Table                      show ip igmp
AP Interface Counters                    show interface counters
AP Interface Status                      show port status
AP Internal DHCP Status                  show dhcp-allocation
AP IP Interface                          show ip interface brief
AP IP Route Table                        show ip route
AP L3 Mobility Datapath                  show l3-mobility datapath
AP L3 Mobility Events log                show log l3-mobility
AP L3 Mobility Status                    show l3-mobility status
AP LACP Status                           show lacp status
AP Log All                               show log debug
AP Log AP-Debug                          show log ap-debug
AP Log Conversion                        show log convert
AP Log Driver                            show log driver
AP Log Kernel                            show log kernel
AP Log Network                           show log network
AP Log PPPd                              show log pppd
AP Log Rapper                            show log rapper
AP Log Rapper Counter                    show log rapper-counter
AP Log Rapper Brief                      show log rapper-brief
AP Log Sapd                              show log sapd
AP Log Security                          show log security
AP Log System                            show log system
AP Log Tunnel Status Management          show log apifmgr
AP Log Upgrade                           show log upgrade
AP Log User-Debug                        show log user-debug
AP Log User                              show log user
AP Log VPN Tunnel                        show log vpn-tunnel
AP Log Wireless                          show log wireless
AP Management Frames                     show ap debug mgmt-frames
AP Memory Allocation State Dumps         show malloc-state-dumps
AP Memory Utilization                    show memory
AP Mesh Counters                         show ap mesh counters
AP Mesh Link                             show ap mesh link
AP Mesh Neighbors                        show ap mesh neighbours
AP Monitor Active Laser Beams            show ap monitor active-laser-beams
AP Monitor AP Table                      show ap monitor ap-list
AP Monitor ARP Cache                     show ap monitor ARP Cache
AP Monitor Client Table                  show ap monitor sta-list
AP Monitor Containment Information       show ap monitor containment-info
AP Monitor Potential AP Table            show ap monitor pot-ap-list
AP Monitor Potential Client Table        show ap monitor pot-sta-list
AP Monitor Router                        show ap monitor routers
AP Monitor Scan Information              show ap monitor scan-info
AP Monitor Status                        show ap monitor status
AP Persistent Clients                    show ap debug persistent-clients
AP PMK Cache                             show ap pmkcache
AP PPPoE uplink debug                    show pppoe debug-logs
AP PPPoE uplink status                   show pppoe status
AP Processes                             show process
AP Radio 0 Client Probe Report           show ap client-probe-report 0
AP Radio 0 Stats                         show ap debug radio-stats 0
AP Radio 0 info                          show ap debug radio-info 0
AP Radio 1 Client Probe Report           show ap client-probe-report 1
AP Radio 1 Stats                         show ap debug radio-stats 1
AP Radio 1 info                          show ap debug radio-info 1
AP RADIUS Statistics                     show ap debug radius-statistics
AP Termination RADIUS Statistics         show ap debug radius-statistics termination
AP Shaping Table                         show ap debug shaping-table
AP Sockets                               show socket
AP STM Configuration                     show ap debug stm-config
AP Swarm State                           show swarm state
AP System Status                         show ap debug system-status
AP System Summary                        show summary support
AP Uplink Status                         show uplink status
AP User Table                            show clients
AP Valid Channels                        show valid-channels
AP Version                               show version
AP Virtual Beacon Report                 show ap virtual-beacon-report
AP VPN Config                            show vpn config
AP VPN Status                            show vpn status
AP IAP-VPN Retry Counters                show vpn tunnels
AP Wired Port Settings                   show wired-port-settings
```

AP Wired User Table	show clients wired
AP Checksum	show ap checksum
AP Spectrum AP table	show ap spectrum ap-list
AP Spectrum channel table	show ap spectrum channel-details
AP Spectrum channel metrics	show ap spectrum channel-metrics
AP Spectrum channel summary	show ap spectrum channel-summary
AP Spectrum client table	show ap spectrum client-list
AP Spectrum device duty cycle	show ap spectrum device-duty-cycle
AP Spectrum non-wifi device history	show ap spectrum device-history
AP Spectrum non-wifi device table	show ap spectrum device-list
AP Spectrum non-wifi device log	show ap spectrum device-log
AP Spectrum number of device	show ap spectrum device-summary
AP Spectrum interference-power table	show ap spectrum interference-power
AP Spectrum status	show ap spectrum status
VC 802.1x Certificate	show 1xcert
VC All Certificates	show cert all
VC radsec Certificates	show radseccert
VC Captive Portal domains	show captive-portal-domains
VC About	show about
VC Active Configuration	show running-config
VC AirGroup Service	show airgroupservice
VC AirGroup Status	show airgroup status
VC Allowed AP Table	show allowed-aps
VC AMP Status	show ap debug airwave
VC AMP Current State Data	show ap debug airwave-state
VC AMP Current Stats Data	show ap debug airwave-stats
VC AMP Data Sent	show ap debug airwave-data-sent
VC AMP Events Pending	show ap debug airwave-events-pending
VC AMP Last Configuration Received	show ap debug airwave-config-received
VC AMP Single Sign-on Key	show ap debug airwave-signon-key
VC AMP Configuration Restore Status	show ap debug airwave-restore-status
VC Central Current State Data	show ap debug cloud-state
VC Central Current Stats Data	show ap debug cloud-stats
VC Central Data Sent	show ap debug cloud-data-sent
VC Central Events Pending	show ap debug cloud-events-pending
VC Central Last Configuration Received	show ap debug cloud-config-received
VC Central Single Sign-on Key	show ap debug cloud-signon-key
VC Central Configuration Restore Status	show ap debug cloud-restore-status
VC Application Services	show app-services
VC Cloud Server Status	show ap debug cloud-server
VC DHCP Option 43 Received	show dhcpc-opts
VC Global Alerts	show alert global
VC Global Statistics	show stats global
VC IDS AP List	show ids aps
VC IDS Client List	show ids clients
VC Internal DHCP Server Configuration	show ip dhcp database
VC L2TPv3 config	show l2tpv3 config
VC L2TPv3 session status	show l2tpv3 session status
VC L2TPv3 system wide global statistics	show l2tpv3 system statistics
VC L2TPv3 tunnel configuration	show l2tpv3 tunnel config
VC L2TPv3 tunnel status	show l2tpv3 tunnel status
VC Local User Database	show users
VC OpenDNS Configuration and Status	show opendns support
VC Provisioning Log	show log provision
VC Radius Attributes	show radius-attributes
VC Radius Servers	show radius-servers support
AP Radius Status	show radius status
VC Saved Configuration	show configuration
VC Scanning Stats	show aps scanning
VC Show SBR Table	show datapath sbr
VC SNMP Configuration	show snmp-configuration
VC Uplink 3G/4G Configuration	show cellular config

```
VC Uplink Management Configuration       show uplink config
VC WISPr Configuation                    show wispr config
VC XML API Server Information            show xml-api-server
VC rfc3576-radius statistics             show ap debug rfc3576-radius-statistics
```

Use the support commands under the supervision of Aruba technical support.

Uplink Bandwidth Monitoring

An IAP uses Iperf3 as a TCP or UDP client to run a speed test and measure the bandwidth on an uplink. The results from the speed test are collated by the IAP and published to Analytics and Location Engine (ALE). The speed tests can be run only on the master IAP of the cluster. You may choose to configure and execute a speed test profile during boot time and additionally at specific time intervals using the configuration mode or execute the speed test at any preferred time using the privileged EXEC mode in the CLI.

To configure and automatically run speed tests at specific time intervals:

```
(Instant AP)(config)# speed-test
(Instant AP)(speed-test)# include-reverse
(Instant AP)(speed-test)# server-ip <server>
(Instant AP)(speed-test)# server-port <port>
(Instant AP)(speed-test)# protocol <tcp/udp>
(Instant AP)(speed-test)# on-boot
(Instant AP)(speed-test)# time-interval <interval>
(Instant AP)(speed-test)# bandwidth <bandwidth>
(Instant AP)(speed-test)# sec-to-measure <secs>
(Instant AP)(speed-test)# end
(Instant AP)# commit apply
```

To configure and execute a speed test at any point in time:

```
(Instant AP)# speed-test <server> <protocol> [<bandwidth>|<include-reverse>|<sec-to-measure>
|<server-port>]
(Instant AP)# end
```

The view the speed test results:

```
(Instant AP)# show speed-test data
(Instant AP)# end
```

Following is an example of the speed-test result

```
(Instant AP)# show speed-test data
Speed Test results :
Time of Execution :Fri, 11 Nov 2016 07:06:29
Server IP :10.17.138.2
Local IP :10.17.138.92
Local Port :62716
Remote Port :5201
MAC :40:e3:d6:cf:f5:2e
System Name :40:e3:d6:cf:f5:2e
Protocol :TCP
Duration :10
Upstream Bytes :496028352
Upstream Bandwitdh(Mbps) :395.97
upstream retries :0
Downstream Bytes :615227296
Downstream bandwidth (Mbps) :492.18
```

The following command shows the number of times the uplink bandwidth report was sent to the ALE server.

To display the uplink bandwidth counter:

```
(Instant AP)# show ale stats
ALE Stats
```

```
---------
Type Value
---- -----
VC package 0
RSSI package 0
APPRF package 0
URLv package 0
STATE package 0
STAT package 0
UPLINK BW package 0
Total 0
```

This chapter contains the following topics:

NOTE

In the current release, Instant supports the hotspot profile configuration only through the CLI.

Understanding Hotspot Profiles

Hotspot 2.0 (Passpoint Release 1) is a Wi-Fi Alliance specification based on the 802.11u protocol, which allows wireless clients to discover hotspots using management frames (such as beacon, association request, and association response), connect to networks, and roam between networks without additional authentication.

Hotspot 2.0 provides the following services:

- Network discovery and selection—Allows the clients to discover suitable and available networks by advertising the access network type, roaming consortium, and venue information through the management frames. For network discovery and selection, Generic Advertisement Service (GAS) and Access Network Query Protocol (ANQP) are used.
- QOS Mapping—Provides a mapping between the network-layer QoS packet marking and over- the-air QoS frame marking based on user priority.

When a hotspot is configured in a network:

- The clients search for available hotspots using the beacon management frame.
- When a hotspot is found, the client sends queries to obtain information about the type of network authentication and IP address, and IP address availability using the Generic Advertisement Service (GAS) action frames.
- Based on the response of the advertisement server (response to the GAS Action Frames), the relevant hotspot is selected and the client attempts to associate with it.
- Based on the authentication mode used for mobility clients, the client authenticates to access the network.

Generic Advertisement Service (GAS)

GAS is a request-response protocol, that provides L2 transport mechanism between a wireless client and a server in the network prior to authentication. It helps to determine an 802.11 infrastructure before associating clients and allows clients to send queries to multiple 802.11 networks in parallel.

An IAP can include its SP Organization Identifier (OI) indicating the identity of the SP in beacons and probe responses to clients. When a client recognizes an IAP's OI, it attempts to associate to that IAP using the security credentials corresponding to that SP. If the client does not recognize the AP's OI, the client sends a Generic Advertisement Service (GAS) query to the IAP to request more information about the network before associating. A client transmits a GAS Query using a GAS Initial Request frame and the IAP provides the query response or information on how to receive the query response in a GAS Initial Response frame. To transmit a GAS query for any advertisement protocol, the advertisement protocol ID must include the advertisement protocol information element (IE) with details of the advertisement protocol and its corresponding advertisement control.

Access Network Query Protocol (ANQP)

ANQP provides a range of information, such as IP address type and availability, roaming partners accessible through a hotspot, and the Extensible Authentication Protocol (EAP) method supported for authentication, for a query and response protocol. The ANQP Information Elements (IEs) provide additional data that can be sent from an IAP to the client to identify the IAP's network and service provider. If a client requests this information through a GAS query, the hotspot IAP sends the ANQP capability list in the GAS Initial Response frame indicating support for the following IEs:

- Venue Name
- Domain Name
- Network Authentication Type
- Roaming Consortium List
- Network Access Identifier Realm
- 3GPP Cellular Network Data
- IP Address Availability

Hotspot 2.0 Query Protocol (H2QP)

The H2QP profiles provide a range of information on Hotspot 2.0 elements such as hotspot protocol and port, operating-class, operator names, WAN status, and uplink and downlink metrics.

Information Elements (IEs) and Management Frames

The Hotspot 2.0 configuration supports the following IEs:

- Interworking IE—Provides information about the Interworking service capabilities such as the Internet availability in a specific service provider network.
- Advertisement Protocol IE—Provides information about the advertisement protocol that a client can use for communication with the advertisement servers in a network.
- Roaming Consortium IE—Provides information about the service provider network for roaming clients, which can be used to authenticate with the IAP.

The IEs are included in the following Management Frames when 802.11u is enabled:

- Beacon Frame
- Probe Request Frame
- Probe Response frame
- Association Request
- Re-Association request

NAI Realm List

An Network Access Identifier (NAI) Realm profile identifies and describes a NAI realm to which the clients can connect. The NAI realm settings on an IAP act as an advertisement profile to determine the NAI realm elements that must be included as part of a GAS Response frame.

Configuring Hotspot Profiles

To configure a hotspot profile, perform the following steps:

1. Create the required ANQP and H2QP advertisement profiles.
2. Create a hotspot profile.
3. Associate the required ANQP and H2QP advertisement profiles created in step 1 to the hotspot profile created in step 2.
4. Create an SSID Profile with enterprise security and WPA-2 encryption settings and then associate the SSID with the hotspot profile created in step 2.

Creating Advertisement Profiles for Hotspot Configuration

A hotspot profile contains one or several advertisement profiles. The following advertisement profiles can be configured through the Instant CLI:

- ANQP advertisement profiles
  - NAI Realm profile
  - Venue Name Profile
  - Network Authentication Profile
  - Roaming Consortium Profile
  - 3GPP Profile
  - IP Address availability Profile
  - Domain Name Profile
- H2QP advertisement profiles
  - Operator Friendly Name Profile
  - Connection Capability Profile
  - Operating-Class Profile
  - WAN-Metrics Profile

Configuring an NAI Realm Profile

You can configure a Network Access Identifier (NAI) Realm profile to define the NAI realm information, which can be sent as an ANQP IE in a GAS query response.

To configure a NAI profile:

```
(Instant AP)(config)# hotspot anqp-nai-realm-profile <name>
(Instant AP)(nai-realm <name>)# nai-realm-name <name>
(Instant AP)(nai-realm <name>)# nai-realm-encoding {<utf8>|<rfc4282>}
(Instant AP)(nai-realm <name>)# nai-realm-eap-method <eap-method>
(Instant AP)(nai-realm <name>)# nai-realm-auth-id-1 <authentication-ID>
(Instant AP)(nai-realm <name>)# nai-realm-auth-id-2 <authentication-ID>
(Instant AP)(nai-realm <name>)# nai-realm-auth-value-1 <authentication-value>
(Instant AP)(nai-realm <name>)# nai-realm-auth-value-2 <authentication-value>
(Instant AP)(nai-realm <name>)# nai-home-realm
(Instant AP)(nai-realm <name>)# enable
(Instant AP)(nai-realm <name>)# end
(Instant AP)# commit apply
```

You can specify any of the following EAP methods for the **nai-realm-eap-method <eap-method>** command:

- **identity**—To use EAP Identity type. The associated numeric value is 1.
- **notification**—To allow the hotspot realm to use EAP Notification messages for authentication. The associated numeric value is 2.
- **one-time-password**—To use Authentication with a single-use password. The associated numeric value is 5.
- **generic-token-card**—To use EAP Generic Token Card (EAP-GTC). The associated numeric value is 6.
- **eap-tls**—To use EAP-Transport Layer Security. The associated numeric value is 13.
- **eap-sim**—To use EAP for Global System for Mobile Communication (GSM) Subscriber Identity Modules (SIM). The associated numeric value is 18.
- **eap-ttls**—To use EAP-Tunneled Transport Layer Security. The associated numeric value is 21.
- **peap**—To use protected Extensible Authentication Protocol. The associated numeric value is 25.
- **crypto-card**—To use crypto card authentication. The associated numeric value is 28.
- **peapmschapv2**—To use PEAP with Microsoft Challenge Handshake Authentication Protocol version 2 (MSCHAPv2). The associated numeric value is 29.
- **eap-aka**—To use EAP for Universal Mobile Telecommunications System (UMTS) Authentication and Key Agreement (AKA). The associated numeric value is 50.

The following table lists the possible authentication IDs and their respective values:

Table 79: *NAI Realm Profile Configuration Parameters*

Authentication ID	Authentication Value
reserved • Uses the reserved authentication method. • The associated numeric value is **0**.	—
expanded-eap • Uses the expanded EAP authentication method. • The associated numeric value is **1**.	Use expanded-eap as the authentication value.
non-eap-inner-auth • Uses non-EAP inner authentication type. • The associated numeric value is **2**.	The following authentication values apply: • **reserved**—The associated numeric value is **0**. • **pap**—The associated numeric value is **1**. • **chap**—The associated numeric value is **2**. • **mschap**—The associated numeric value is **3**. • **mschapv2**—The associated numeric value is **4**.

Table 79: *NAI Realm Profile Configuration Parameters*

Authentication ID	Authentication Value
eap-inner-auth - Uses EAP inner authentication type. - The associated numeric value is **3**.	The following authentication values apply: - **reserved**—The associated numeric value is **0**. - **pap**—The associated numeric value is **1**. - **chap**—The associated numeric value is **2**. - **mschap**—The associated numeric value is **3**. - **mschapv2**—The associated numeric value is **4**.
exp-inner-eap - Uses the expanded inner EAP authentication method. - The associated numeric value is **4**.	Use the exp-inner-eap authentication value.
credential - Uses credential authentication. - The associated numeric value is **5**.	The following authentication values apply: - **sim**—The associated numeric value is **1**. - **usim**—The associated numeric value is **2**. - **nfc-secure**—The associated numeric value is **3**. - **hw-token**—The associated numeric value is **4**. - **softoken**—The associated numeric value is **5**. - **certificate**—The associated numeric value is **6**. - **uname-passward**—The associated numeric value is **7**. - **none**—The associated numeric value is **8**. - **reserved**—The associated numeric value is **9**. - **vendor-specific**—The associated numeric value is **10**.

Configuring a Venue Name Profile

You can configure a venue name profile to send the venue information as an ANQP IE in a GAS query response.

To configure a venue name profile:

```
(Instant AP)(config)# hotspot anqp-venue-name-profile <name>
(Instant AP)(venue-name <name>)# venue-name <name>
(Instant AP)(venue-name <name>)# venue-group <group-name>
(Instant AP)(venue-name <name>)# venue-type <type>
(Instant AP)(venue-name <name>)# venue-lang-code <language>
(Instant AP)(venue-name <name>)# enable
(Instant AP)(venue-name <name>)# end
(Instant AP)# commit apply
```

You can specify any of the following venue groups and the corresponding venue types:

Table 80: *Venue Types*

Venue Group	Associated Venue Type Value
unspecified The associated numeric value is **0**.	—
assembly The associated numeric value is **1**.	- unspecified—The associated numeric value is **0**. - arena—The associated numeric value is **1**. - stadium—The associated numeric value is **2**. - passenger-terminal—The associated numeric value is **3**. - amphitheater—The associated numeric value is **4**. - amusement-park—The associated numeric value is **5**. - place-of-worship—The associated numeric value is **6**. - convention-center—The associated numeric value is **7**. - library—The associated numeric value is **8**. - museum—The associated numeric value is **9**. - restaurant—The associated numeric value is **10**. - theater—The associated numeric value is **11**. - bar—The associated numeric value is **12**. - coffee-shop—The associated numeric value is **13**. - zoo-or-aquarium—The associated numeric value is **14**. - emergency-cord-center—The associated numeric value is **15**.
business The associated numeric value is **2**.	- unspecified—The associated numeric value is **0**. - doctor—The associated numeric value is **1**. - bank—The associated numeric value is **2**. - fire-station—The associated numeric value is **3**. - police-station—The associated numeric value is **4**. - post-office—The associated numeric value is **6**. - professional-office—The associated numeric value is **7**. - research-and-dev-facility—The associated numeric value is **8**. - attorney-office—The associated numeric value is **9**.
educational The associated numeric value is **3**.	- unspecified—The associated numeric value is **0**. - school-primary—The associated numeric value is **1**. - school-secondary—The associated numeric value is **2**. - univ-or-college—The associated numeric value is **3**.
factory-and-industrial The associated numeric value is **4**.	- unspecified—The associated numeric value is **0**. - factory—The associated numeric value is **1**.
institutional	- unspecified—The associated numeric value is **0**.

Table 80: *Venue Types*

Venue Group	Associated Venue Type Value
The associated numeric value is **5**.	- hospital—The associated numeric value is **1**. - long-term-care—The associated numeric value is **2**. - alc-drug-rehab—The associated numeric value is **3**. - group-home—The associated numeric value is **4**. - prison-or-jail—The associated numeric value is **5**.
mercantile The associated numeric value is **6**.	- unspecified—The associated numeric value is **0**. - retail-store—The associated numeric value is **1**. - grocery-market—The associated numeric value is **2**. - auto-service-station—The associated numeric value is **3**. - shopping-mall—The associated numeric value is **4**. - gas-station—The associated numeric value is **5**
residential The associated numeric value is **7**.	- unspecified—The associated numeric value is **0**. - private-residence—The associated numeric value is **1**. - hotel—The associated numeric value is **2**. - dormitory—The associated numeric value is **3**. - boarding-house—The associated numeric value is **4**.
storage The associated numeric value is **8**.	unspecified—The associated numeric value is **0**.
utility-misc The associated numeric value is **9**.	unspecified—The associated numeric value is **0**.
vehicular The associated numeric value is **10**.	- unspecified—The associated numeric value is **0**. - automobile-or-truck—The associated numeric value is **1**. - airplane—The associated numeric value is **2**. - bus—The associated numeric value is **3**. - ferry—The associated numeric value is **4**. - ship—The associated numeric value is **5**. - train—The associated numeric value is **6**. - motor-bike—The associated numeric value is **7**.
outdoor The associated numeric value is **11**.	- unspecified—The associated numeric value is **0** - muni-mesh-network—The associated numeric value is **1**. - city-park—The associated numeric value is **2**. - rest-area—The associated numeric value is **3**. - traffic-control—The associated numeric value is **4**. - bus-stop—The associated numeric value is **5**. - kiosk—The associated numeric value is **6**.

Configuring a Network Authentication Profile

You can configure a network authentication profile to define the authentication type used by the hotspot network.

To configure a network authentication profile:

```
(Instant AP)(config)# hotspot anqp-nwk-auth-profile <name>
(Instant AP)(network-auth <name>)# nwk-auth-type <type>
(Instant AP)(network-auth <name>)# url <URL>
(Instant AP)(network-auth <name>)# enable
(Instant AP)(network-auth <name>)# end
(Instant AP)# commit apply
```

You can specify any of the following network authentication type for the **nwk-auth-type <type>** command:

- **accept-term-and-cond**—When configured, the network requires the user to accept terms and conditions. This option requires you to specify a redirection URL string as an IP address, FQDN or URL.
- **online-enrollment**—When configured, the network supports the online enrollment.
- **http-redirect**—When configured, additional information on the network is provided through HTTP/HTTPS redirection.
- **dns-redirect**—When configured, additional information on the network is provided through DNS redirection. This option requires you to specify a redirection URL string as an IP address, FQDN, or URL.

Configuring a Roaming Consortium Profile

You can configure a roaming consortium profile to send the roaming consortium information as an ANQP IE in a GAS query response.

To configure a roaming consortium profile:

```
(Instant AP)(config)# hotspot anqp-roam-cons-profile <name>
(Instant AP)(roaming-consortium <name>)# roam-cons-oi <roam-cons-oi>
(Instant AP)(roaming-consortium <name>)# roam-cons-oi-len <roam-cons-oi-len>
(Instant AP)(roaming-consortium <name>)# enable
(Instant AP)(roaming-consortium <name>)# end
(Instant AP)# commit apply
```

Specify a hexadecimal string of 3–5 octets for **roam-cons-oi <roam-cons-oi>**.

Based on the Organization Identifier (OI) specified, you can specify the following parameters for the length of OI in **roam-cons-oi-len <roam-cons-oi-len>**.

- For 0: 0 Octets in the OI (Null)
- For 3: OI length is 24-bits (3 Octets)
- For 5: OI length is 36-bits (5 Octets)

Configuring a 3GPP Profile

You can configure a 3rd Generation Partnership Project (3GPP) profile to define information for the 3G Cellular Network for hotspots.

To configure a 3GPP profile:

```
(Instant AP)(config)# hotspot anqp-3gpp-profile <name>
(Instant AP)(3gpp <name>)# 3gpp-plmn1 <plmn-ID>
(Instant AP)(3gpp <name>)# enable
(Instant AP)(3gpp <name>)# end
(Instant AP)# commit apply
```

The Public Land Mobile Network (PLMN) ID is a combination of the mobile country code and network code. You can specify up to 6 PLMN IDs for a 3GPP profile.

Configuring an IP Address Availability Profile

You can configure an available IP address types to send information on IP address availability as an ANQP IE in a GAS query response.

To configure an IP address availability profile:

```
(Instant AP)(config)# hotspot anqp-ip-addr-avail-profile <name>
(Instant AP)(IP-addr-avail <name>)# ipv4-addr-avail
(Instant AP)(IP-addr-avail <name>)# ipv6-addr-avail
(Instant AP)(IP-addr-avail <name>)# enable
(Instant AP)(IP-addr-avail <name>)# end
(Instant AP)# commit apply
```

Configuring a Domain Profile

You can configure a domain profile to send the domain names as an ANQP IE in a GAS query response.

To configure a domain name profile, execute the following commands:

```
(Instant AP)(config)# hotspot anqp-domain-name-profile <name>
(Instant AP)(domain-name <name>)# domain-name <domain-name>
(Instant AP)(domain-name <name>)# enable
(Instant AP)(domain-name <name>)# end
(Instant AP)# commit apply
```

Configuring an Operator-Friendly Profile

You can configure an operator-friendly name profile to define the identify the operator.

To configure an H2QP operator-friendly name profile:

```
(Instant AP)(config)# hotspot h2qp-oper-name-profile <name>
(Instant AP)(operator-friendly-name <name>)# op-fr-name <op-fr-name>
(Instant AP)(operator-friendly-name <name>)# op-lang-code <op-lang-code>
(Instant AP)(operator-friendly-name <name>)# enable
(Instant AP)(operator-friendly-name <name>)# end
(Instant AP)# commit apply
```

Configuring a Connection Capability Profile

You can configure a connection capability profile to define information such as the hotspot IP protocols and associated port numbers that are available for communication.

To configure an H2QP connection capability profile:

```
(Instant AP)(config) # hotspot h2qp-conn-cap-profile <name>
(Instant AP)(connection-capabilities <name>)# esp-port
(Instant AP)(connection-capabilities <name>)# icmp
(Instant AP)(connection-capabilities <name>)# tcp-ftp
(Instant AP)(connection-capabilities <name>)# tcp-http
(Instant AP)(connection-capabilities <name>)# tcp-pptp-vpn
(Instant AP)(connection-capabilities <name>)# tcp-ssh
(Instant AP)(connection-capabilities <name>)# tcp-tls-vpn
(Instant AP)(connection-capabilities <name>)# tcp-voip
(Instant AP)(connection-capabilities <name>)# udp-ike2
(Instant AP)(connection-capabilities <name>)# udp-ipsec-vpn
(Instant AP)(connection-capabilities <name>)# udp-voip
(Instant AP)(connection-capabilities <name>)# enable
(Instant AP)(connection-capabilities <name>)# end
(Instant AP)# commit apply
```

Configuring an Operating-Class Profile

You can configure an operating-class profile to list the channels on which the hotspot is capable of operating. To configure an H2QP operating-class profile:

```
(Instant AP)(config) # hotspot h2qp-oper-class-profile <name>
```

```
(Instant AP)(operator-class <name>)# op-class <class-ID>
(Instant AP)(operator-class <name>)# enable
(Instant AP)(operator-class <name>)# end
(Instant AP)# commit apply
```

Configuring a WAN Metrics Profile

You can configure a WAN metrics profile to define information about access network characteristics such as link status and metrics.

To configure a WAN metrics profile:

```
(Instant AP)(config)# hotspot h2qp-wan-metrics-profile <name>
(Instant AP)(WAN-metrics <name>)# at-capacity
(Instant AP)(WAN-metrics <name>)# downlink-load <load>
(Instant AP)(WAN-metrics <name>)# downlink-speed <speed>
(Instant AP)(WAN-metrics <name>)# load-duration <duration>
(Instant AP)(WAN-metrics <name>)# symm-link
(Instant AP)(WAN-metrics <name>)# uplink-load <load>
(Instant AP)(WAN-metrics <name>)# uplink-speed <speed>
(Instant AP)(WAN-metrics <name>)# wan-metrics-link-status <status>
(Instant AP)(WAN-metrics <name>)# end
(Instant AP)# commit apply
```

You can specify the following WAN downlink and uplink parameters:

- **Downlink load**—Indicates the percentage of the WAN downlink currently utilized. The default value of 0 indicates that the downlink speed is unknown or unspecified.
- **Downlink speed**—Indicates the WAN downlink speed in Kbps.
- **Uplink load**—Indicates the percentage of the WAN uplink currently utilized. The default value of 0 indicates that the downlink speed is unknown or unspecified.
- **Uplink speed**—Indicates the WAN uplink speed in Kbps.
- **Load duration**—Indicates the duration in seconds during which the downlink utilization is measured.
- **Symmetric links**—Indicates if the uplink and downlink have the same speed.
- **WAN Link Status**—Indicates if the WAN is down (link-down), up (link-up), or in test state (link-under-test).

Creating a Hotspot Profile

To create a hotspot profile:

```
(Instant AP)(config)# hotspot hs-profile <name>
(Instant AP)(Hotspot2.0 <name>)# asra
(Instant AP)(Hotspot2.0 <name>)# access-network-type <type>
(Instant AP)(Hotspot2.0 <name>)# addtl-roam-cons-ois <roam-consortium-OIs>
(Instant AP)(Hotspot2.0 <name>)# comeback-mode
(Instant AP)(Hotspot2.0 <name>)# gas-comeback <delay-interval>
(Instant AP)(Hotspot2.0 <name>)# group-frame-block
(Instant AP)(Hotspot2.0 <name>)# hessid <hotspot-essid>
(Instant AP)(Hotspot2.0 <name>)# internet
(Instant AP)(Hotspot2.0 <name>)# p2p-cross-connect
(Instant AP)(Hotspot2.0 <name>)# p2p-dev-mgmt
(Instant AP)(Hotspot2.0 <name>)# pame-bi
(Instant AP)(Hotspot2.0 <name>)# query-response-length-limit <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-len-1 <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-len-2 <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-len-3 <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-oi-1 <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-oi-2 <integer>
(Instant AP)(Hotspot2.0 <name>)# roam-cons-oi-3 <integer>
(Instant AP)(Hotspot2.0 <name>)# venue-group <group>
(Instant AP)(Hotspot2.0 <name>)# venue-type <type>
```

```
(Instant AP)(Hotspot2.0 <name>)# enable
(Instant AP)(Hotspot2.0 <name>)# end
(Instant AP)# commit apply
```

The hotspot profile configuration parameters are described in the following table:

Table 81: *Hotspot Profile Configuration Parameters*

Parameter	Description
access-network-type <type>	Specify any of the following 802.11u network types. - **private**—This network is accessible for authorized users only. For example, home networks or enterprise networks that require user authentication. The corresponding integer value for this network type is 0. - **private-with-guest**—This network is accessible to guest users based on guest authentication methods. For example, enterprise networks that allow guest users with captive portal authentication. The corresponding integer value for this network type is 1. - **chargeable-public**—This network provides access to the Internet based on payment. For example, a subscription-based Internet access in a coffee shop or a hotel offering chargeable in-room Internet access service. The corresponding integer value for this network type is 2. - **free-public**—This network is accessible to all without any charges applied. For example, a hotspot in airport or other public places that provide Internet access with no additional cost. The corresponding integer value for this network type is 3. - **personal-device**—This network is accessible for personal devices. For example, a laptop or camera configured with a printer for the purpose of printing. The corresponding integer value for this network type is 4. - **emergency-services**—This network is limited to accessing emergency services only. The corresponding integer value for this network type is 5. - **test**—This network is used for test purposes only. The corresponding integer value for this network type is 14. - **wildcard**—This network indicates a wildcard network. The corresponding integer value for this network type is 15.
addtl-roam-cons-ois	Specify the number of additional roaming consortium Organization Identifiers (OIs) advertised by the IAP. You can specify up to three additional OIs.
asra	Enable the Additional Steps Required for Access (asra) to indicate if additional steps are required for authentication. When enabled, the following information is sent to the client in response to an ANQP query. For ASRA, ensure that the network authentication type is associated.
comeback-mode	Enable this parameter to allow the client to obtain a GAS Request and Response as a Comeback-Request and Comeback-Response. By default, this comeback mode is disabled.
gas-comeback-delay	Specify a GAS comeback delay interval in milliseconds to allow the client to retrieve the query response using a comeback request action frame when the GAS response is delayed. You can specify a value within the range of 100-2000 milliseconds and the default value is 500 milliseconds.

Table 81: *Hotspot Profile Configuration Parameters*

Parameter	Description
group-frame-block	Enable this parameter if you want to stop the IAP from sending forward downstream group-addressed frames.
hessid	Specify a Homogenous Extended Service Set Identifier (HESSID) in a hexadecimal format separated by colons.
internet	Specify this parameter to allow the IAP to send an Information Element (IE) indicating that the network allows Internet access.
p2p-cross-connect	Specify this parameter to advertise support for P2P cross-connections.
p2p-dev-mgmt	Specify this parameter to advertise support for P2P device management.
pame-bi	Specify this parameter to enable Pre-Association Message Exchange BSSID Independent (PAME-BI) bit, with which the IAP can indicate that the Advertisement Server can return a query response independent of the BSSID used in the GAS Frame exchange.
query-response-length-limit	Specify this parameter to set the maximum length of the GAS query response, in octets. You can specify a value within the range of 1–127. The default value is 127.
roam-cons-len-1 roam-cons-len-2 roam-cons-len-3	Specify the length of the organization identifier (OI). That is, the value for the length of OIs of **roam-cons-len-1**, **roam-cons-len-2**, or **roam-cons-len-3**. The roaming consortium OI is based on the following parameters: ● **0**: Zero Octets in the OI (Null) ● **3**: OI length is 24-bits (3 Octets) ● **5**: OI length is 36-bits (5 Octets)
venue-group	Specify one of the following venue groups ● unspecified ● assembly ● business ● educational ● factory-and-industrial ● institutional ● mercantile ● outdoor ● residential ● storage ● utility-misc ● vehicular By default, the business venue group is used.
venue-type	Specify a venue type to be advertised in the ANQP IEs from IAPs associated with this hotspot profile. For more information about the supported venue types for each venue group, see Table 80.

Associating an Advertisement Profile to a Hotspot Profile

To associate a hotspot profile with an advertisement profile:

```
(Instant AP)(config)# hotspot hs-profile <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-protocol <protocol>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-3gpp <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-domain-name <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-ip-addr-avail <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-nai-realm <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-nwk-auth <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-roam-cons <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile anqp-venue-name <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile h2qp-conn-cap <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile h2qp-oper-class <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile h2qp-oper-name <name>
(Instant AP)(Hotspot2.0 <name>)# advertisement-profile h2qp-wan-metrics <name>
(Instant AP)(Hotspot2.0 <name>)# end
(Instant AP)# commit apply
```

The configuration parameters for associating an advertisement profile with a hotspot profile are described in the following table:

Table 82: *Advertisement Profile Association Parameters*

Parameter	Description
advertisement-profile	Specify the advertisement profile to associate with this hotspot profile. For information on advertisement profiles, see Creating Advertisement Profiles for Hotspot Configuration on page 380.
advertisement-protocol	Specify the advertisement protocol type; for example, specify the Access Network Query Protocol (ANQP) as **anqp**.

Creating a WLAN SSID and Associating Hotspot Profile

To create a WLAN SSID with Enterprise Security and WPA-2 Encryption Settings:

```
(Instant AP)(config)# wlan ssid-profile <name>
(Instant AP)(SSID Profile <name>)# essid <ESSID-name>
(Instant AP)(SSID Profile <name>)# type {<Employee> | <Voice>| <Guest>}
(Instant AP)(SSID Profile <name>)# vlan <vlan-ID>
(Instant AP)(SSID Profile <name>)# set-vlan <attribute>{equals|not-equals|starts-with|ends-
with|contains} <operator> <VLAN-ID>| value-of}
(Instant AP)(SSID Profile <name>)# opmode {wpa2-aes|wpa-tkip,wpa2-aes}
(Instant AP)(SSID Profile <name>)# blacklist
(Instant AP)(SSID Profile <name>)# mac-authentication
(Instant AP)(SSID Profile <name>)# l2-auth-failthrough
(Instant AP)(SSID Profile <name>)# termination
(Instant AP)(SSID Profile <name>)# external-server
(Instant AP)(SSID Profile <name>)# auth-server <server-name>
(Instant AP)(SSID Profile <name>)# server-load-balancing
(Instant AP)(SSID Profile <name>)# radius-accounting
(Instant AP)(SSID Profile <name>)# radius-accounting-mode {user-authentication| user-
association}
(Instant AP)(SSID Profile <name>)# radius-interim-accounting-interval <minutes>
(Instant AP)(SSID Profile <name>)# radius-reauth-interval <minutes>
(Instant AP)(SSID Profile <name>)# set-role-by-ssid
(Instant AP)(SSID Profile <name>)# end
(Instant AP)# commit apply
```

Sample Configuration

Step 1: Creating ANQP and H2QP Advertisement Profiles

```
(Instant AP)# configure terminal
(Instant AP)(config)# hotspot anqp-nai-realm-profile nr1
(Instant AP)(nai-realm "nr1")# nai-realm-name name1
(Instant AP)(nai-realm "nr1")# nai-realm-encoding utf8
(Instant AP)(nai-realm "nr1")# nai-realm-eap-method eap-sim
(Instant AP)(nai-realm "nr1")# nai-realm-auth-id-1 non-eap-inner-auth
(Instant AP)(nai-realm "nr1")# nai-realm-auth-value-1 mschapv2
(Instant AP)(nai-realm "nr1")# nai-home-realm
(Instant AP)(nai-realm "nr1")# exit

(Instant AP)(config)# hotspot anqp-venue-name-profile vn1
(Instant AP)(venue-name "vn1")# venue-group business
(Instant AP)(venue-name "vn1")# venue-type research-and-dev-facility
(Instant AP)(venue-name "vn1")# venue-lang-code eng
(Instant AP)(venue-name "vn1")# venue-name VenueName
(Instant AP)(venue-name "vn1")# exit

(Instant AP)(config)# hotspot anqp-nwk-auth-profile na1
(Instant AP)(network-auth "na1")# nwk-auth-type accept-term-and-cond
(Instant AP)(network-auth "na1")# url www.nwkauth.com
(Instant AP)(network-auth "na1")# exit

(Instant AP)(config)# hotspot anqp-roam-cons-profile rc1
(Instant AP)(roaming-consortium "rc1")# roam-cons-oi-len 3
(Instant AP)(roaming-consortium "rc1")# roam-cons-oi 888888
(Instant AP)(roaming-consortium "rc1")# exit

(Instant AP)(config)# hotspot anqp-3gpp-profile 3g
(Instant AP)(3gpp "3g")# 3gpp-plmn1 40486
(Instant AP)(3gpp "3g")# exit

(Instant AP)(config)# hotspot anqp-ip-addr-avail-profile ip1
(Instant AP)(IP-addr-avail "ip1")# no ipv4-addr-avail
(Instant AP)(IP-addr-avail "ip1")# ipv6-addr-avail
(Instant AP)(IP-addr-avail "ip1")# exit

(Instant AP)(config)# hotspot anqp-domain-name-profile dn1
(Instant AP)(domain-name "dn1")# domain-name DomainName
(Instant AP)(domain-name "dn1")# exit

(Instant AP)(config)# hotspot h2qp-oper-name-profile on1
(Instant AP)(operator-friendly-name"on1")# op-lang-code eng
(Instant AP)(operator-friendly-name"on1")# op-fr-name OperatorFriendlyName
(Instant AP)(operator-friendly-name"on1")# exit

(Instant AP)(config) # hotspot h2qp-conn-cap-profile <name>
(Instant AP)(connection-capabilities <name>)# esp-port
(Instant AP)(connection-capabilities <name>)# icmp
(Instant AP)(connection-capabilities <name>)# tcp-ftp
(Instant AP)(connection-capabilities <name>)# tcp-http
(Instant AP)(connection-capabilities <name>)# tcp-pptp-vpn
(Instant AP)(connection-capabilities <name>)# tcp-ssh
(Instant AP)(connection-capabilities <name>)# tcp-tls-vpn
(Instant AP)(connection-capabilities <name>)# tcp-voip
(Instant AP)(connection-capabilities <name>)# udp-ike2
(Instant AP)(connection-capabilities <name>)# udp-ipsec-vpn
(Instant AP)(connection-capabilities <name>)# udp-voip
(Instant AP)(connection-capabilities <name>)# enable
(Instant AP)(connection-capabilities <name>)# exit
```

```
(Instant AP)(config) # hotspot h2qp-oper-class-profile <profile>
(Instant AP)(operator-class <name>)# op-class <class-ID>
(Instant AP)(operator-class <name>)# enable
(Instant AP)(operator-class <name>)# exit

(Instant AP)(config)# hotspot h2qp-wan-metrics-profile <name>
(Instant AP)(WAN-metrics <name>)# at-capacity
(Instant AP)(WAN-metrics <name>)# downlink-load <load>
(Instant AP)(WAN-metrics <name>)# downlink-speed <speed>
(Instant AP)(WAN-metrics <name>)# load-duration <duration>
(Instant AP)(WAN-metrics <name>)# symm-link
(Instant AP)(WAN-metrics <name>)# uplink-load <load>
(Instant AP)(WAN-metrics <name>)# uplink-speed <speed>
(Instant AP)(WAN-metrics <name>)# wan-metrics-link-status <status>
(Instant AP)(WAN-metrics <name>)# exit
```

Step 2: Creating a hotspot profile

```
(Instant AP)# configure terminal
(Instant AP)(config)# hotspot hs-profile hs1
(Instant AP)(Hotspot2.0 "hs1")# enable
(Instant AP)(Hotspot2.0 "hs1")# comeback-mode
(Instant AP)(Hotspot2.0 "hs1")# gas-comeback-delay 10
(Instant AP)(Hotspot2.0 "hs1")# no asra
(Instant AP)(Hotspot2.0 "hs1")# no internet
(Instant AP)(Hotspot2.0 "hs1")# query-response-length-limit 20
(Instant AP)(Hotspot2.0 "hs1")# access-network-type chargeable-public
(Instant AP)(Hotspot2.0 "hs1")# roam-cons-len-1 3
(Instant AP)(Hotspot2.0 "hs1")# roam-cons-oi-1 123456
(Instant AP)(Hotspot2.0 "hs1")# roam-cons-len-2 3
(Instant AP)(Hotspot2.0 "hs1")# roam-cons-oi-2 223355
(Instant AP)(Hotspot2.0 "hs1")# addtl-roam-cons-ois 0
(Instant AP)(Hotspot2.0 "hs1")# venue-group business
(Instant AP)(Hotspot2.0 "hs1")# venue-type research-and-dev-facility
(Instant AP)(Hotspot2.0 "hs1")# pame-bi
(Instant AP)(Hotspot2.0 "hs1")# group-frame-block
(Instant AP)(Hotspot2.0 "hs1")# p2p-dev-mgmt
(Instant AP)(Hotspot2.0 "hs1")# p2p-cross-connect
(Instant AP)(Hotspot2.0 "hs1")# end
(Instant AP)# commit apply
```

Step 3: Associating advertisement profiles with the hotspot profile

```
(Instant AP)# configure terminal
(Instant AP)(config)# hotspot hs-profile hs1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-nai-realm nr1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-venue-name vn1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-nwk-auth na1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-roam-cons rc1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-3gpp 3g1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-ip-addr-avail ip1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile anqp-domain-name dn1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile h2qp-oper-name on1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile h2qp-wan-metrics wm1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile h2qp-conn-cap cc1
(Instant AP)(Hotspot2.0 "hs1")# advertisement-profile h2qp-oper-class oc1
(Instant AP)(Hotspot2.0 "hs1")# end
(Instant AP)# commit apply
```

Step 4: Associating the hotspot profile with WLAN SSID:

```
(Instant AP)# configure terminal
(Instant AP)# wlan ssid-profile ssidProfile1
(Instant AP)(SSID Profile "ssidProfile1")# essid hsProf
```

```
(Instant AP)(SSID Profile "ssidProfile1")# type employee
(Instant AP)(SSID Profile "ssidProfile1")# vlan 200
(Instant AP)(SSID Profile "ssidProfile1")# opmode wpa2-aes
(Instant AP)(SSID Profile "ssidProfile1")# blacklist
(Instant AP)(SSID Profile "ssidProfile1")# mac-authentication
(Instant AP)(SSID Profile "ssidProfile1")# l2-auth-failthrough
(Instant AP)(SSID Profile "ssidProfile1")# radius-accounting
(Instant AP)(SSID Profile "ssidProfile1")# radius-accounting-mode user-association
(Instant AP)(SSID Profile "ssidProfile1")# radius-interim-accounting-interval 10
(Instant AP)(SSID Profile "ssidProfile1")# radius-reauth-interval 20
(Instant AP)(SSID Profile "ssidProfile1")# max-authentication-failures 2
(Instant AP)(SSID Profile "ssidProfile1")# set-role-by-ssid
(Instant AP)(SSID Profile "ssidProfile1")# hotspot-profile hs1
(Instant AP)(SSID Profile "ssidProfile1")# end
(Instant AP)# commit apply
```

Chapter 34
Mobility Access Switch Integration

This chapter provides the following information:

Mobility Access Switch Overview

The Aruba Mobility Access Switch enables a secure, role-based network access for wired users and devices, independent of their location or application. Installed in wiring closets, the Mobility Access Switch delivers up to 384 wire-speed Gigabit Ethernet switch ports and operates as a wired access point when deployed with an Aruba Mobility Controller.

As a wired access point, users and their devices are authenticated and assigned a unique role by the Mobility Controller. These roles are applied irrespective of whether the user is a Wi-Fi client, or is connected to a port on the Mobility Access Switch. The use of Mobility Access Switchallows an enterprise workforce to have a consistent and secure access to network resources based on the type of users, client devices, and connection method used.

Instant supports S3500 and S2500 Mobility Access Switch models.

For more information on Mobility Access Switches, refer to ArubaOS *User Guide*.

Mobility Access Switch Integration with an IAP

You can integrate an IAP with a Mobility Access Switch by connecting it directly to the switch port. The following integration features can be applied while integrating Mobility Access Switch with an IAP:

- **Rogue AP containment**—When a rogue IAP is detected by an IAP, it sends the MAC Address of the rogue IAP to the Mobility Access Switch. The Mobility Access Switch blacklists the MAC address of the rogue IAP and turns off the PoE on the port.
- **PoE prioritization**—When an IAP is connected directly into the switch port, the switch increases the PoE priority of the port. This is done only if the PoE priority is set by default in the Mobility Access Switch.

NOTE

The PoE Prioritization and Rogue AP Containment features are available for ArubaOS 7.2 release on Aruba Mobility Access Switches.

- **GVRP Integration**—Configuring GARP VLAN Registration Protocol (GVRP) enables the switch to dynamically register or unregister VLAN information received from a GVRP applicant such as an IAP. GVRP also enables the switch to propagate the registered VLAN information to the neighboring switches in the network.

NOTE

The associated static VLANs used in wired and wireless profiles are propagated to the upstream Mobility Access Switch using GVRP messages.

For information on steps to integrate Mobility Access Switch with an IAP, see Configuring IAPs for Mobility Access Switch Integration on page 395.

Configuring IAPs for Mobility Access Switch Integration

When an IAP is integrated with a Mobility Access Switch, the Link Layer Discovery Protocol (LLDP) is enabled. Using this protocol, the IAPs instruct the switch to turn off the ports where rogue IAPs are connected, perform actions such as increasing the PoE priority, and configure the VLANs on the ports to which the IAPs are connected.

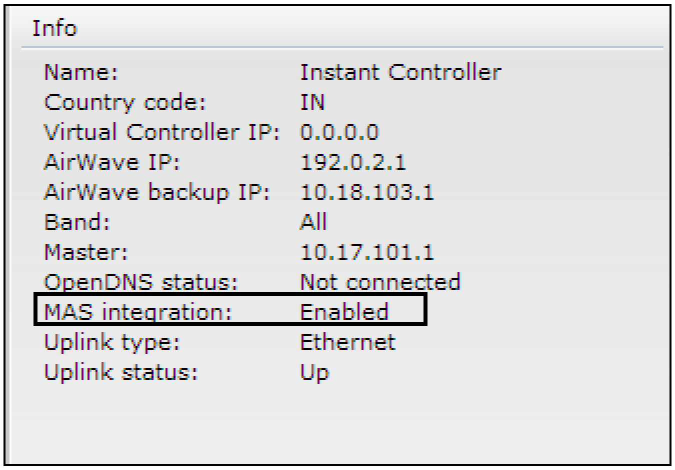
You can enable Mobility Access Switch integration either by using the Instant UI or the CLI.

In the Instant UI

To enable the Mobility Access Switch integration:

1. Navigate to **System > General**.
2. Select **Enabled** from the **MAS integration** drop-down list. The **MAS integration** status is displayed in the **Info** area of the main window as shown in the following figure:

Figure 113 *Mobility Access Switch Integration Status*



Info

Name:	Instant Controller
Country code:	IN
Virtual Controller IP:	0.0.0.0
AirWave IP:	192.0.2.1
AirWave backup IP:	10.18.103.1
Band:	All
Master:	10.17.101.1
OpenDNS status:	Not connected
MAS integration:	Enabled
Uplink type:	Ethernet
Uplink status:	Up

In the CLI

To enable the Mobility Access Switch integration:

```
(Instant AP)(config)# mas-integration
(Instant AP)(config# end
(Instant AP)# commit apply
```

This chapter consists of the following topics:

Configuring ClearPass Guest on page 396

Verifying ClearPass Guest Setup on page 400

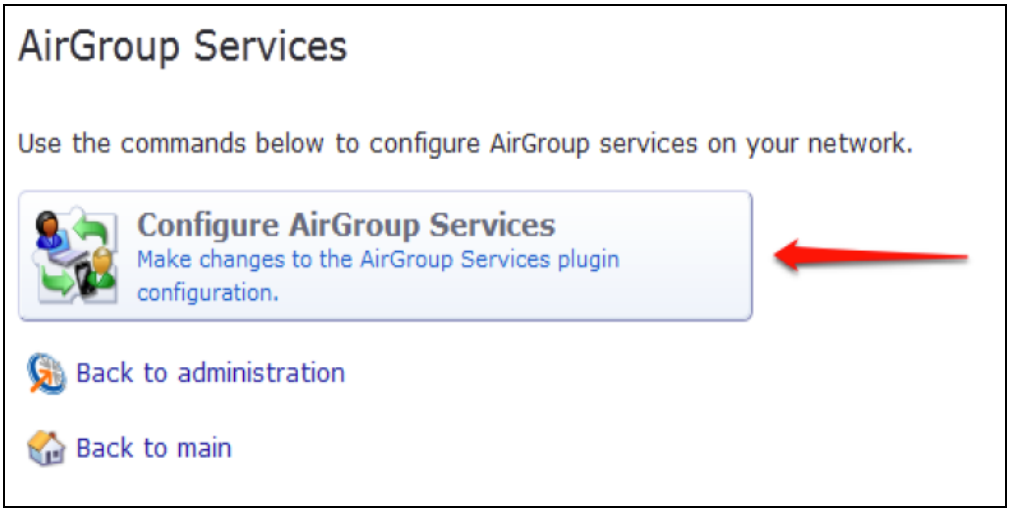
Troubleshooting on page 400

Configuring ClearPass Guest

To configure ClearPass Guest:

1. From the ClearPass Guest UI, navigate to **Administration > AirGroup Services**.
2. Click **Configure AirGroup Services**.

Figure 114 *Configure AirGroup Services*



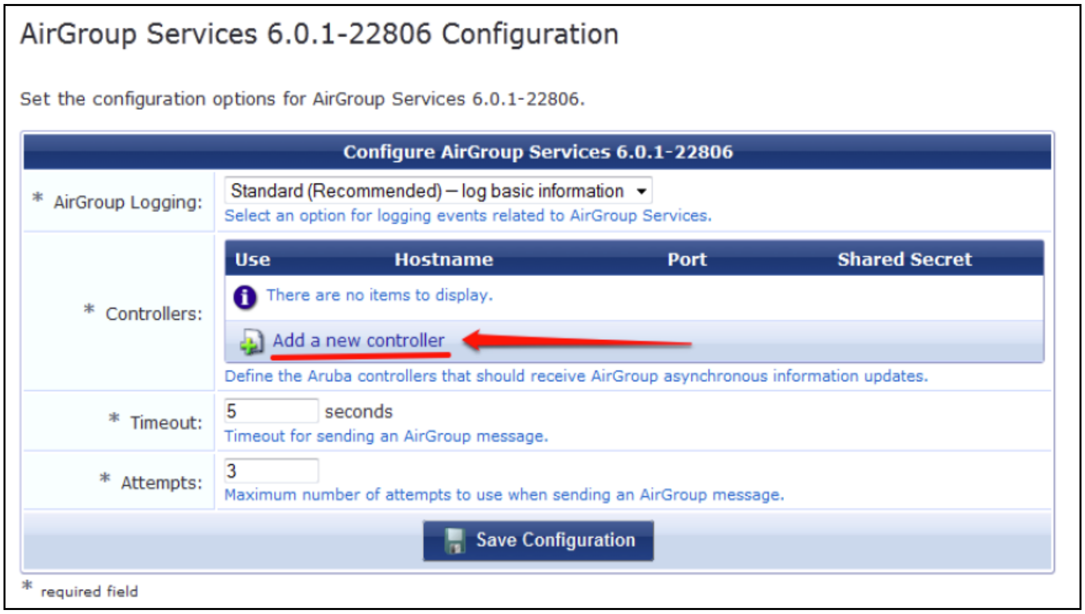
AirGroup Services

Use the commands below to configure AirGroup services on your network.

Configure AirGroup Services
Make changes to the AirGroup Services plugin configuration.
Back to administration
Back to main

3. Click **Add a new controller**.

Figure 115 *Add a New Controller for AirGroup Services*



AirGroup Services 6.0.1-22806 Configuration

Set the configuration options for AirGroup Services 6.0.1-22806.

Configure AirGroup Services 6.0.1-22806

* AirGroup Logging: Standard (Recommended) – log basic information
Select an option for logging events related to AirGroup Services.

* Controllers:

Use	Hostname	Port	Shared Secret
There are no items to display.			

Add a new controller

Define the Aruba controllers that should receive AirGroup asynchronous information updates.

* Timeout: 5 seconds
Timeout for sending an AirGroup message.

* Attempts: 3
Maximum number of attempts to use when sending an AirGroup message.

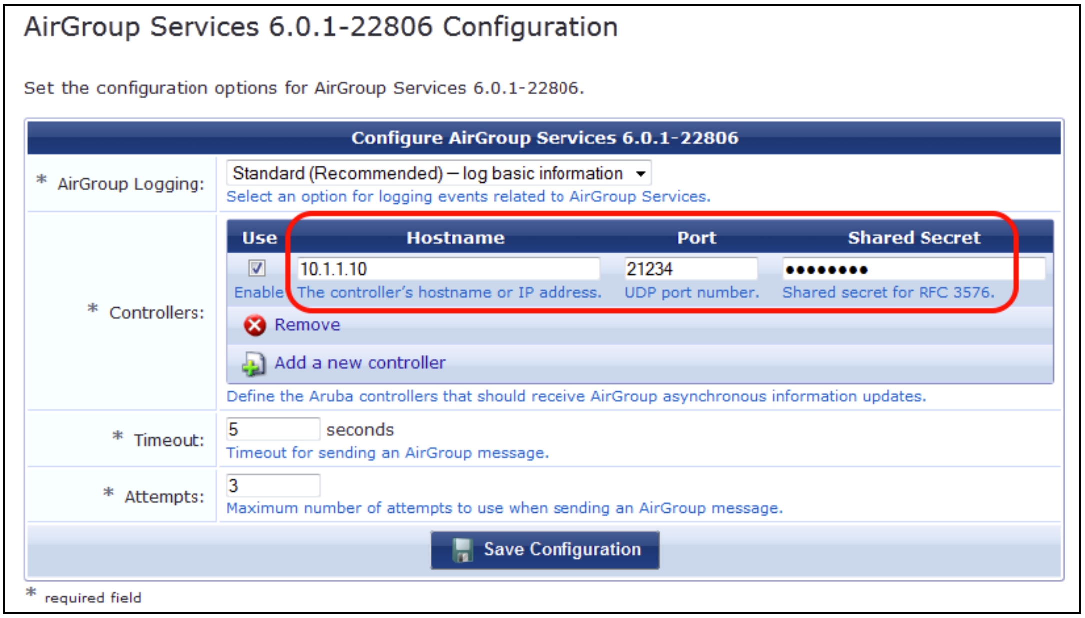
* required field

4. Update the parameters with appropriate values.

NOTE

Ensure that the port configured matches the CoA port (RFC 3576) set on the IAP configuration.

Figure 116 *Configure AirGroup Services: Controller Settings*



AirGroup Services 6.0.1-22806 Configuration

Set the configuration options for AirGroup Services 6.0.1-22806.

Configure AirGroup Services 6.0.1-22806

* AirGroup Logging: Standard (Recommended) – log basic information
Select an option for logging events related to AirGroup Services.

* Controllers:

Use	Hostname	Port	Shared Secret
☑	10.1.1.10	21234	••••••••
Enable	The controller's hostname or IP address.	UDP port number.	Shared secret for RFC 3576.

Remove

Add a new controller

Define the Aruba controllers that should receive AirGroup asynchronous information updates.

* Timeout: 5 seconds
Timeout for sending an AirGroup message.

* Attempts: 3
Maximum number of attempts to use when sending an AirGroup message.

* required field

5. Click **Save Configuration**.

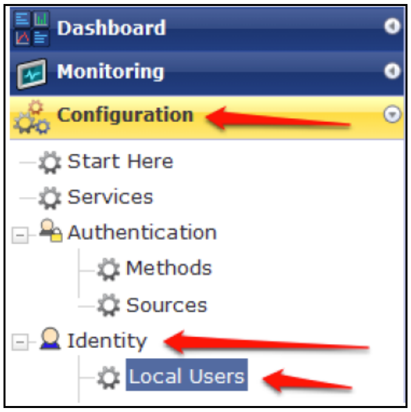
In order to demonstrate AirGroup, either an AirGroup Administrator or an AirGroup Operator account must be created.

Creating AirGroup Administrator and Operator Account

To create a AirGroup administrator and AirGroup operator account using the ClearPass Policy Manager UI:

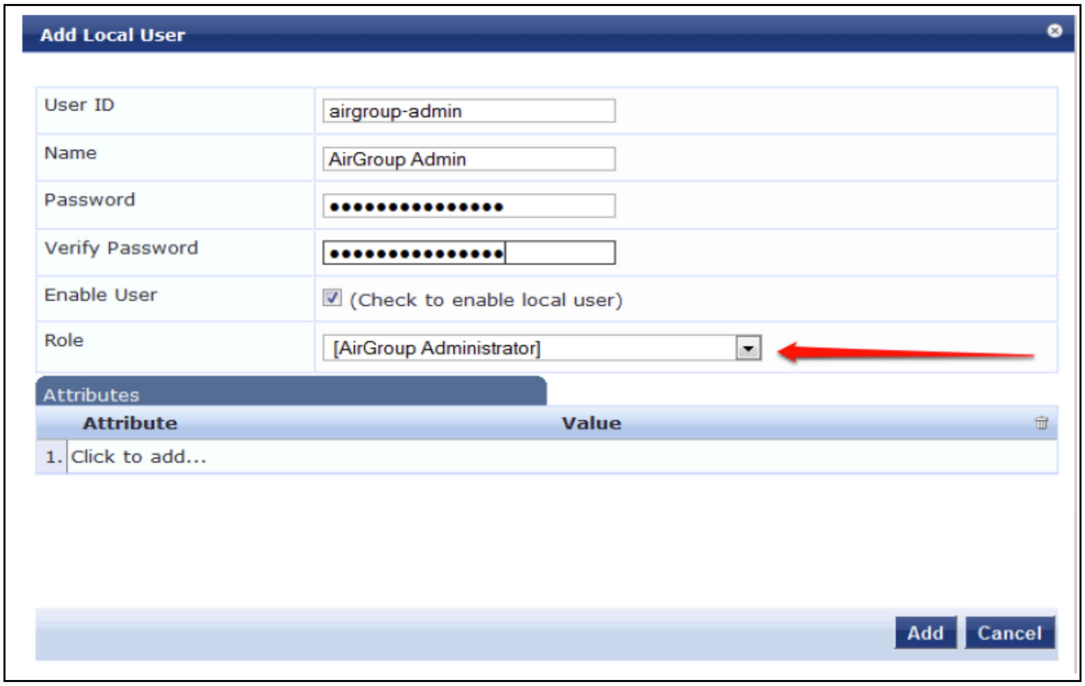
1. Navigate to the ClearPass Policy Manager UI, and navigate to **Configuration > Identity > Local Users**.

Figure 117 *Configuration > Identity > Local Users Selection*



2. Click **Add User**.
3. Create an **AirGroup Administrator** by entering the required values.

Figure 118 *Create an AirGroup Administrator*



Add Local User

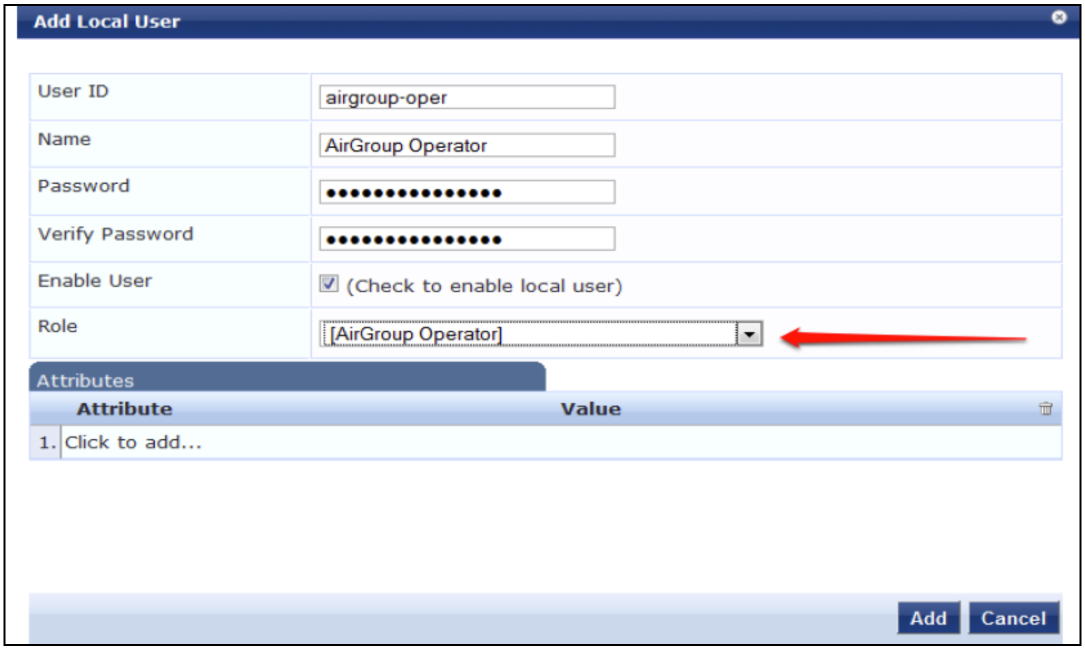
User ID	airgroup-admin
Name	AirGroup Admin
Password	•••••••••••••••
Verify Password	•••••••••••••••
Enable User	☑ (Check to enable local user)
Role	[AirGroup Administrator]

Attributes

	Attribute	Value
1.	Click to add...	

4. Click **Add**.
5. Now click **Add User** to create an **AirGroup Operator**.

Figure 119 *Create an AirGroup Operator*



Add Local User

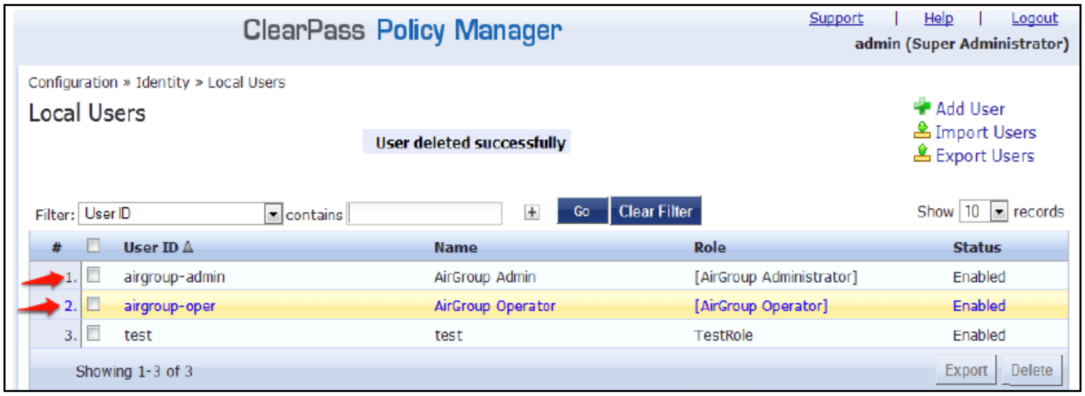
User ID	airgroup-oper
Name	AirGroup Operator
Password	●●●●●●●●●●●●●●●●
Verify Password	●●●●●●●●●●●●●●●●
Enable User	☑ (Check to enable local user)
Role	[AirGroup Operator]

Attributes

	Attribute	Value
1.	Click to add...	

6. Click **Add** to save the user with an **AirGroup Operator** role. The **AirGroup Administrator** and **AirGroup Operator IDs** will be displayed in the **Local Users** UI screen.

Figure 120 *Local Users UI Screen*



ClearPass Policy Manager
Support | Help | Logout
admin (Super Administrator)
Configuration » Identity » Local Users

Local Users

User deleted successfully

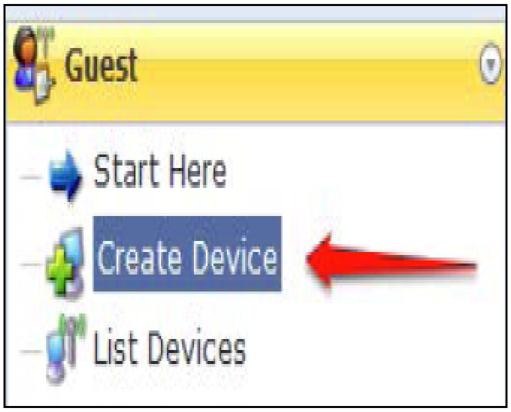
#	□	User ID ▲	Name	Role	Status
1.	□	airgroup-admin	AirGroup Admin	[AirGroup Administrator]	Enabled
2.	□	airgroup-oper	AirGroup Operator	[AirGroup Operator]	Enabled
3.	□	test	test	TestRole	Enabled

Showing 1-3 of 3

7. Navigate to the ClearPass Guest UI and click **Logout**. The **ClearPass Guest Login** page is displayed. Use the AirGroup admin credentials to log in.

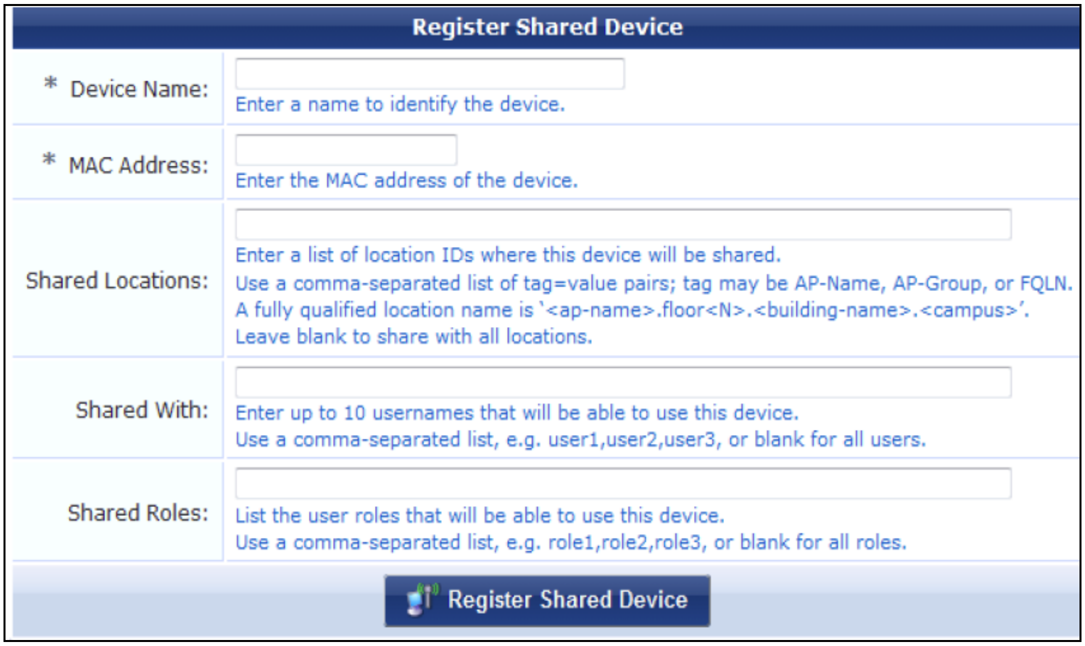
8. After logging in, click **Create Device**.

Figure 121 *Create a Device*



The **Register Shared Device** page is displayed.

Figure 122 *ClearPass Guest- Register Shared Device*



Register Shared Device

* Device Name:	Enter a name to identify the device.
* MAC Address:	Enter the MAC address of the device.
Shared Locations:	Enter a list of location IDs where this device will be shared. Use a comma-separated list of tag=value pairs; tag may be AP-Name, AP-Group, or FQLN. A fully qualified location name is '<ap-name>.floor<N>.<building-name>.<campus>'. Leave blank to share with all locations.
Shared With:	Enter up to 10 usernames that will be able to use this device. Use a comma-separated list, e.g. user1,user2,user3, or blank for all users.
Shared Roles:	List the user roles that will be able to use this device. Use a comma-separated list, e.g. role1,role2,role3, or blank for all roles.

For this test, add your AppleTV device name and MAC address but leave all other boxes empty.

9. Click **Register Shared Device**.

Verifying ClearPass Guest Setup

To verify the setup:

1. Disconnect your AppleTV and OSX Mountain Lion/iOS 6 devices if they were previously connected to the wireless network. Remove their entries from the controller's user table using these commands:
   - Find the MAC address—**show user table**
   - Delete the address from the table—**aaa user delete mac 00:aa:22:bb:33:cc**
2. Reconnect both devices. To limit access to the AppleTV, access the ClearPass Guest UI using either the AirGroup admin or the AirGroup operator credentials. Next, navigate to **List Devices > Test Apple TV > Edit**. Add a username that is not used to log in to the Apple devices in the **Shared With** box.
3. Disconnect and remove the OSX Mountain Lion/iOS 6 device from the controller's user table. Reconnect the device by not using the username that you added to the **Shared With** box. The AppleTV should not be available to this device.
4. Disconnect the OSX Mountain Lion/iOS 6 device and delete it from the controller's user table. Reconnect using the username that was added to the **Shared With** box. The OSX Mountain Lion/iOS 6 device should once again have access to the AppleTV.

Troubleshooting

Table 83: *Troubleshooting*

Problem	Solution
Limiting devices has no effect.	Ensure IPv6 is disabled.
Apple Macintosh running Mountain Lion can use AirPlay but iOS devices cannot.	Ensure IPv6 is disabled.

Chapter 36
IAP-VPN Deployment Scenarios

This section describes the most common IAP-VPN deployment models and provides information to carry out the necessary configuration procedures. The examples in this section refer to more than one DHCP profile and wired port configuration in addition to wireless SSID configuration. All these are optional. In most networks, a single DHCP profile and wireless SSID configuration referring to a DHCP profile is sufficient.

The following scenarios are described in this section:

- Scenario 1—IPsec: Single Datacenter Deployment with No Redundancy on page 403
- Scenario 2—IPsec: Single Datacenter with Multiple Controllers for Redundancy on page 407
- Scenario 3—IPsec: Multiple Datacenter Deployment with Primary and Backup Controllers for Redundancy on page 411
- Scenario 4—GRE: Single Datacenter Deployment with No Redundancy on page 416

Scenario 1—IPsec: Single Datacenter Deployment with No Redundancy

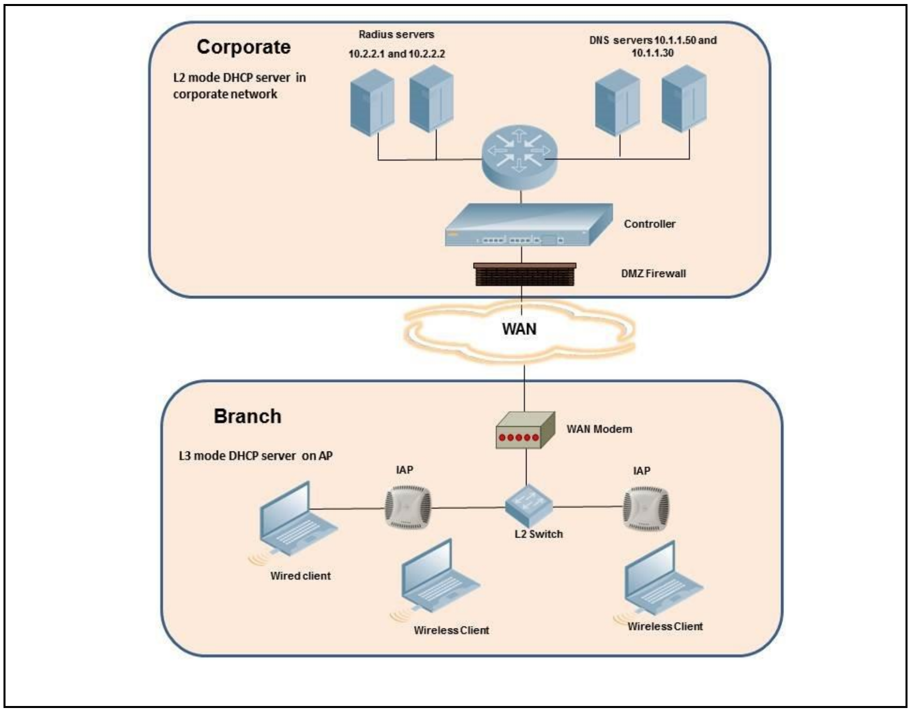
This scenario includes the following configuration elements:

1. Single VPN primary configuration using IPsec.
2. Split-tunneling of client traffic.
3. Split-tunneling of DNS traffic from clients.
4. Distributed, L3 and Centralized, L2 mode DHCP.
5. RADIUS server within corporate network and authentication survivability for branch survivability.
6. Wired and wireless users in L2 and L3 modes, respectively.
7. Access rules defined for wired and wireless networks to permit all traffic.

Topology

Figure 123 shows the topology and the IP addressing scheme used in this scenario.

Figure 123 *Scenario 1—IPsec: Single datacenter Deployment with No Redundancy*


Corporate
L2 mode DHCP server in corporate network
Radius servers 10.2.2.1 and 10.2.2.2
DNS servers 10.1.1.50 and 10.1.1.30
Controller
DMZ Firewall
WAN
Branch
L3 mode DHCP server on AP
WAN Modem
IAP
IAP
L2 Switch
Wired client
Wireless Client
Wireless Client

The following IP addresses are used in the examples for this scenario:

- 10.0.0.0/8 is the corporate network
- 10.20.0.0/16 subnet is reserved for L2 mode
- 10.30.0.0/16 subnet is reserved for L3 mode
- Client count in each branch is 200

IAP Configuration

The following table provides information on the configuration steps performed through the CLI with example values. For information on the UI procedures, see the topics referenced in the *UI Procedure* column.

Table 84: *IAP Configuration for Scenario 1—IPsec: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure
1. Configure the primary host for VPN with the Public VRRP IP address of the controller.	(Instant AP)(config)# vpn primary <public VRRP IP of controller>	See Configuring an IPsec Tunnel
2. Configure a routing profile to tunnel all 10.0.0.0/8 subnet traffic to controller.	(Instant AP)(config)# routing-profile (Instant AP)(routing-profile)# route 10.0.0.0 255.0.0.0 <public VRRP IP of controller>	See Configuring Routing Profiles
3. Configure Enterprise DNS for split DNS. The example in the next column uses a specific enterprise domain to only tunnel all DNS queries matching that domain to corporate.	(Instant AP)(config)# internal-domains (Instant AP)(domains)# domain-name corpdomain.com	See Configuring Enterprise Domains
4. Configure Centralized, L2 and Distributed, L3 with VLAN 20 and VLAN 30, respectively.	**Centralized, L2 profile** (Instant AP)(config)# ip dhcp l2-dhcp (Instant AP)(DHCP Profile "l2-dhcp")# server-type Centralized,L2 (Instant AP)(DHCP Profile "l2-dhcp")# server-vlan 20 **Distributed, L3 profile** (Instant AP)(config)# ip dhcp l3-dhcp (Instant AP)(DHCP Profile "l3-dhcp")# server-type Distributed,L3 (Instant AP)(DHCP Profile "l3-dhcp")# server-vlan 30 (Instant AP)(DHCP Profile "l3-dhcp")# ip-range 10.30.0.0 10.30.255.255 (Instant AP)(DHCP Profile "l3-dhcp")# dns-server 10.1.1.50,10.1.1.30 (Instant AP)(DHCP Profile "l3-dhcp")# domain-name corpdomain.com (Instant AP)(DHCP Profile "l3-dhcp")# client-count 200 **NOTE:** The IP range configuration on each branch will be the same. Each IAP will derive a smaller subnet based on the client count scope using the Branch ID (BID) allocated by controller.	See Configuring Centralized DHCP Scopes and Configuring Distributed DHCP Scopes
5. Create authentication servers for user authentication. The example in the next column assumes 802.1X SSID.	(Instant AP)(config)# wlan auth-server server1 (Instant AP)(Auth Server "server1")# ip 10.2.2.1 (Instant AP)(Auth Server "server1")# port 1812 (Instant AP)(Auth Server "server1")# acctport 1813 (Instant AP)(Auth Server "server1")# key "presharedkey" (Instant AP)(Auth Server "server1")# exit (Instant AP)(config)# wlan auth-server server2 (Instant AP)(Auth Server "server2")# ip 10.2.2.2 (Instant AP)(Auth Server "server2")# port 1812	See Configuring an External Server for Authentication

Table 84: *IAP Configuration for Scenario 1—IPsec: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure

	`(Instant AP)(Auth Server "server2")# acctport 1813`
	`(Instant AP)(Auth Server "server2")# key "presharedkey"`	

6. Configure wired port and wireless SSIDs using the authentication servers.	Configure wired ports to operate in L2 mode and associate Centralized, L2 mode VLAN 20 to the wired port profile.
	`(Instant AP)(config) # wired-port-profile wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# switchport-mode access`
	`(Instant AP)(wired-port-profile "wired-port")# allowed-vlan all`
	`(Instant AP)(wired-port-profile "wired-port")# native-vlan 20`
	`(Instant AP)(wired-port-profile "wired-port")# no shutdown`
	`(Instant AP)(wired-port-profile "wired-port")# access-rule-name wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# type employee`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server1`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server2`
	`(Instant AP)(wired-port-profile "wired-port")# dot1x`
	`(Instant AP)(wired-port-profile "wired-port")# exit`
	`(Instant AP)(config)# enet1-port-profile wired-port`
	Configure a wireless SSID to operate in L3 mode and associate Distributed, L3 mode VLAN 30 to the WLAN SSID profile.
	`(Instant AP)(config) # wlan ssid-profile wireless-ssid`
	`(Instant AP)(SSID Profile "wireless-ssid")# enable`
	`(Instant AP)(SSID Profile "wireless-ssid")# type employee`
	`(Instant AP)(SSID Profile "wireless-ssid")# essid wireless-ssid`
	`(Instant AP)(SSID Profile "wireless-ssid")# opmode wpa2-aes`
	`(Instant AP)(SSID Profile "wireless-ssid")# vlan 30`
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-server server1`
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-server server2`
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-survivability`
		See Configuring a Wired Profile and Wireless Network Profiles

7. Create access rule for wired and wireless authentication. In this example, the rule permits all traffic.	**For wired profile:**
	`(Instant AP)(config)# wlan access-rule wired-port`
	`(Instant AP)(Access Rule "wired-port")# rule any any match any any any permit`
	For WLAN SSID:
	`(Instant AP)(config)# wlan access-rule wireless-ssid`
		See Configuring ACL Rules for Network Services

Table 84: *IAP Configuration for Scenario 1—IPsec: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure
	`(Instant AP)(Access Rule "wireless-ssid")# rule any any match any any any permit`	
NOTE: Ensure that you execute the **commit apply** command in the Instant CLI before saving the configuration and propagating changes across the IAP cluster.		

IAP-Connected Switch Configuration

Client VLANs defined in this example must be opened on the upstream switches in multiple IAP deployments, as client traffic from the slave to the master is tagged with the client VLAN.

Datacenter Configuration

For information on controller configuration, see Configuring a Controller for IAP-VPN Operations on page 246. Ensure that the upstream router is configured with a static route pointing to the controller for the L3 VLAN.

Scenario 2—IPsec: Single Datacenter with Multiple Controllers for Redundancy

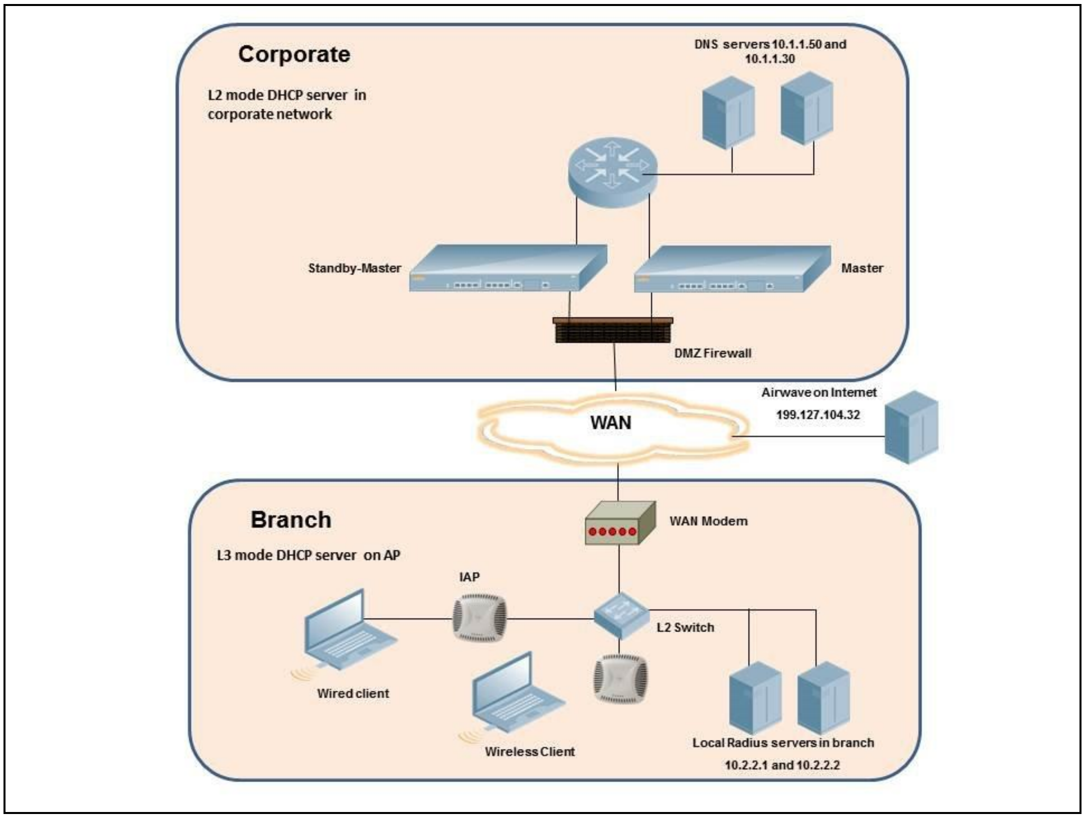
This scenario includes the following configuration elements:

- A VRRP instance between the master/standby-master pair, which is configured as the primary VPN IP address.
- Tunneling of all traffic to datacenter.
- Exception route to bypass tunneling of RADIUS and AirWave traffic, which are locally reachable in the branch and the Internet, respectively.
- All client DNS queries are tunneled to the controller.
- Distributed, L3 and Centralized, L2 mode DHCP on all branches. L3 is used by the employee network and L2 is used by the guest network with captive portal.
- Wired and wireless users in L2 and L3 modes.
- Access rules defined for wired and wireless networks.

Topology

Figure 124 shows the topology and the IP addressing scheme used in this scenario.

Figure 124 *Scenario 2—IPsec: Single Datacenter with Multiple controllers for Redundancy*



The following IP addresses are used in the examples for this scenario:

- 10.0.0.0/8 is the corporate network
- 10.20.0.0/16 subnet is reserved for L2 mode – used for guest network
- 10.30.0.0/16 subnet is reserved for L3 mode
- Client count in each branch is 200

- 10.2.2.0/24 is a branch-owned subnet, which needs to override global routing profile
- 199.127.104.32 is used an example IP address of the AirWave server in the Internet

IAP Configuration

The following table provides information on the configuration steps performed through the CLI with example values. For information on the UI procedures, see the topics referenced in the *UI Procedure* column.

Table 85: *IAP Configuration for Scenario 2—IPsec: Single Datacenter with Multiple controllers for Redundancy*

Configuration Steps	CLI Commands	UI Procedure
1. Configure the primary host for VPN with the Public VRRP IP address of the controller.	`(Instant AP)(config)# vpn primary <public VRRP IP of controller>`	See Configuring an IPsec Tunnel

2. Configure routing profiles to tunnel traffic through IPsec.	`(Instant AP)(config)# routing-profile`
	`(Instant AP)(routing-profile)# route 0.0.0.0 0.0.0.0 <public VRRP IP of controller>`
		See Configuring Routing Profiles

3. Define routing profile exception RADIUS server and AirWave IPs, since the design requirement for this solution requires local RADIUS authentication, even though the IP matches the routing profile destination.	`(Instant AP)(config)# routing-profile`
	`(Instant AP)(routing-profile)# route 10.2.2.1 255.255.255.255 0.0.0.0`
	`(Instant AP)(routing-profile)# route 10.2.2.2 255.255.255.255 0.0.0.0`
	`(Instant AP)(routing-profile)# route 199.127.104.32 255.255.255.255 0.0.0.0`
		See Configuring Routing Profiles

4. Configure Enterprise DNS. The configuration example in the next column tunnels all DNS queries to the original DNS server of clients without proxying on IAP.	`(Instant AP)(config)# internal-domains`
	`(Instant AP)(domains)# domain-name *`
		See Configuring Enterprise Domains

5. Configure Centralized, L2 and Distributed, L3 with VLAN 20 and VLAN 30, respectively.	**Centralized, L2 profile**
	`(Instant AP)(config)# ip dhcp l2-dhcp`
	`(Instant AP)(DHCP Profile "l2-dhcp")# server-type Centralized,L2`
	`(Instant AP)(DHCP Profile "l2-dhcp")# server-vlan 20`
	Distributed, L3 profile
	`(Instant AP)(config)# ip dhcp l3-dhcp`
	`(Instant AP)(DHCP Profile "l3-dhcp")# server-type Distributed,L3`
	`(Instant AP)(DHCP Profile "l3-dhcp")# server-vlan 30`
	`(Instant AP)(DHCP Profile "l3-dhcp")# ip-range 10.30.0.0 10.30.255.255`
	`(Instant AP)(DHCP Profile "l3-dhcp")# dns-server 10.1.1.50,10.1.1.30`
	`(Instant AP)(DHCP Profile "l3-dhcp")# domain-name corpdomain.com`
		See Configuring Centralized DHCP Scopes and Configuring Distributed DHCP Scopes

Table 85: *IAP Configuration for Scenario 2—IPsec: Single Datacenter with Multiple controllers for Redundancy*

Configuration Steps	CLI Commands	UI Procedure
	`(Instant AP)(DHCP Profile "l3-dhcp")# client-count 200` **NOTE:** The IP range configuration on each branch will be the same. Each IAP will derive a smaller subnet based on the client count scope using the Branch ID (BID) allocated by controller.	

6. Create authentication servers for user authentication. The example in the next column assumes 802.1X SSID.	`(Instant AP)(config)# wlan auth-server server1`
	`(Instant AP)(Auth Server "server1")# ip 10.2.2.1`
	`(Instant AP)(Auth Server "server1")# port 1812`
	`(Instant AP)(Auth Server "server1")# acctport 1813`
	`(Instant AP)(Auth Server "server1")# key "presharedkey"`
	`(Instant AP)(Auth Server "server1")# exit`
	`(Instant AP)(config)# wlan auth-server server2`
	`(Instant AP)(Auth Server "server2")# ip 10.2.2.2`
	`(Instant AP)(Auth Server "server2")# port 1812`
	`(Instant AP)(Auth Server "server2")# acctport 1813`
	`(Instant AP)(Auth Server "server2")# key "presharedkey"`
		See Configuring an External Server for Authentication

7. Configure wired port and wireless SSIDs using the authentication servers.	Configure wired ports to operate in L3 mode and associate Distributed, L3 mode VLAN 30 to the wired port profile.
	`(Instant AP)(config) # wired-port-profile wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# switchport-mode access`
	`(Instant AP)(wired-port-profile "wired-port")# allowed-vlan all`
	`(Instant AP)(wired-port-profile "wired-port")# native-vlan 30`
	`(Instant AP)(wired-port-profile "wired-port")# no shutdown`
	`(Instant AP)(wired-port-profile "wired-port")# access-rule-name wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# type employee`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server1`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server2`
	`(Instant AP)(wired-port-profile "wired-port")# dot1x`
	`(Instant AP)(wired-port-profile "wired-port")# exit`
	`(Instant AP)(config)# enet1-port-profile wired-port`
	Configure a wireless SSID to operate in L2 mode and associate Centralized, L2 mode VLAN 20 to the WLAN SSID profile.
	`(Instant AP)(config) # wlan ssid-profile guest`
	`(Instant AP)(SSID Profile "guest")# enable`
	`(Instant AP)(SSID Profile "guest")# type guest`
	`(Instant AP)(SSID Profile "guest")# essid guest`
	`(Instant AP)(SSID Profile "guest")# opmode opensystem`
	`(Instant AP)(SSID Profile "guest")# vlan 20`
		See Configuring a Wired Profile and Wireless Network Profiles

Table 85: *IAP Configuration for Scenario 2—IPsec: Single Datacenter with Multiple controllers for Redundancy*

Configuration Steps	CLI Commands	UI Procedure

	`(Instant AP)(SSID Profile "guest")# auth-server server1`
	`(Instant AP)(SSID Profile "guest")# auth-server server2`
	`(Instant AP)(SSID Profile "guest")# captive-portal internal`
	NOTE: This example uses internal captive portal use case using external authentication server. You can also use an external captive portal example.
	NOTE: The SSID type **guest** is used in this example to enable configuration of captive portal. However, corporate access through VPN tunnel is still allowed for this SSID because the VLAN associated to this SSID is a VPN-enabled VLAN (20 in this example).	

8. Create access rule for wired and wireless authentication. In this example, the rule permits all traffic.	**For wired profile:**
	`(Instant AP)(config)# wlan access-rule wired-port`
	`(Instant AP)(Access Rule "wired-port")# rule any any match any any any permit`
	For WLAN SSID:
	`(Instant AP)(config)# wlan access-rule guest`
	`(Instant AP)(Access Rule "guest")# rule any any match any any any permit`
		See Configuring ACL Rules for Network Services

NOTE: Ensure that you execute the **commit apply** command in the Instant CLI before saving the configuration and propagating changes across the IAP cluster.		

IAP-Connected Switch Configuration

Client VLANs defined in this example must be opened on the upstream switches in multiple IAP deployments, as client traffic from the slave to the master is tagged with the client VLAN.

Datacenter Configuration

For information on controller configuration, see Configuring a Controller for IAP-VPN Operations on page 246. Ensure that the upstream router is configured with a static route pointing to the controller for the L3 VLAN.

Scenario 3—IPsec: Multiple Datacenter Deployment with Primary and Backup Controllers for Redundancy

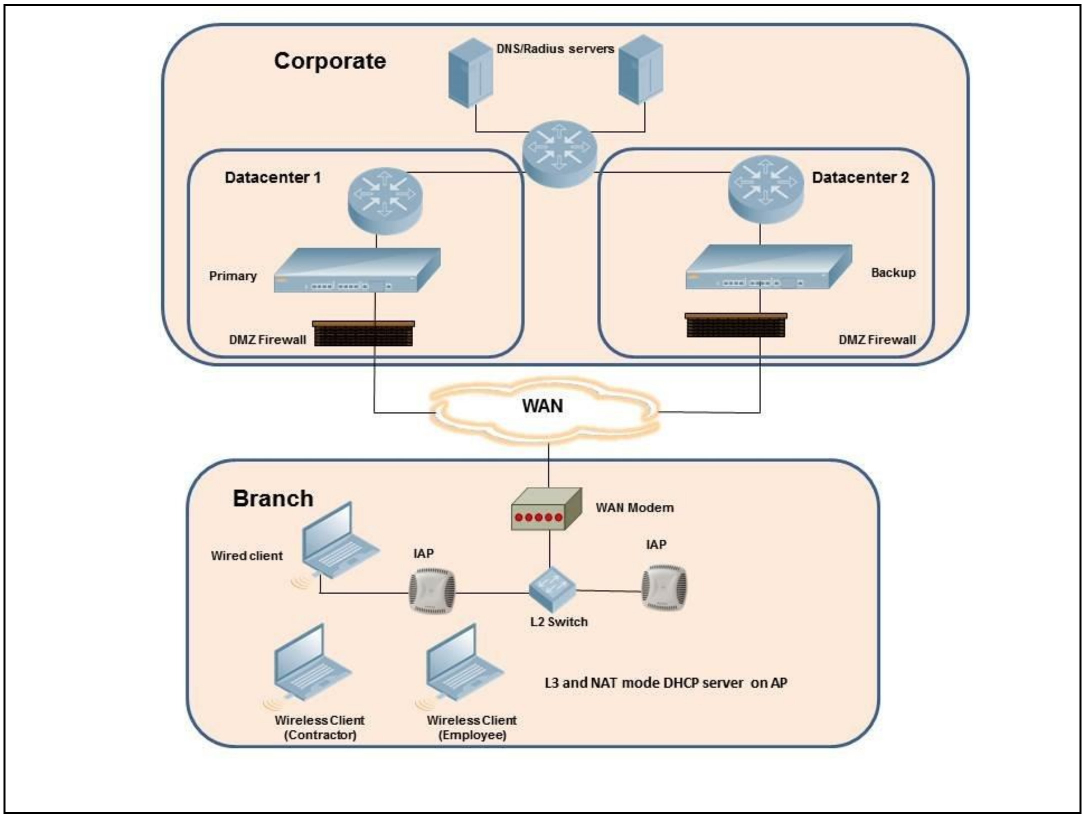
This scenario includes the following configuration elements:

- Multiple controller deployment model with controllers in different data centers operating as primary/backup VPN with **Fast Failover** and preemption enabled.
- Split-tunneling of traffic.
- Split-tunneling of client DNS traffic.
- Two Distributed, L3 mode DHCPs, one each for employee and contractors; and one Local mode DHCP server.
- RADIUS server within corporate network and authentication survivability enabled for branch survivability.
- Wired and wireless users in L3 and NAT modes, respectively.
- Access rules for wired and wireless users with source-NAT-based rule for contractor roles to bypass global routing profile.
- OSPF based route propagation on controller.

Topology

Figure 125 shows the topology and the IP addressing scheme used in this scenario.

Figure 125 *Scenario 3—IPsec: Multiple Datacenter Deployment with Primary and Backup Controllers for Redundancy*



The IP addressing scheme used in this example is as follows:

- 10.0.0.0/8 is the corporate network.
- 10.30.0.0/16 subnet is reserved for L3 mode –used by Employee SSID.

- 10.40.0.0/16 subnet is reserved for L3 mode –used by Contractor SSID.
- 172.16.20.0/24 subnet is used for NAT mode – used for wired network.
- Client count in each branch is 200.
- Contractors are only permitted to reach 10.16.0.0/16 network.

IAP Configuration

This section provides information on configuration steps performed through the CLI and the UI.

Table 86: *IAP Configuration for Scenario 3—IPsec: Multiple Datacenter Deployment*

Configuration Steps	CLI Commands	UI Procedure

1. Configure the primary IP address. This IP address is the Public IP address of the controller. **Fast Failover** is enabled for fast convergence.	`(Instant AP)(config)# vpn primary <public IP of primary controller>`
	`(Instant AP)(config)# vpn backup <public IP of backup controllers>`
	`(Instant AP)(config)# vpn preemption`
	`(Instant AP)(config)# vpn fast-failover`
		See Configuring an IPsec Tunnel

2. Configure routing profiles to tunnel traffic through IPsec.	`(Instant AP)(config)# routing-profile`
	`(Instant AP)(routing-profile)# route 0.0.0.0 0.0.0.0 <public IP of primary controller>`
	`(Instant AP)(routing-profile)# route 10.0.0.0 255.0.0.0 <public IP of backup controller>`
		See Configuring Routing Profiles

3. Configure Enterprise DNS for split DNS. The example in the next column uses a specific enterprise domain to tunnel all DNS queries matching that domain to corporate.	`(Instant AP)(config)# internal-domains`
	`(Instant AP)(domains)# domain-name corpdomain.com`
		See Configuring Enterprise Domains

4. Configure Distributed, L3 DHCP profiles with VLAN 30 and VLAN 40.	**Distributed, L3 profile with VLAN 30**
	`(Instant AP)(config)# ip dhcp l3-dhcp`
	`(Instant AP)(DHCP profile "l3-dhcp")# server-type Distributed,L3`
	`(Instant AP)(DHCP profile "l3-dhcp")# server-vlan 30`
	`(Instant AP)(DHCP profile "l3-dhcp")# ip-range 10.30.0.0 10.30.255.255`
	`(Instant AP)(DHCP profile "l3-dhcp")# dns-server 10.1.1.50,10.1.1.30`
	`(Instant AP)(DHCP profile "l3-dhcp")# domain-name corpdomain.com`
	`(Instant AP)(DHCP profile "l3-dhcp")# client-count 200`
	Distributed, L3 profile with VLAN 40
	`(Instant AP)(config)# ip dhcp l3-dhcp`
	`(Instant AP)(DHCP profile "l3-dhcp")# server-type Distributed,L3`
	`(Instant AP)(DHCP profile "l3-dhcp")# server-vlan 40`
	`(Instant AP)(DHCP profile "l3-dhcp")# ip-range 10.40.0.0 10.40.255.255`
	`(Instant AP)(DHCP profile "l3-dhcp")# dns-server 10.1.1.50,10.1.1.30`
		See Configuring Distributed DHCP Scopes
		and
		Configuring Local DHCP Scopes

Table 86: *IAP Configuration for Scenario 3—IPsec: Multiple Datacenter Deployment*

Configuration Steps	CLI Commands	UI Procedure
	(Instant AP)(DHCP profile "l3-dhcp")# domain-name corpdomain.com (Instant AP)(DHCP profile "l3-dhcp")# client-count 200 **Local profile with VLAN 20** (Instant AP)(config)# ip dhcp local (Instant AP)(DHCP profile "local")# server-type Local (Instant AP)(DHCP profile "local")# server-vlan 20 (Instant AP)(DHCP profile "local")# subnet 172.16.20.1 (Instant AP)(DHCP profile "local")# subnet-mask 255.255.255.0 (Instant AP)(DHCP profile "local")# lease-time 86400 (Instant AP)(DHCP profile "local")# dns-server 10.1.1.30,10.1.1.50 (Instant AP)(DHCP profile "local")# domain-name arubanetworks.com **NOTE:** The IP range configuration on each branch will be the same. Each IAP will derive a smaller subnet based on the client count scope using the Branch ID (BID) allocated by the controller.	
5. Create authentication servers for user authentication. The example in the next column assumes 802.1X SSID.	(Instant AP)(config)# wlan auth-server server1 (Instant AP)(Auth Server "server1")# ip 10.2.2.1 (Instant AP)(Auth Server "server1")# port 1812 (Instant AP)(Auth Server "server1")# acctport 1813 (Instant AP)(Auth Server "server1")# key "presharedkey" (Instant AP)(Auth Server "server1")# exit (Instant AP)(config)# wlan auth-server server2 (Instant AP)(Auth Server "server1")# ip 10.2.2.2 (Instant AP)(Auth Server "server1")# port 1812 (Instant AP)(Auth Server "server1")# acctport 1813 (Instant AP)(Auth Server "server1")# key "presharedkey"	See Configuring an External Server for Authentication
6. Configure wired port and wireless SSIDs using the authentication servers and access rules; enable authentication survivability.	Configure wired ports to operate in NAT mode and associate VLAN 20 to the wired port profile. (Instant AP)(config) # wired-port-profile wired-port (Instant AP)(wired-port-profile "wired-port")# switchport-mode access (Instant AP)(wired-port-profile "wired-port")# allowed-vlan all (Instant AP)(wired-port-profile "wired-port")# native-vlan 20 (Instant AP)(wired-port-profile "wired-port")# no shutdown (Instant AP)(wired-port-profile "wired-port")# access-rule-name wired-port (Instant AP)(wired-port-profile "wired-port")# type employee (Instant AP)(wired-port-profile "wired-port")# auth-server server1	See Configuring a Wired Profile and Wireless Network Profiles

Table 86: *IAP Configuration for Scenario 3—IPsec: Multiple Datacenter Deployment*

Configuration Steps	CLI Commands	UI Procedure
	(Instant AP)(wired-port-profile "wired-port")# auth-server server2 (Instant AP)(wired-port-profile "wired-port")# dot1x (Instant AP)(wired-port-profile "wired-port")# exit (Instant AP)(config)# enet1-port-profile wired-port Configure a wireless SSID to operate in L3 mode for employee and associate Distributed, L3 mode VLAN 30 to the WLAN SSID profile. (Instant AP)(config) # wlan ssid-profile wireless-ssid (Instant AP)(SSID Profile "wireless-ssid")# enable (Instant AP)(SSID Profile "wireless-ssid")# type employee (Instant AP)(SSID Profile "wireless-ssid")# essid wireless-ssid (Instant AP)(SSID Profile "wireless-ssid")# opmode wpa2-aes (Instant AP)(SSID Profile "wireless-ssid")# vlan 30 (Instant AP)(SSID Profile "wireless-ssid")# auth-server server1 (Instant AP)(SSID Profile "wireless-ssid")# auth-server server2 (Instant AP)(SSID Profile "wireless-ssid")# auth-survivability Configure a wireless SSID to operate in L3 mode for contractor and associate Distributed, L3 mode VLAN 40 to the WLAN SSID profile. (Instant AP)(config) # wlan ssid-profile wireless-ssid-contractor (Instant AP)(SSID Profile "wireless-ssid-contractor")# enable (Instant AP)(SSID Profile "wireless-ssid-contractor")# type contractor (Instant AP)(SSID Profile "wireless-ssid-contractor")# essid wireless-ssid-contractor (Instant AP)(SSID Profile "wireless-ssid-contractor")# opmode wpa2-aes (Instant AP)(SSID Profile "wireless-ssid-contractor")# vlan 40 (Instant AP)(SSID Profile "wireless-ssid-contractor")# auth-server server1 (Instant AP)(SSID Profile "wireless-ssid-contractor")# auth-server server2 (Instant AP)(SSID Profile "wireless-ssid-contractor")# auth-survivability	
7. Create access rule for wired and wireless authentication. In this example, the rule permits all traffic. For contractor SSID role, the rule allows only	**For wired profile:** (Instant AP)(config)# wlan access-rule wired-port (Instant AP)(Access Rule "wired-port")# rule any any match any any any permit **For WLAN SSID employee roles:**	See Configuring ACL Rules for Network Services

Table 86: *IAP Configuration for Scenario 3—IPsec: Multiple Datacenter Deployment*

Configuration Steps	CLI Commands	UI Procedure

10.16.0.0/16 network and all other traffic address is translated at the source and the global routing profile definition is bypassed.	`(Instant AP)(config)# wlan access-rule wireless-ssid`
	`(Instant AP)(Access Rule "wireless-ssid")# rule any any match any any any permit`
	For WLAN SSID contractor roles:
	`(Instant AP)(config)# wlan access-rule wireless-ssid-contractor`
	`(Instant AP)(Access Rule "wireless-ssid-contractor") # rule 10.16.0.0 255.255.0.0 match any any any permit`
	`(Instant AP)(Access Rule "wireless-ssid-contractor") # rule any any match any any any src-nat`	

NOTE: Ensure that you execute the **commit apply** command in the Instant CLI before saving the configuration and propagating changes across the IAP cluster.		

IAP-Connected Switch Configuration

Client VLANs defined in this example must be opened on the upstream switches in multiple IAP deployments, as client traffic from the slave to the master is tagged with the client VLAN.

Datacenter Configuration

For information on controller configuration, see Configuring a Controller for IAP-VPN Operations on page 246.

The following OSPF configuration is required on the controller to redistribute IAP-VPN routes to upstream routers:

```
(host)(config) # router ospf
(host)(config) # router ospf router-id <ID>
(host)(config) # router ospf area 0.0.0.0
(host)(config) # router ospf redistribute rapng-vpn
```

Scenario 4—GRE: Single Datacenter Deployment with No Redundancy

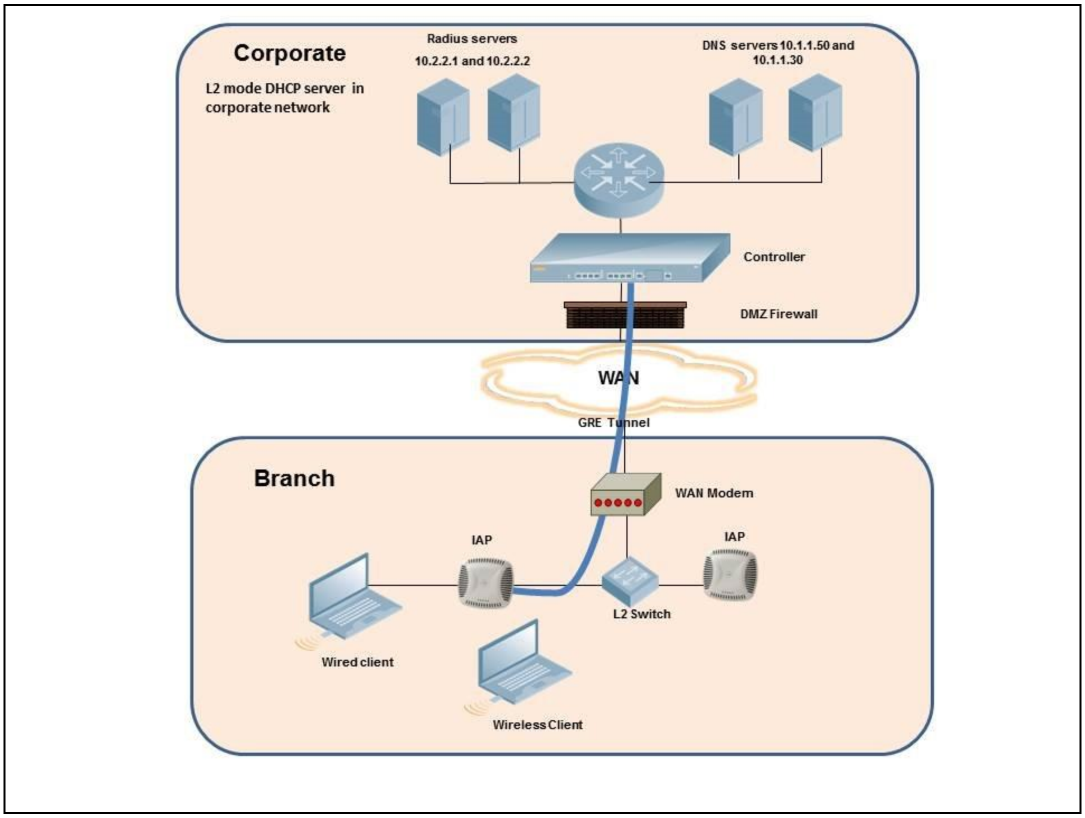
This scenario includes the following configuration elements:

- Single VPN primary configuration using GRE
  - **Aruba GRE**, does not require any configuration on the Aruba Mobility Controller that acts as a GRE endpoint.
  - **Manual GRE**, which requires GRE tunnels to be explicitly configured on the GRE endpoint that can be an Aruba Mobility Controller or any device that supports GRE termination.
- Tunneling of all traffic to datacenter
- Centralized, L2 mode DHCP profile
- RADIUS server within corporate network and authentication survivability for branch survivability.
- Wired and wireless users in L2 mode
- Access rules defined for wired and wireless networks to permit all traffic

Topology

Figure 126 shows the topology and the IP addressing scheme used in this scenario:

Figure 126 *Scenario 4—GRE: Single Datacenter Deployment with No Redundancy*


Corporate
L2 mode DHCP server in corporate network
Radius servers 10.2.2.1 and 10.2.2.2
DNS servers 10.1.1.50 and 10.1.1.30
Controller
DMZ Firewall
WAN
GRE Tunnel
Branch
WAN Modem
IAP
IAP
L2 Switch
Wired client
Wireless Client

The following IP addresses are used in the examples for this scenario:

- 10.0.0.0/8 is the corporate network.
- 10.20.0.0/16 subnet is reserved for L2 mode.

IAP Configuration

This section provides information on configuration steps performed by using the CLI and the UI.

Table 87: *IAP Configuration for Scenario—GRE: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure

1. Configure Aruba GRE or manual GRE
- Aruba GRE uses an IPsec tunnel to facilitate controller configuration and requires VPN to be configured. This VPN tunnel is not used for any client traffic.
- Manual GRE uses standard GRE tunnel configuration and requires controller configuration to complete the GRE tunnel.
	Aruba GRE configuration
	`(Instant AP)(config)# vpn primary <controller-IP>`
	`(Instant AP)(config)# vpn gre-outside`
	Manual GRE configuration
	`(Instant AP)(config)# gre primary <controller-IP>`
	`(Instant AP)(config)# gre type 80`
	Per-AP GRE tunnel configuration
	Optionally, per-AP GRE tunnel can also be enabled, which causes each IAP to form an independent GRE tunnel to the GRE end-point. Aruba GRE requires each IAP MAC to be present in the controller whitelist. Manual GRE requires GRE configuration for the IP of each IAP on the controller.
	`(Instant AP)(config)# gre per-ap-tunnel`
	NOTE: Starting with Instant 6.5.1.0-4.3.1.0, if VC IP is configured and per-AP GRE tunnel is disabled, IAP uses VC IP as the GRE source IP. For Manual GRE, this simplifies configuration on controller, since only the VC IP destined GRE tunnel interface configuration is required.
		See Configuring Aruba GRE Parameters
		and Configuring Manual GRE Parameters

2. Configure routing profiles to tunnel traffic through GRE.	`(Instant AP)(config)# routing-profile`
	`(Instant AP)(routing-profile)# route 0.0.0.0 0.0.0.0 <IP of GRE-endpoint>`
		See Configuring Routing Profiles

3. Configure Enterprise DNS. The example in the next column tunnels all DNS queries to the client's original DNS server without proxying on IAP.	`(Instant AP)(config)# internal-domains`
	`(Instant AP)(domains)# domain-name *`
		See Configuring Enterprise Domains

4. Configure Centralized, L2 DHCP profile with VLAN 20.	**Centralized, L2 DHCP profile VLAN 20**
	`(Instant AP)(config)# ip dhcp l2-dhcp`
	`(Instant AP)(DHCP profile "l2-dhcp")# server-type Centralized,L2`
	`(Instant AP)(DHCP profile "l2-dhcp")# server-vlan 20`
		See Configuring Centralized DHCP Scopes

Table 87: *IAP Configuration for Scenario—GRE: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure

5. Create authentication servers for user authentication. The example in the next column assumes 802.1X SSID.	`(Instant AP)(config)# wlan auth-server server1`
	`(Instant AP)(Auth Server "server1")# ip 10.2.2.1`
	`(Instant AP)(Auth Server "server1")# port 1812`
	`(Instant AP)(Auth Server "server1")# acctport 1813`
	`(Instant AP)(Auth Server "server1")# key "presharedkey"`
	`(Instant AP)(Auth Server "server1")# exit`
	
	`(Instant AP)(config)# wlan auth-server server2`
	`(Instant AP)(Auth Server "server1")# ip 10.2.2.2`
	`(Instant AP)(Auth Server "server1")# port 1812`
	`(Instant AP)(Auth Server "server1")# acctport 1813`
	`(Instant AP)(Auth Server "server1")# key "presharedkey"`
		See Configuring an External Server for Authentication

6. Configure wired and wireless SSIDs using the authentication servers and access rules; enable authentication survivability.	Configure wired ports to operate in Centralized, L2 mode and associate VLAN 20 to the wired port profile.
	`(Instant AP)(config) # wired-port-profile wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# switchport-mode access`
	`(Instant AP)(wired-port-profile "wired-port")# allowed-vlan all`
	`(Instant AP)(wired-port-profile "wired-port")# native-vlan 20`
	`(Instant AP)(wired-port-profile "wired-port")# no shutdown`
	`(Instant AP)(wired-port-profile "wired-port")# access-rule-name wired-port`
	`(Instant AP)(wired-port-profile "wired-port")# type employee`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server1`
	`(Instant AP)(wired-port-profile "wired-port")# auth-server server2`
	`(Instant AP)(wired-port-profile "wired-port")# dot1x`
	`(Instant AP)(wired-port-profile "wired-port")# exit`
	`(Instant AP)(config)# enet1-port-profile wired-port`
	
	Configure a wireless SSID to operate in Centralized, L2 mode and associate VLAN 20 to the WLAN SSID profile.
	`(Instant AP)(config) # wlan ssid-profile wireless-ssid`
	`(Instant AP)(SSID Profile "wireless-ssid")# enable`
	`(Instant AP)(SSID Profile "wireless-ssid")# type employee`
	`(Instant AP)(SSID Profile "wireless-ssid")# essid wireless-ssid`
	`(Instant AP)(SSID Profile "wireless-ssid")# opmode wpa2-aes`
	`(Instant AP)(SSID Profile "wireless-ssid")# vlan 20`
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-server server1`
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-server server2`
		See Configuring a Wired Profile and Wireless Network Profiles

Table 87: *IAP Configuration for Scenario—GRE: Single Datacenter Deployment with No Redundancy*

Configuration Steps	CLI Commands	UI Procedure
	`(Instant AP)(SSID Profile "wireless-ssid")# auth-survivability`	

7. Create access rule for wired and wireless authentication.	**For wired profile:**
	`(Instant AP)(config)# wlan access-rule wired-port`
	`(Instant AP)(Access Rule "wired-port")# rule any any match any any any permit`
	
	For WLAN SSID employee roles:
	`(Instant AP)(config)# wlan access-rule wireless-ssid`
	`(Instant AP)(Access Rule "wireless-ssid")# rule any any match any any any permit`
		See Configuring ACL Rules for Network Services

NOTE: Ensure that you execute the **commit apply** command in the Instant CLI before saving the configuration and propagating changes across the IAP cluster.		

IAP-Connected Switch Configuration

Client VLANs defined in this example must be opened on the upstream switches in multiple IAP deployments, as client traffic from the slave to the master is tagged with the client VLAN.

Datacenter Configuration

For information on controller configuration, see Configuring a Controller for IAP-VPN Operations on page 246.

The following GRE configuration is required on the controller:

```
(host)(config)# interface tunnel <Number>
(host)(config-tunnel)# description <Description>
(host)(config-tunnel)# tunnel mode gre <ID>
(host)(config-tunnel)# tunnel source <controller-IP>
(host)(config-tunnel)# tunnel destination <AP-IP>
(host)(config-tunnel)# trusted
(host)(config-tunnel)# tunnel vlan <allowed-VLAN>
```

Glossary

The following table lists the terms and their definitions used in this document.

Table 88: *List of Terms*

Term	Definition
802.11	An evolving family of specifications for wireless LANs developed by a working group of the Institute of Electrical and Electronics Engineers (IEEE). 802.11 standards use the Ethernet protocol and CSMA/CA (carrier sense multiple access with collision avoidance) for path sharing.
802.11a	Provides specifications for wireless systems. Networks using 802.11a operate at radio frequencies in the 5GHz band. The specification uses a modulation scheme known as orthogonal frequency-division multiplexing (OFDM) that is especially well suited to use in office settings. The maximum data transfer rate is 54 Mbps.
802.11b	WLAN standard often called Wi-Fi; backward compatible with 802.11. Instead of the phase-shift keying (PSK) modulation method historically used in 802.11 standards, 802.11b uses complementary code keying (CCK), which allows higher data speeds and is less susceptible to multipath-propagation interference. 802.11b operates in the 2.4 GHz band and the maximum data transfer rate is 11 Mbps.
802.11g	Offers transmission over relatively short distances at up to 54 Mbps, compared with the 11 Mbps theoretical maximum of 802.11b. 802.11g operates in the 2.4 GHz band and employs orthogonal frequency division multiplexing (OFDM), the modulation scheme used in 802.11a, to obtain higher data speed. Computers or terminals set up for 802.11g can fall back to speeds of 11 Mbps, so that 802.11b and 802.11g devices can be compatible within a single network.
802.11n	Wireless networking standard to improve network throughput over the two previous standards 802.11a and 802.11g with a significant increase in the maximum raw data rate from 54 Mbps to 600 Mbps with the use of four spatial streams at a channel width of 40 MHz. 802.11n operates in the 2.4 and 5.0 bands.
AP	An access point (AP) connects users to other users within the network and also can serve as the point of interconnection between the WLAN and a fixed wire network. The number of access points a WLAN needs is determined by the number of users and the size of the network.
access point mapping	The act of locating and possibly exploiting connections to WLANs while driving around a city or elsewhere. To do war driving, you need a vehicle, a computer (which can be a laptop), a wireless Ethernet card set to work in promiscuous mode, and some kind of an antenna which can be mounted on top of or positioned inside the car. Because a WLAN may have a range that extends beyond an office building, an outside user may be able to intrude into the network, obtain a free Internet connection, and possibly gain access to company records and other resources.

Table 88: *List of Terms*

Term	Definition
ad-hoc network	A LAN or other small network, especially one with wireless or temporary plug-in connections, in which some of the network devices are part of the network only for the duration of a communications session or, in the case of mobile or portable devices, while in some close proximity to the rest of the network.
band	A specified range of frequencies of electromagnetic radiation.
DHCP	The Dynamic Host Configuration Protocol (DHCP) is an auto-configuration protocol used on IP networks. Computers or any network peripherals that are connected to IP networks must be configured, before they can communicate with other computers on the network. DHCP allows a computer to be configured automatically, eliminating the need for a network administrator. DHCP also provides a central database to keep track of computers connected to the network. This database helps in preventing any two computers from being configured with the same IP address.
DNS Server	A Domain Name System (DNS) server functions as a phonebook for the Internet and Internet users. It converts human readable computer hostnames into IP addresses and vice-versa. A DNS server stores several records for a domain name such as an address 'A' record, name server (NS), and mail exchanger (MX) records. The Address 'A' record is the most important record that is stored in a DNS server, because it provides the required IP address for a network peripheral or element.
DST	Daylight saving time (DST), also known as summer time, is the practice of advancing clocks, so that evenings have more daylight and mornings have less. Typically clocks are adjusted forward one hour near the start of spring and are adjusted backward in autumn.
EAP	Extensible authentication protocol (EAP) refers to the authentication protocol in wireless networks that expands on methods used by the point-to-point protocol (PPP), a protocol often used when connecting a computer to the Internet. EAP can support multiple authentication mechanisms, such as token cards, smart cards, certificates, one-time passwords, and public key encryption authentication.
fixed wireless	Wireless devices or systems in fixed locations such as homes and offices. Fixed wireless devices usually derive their electrical power from the utility mains, unlike mobile wireless or portable wireless which tend to be battery-powered. Although mobile and portable systems can be used in fixed locations, efficiency and bandwidth are compromised compared with fixed systems.
frequency allocation	Use of radio frequency spectrum regulated by governments.
frequency spectrum	Part of the electromagnetic spectrum.

Table 88: *List of Terms*

Term	Definition
hotspot	A WLAN node that provides Internet connection and virtual private network (VPN) access from a given location. A business traveler, for example, with a laptop equipped for Wi-Fi can look up a local hot spot, contact it, and get connected through its network to reach the Internet and their own company remotely with a secure connection. Increasingly, public places, such as airports, hotels, and coffee shops are providing free wireless access for customers.
IEEE 802.11 standards	The IEEE 802.11 is a set of standards that are categorized based on the radio wave frequency and the data transfer rate.
POE	Power over Ethernet (PoE) is a method of delivering power on the same physical Ethernet wire used for data communication. Power for devices is provided in one of the following two ways: ● Endspan— The switch that an AP is connected for power supply. ● Midspan— A device can sit between the switch and APs The choice of endspan or midspan depends on the capabilities of the switch to which the IAP is connected. Typically if a switch is in place and does not support PoE, midspan power injectors are used.
PPPoE	Point-to-Point Protocol over Ethernet (PPPoE) is a method of connecting to the Internet typically used with DSL services where the client connects to the DSL modem.
QoS	Quality of Service (QoS) refers to the capability of a network to provide better service to a specific network traffic over various technologies.
RF	Radio Frequency (RF) refers to the portion of electromagnetic spectrum in which electromagnetic waves are generated by feeding alternating current to an antenna.
TACACS	Family of protocols that handle remote authentication and related services for network access control through a centralized server.
TACACS+	Derived from TACACS but an entirely new and separate protocol to handle AAA services. TACACS+ uses TCP and is not compatible with TACACS. Because it encrypts password, username, authorization, and accounting, it is less vulnerable than RADIUS.
VPN	A Virtual Private Network (VPN) network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A VPN ensures privacy through security procedures and tunneling protocols such as the Layer Two Tunneling Protocol (L2TP). Data is encrypted at the sending end and decrypted at the receiving end.

Table 88: *List of Terms*

Term	Definition
W-CDMA	Officially known as IMT-2000 direct spread; ITU standard derived from Code-Division Multiple Access (CDMA). Wideband code-division multiple access (W-CDMA) is a third-generation (3G) mobile wireless technology that promises much higher data speeds to mobile and portable wireless devices than commonly offered in today's market.
Wi-Fi	A term for certain types of WLANs. Wi-Fi can apply to products that use any 802.11 standard. Wi-Fi has gained acceptance in many businesses, agencies, schools, and homes as an alternative to a wired LAN. Many airports, hotels, and fast-food facilities offer public access to Wi-Fi networks.
WEP	Wired equivalent privacy (WEP) is a security protocol specified in 802.11b, designed to provide a WLAN with a level of security and privacy comparable to what is usually expected of a wired LAN. Data encryption protects the vulnerable wireless link between clients and access points; once this measure has been taken, other typical LAN security mechanisms such as password protection, end-to-end encryption, virtual private networks (VPNs), and authentication can be put in place to ensure privacy.
wireless	Describes telecommunications in which electromagnetic waves (rather than some form of wire) carry the signal over part or all of the communication path.
wireless network	In a Wireless LAN (WLAN), laptops, desktops, PDAs, and other computer peripherals are connected to each other without any network cables. These network elements or clients use radio signals to communicate with each other. Wireless networks are set up based on the IEEE 802.11 standards.
WISP	Wireless ISP (WISP) refers to an internet service provider (ISP) that allows subscribers to connect to a server at designated hot spots (access points) using a wireless connection such as Wi-Fi. This type of ISP offers broadband service and allows subscriber computers, called stations, to access the Internet and the web from anywhere within the zone of coverage provided by the server antenna, usually a region with a radius of several kilometers.
wireless service provider	A company that offers transmission services to users of wireless devices through radio frequency (RF) signals rather than through end-to-end wire communication.
WLAN	Wireless local area network (WLAN) is a local area network (LAN) that the users access through a wireless connection.

Acronyms and Abbreviations

The following table lists the acronyms and abbreviations used in Aruba documents.

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
3G	Third Generation of Wireless Mobile Telecommunications Technology
4G	Fourth Generation of Wireless Mobile Telecommunications Technology
AAA	Authentication, Authorization, and Accounting
ABR	Area Border Router
AC	Access Category
ACC	Advanced Cellular Coexistence
ACE	Access Control Entry
ACI	Adjacent Channel interference
ACL	Access Control List
AD	Active Directory
ADO	Active X Data Objects
ADP	Aruba Discovery Protocol
AES	Advanced Encryption Standard
AIFSN	Arbitrary Inter-frame Space Number
ALE	Analytics and Location Engine
ALG	Application Level Gateway
AM	Air Monitor
AMON	Advanced Monitoring
AMP	AirWave Management Platform
A-MPDU	Aggregate MAC Protocol Data Unit
A-MSDU	Aggregate MAC Service Data Unit
ANQP	Access Network Query Protocol

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
ANSI	American National Standards Institute
AP	Access Point
API	Application Programming Interface
ARM	Adaptive Radio Management
ARP	Address Resolution Protocol
AVF	AntiVirus Firewall
BCMC	Broadcast-Multicast
BGP	Border Gateway protocol
BLE	Bluetooth Low Energy
BMC	Beacon Management Console
BPDU	Bridge Protocol Data Unit
BRAS	Broadband Remote Access Server
BRE	Basic Regular Expression
BSS	Basic Service Set
BSSID	Basic Service Set Identifier
BYOD	Bring Your Own Device
CA	Certification Authority
CAC	Call Admission Control
CALEA	Communications Assistance for Law Enforcement Act
CAP	Campus AP
CCA	Clear Channel Assessment
CDP	Cisco Discovery Protocol
CDR	Call Detail Records
CEF	Common Event Format
CGI	Common Gateway Interface

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
CHAP	Challenge Handshake Authentication Protocol
CIDR	Classless Inter-Domain Routing
CLI	Command-Line Interface
CN	Common Name
CoA	Change of Authorization
CoS	Class of Service
CPE	Customer Premises Equipment
CPsec	Control Plane Security
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
CRL	Certificate Revocation List
CSA	Channel Switch Announcement
CSMA/CA	Carrier Sense Multiple Access / Collision Avoidance
CSR	Certificate Signing Request
CSV	Comma Separated Values
CTS	Clear to Send
CW	Contention Window
DAS	Distributed Antenna System
dB	Decibel
dBm	Decibel Milliwatt
DCB	Data Center Bridging
DCE	Data Communication Equipment
DCF	Distributed Coordination Function
DDMO	Distributed Dynamic Multicast Optimization
DES	Data Encryption Standard

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
DFS	Dynamic Frequency Selection
DFT	Discreet Fourier Transform
DHCP	Dynamic Host Configuration Protocol
DLNA	Digital Living Network Alliance
DMO	Dynamic Multicast optimization
DN	Distinguished Name
DNS	Domain Name System
DOCSIS	Data over Cable Service Interface Specification
DoS	Denial of Service
DPD	Dead Peer Detection
DPI	Deep Packet Inspection
DR	Designated Router
DRT	Downloadable Regulatory Table
DS	Differentiated Services
DSCP	Differentiated Services Code Point
DSSS	Direct Sequence Spread Spectrum
DST	Daylight Saving Time
DTE	Data Terminal Equipment
DTIM	Delivery Traffic Indication Message
DTLS	Datagram Transport Layer Security
DU	Data Unit
EAP	Extensible Authentication Protocol
EAP-FAST	EAP-Flexible Authentication Secure Tunnel
EAP-GTC	EAP-Generic Token Card
EAP-MD5	EAP-Method Digest 5

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
EAP-MSCHAP EAP-MSCHAPv2	EAP-Microsoft Challenge Handshake Authentication Protocol
EAPoL	EAP over LAN
EAPoUDP	EAP over UDP
EAP-PEAP	EAP-Protected EAP
EAP-PWD	EAP-Password
EAP-TLS	EAP-Transport Layer Security
EAP-TTLS	EAP-Tunneled Transport Layer Security
ECC	Elliptical Curve Cryptography
ECDSA	Elliptic Curve Digital Signature Algorithm
EIGRP	Enhanced Interior Gateway Routing Protocol
EIRP	Effective Isotropic Radiated Power
EMM	Enterprise Mobility Management
ESI	External Services Interface
ESS	Extended Service Set
ESSID	Extended Service Set Identifier
EULA	End User License Agreement
FCC	Federal Communications Commission
FFT	Fast Fourier Transform
FHSS	Frequency Hopping Spread Spectrum
FIB	Forwarding Information Base
FIPS	Federal Information Processing Standards
FQDN	Fully Qualified Domain Name
FQLN	Fully Qualified Location Name
FRER	Frame Receive Error Rate

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
FRR	Frame Retry Rate
FSPL	Free Space Path Loss
FTP	File Transfer Protocol
GBps	Gigabytes per second
Gbps	Gigabits per second
GHz	Gigahertz
GIS	Generic Interface Specification
GMT	Greenwich Mean Time
GPP	Guest Provisioning Page
GPS	Global Positioning System
GRE	Generic Routing Encapsulation
GUI	Graphical User Interface
GVRP	GARP or Generic VLAN Registration Protocol
H2QP	Hotspot 2.0 Query Protocol
HA	High Availability
HMD	High Mobility Device
HSPA	High-Speed Packet Access
HT	High Throughput
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
IAS	Internet Authentication Service
ICMP	Internet Control Message Protocol
IdP	Identity Provider
IDS	Intrusion Detection System
IE	Information Element

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
IGP	Interior Gateway Protocol
IGRP	Interior Gateway Routing Protocol
IKE PSK	Internet Key Exchange Pre-shared Key
IoT	Internet of Things
IP	Internet Protocol
IPM	Intelligent Power Monitoring
IPS	Intrusion Prevention System
IPsec	IP Security
ISAKMP	Internet Security Association and Key Management Protocol
ISP	Internet Service Provider
JSON	JavaScript Object Notation
KBps	Kilobytes per second
Kbps	Kilobits per second
L2TP	Layer-2 Tunneling Protocol
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation Group
LAN	Local Area Network
LCD	Liquid Crystal Display
LDAP	Lightweight Directory Access Protocol
LDPC	Low-Density Parity-Check
LEA	Law Enforcement Agency
LEAP	Lightweight Extensible Authentication Protocol
LED	Light Emitting Diode

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
LEEF	Long Event Extended Format
LI	Lawful Interception
LLDP	Link Layer Discovery Protocol
LLDP-MED	LLDP–Media Endpoint Discovery
LMS	Local Management Switch
LNS	L2TP Network Server
LTE	Long Term Evolution
MAB	MAC Authentication Bypass
MAC	Media Access Control
MAM	Mobile Application Management
MBps	Megabytes per second
Mbps	Megabits per second
MCS	Modulation and Coding Scheme
MD5	Message Digest 5
MDM	Mobile Device Management
mDNS	Multicast Domain Name System
MFA	Multi-factor Authentication
MHz	Megahertz
MIB	Management Information Base
MIMO	Multiple-Input Multiple-Output
MLD	Multicast Listener Discovery
MPDU	MAC Protocol Data Unit
MPLS	Multiprotocol Label Switching
MPPE	Microsoft Point-to-Point Encryption
MSCHAP	Microsoft Challenge Handshake Authentication Protocol

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
MSS	Maximum Segment Size
MSSID	Mesh Service Set Identifier
MSTP	Multiple Spanning Tree Protocol
MTU	Maximum Transmission Unit
MU-MIMO	Multi-User Multiple-Input Multiple-Output
MVRP	Multiple VLAN Registration Protocol
NAC	Network Access Control
NAD	Network Access Device
NAK	Negative Acknowledgment Code
NAP	Network Access Protection
NAS	Network Access Server Network-attached Storage
NAT	Network Address Translation
NetBIOS	Network Basic Input/Output System
NIC	Network Interface Card
Nmap	Network Mapper
NMI	Non-Maskable Interrupt
NMS	Network Management Server
NOE	New Office Environment
NTP	Network Time Protocol
OAuth	Open Authentication
OCSP	Online Certificate Status Protocol
OFA	OpenFlow Agent
OFDM	Orthogonal Frequency Division Multiplexing
OID	Object Identifier

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
OKC	Opportunistic Key Caching
OS	Operating System
OSPF	Open Shortest Path First
OUI	Organizationally Unique Identifier
OVA	Open Virtual Appliance
OVF	Open Virtualization Format
PAC	Protected Access Credential
PAP	Password Authentication Protocol
PAPI	Proprietary Access Protocol Interface
PCI	Peripheral Component Interconnect
PDU	Power Distribution Unit
PEAP	Protected Extensible Authentication Protocol
PEAP-GTC	Protected Extensible Authentication Protocol-Generic Token Card
PEF	Policy Enforcement Firewall
PFS	Perfect Forward Secrecy
PHB	Per-hop behavior
PIM	Protocol-Independent Multicast
PIN	Personal Identification Number
PKCS	Public Key Cryptography Standard
PKI	Public Key Infrastructure
PLMN	Public Land Mobile Network
PMK	Pairwise Master Key
PoE	Power over Ethernet
POST	Power On Self Test
PPP	Point-to-Point Protocol

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
PPPoE	PPP over Ethernet
PPTP	PPP Tunneling Protocol
PRNG	Pseudo-Random Number Generator
PSK	Pre-Shared Key
PSU	Power Supply Unit
PVST	Per VLAN Spanning Tree
QoS	Quality of Service
RA	Router Advertisement
RADAR	Radio Detection and Ranging
RADIUS	Remote Authentication Dial-In User Service
RAM	Random Access Memory
RAP	Remote AP
RAPIDS	Rogue Access Point and Intrusuin Detection System
RARP	Reverse ARP
REGEX	Regular Expression
REST	Representational State Transfer
RF	Radio Frequency
RFC	Request for Comments
RFID	Radio Frequency Identification
RIP	Routing Information Protocol
RRD	Round Robin Database
RSA	Rivest, Shamir, Adleman
RSSI	Received Signal Strength Indicator
RSTP	Rapid Spanning Tree Protocol
RTCP	RTP Control Protocol

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
RTLS	Real-Time Location Systems
RTP	Real-Time Transport Protocol
RTS	Request to Send
RTSP	Real Time Streaming Protocol
RVI	Routed VLAN Interface
RW RoW	Rest of World
SA	Security Association
SAML	Security Assertion Markup Language
SAN	Subject Alternative Name
SCB	Station Control Block
SCEP	Simple Certificate Enrollment Protocol
SCP	Secure Copy Protocol
SCSI	Small Computer System Interface
SDN	Software Defined Networking
SDR	Software-Defined Radio
SDU	Service Data Unit
SD-WAN	Software-Defined Wide Area Network
SFTP	Secure File Transfer Protocol
SHA	Secure Hash Algorithm
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SIRT	Security Incident Response Team
SLAAC	Stateless Address Autoconfiguration
SMB	Small and Medium Business

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
SMB	Server Message Block
SMS	Short Message Service
SMTP	Simple Mail Transport Protocol
SNIR	Signal-to-Noise-Plus-Interference Ratio
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SNTP	Simple Network Time Protocol
SOAP	Simple Object Access Protocol
SoC	System on a Chip
SoH	Statement of Health
SSH	Secure Shell
SSID	Service Set Identifier
SSL	Secure Sockets Layer
SSO	Single Sign-On
STBC	Space-Time Block Coding
STM	Station Management
STP	Spanning Tree Protocol
STRAP	Secure Thin RAP
SU-MIMO	Single-User Multiple-Input Multiple-Output
SVP	SpectraLink Voice Priority
TAC	Technical Assistance Center
TACACS	Terminal Access Controller Access Control System
TCP/IP	Transmission Control Protocol/ Internet Protocol
TFTP	Trivial File Transfer Protocol
TIM	Traffic Indication Map

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
TKIP	Temporal Key Integrity Protocol
TLS	Transport Layer Security
TLV	Type-length-value
ToS	Type of Service
TPC	Transmit Power Control
TPM	Trusted Platform Module
TSF	Timing Synchronization Function
TSPEC	Traffic Specification
TTL	Time to Live
TTLS	Tunneled Transport Layer Security
TXOP	Transmission Opportunity
U-APSD	Unscheduled Automatic Power Save Delivery
UCC	Unified Communications and Collaboration
UDID	Unique Device Identifier
UDP	User Datagram Protocol
UI	User Interface
UMTS	Universal Mobile Telecommunication System
UPnP	Universal Plug and Play
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
USB	Universal Serial Bus
UTC	Coordinated Universal Time
VA	Virtual Appliance
VBN	Virtual Branch Networking
VBR	Virtual Beacon Report

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
VHT	Very High Throughput
VIA	Virtual Intranet Access
VIP	Virtual IP Address
VLAN	Virtual Local Area Network
VM	Virtual Machine
VoIP	Voice over IP
VoWLAN	Voice over Wireless Local Area Network
VPN	Virtual Private Network
VRD	Validated Reference Design
VRF	Visual RF
VRRP	Virtual Router Redundancy Protocol
VSA	Vendor-Specific Attributes
VTP	VLAN Trunking Protocol
WAN	Wide Area Network
WebUI	Web browser User Interface
WEP	Wired Equivalent Privacy
WFA	Wi-Fi Alliance
WIDS	Wireless Intrusion Detection System
WINS	Windows Internet Naming Service
WIPS	Wireless Intrusion Prevention System
WISPr	Wireless Internet Service Provider Roaming
WLAN	Wireless Local Area Network
WME	Wireless Multimedia Extensions
WMI	Windows Management Instrumentation
WMM	Wi-Fi Multimedia

Table 89: *List of Acronyms and Abbreviations*

Acronym or Abbreviation	Definition
WMS	WLAN Management System
WPA	Wi-Fi Protected Access
WSDL	Web Service Description Language
WWW	World Wide Web
WZC	Wireless Zero Configuration
XAuth	Extended Authentication
XML	Extensible Markup Language
XML-RPC	XML Remote Procedure Call
ZTP	Zero Touch Provisioning

Glossary

The following table lists the terms and their definitions used in this document.

Table 90: *List of Terms*

Term	Definition
802.11	An evolving family of specifications for wireless LANs developed by a working group of the Institute of Electrical and Electronics Engineers (IEEE). 802.11 standards use the Ethernet protocol and CSMA/CA (carrier sense multiple access with collision avoidance) for path sharing.
802.11a	Provides specifications for wireless systems. Networks using 802.11a operate at radio frequencies in the 5GHz band. The specification uses a modulation scheme known as orthogonal frequency-division multiplexing (OFDM) that is especially well suited to use in office settings. The maximum data transfer rate is 54 Mbps.
802.11b	WLAN standard often called Wi-Fi; backward compatible with 802.11. Instead of the phase-shift keying (PSK) modulation method historically used in 802.11 standards, 802.11b uses complementary code keying (CCK), which allows higher data speeds and is less susceptible to multipath-propagation interference. 802.11b operates in the 2.4 GHz band and the maximum data transfer rate is 11 Mbps.

Table 90: *List of Terms*

Term	Definition
802.11g	Offers transmission over relatively short distances at up to 54 Mbps, compared with the 11 Mbps theoretical maximum of 802.11b. 802.11g operates in the 2.4 GHz band and employs orthogonal frequency division multiplexing (OFDM), the modulation scheme used in 802.11a, to obtain higher data speed. Computers or terminals set up for 802.11g can fall back to speeds of 11 Mbps, so that 802.11b and 802.11g devices can be compatible within a single network.
802.11n	Wireless networking standard to improve network throughput over the two previous standards 802.11a and 802.11g with a significant increase in the maximum raw data rate from 54 Mbps to 600 Mbps with the use of four spatial streams at a channel width of 40 MHz. 802.11n operates in the 2.4 and 5.0 bands.
AP	An access point (AP) connects users to other users within the network and also can serve as the point of interconnection between the WLAN and a fixed wire network. The number of access points a WLAN needs is determined by the number of users and the size of the network.
access point mapping	The act of locating and possibly exploiting connections to WLANs while driving around a city or elsewhere. To do war driving, you need a vehicle, a computer (which can be a laptop), a wireless Ethernet card set to work in promiscuous mode, and some kind of an antenna which can be mounted on top of or positioned inside the car. Because a WLAN may have a range that extends beyond an office building, an outside user may be able to intrude into the network, obtain a free Internet connection, and possibly gain access to company records and other resources.
ad-hoc network	A LAN or other small network, especially one with wireless or temporary plug-in connections, in which some of the network devices are part of the network only for the duration of a communications session or, in the case of mobile or portable devices, while in some close proximity to the rest of the network.
band	A specified range of frequencies of electromagnetic radiation.
DHCP	The Dynamic Host Configuration Protocol (DHCP) is an auto-configuration protocol used on IP networks. Computers or any network peripherals that are connected to IP networks must be configured, before they can communicate with other computers on the network. DHCP allows a computer to be configured automatically, eliminating the need for a network administrator. DHCP also provides a central database to keep track of computers connected to the network. This database helps in preventing any two computers from being configured with the same IP address.

Table 90: *List of Terms*

Term	Definition
DNS Server	A Domain Name System (DNS) server functions as a phonebook for the Internet and Internet users. It converts human readable computer hostnames into IP addresses and vice-versa. A DNS server stores several records for a domain name such as an address 'A' record, name server (NS), and mail exchanger (MX) records. The Address 'A' record is the most important record that is stored in a DNS server, because it provides the required IP address for a network peripheral or element.
DST	Daylight saving time (DST), also known as summer time, is the practice of advancing clocks, so that evenings have more daylight and mornings have less. Typically clocks are adjusted forward one hour near the start of spring and are adjusted backward in autumn.
EAP	Extensible authentication protocol (EAP) refers to the authentication protocol in wireless networks that expands on methods used by the point-to-point protocol (PPP), a protocol often used when connecting a computer to the Internet. EAP can support multiple authentication mechanisms, such as token cards, smart cards, certificates, one-time passwords, and public key encryption authentication.
fixed wireless	Wireless devices or systems in fixed locations such as homes and offices. Fixed wireless devices usually derive their electrical power from the utility mains, unlike mobile wireless or portable wireless which tend to be battery-powered. Although mobile and portable systems can be used in fixed locations, efficiency and bandwidth are compromised compared with fixed systems.
frequency allocation	Use of radio frequency spectrum regulated by governments.
frequency spectrum	Part of the electromagnetic spectrum.
hotspot	A WLAN node that provides Internet connection and virtual private network (VPN) access from a given location. A business traveler, for example, with a laptop equipped for Wi-Fi can look up a local hot spot, contact it, and get connected through its network to reach the Internet and their own company remotely with a secure connection. Increasingly, public places, such as airports, hotels, and coffee shops are providing free wireless access for customers.
IEEE 802.11 standards	The IEEE 802.11 is a set of standards that are categorized based on the radio wave frequency and the data transfer rate.
POE	Power over Ethernet (PoE) is a method of delivering power on the same physical Ethernet wire used for data communication. Power for devices is provided in one of the following two ways: ● Endspan— The switch that an AP is connected for power supply. ● Midspan— A device can sit between the switch and APs

Table 90: *List of Terms*

Term	Definition
	The choice of endspan or midspan depends on the capabilities of the switch to which the IAP is connected. Typically if a switch is in place and does not support PoE, midspan power injectors are used.
PPPoE	Point-to-Point Protocol over Ethernet (PPPoE) is a method of connecting to the Internet typically used with DSL services where the client connects to the DSL modem.
QoS	Quality of Service (QoS) refers to the capability of a network to provide better service to a specific network traffic over various technologies.
RF	Radio Frequency (RF) refers to the portion of electromagnetic spectrum in which electromagnetic waves are generated by feeding alternating current to an antenna.
TACACS	Family of protocols that handle remote authentication and related services for network access control through a centralized server.
TACACS+	Derived from TACACS but an entirely new and separate protocol to handle AAA services. TACACS+ uses TCP and is not compatible with TACACS. Because it encrypts password, username, authorization, and accounting, it is less vulnerable than RADIUS.
VPN	A Virtual Private Network (VPN) network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network. A VPN ensures privacy through security procedures and tunneling protocols such as the Layer Two Tunneling Protocol (L2TP). Data is encrypted at the sending end and decrypted at the receiving end.
W-CDMA	Officially known as IMT-2000 direct spread; ITU standard derived from Code-Division Multiple Access (CDMA). Wideband code-division multiple access (W-CDMA) is a third-generation (3G) mobile wireless technology that promises much higher data speeds to mobile and portable wireless devices than commonly offered in today's market.
Wi-Fi	A term for certain types of WLANs. Wi-Fi can apply to products that use any 802.11 standard. Wi-Fi has gained acceptance in many businesses, agencies, schools, and homes as an alternative to a wired LAN. Many airports, hotels, and fast-food facilities offer public access to Wi-Fi networks.

Table 90: *List of Terms*

Term	Definition
WEP	Wired equivalent privacy (WEP) is a security protocol specified in 802.11b, designed to provide a WLAN with a level of security and privacy comparable to what is usually expected of a wired LAN. Data encryption protects the vulnerable wireless link between clients and access points; once this measure has been taken, other typical LAN security mechanisms such as password protection, end-to-end encryption, virtual private networks (VPNs), and authentication can be put in place to ensure privacy.
wireless	Describes telecommunications in which electromagnetic waves (rather than some form of wire) carry the signal over part or all of the communication path.
wireless network	In a Wireless LAN (WLAN), laptops, desktops, PDAs, and other computer peripherals are connected to each other without any network cables. These network elements or clients use radio signals to communicate with each other. Wireless networks are set up based on the IEEE 802.11 standards.
WISP	Wireless ISP (WISP) refers to an internet service provider (ISP) that allows subscribers to connect to a server at designated hot spots (access points) using a wireless connection such as Wi-Fi. This type of ISP offers broadband service and allows subscriber computers, called stations, to access the Internet and the web from anywhere within the zone of coverage provided by the server antenna, usually a region with a radius of several kilometers.
wireless service provider	A company that offers transmission services to users of wireless devices through radio frequency (RF) signals rather than through end-to-end wire communication.
WLAN	Wireless local area network (WLAN) is a local area network (LAN) that the users access through a wireless connection.