

The screenshot shows the 'Administrators' configuration screen. It includes a 'Settings' section with a 'Password' field, an 'Access' section with 'Access Type' checkboxes for Web UI, Telnet, SSH, and Console, an 'Administrator Roles' section with a list of roles (Superuser, System, Network, Security, Monitor, Help Desk, Web User, Device Provisioning, Vendor Admin), and an 'Allowed Locations' section with 'Locations' and 'Group' fields. At the bottom are 'OK', 'Reset', and 'Exit' buttons.

Figure 12-4 Administrators screen

- 3 If creating a new administrator, enter a user name in the **User Name** field. This is a mandatory field for new administrators and cannot exceed 32 characters. Optimally assign a name representative of the user and role.
- 4 Provide a strong password for the administrator within the **Password** field, once provided, **Reconfirm** the password to ensure its accurately entered. This is a mandatory field.
- 5 Select **Access** options to define the permitted access for the user. Access modes can be assigned to management user accounts to restrict which management interfaces the user can access. A management user can be assigned one or more access roles allowing access to multiple management interfaces. If required, all four options can be selected and invoked simultaneously.

Web UI	Select this option to enable access to the device's Web User Interface.
Telnet	Select this option to enable access to the device using TELNET.
SSH	Select this option to enable access to the device using SSH.
Console	Select this option to enable access to the device's console.

- 6 Select the **Administrator Role** for the administrator using this profile. Only one role can be assigned.

Superuser	Select this option to assign complete administrative rights to the user. This entails all the roles listed for all the other administrative roles.
System	The <i>System</i> role provides permissions to configure general settings like NTP, boot parameters, licenses, perform image upgrades, auto install, manager redundancy/clustering and control access.
Network	The <i>Network</i> role provides privileges to configure all wired and wireless parameters like IP configuration, VLANs, L2/L3 security, WLANs, radios, and captive portal.
Security	Select Security to set the administrative rights for a security administrator allowing configuration of all security parameters.

Monitor	Select Monitor to assign permissions without any administrative rights. The Monitor option provides read-only permissions.
Help Desk	Assign this role to someone who typically troubleshoots and debugs problems reported by the customer. The Help Desk manager typically runs troubleshooting utilities (like a sniffer), executes service commands, views/retrieves logs and reboots the controller or service platform. However, Help Desk personnel are <i>not</i> allowed to conduct controller or service platform reloads.
Web User	Select Web User to assign the administrator privileges needed to add users for authentication.
Device Provisioning	Select Device Provisioning to assign an administrator privileges to update (provision) device configuration files or firmware. Such updates run the risk of overwriting and losing a device's existing configuration unless the configuration is properly archived.
Vendor Admin	Select this option to create a vendor-admin user role group so this particular user type can access offline device-registration portal data. Vendors are assigned username/password credentials for securely on-boarding devices. Devices are moved to a vendor allowed VLAN immediately after this on-boarding process, so vendors do require unique administration roles. When the Vendor-Admin role is selected, provide the vendor's <i>Group</i> name for RADIUS authentication. The vendor's RADIUS group takes precedence over the statically configured group for device registration.

- 7 Select the **OK** button to save the administrator's configuration. Select **Reset** to revert to the last saved configuration.

12.1.1.2 Setting an Allowed Location Configuration

► *Adding or Editing a Management Access Policy*

Extreme Networks' WiNG and NSight applications may have the same users with different permissions defined in each application. Various user roles are supported in WiNG (superuser, system-admin, network-admin, security-admin, device-provisioning-admin, helpdesk and monitor). With NSight, a user logging into the NSight UI should also have an access control restriction based on the role they're assigned. For example, a WiNG user with helpdesk privileges should have access to only the site (RF Domain) in which the helpdesk is situated, and the location tree should contain only one RF Domain. Similarly, when a user responsible for a set of sites logs in NSight, their location tree needs to contain the RF Domains for which they're responsible.

To set an allowed location configuration:

- 1 Select the **Allowed Locations** tab from the Management Policy screen.

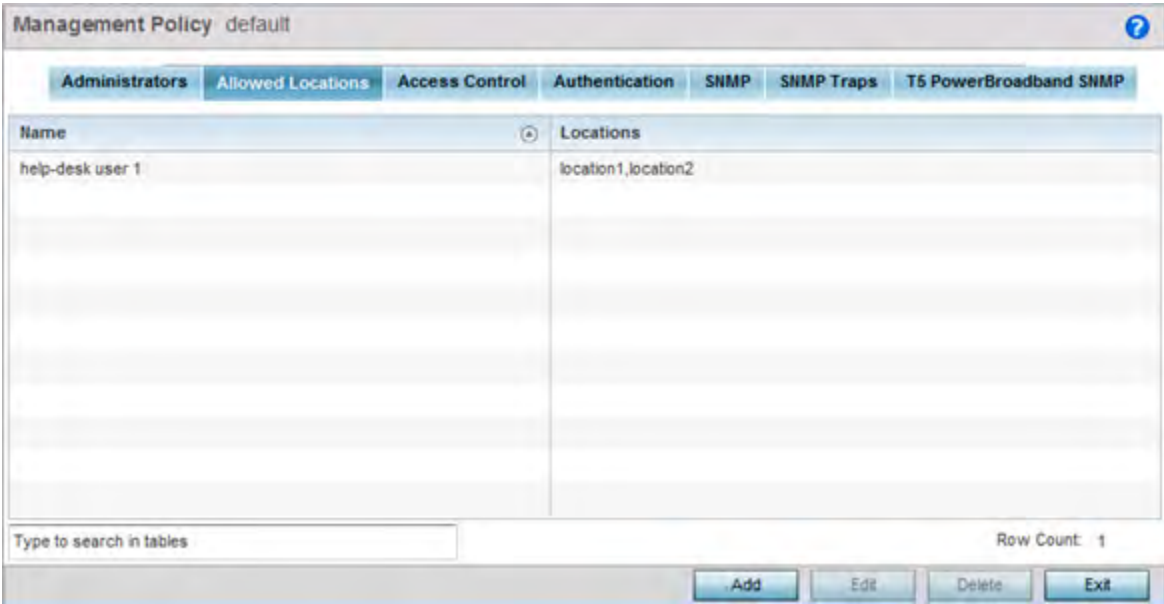


Figure 12-5 Management Policy screen - Allowed Locations tab

The Allowed Locations screen lists existing users and their permitted locations.

- 2 Select **Add** to create a new allowed location, **Edit** to modify an existing location or **Delete** to permanently remove a user name and location from the list of those available.

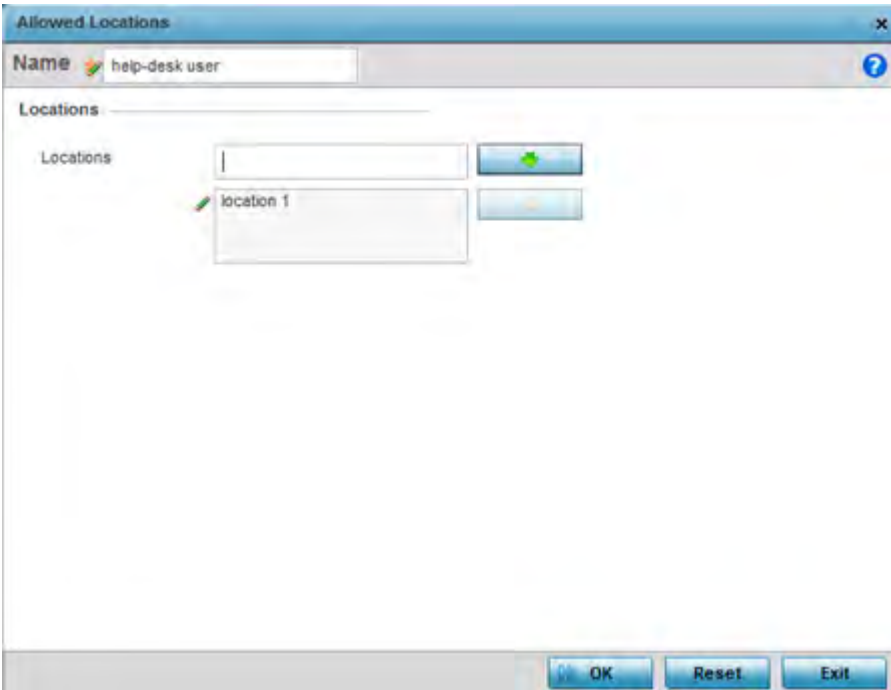


Figure 12-6 Adding Allowed Locations screen

- 3 Set the following allowed location parameters:

Name	Define a 32 character maximum user name whose access is a mapped to a specific site (RF Domain).

Locations	Create locations and use the navigation arrows to move them into the list of those enabled once saved.

4 Select **OK** to update the allowed location configuration. Select **Reset** to the last saved configuration.

12.1.1.3 Setting the Access Control Configuration

► *Adding or Editing a Management Access Policy*

Restricting remote access to a controller or service platform ensures only trusted hosts can communicate with enabled management services. This ensures only trusted hosts can perform management tasks and provide protection from brute force attacks from hosts attempting to break into the controller or service platform managed network.

Administrators can permit management connections to be established on any IP interface on the controller or service platform (including IP interfaces used to provide captive portal guest access). Administrators can restrict management access by limiting access to a specific host (IP address), subnet, or ACL on the controller or service platform.

Refer to the Access Control tab to allow/deny management access to the network using strategically selected protocols (HTTP, HTTPS, Telnet, SSH or SNMP). Access options can be either enabled or disabled as required. Disabling unused interfaces is recommended to close unnecessary security holes. The Access Control tab is not meant to function as an ACL (in routers or other firewalls), where you can specify and customize specific IPs to access specific interfaces.

- *Source hosts* - Management access can be restricted to one or more hosts by specifying their IP addresses
- *Source subnets* - Management access can be restricted to one or more subnets
- *IP ACL* - Management access can be based on the policies defined in an IP based ACL

In the following example, a controller has two IP interfaces defined with VLAN10 hosting management and network services and VLAN70 providing guest services. For security the guest network is separated from all trusted VLANs by a firewall.

Interface	Description	IP Address	Management
VLAN10	Services	Yes	Yes
VLAN70	Guest	Yes	No

By default, management services are accessible on both VLAN10 and VLAN70, and that's not desirable to an administrator. By restricting access to VLAN10, the controller only accepts management sessions on VLAN10. Management access on VLAN70 is longer available.

Administrators can secure access to a controller or service platform by disabling less secure interfaces. By default, the CLI, SNMP and FTP disable interfaces that do not support encryption or authentication. However, Web management using HTTP is enabled. Insecure management interfaces such as Telnet, HTTP and SNMP should be disabled, and only secure management interfaces, like SSH and HTTPS should be used to access the controller or service platform managed network.

The following table demonstrates some interfaces provide better security than others:

Access Type	Encrypted	Authenticated	Default State
Telnet	No	Yes	Disabled
SNMPv2	No	No	Enabled

SNMPv3	Yes	Yes	Enabled
HTTP	No	Yes	Disabled
HTTPS	Yes	Yes	Disabled
FTP	No	Yes	Disabled
SSHv2	Yes	Yes	Disabled

To set an access control configuration for the Management Access policy:

- 1 Select the **Access Control** tab from the Management Policy screen.

Management Policy Test

Administrators | Allowed Locations | Access Control | Authentication | SNMP | SNMP Traps | T5 PowerBroadband SNMP

Telnet

Enable Telnet ☐

Telnet Port (1 to 65,535)

SSH

Enable SSHv2 ☒

SSHv2 Port

HTTP/HTTPS

Enable HTTP ☐

Enable HTTPS ☒

Rest Server

Enable Rest Server ☒

FTP

Enable FTP ☐

FTP Username

FTP Password

FTP Root Directory

General

Idle Session Timeout (1 to 4,320)

Message of the Day

Access Restrictions

Filter Type

IP Access List

Source Hosts

IP Address	Clear
0 . 0 . 0 . 0	Clear
0 . 0 . 0 . 0	Clear
0 . 0 . 0 . 0	Clear
0 . 0 . 0 . 0	Clear

Source Subnets

Logging Policy

User Lockout Settings

Role	Lockout Time	Number of Password Attempts	

+ Add Row

Figure 12-7 Management Policy screen - Access Control tab

- 2 Set the following parameters required for **Telnet** access:

Enable Telnet	Select the checkbox to enable Telnet device access. Telnet provides a command line interface to a remote host over TCP. Telnet provides no encryption, but it does provide a measure of authentication. Telnet access is disabled by default.
Telnet Port	Set the port on which Telnet connections are made (1 - 65,535). The default port is 23. Change this value using the spinner control next to this field or by entering the port number in the field.

- 3 Set the following parameters required for **SSH** access:

Enable SSHv2	Select the checkbox to enable SSH device access. SSH (<i>Secure Shell</i>) version 2, like Telnet, provides a command line interface to a remote host. SSH transmissions are encrypted and authenticated, increasing the security of transmission. SSH access is disabled by default.
SSHv2 Port	Set the port on which SSH connections are made. The default port is 22. Change this value using the spinner control next to this field or by entering the port number in the field.

- 4 Set the following **HTTP/HTTPS** parameters:

Enable HTTP	Select the checkbox to enable HTTP device access. HTTP provides limited authentication and no encryption.
Enable HTTPS	Select the checkbox to enable HTTPS device access. HTTPS (<i>Hypertext Transfer Protocol Secure</i>) is more secure than plain HTTP. HTTPS provides both authentication and data encryption as opposed to just authentication (as is the case with HTTP).



NOTE: If the a RADIUS server is not reachable, HTTPS or SSH management access to the controller or service platform may be denied.

- 5 Select the **Enable Rest Server** option, within the **Rest Server** field, to facilitate device on-boarding. When selected, the REST server allows vendor-specific users access to the online device registration portal. All requests and responses to and from the on-boarding portal are handled by the REST server through *restful Application Programming Interface* (API) transactions. The REST server serves the Web pages used to associate a device's MAC address with a specific vendor group. This option is enabled by default.
- 6 Set the following parameters required for **FTP** access:

Enable FTP	Select the checkbox to enable FTP device access. FTP (<i>File Transfer Protocol</i>) is the standard protocol for transferring files over a TCP/IP network. FTP requires administrators enter a valid username and password authenticated locally. FTP access is disabled by default.
FTP Username	Specify a username required when logging in to the FTP server. The username cannot exceed 32 characters.
FTP Password	Specify a password required when logging in to the FTP server. Reconfirm the password in the field provided to ensure it has been entered correctly. The password cannot exceed 63 characters.
FTP Root Directory	Provide the complete path to the root directory in the space provided. The default setting has the root directory set to flash:/

7 Set the following **General** parameters:

Idle Session Timeout	Specify an inactivity timeout for management connection attempts (in seconds) from 0 - 4,320.
Message of the Day	Enter <i>message of the day</i> text (no longer than 255 characters) displayed at login for clients connecting via the CLI.

8 Set the following **Access Restrictions** parameters:

Filter Type	Select a filter type for access restriction. Options include <i>IP Access List</i> , <i>Source Address</i> or <i>None</i> . To restrict management access to specific hosts, select <i>Source Address</i> as the filter type and provide the allowed addresses within the Source Hosts field.
IP Access List	If the selected filter type is IP Access List, select an access list from the drop-down menu or select the <i>Create</i> button to define a new one. IP based firewalls function like <i>Access Control Lists</i> (ACLs) to filter/mark packets based on the IP from which they arrive, as opposed to filtering packets on layer 2 ports. IP firewalls implement uniquely defined access control policies, so if you don't have an idea of what kind of access to allow or deny, a firewall is of little value, and could provide a false sense of network security.
Source Hosts	If the selected filter type is Source Address, enter an IP Address or IP Addresses for the source hosts. To restrict management access to specific hosts, select Source Address as the filter type and provide the allowed addresses within the Source Hosts field.
Source Subnets	If the selected filter type is Source Address, enter a source subnet or subnets for the source hosts. To restrict management access to specific subnets, select Source Address as the filter type and provide the allowed addresses within the Source Subnets field.
Logging Policy	If the selected filter is Source Address, enter a logging policy for administrative access. Options includes <i>None</i> , <i>Denied Requests</i> or <i>All</i> .

- 9 Set the **User Lockout Settings**. Click the **Add Row** button and configure the following role-based user-account lockout and unlock criteria:

Role	Specify the user-role for which account lockout is to be enabled. The options are: • device-provisioning-admin • helpdesk • monitor • network-admin • security-admin • system-admin • vendor-admin • web-suer-admin Note, you can enable account lockout for multiple roles. After specifying the role/roles, set the <i>Lockout Time</i> and <i>Number of Password Attempts</i>. User-account lockout is individually applied to each account within the specified role/roles. For example, consider the 'monitor' role having two users: 'user1' and 'user2'. The <i>Number of Password Attempts</i> and <i>Lockout Time</i> is set at '5' attempts and '10' minutes respectively. In this scenario, user2 makes 5 consecutive, failed login attempts, and the user2 account is locked out for 10 minutes. However, during this lockout time the user1 account remains active.
Lockout Time	Specify the maximum time for which an account remains locked. Specify a value from 0 to 600 minutes. The value '0' indicates that the account is permanently locked.
Number of Password Attempts	Specify the maximum number of consecutive, failed attempts allowed before an account is locked. Specify a value from 1 to 100.

- 10 Select **OK** to update the access control configuration. Select **Reset** to the last saved configuration.

12.1.1.4 Setting the Authentication Configuration

► Adding or Editing a Management Access Policy

Refer to the **Authentication** tab to define how user credential validation is conducted on behalf of a Management Access policy. If utilizing an external authentication resource, an administrator can optionally apply a TACACS policy. *Terminal Access Controller Access - Control System+* (TACACS+) is a protocol created by CISCO to provide access control to network devices (routers, network access servers or other networked devices) through one or more centralized servers. TACACS provides separate authentication, authorization, and accounting services running on different servers.

To configure an external authentication resource:

- 1 Select the **Authentication** tab from the Management Policy screen.

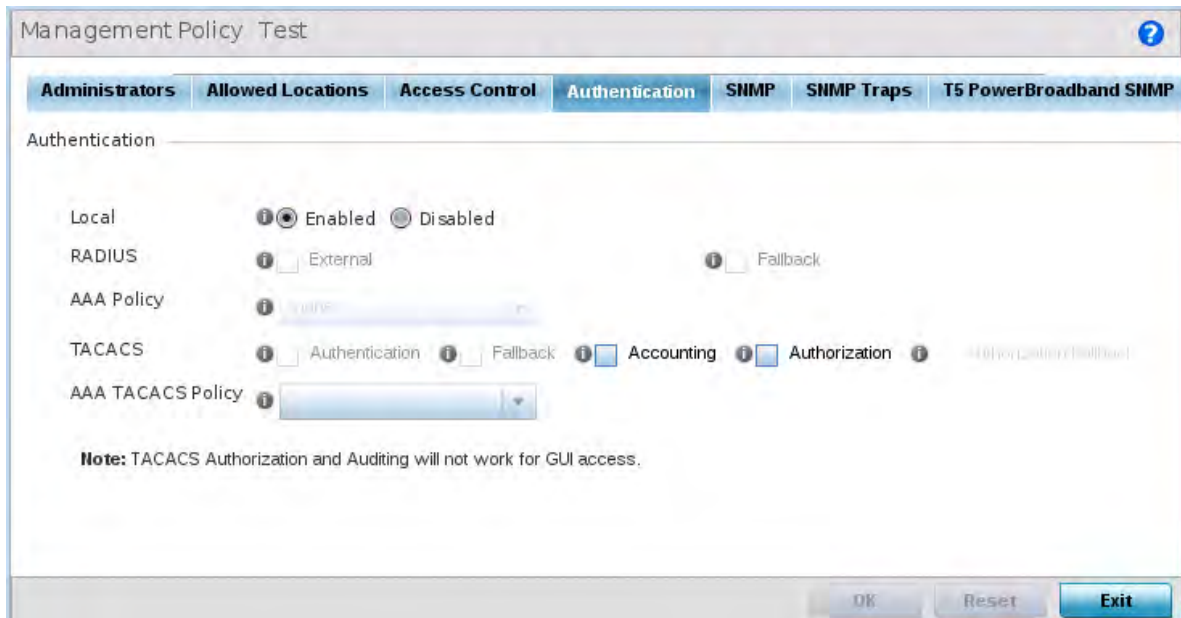


Figure 12-8 Management Policy screen - Authentication tab

- 2 Define the following settings to authenticate management access requests:

Local	Select whether the authentication server resource is centralized (local), or whether an external authentication resource is deployed for validating user access. Local is enabled by default.
RADIUS	If local authentication is disabled, define whether the RADIUS server is <i>External</i> or <i>Fallback</i> .
AAA Policy	Define the AAA policy used to authenticate user validation requests to the controller or service platform managed network. Select the <i>Create</i> icon as needed to define a new AAA policy or select the <i>Edit</i> icon to modify an existing policy.
TACACS	If local authentication is <i>disabled</i> , optionally select <i>Authentication</i> or <i>Fallback</i> (only one authentication or fallback option can be selected) or <i>Accounting</i> and <i>Authorization</i> . TACACS policies control user access to devices and network resources while providing separate accounting, authentication, and authorization services.
AAA TACACS Policy	Select an existing AAA TACACS policy (if available), or select <i>Create</i> to define a new policy or <i>Edit</i> to modify an existing one.

- 3 Select **OK** to update the authentication configuration. Select **Reset** to the last saved configuration.

12.1.1.5 Setting the SNMP Configuration

► Adding or Editing a Management Access Policy

Optionally use the *Simple Network Management Protocol* (SNMP) to communicate with devices within the network. SNMP is an application layer protocol that facilitates the exchange of management information between the controller or service platform and a managed device. SNMP enabled devices listen on port 162 (by default) for SNMP packets from the controller or service platform's management server. SNMP uses read-only and read-write community strings as an authentication mechanism to monitor and configure supported devices. The read-only

community string is used to gather statistics and configuration parameters from a supported wireless device. The read-write community string is used by a management server to *set* device parameters. SNMP is generally used to monitor a system's performance and other parameters.

SNMP Version	Encrypted	Authenticated	Default State
SNMPv1	No	No	Disabled
SNMPv2	No	No	Enabled
SNMPv3	Yes	Yes	Enabled

To configure SNMP Management Access:

- 1 Select the **SNMP** tab from the Management Policy screen.

Management Policy default

Administrators Allowed Locations Access Control Authentication **SNMP** SNMP Traps T5 PowerBroadband SNMP

SNMP

Enable SNMPv1 ☒
 Enable SNMPv2 ☐
 Enable SNMPv3 ☒

SNMP v1/v2c Community String

Community	Access Control	IP SNMP ACL
private	rw	default
public	ro	default

+ Add Row

SNMPv3 Users

User Name	Authentication	Encryption	Password
snmpmanager	md5	des	motorola
snmpoperator	md5	des	operator
snmptrap	md5	des	motorola

+ Add Row

OK Reset Exit

Figure 12-9 Management Policy screen - SNMP tab

- 2 Enable or disable SNMP v1, SNMPv2 and SNMPv3.

Enable SNMPv1	SNMP v1 exposes a device's management data so it can be managed remotely. Device data is exposed as variables that can be accessed and modified as text strings, with version 1 being the original (rudimentary) implementation. SNMPv1 is enabled by default.

Enable SNMPv2	Select the checkbox to enable SNMPv2 support. SNMPv2 provides device management using a hierarchical set of variables. SNMPv2 uses <i>Get</i> , <i>GetNext</i> , and <i>Set</i> operations for data management. SNMPv2 is enabled by default.
Enable SNMPv3	Select the checkbox to enable SNMPv3 support. SNMPv3 adds security and remote configuration capabilities to previous versions. The SNMPv3 architecture introduces the <i>user-based security model</i> (USM) for message security and the <i>view-based access control model</i> (VACM) for access control. The architecture supports the concurrent use of different security, access control and message processing techniques. SNMPv3 is enabled by default.

- 3 Set the **SNMP v1/v2 Community String** configuration. Use the **+ Add Row** function as needed to add additional SNMP v1/2 community strings, or select an existing community string's radio button and select the **Delete** icon to remove it.

Community	Define a <i>public</i> or <i>private</i> community designation. By default, SNMPv2 community strings on most devices are set to <i>public</i> , for the read-only community string, and <i>private</i> for the read-write community string.
Access Control	Set the access permission for each community string used by devices to retrieve or modify information. Available options include: <i>Read Only</i> - Allows a remote device to retrieve information. <i>Read-Write</i> - Allows a remote device to modify settings.
IP SNMP ACL	Set the IP SNMP ACL used along with community string. Use the drop-down menu to select an existing ACL. Use the <i>Create</i> icon to create and add a new ACL. Select an existing ACL and the <i>Edit</i> icon to update an existing ACL.

- 4 Set the **SNMPv3 Users** configuration. Use the **+ Add Row** function as needed to add additional SNMPv3 user configurations, or select a SNMP user's radio button and select the **Delete** icon to remove the user.

User Name	Use the drop-down menu to define a user name of <i>snmpmanager</i> , <i>snmpoperator</i> or <i>snmptrap</i> .
Authentication	Displays the authentication scheme used with the listed SNMPv3 user. The listed authentication scheme ensures only trusted and authorized users and devices can access the network.
Encryption	Displays the encryption scheme used with the listed SNMPv3 user.
Password	Provide the user's password in the field provided. Select the <i>Show</i> check box to display the actual character string used in the password, while leaving the check box unselected protects the password and displays each character as "*".

- 5 Select **OK** to update the SNMP configuration. Select **Reset** to revert to the last saved configuration.

12.1.1.6 SNMP Trap Configuration

► Adding or Editing a Management Access Policy

The managed network can use SNMP trap receivers for fault notifications. SNMP traps are unsolicited notifications triggered by thresholds (or actions), and are therefore an important fault management tool.

A SNMP trap receiver is the destination of SNMP messages (external to the controller or service platform). A trap is like a Syslog message, just over another protocol (SNMP). A trap is generated when a device consolidates event

information and transmits the information to an external repository. The trap contains several standard items, such as the SNMP version, community etc.

SNMP trap notifications exist for most controller or service platform operations, but not all are necessary for day-to-day operation.

To define a SNMP trap configuration for receiving events at a remote destination:

- 1 Select the **SNMP Traps** tab from the Management Policy screen.

Figure 12-10 Management Policy screen - SNMP Traps tab

- 2 Select the **Enable Trap Generation** checkbox to enable trap generation using the trap receiver configuration defined. This feature is disabled by default.
- 3 Refer to the **Trap Receiver** table to set the configuration of the external resource dedicated to receiving trap information. Select **Add Row +** as needed to add additional trap receivers. Select the **Delete** icon to permanently remove a trap receiver.

IP Address	Sets the IP address of the external server resource dedicated to receiving the SNMP traps on behalf of the controller or service platform.
Port	Set the port of the server resource dedicated to receiving SNMP traps. The default port is port 162.
Version	Sets the SNMP version to use to send SNMP traps. SNMPv2 is the default.
Trap Community	Provide a 32 character maximum trap community string. The community string functions like a user id or password allowing access to controller or Access Point resources. If the community string is correct, the controller or Access Point provides with the requested information. If the community string is incorrect, the device controller or Access Point discards the request and does not respond. Community strings are used only by devices which support SNMPv1 and SNMPv2c. SNMPv3 uses username/password authentication, along with an encryption key. The default setting is <i>public</i> .

- 4 Select **OK** to update the SNMP Trap configuration. Select **Reset** to revert to the last saved configuration.

12.1.1.7 T5 PowerBroadband SNMP

► Adding or Editing a Management Access Policy

A T5 controller, once enabled as a supported external device, can provide data to WiNG to assist in a T5's management within a WiNG supported subnet populated by both types of devices.

To define a T5 controller power broadband SNMP configuration:

- 1 Select the **T5 Power Broadband** tab from the Management Policy screen.

Management Policy default

Administrators Allowed Locations Access Control Authentication SNMP SNMP Traps **T5 PowerBroadband SNMP**

SNMP

Contact

Enable Server ☒

Location

Traps ☒

SNMP v1/v2c Community String

Name	Access	IP
private	rw	192.168.0.1
public	ro	192.168.0.1
	Read Only	

+ Add Row

OK Reset Exit

Figure 12-11 Management Policy screen - T5 PowerBroadband tab

- 2 Set the following **SNMP** settings:

Contact	Set a 64 character maximum contact name for the administration of T5 controller SNMP events.
Enable Server	Select this option to enable SNMP event management for the T5 controller. This setting is disabled by default.
Location	Set a 64 character maximum location for the SNMP resource dedicated to T5 controller support.
Traps	Select this option for SNMP trap support for the T5 controller. A trap is like a Syslog message, just over another protocol (SNMP). A trap is generated when a device consolidates event information and transmits the information to an external repository. The trap contains several standard items, such as the SNMP version, community etc.

- Set the **SNMP v1/v2c Community String** configuration for T5 controller usage. Use the **+ Add Row** function as needed to add additional SNMP v1/2 community strings, or select an existing community string's radio button and select the **Delete** icon to remove it.

Community	Set a 32 character maximum SNMP community string.
Access	Set the access permission for each community string used by devices to retrieve or modify information. Available options include: <i>Read Only</i> - Allows a remote device to retrieve information. <i>Read-Write</i> - Allows a remote device to modify settings.
IP	Set the IP address of the SNMP manager.

- Use the **Host** table to define up to 4 SNMP receiver resource IP addresses.
- Select **OK** to update the configuration. Select **Reset** to revert to the last saved configuration.

12.2 EX3500 Management Policies

The EX3500 series switch is a Gigabit Ethernet Layer 2 switch with either 24 or 48 10/100/1000-BASE-T ports, and four *Small Form Factor Pluggable* (SFP) transceiver slots for fiber connectivity. Each 10/100/1000 Mbps port supports both the IEEE 802.3af and IEEE 802.3at-2009 PoE standards. Each EX3500 series switch includes an SNMP-based management agent, which provides both in-band and out-of-band access for management. An EX3500 series switch utilizes an embedded HTTP Web agent and *command line interface* (CLI) somewhat different from the WiNG operating system, while still enabling the EX3500 series switch to provide WiNG controllers PoE and port management resources.

Going forward NX9600, NX9500, NX7500, NX5500 WiNG managed services platforms and WiNG VMs can discover, adopt and partially manage EX3500 series Ethernet switches, as DHCP option 193 has been added to support external device adoption. DHCP option 193 is a simplified form of DHCP options 191 and 192 used by WiNG devices currently. DHCP option 193 supports *pool*, *hello-interval* and *adjacency-hold-time* parameters.



NOTE: WiNG can partially manage an EX3500 without using DHCP option 193. In this case the EX3500 must be directly configured to specify the IPv4 addresses of potential WiNG adopters, using the EX3500 **controller host ip address** CLI command.

WiNG service platforms leave the proprietary operating system running the EX3500 switches unmodified, and partially manage them utilizing standardized WiNG interfaces. WiNG service platforms use a translation layer to communicate with EX3500 series switches.

To set EX3500 management settings for user EX3500 user group creation, authentication, password management and SNMP:

- Select **Configuration**.
- Select **Management**.
- Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.

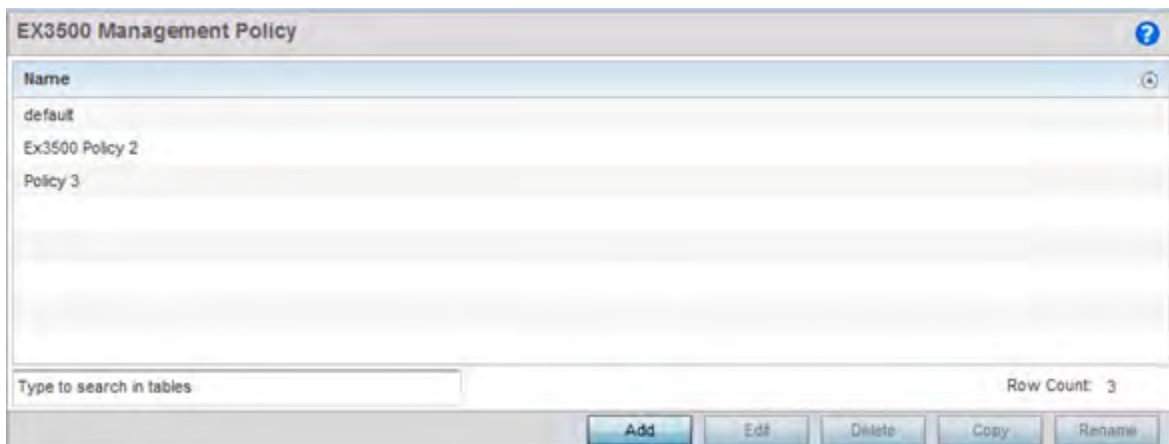


Figure 12-12 EX3500 Management Policy screen

The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify the attributes of a policy or **Delete** to remove an obsolete list from those available. Existing lists can be copied or renamed as needed.

For more information, refer to the following:

- [EX3500 User Groups](#)
- [EX3500 Authentication](#)
- [EX3500 Exec Password Management](#)
- [EX3500 System Settings](#)
- [EX3500 SNMP Management](#)
- [EX3500 SNMP Users](#)

12.2.1 EX3500 User Groups

EX3500 switch user groups are stored in a local database on the WiNG service platform. Each user group can be assigned unique access levels and passwords to provide administrative priority.

To set an EX3500 user group configuration:

- 1 Select **Configuration**.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 If creating a new EX3500 user group, assign it a **Name** up to 32 characters. Select **Continue**.

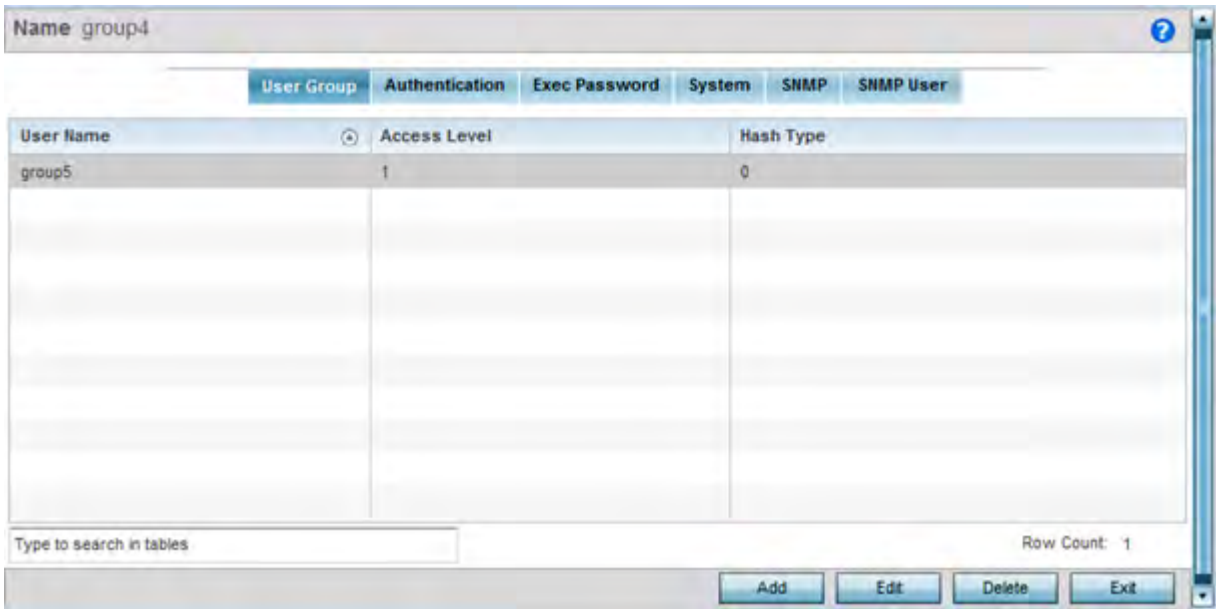


Figure 12-13 EX3500 Management Policy User Group screen

- 6 Select **Add** to create a new EX3500 user group, **Edit** to modify an existing group or **Delete** to remove an obsolete group. Set the following **User Group** attributes:

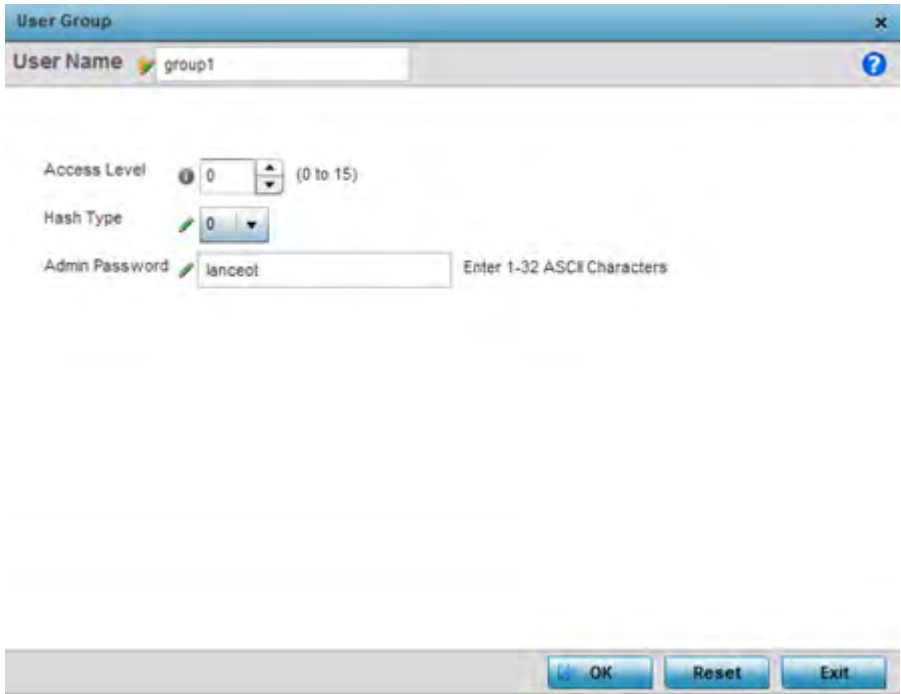


Figure 12-14 User Group Add/Edit screen

Access Level	Use the spinner control to set an access level from 0 - 15 serving as the access priority of each user group requesting access and interoperability with an EX3500 switch. Access level 0 corresponds to a guest user with minimal access to commands while access level 15 corresponds to an administrator user with full access to all commands.

Hash Type	Select either 0 or 7 to define the hash in plain text (0) or encrypted characters (7).
Admin Password	Create a 32 character maximum password for the EX3500 user group.

- 7 Select **OK** when completed to update the EX3500 user group configuration. Select **Reset** to revert the screen back to its last saved configuration.

12.2.2 EX3500 Authentication

Management access to an EX3500 switch can be enabled/disabled as required using separate interfaces and protocols (HTTP, SSH). Disabling un-used and insecure interfaces and unused management services can dramatically reduce an attack footprint and free resources within an EX3500 management policy.

To authenticate an EX3500 management policy:

- 1 Select **Configuration** from the Web UI.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 Select the **Authentication** tab.

Figure 12-15 EX3500 Management Policy Authentication screen

- 6 Select the following **HTTP** server settings to authenticating a HTTP connection to an EX3500:

Server	When selected, access the EX3500 using HTTP from any Windows PC, Linux PC or other device that uses HTTP. This setting is enabled by default.
Port	Set the HTTP port number from 1 - 65,535. The default port is 80.
Secure Server	Select this option to secure HTTP over a designated secure port.

Secure Port	Use the spinner control to select a secure port from 1 - 65, 535.

- 7 Select the following **SSH** server settings to authenticate a SSH connection to an EX3500:

Server	When selected, access the EX3500 using SSH from any Windows PC, Linux PC or other device that uses SSH. This setting is enabled by default.
Retries for SSH	Set the maximum number of retries, from 1 - 5, for connection to the SSH server resource. The default setting is 3.
Server Key	Set the SSH server key length from 512 - 1,024. The default length is 768.
Time Out	Set the inactivity timeout for the SSH server resource from 1 - 120 seconds. When this setting is exceeded, the SSH server resource becomes unreachable and must be reauthenticated. The default value is 120 seconds.

- 8 Select **OK** when completed to update the EX3500 authentication configuration. Select **Reset** to revert the screen back to its last saved configuration.

12.2.3 EX3500 Exec Password Management

Each EX3500 management policy can have a unique exec password with its own privilege level assigned. Utilize these passwords as specific EX3500 management sessions require priority over others.

To administrate EX3500 management passwords and their privileges:

- 1 Select **Configuration** from the Web UI.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 Select the **Exec Password** tab.

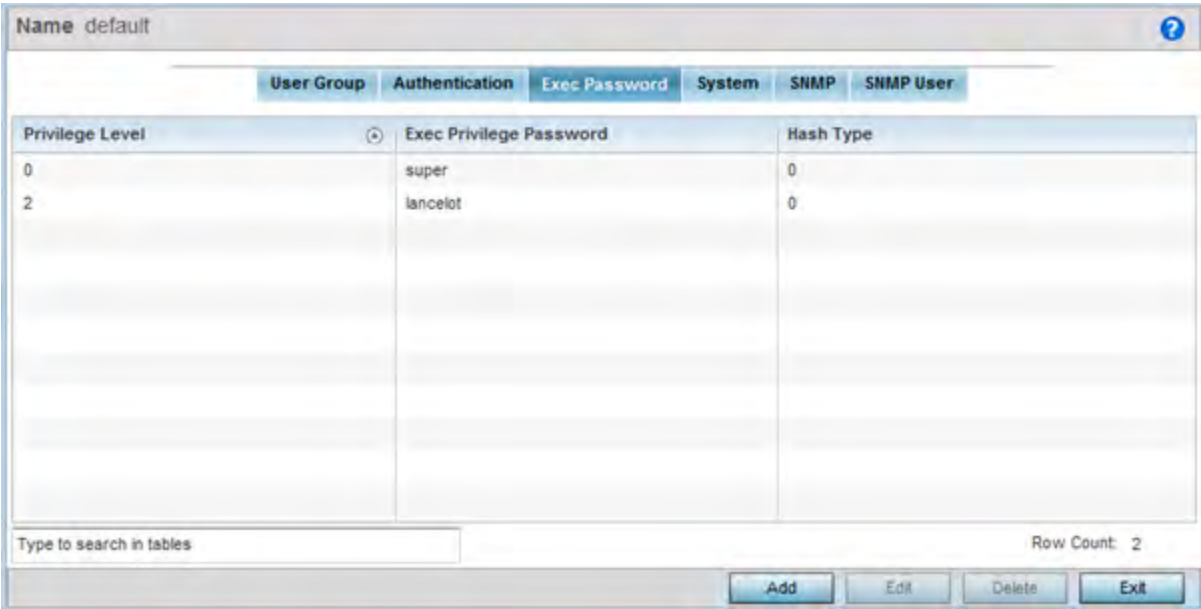


Figure 12-16 EX35000 Management Policy Exec Password screen

- 6 Select **Add** to create a new EX3500 exec password, **Edit** to modify an existing password configuration or **Delete** to remove an obsolete password.

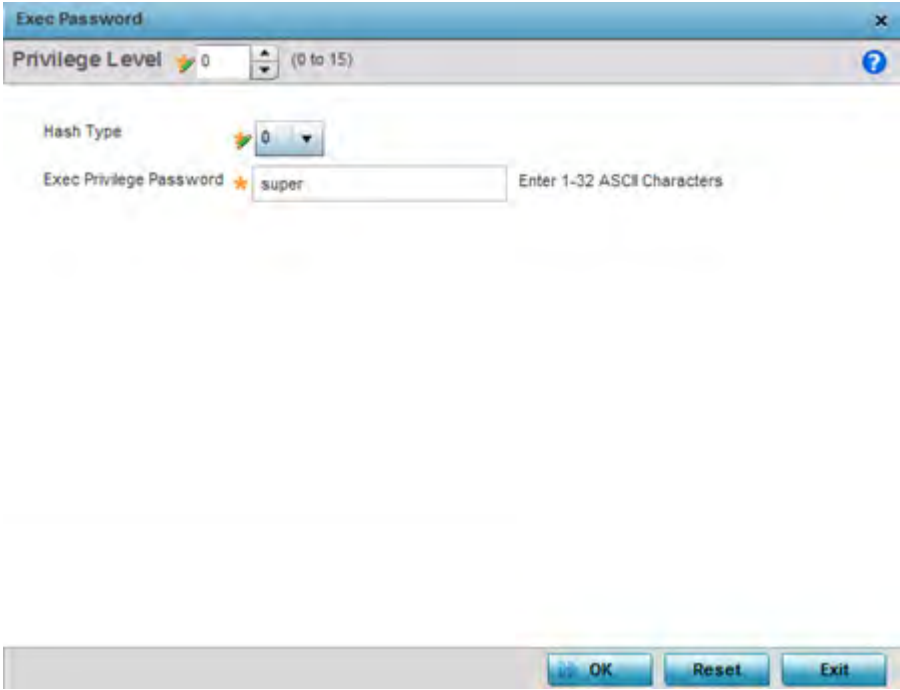


Figure 12-17 EX35000 Management Policy Exec Password Add/Edit screen

- 7 Assign a privilege level from 0 - 15. 0 provides the least access, while level 15 provides the most access. The commands available at each level vary.
- 8 Select the following **Exec Password** settings:

Hash Type	Select either 0 or 7 to define the hash in plain text (0) or encrypted characters (7).

Exec Privilege Password	Create a 32 character maximum password for the EX3500 exec password.

- 9 Select **OK** when completed to update the EX3500 exec password. Select **Reset** to revert the screen back to its last saved configuration.

12.2.4 EX3500 System Settings

An EX3500 management policy can be customized to include high and low alarm thresholds for EX3500 memory and CPU utilization.

The **Memory** and **CPU** rising and falling thresholds control when the EX3500 generates SNMP traps if these thresholds are exceeded. A trap is generated when the utilization exceeds the rising threshold, and another trap is generated after the utilization drops below the falling threshold. These thresholds do not protect the resource, they provide notification of an excessive use of the resource.

To administrate EX3500 management policy memory and CPU threshold settings:

- 1 Select **Configuration** from the Web UI.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 Select the **System** tab.

The screenshot shows a web interface for configuring EX3500 management policies. At the top, there's a header bar with tabs: User Group, Authentication, Exec Password, System (selected), SNMP, and SNMP User. Below the tabs, the 'System' configuration is displayed. It includes two sections: 'Memory - Alarm Configuration' and 'CPU - Alarm Configuration'. Each section has two thresholds: 'Falling Threshold' and 'Rising Threshold'. For Memory, the Falling Threshold is 90 and the Rising Threshold is 95. For CPU, the Falling Threshold is 70 and the Rising Threshold is 90. Each threshold has a small 'i' icon and a range '(1 to 100)'. At the bottom right, there are three buttons: 'OK', 'Reset', and 'Exit'.

Figure 12-18 EX3500 Management Policy System screen

- 6 Set the following **Memory - Alarm Configuration** threshold settings:

Falling Threshold	Set the threshold for clearing the EX3500 memory utilization alarm. Once the rising threshold is exceeded, the memory utilization must drop below this threshold for the alarm to clear. The threshold is set as a percentage from 1 - 100, with a default of 90.
Rising Threshold	Set the threshold for EX3500 memory utilization as too high. The threshold is set as a percentage from 1 - 100, with a default of 95.

- 7 Set the following **CPU - Alarm Configuration** threshold settings:

Falling Threshold	Set the threshold for clearing the EX3500 CPU (processor) utilization alarm. Once the rising threshold is exceeded, the CPU (processor) utilization must drop below this threshold for the alarm to clear. The threshold is set as a percentage from 1 - 100, with a default of 70.
Rising Threshold	Set the notification threshold for EX3500 CPU (processor) utilization as too high. The threshold is set as a percentage from 1 - 100, with a default of 90.

- 8 Select **OK** when completed to update the EX3500 system threshold settings. Select **Reset** to revert the screen back to its last saved configuration.

12.2.5 EX3500 SNMP Management

Optionally use the *Simple Network Management Protocol* (SNMP) with the EX3500 management policy for statistics gathering, or to fully manage the EX3500. SNMP is an application layer protocol that facilitates the exchange of management information between the controller or service platform and a managed device. SNMP enabled devices listen on port 161 (by default) for SNMP packets from the controller or service platform's management server. SNMP uses read-only and read-write community strings as an authentication mechanism to monitor and configure supported devices. The read-only community string is used to gather statistics and configuration parameters from a supported wireless device. The read-write community string is used by a management server to set device parameters. SNMP is generally used to monitor a system's performance and other parameters.

To the EX3500's SNMP management policy configuration:

- 1 Select **Configuration** from the Web UI.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 Select the **SNMP** tab.

Name default

User Group Authentication Exec Password System **SNMP** SNMP User

SNMP

Enable ☒

Contact

Local Engine ID

Location

Community String

Name	Access
private	rw
public	ro

+ Add Row

Group

Group Name	Authentication	Version	Notify View	Read View	Write View
lanelot	none	v2c			

OK Cancel Exit

Figure 12-19 EX35000 Management Policy SNMP screen

6 Set the following **SNMP** settings:

Enable	Select the checkbox to enable SNMPv1, SNMPv2 or SNMPv3 support. The SNMP version utilized is selected and mapped to a user group within the <i>Group</i> table.
Contact	Define a 255 character maximum SNMP contact name for responsible for the WiNG administration of the EX3500 switch.
Local Engine ID	Set a 64 character maximum local engine ID. The local engine ID is the administratively unique identifier of an SNMPv3 engine used for identification, not addressing. There are two parts of an engine ID: <i>prefix</i> and <i>suffix</i> . The prefix is formatted according to the specifications defined in RFC 3411.
Location	Assign a 255 character maximum EX3500 switch location reflecting the switch's physical deployment location.

- 7 Select **+ Add Row** and set the following **Community Strings**:

Name	Define a <i>public</i> or <i>private</i> community designation. By default, SNMPv2 community strings on most devices are set to public, for the read-only community string, and private for the read-write community string.
Access	Set the access permission for each community string used by devices to retrieve or modify information. Available options include: <i>Read Only</i> - Allows a remote device to retrieve information. <i>Read-Write</i> - Allows a remote device to modify settings.

- 8 Select **+ Add Row** and set the following **Group** settings for SNMP management of the EX3500:

Group Name	Define a 32 character maximum name for this SNMP group. A maximum of 17 groups can be set for EX3500 model switches.
Authentication	If utilizing SNMPv3 as the version for this group, select whether <i>auth</i> , <i>noauth</i> or <i>priv</i> is applied to this group as a credential exchange and validation mechanism. This setting is not enabled if utilizing either SNMPv1 or SNMPv2.
Version	Apply either SNMPv1, SNMPv2 or SNMPv3 to this EX3500 SNMP group. SNMP v2 is identical to version 1, but it adds support for 64 bit counters. Most devices support SNMP v2c automatically. However, there are some devices that require you to explicitly enable v2, and that poses no risk. SNMP v3 adds security to the 64 bit counters provided with SNMP v2. SNMP v3 adds both encryption and authentication, which can be used together or separately. Its setup is more complex than just defining a community string. But if you require security, SNMP v3 is recommended.
Notify View	Set a 32 character maximum notify string to restrict and filter the objects in the notification.
Read View	Set an optional 32 character maximum string indicating that users who belong to this group have <i>read</i> access to the EX3500 switch.
Write View	Set an optional 32 character maximum string indicating that users who belong to this group have <i>write</i> access to the EX3500 switch.

- 9 Set the following **SNMP Traps** for SNMP event management of the EX3500:

Authentication	Select the checkbox to enable trap generation for user authentication events when accessing a EX3500 switch from a WING managed controller. This feature is disabled by default.
Enable SNMP Trap	Select the checkbox to enable EX3500 MAC generation traps. When enabled a trap is generated when a dynamic MAC address is added or removed to/from the switch's address table. This feature is disabled by default.
Link Up Down	Select this option to generate a trap a when either a link is established or broken between the EX3500 switch and a connected device (WING managed or not).

- 10 Refer to the **SNMP View** table and select **+ Add Row** to include or exclude up to 31 SNMP views.

View Name	Enter a 32 alphanumeric character maximum name to identify the EX3500 SNMP MIB view. A view is a set of MIB view subtrees, or a family of subtrees, where each is a subtree within the managed object naming tree. Create MIB views to control the OID range that SNMPv3 users can access.

OID Tree	Provide an OID string to include or exclude from the view. The OID string is 128 characters in length.
View Access	Designate whether view access is <i>included</i> or <i>excluded</i> for the subtree or family of subtrees from the MIB view. If creating an excluded view subtree, consider creating a corresponding included entry with the same view name to allow subtrees outside of the excluded subtree to be included.

- 11 Refer to the **Notify Filter** table and select **+ Add Row** to set up to 5 remote resources for archive and retrieval.

Name	Enter a 26 character maximum name for the filter. Notifications indicate erroneous user authentication requests, restarts, connection closures, connection loss to a neighbor router or other events.
Remote Host	Provide a destination IP address for a remote server resource for trap filters.

- 12 Refer to the **Remote Engine** table and select **+ Add Row** to set up to 5 remote IDs and addresses.

Remote Engine IP	Enter a remote engine IP address for the remote SNMP agent of the device where the user resides.
Remote Engine Id	Provide an Id 9 - 64 characters in length. If configuring the EX3500 management for SNMP V3, is it necessary to configure an engine ID, as passwords are localized using the SNMP ID of the SNMP engine. The remote agent's SNMP engine ID is needed when computing authentication from a password.

- 13 Refer to the **Host** table and select **+ Add Row** to set the trap receiver host configuration.

Authentication	If using SNMPv3, define the authentication scheme for user credential validation as either <i>auth</i> , <i>noauth</i> or <i>priv</i> .
Community String	Provide the 1 - 32 character text community strings for accessing EX3500 switch configuration files. SNMP uses read-only and read-write community strings as an authentication mechanism to monitor and configure supported devices.
Inform	Enable this option to enable an EX3500 switch to send inform requests to SNMP managers. Traps are not as reliable than informs since an acknowledgment is not sent from the receiving end when a trap is received. A SNMP manager that receives an inform acknowledges the message with an SNMP response.
IP	Define the trap receiver's IP address.
Retry	Set the number of server connection retries (from 1 - 255). When no response is received after the last retry attempt, the connection session is terminated with the trap receiver IP address.
Timeout	Configures the duration (in seconds) the host connection process is shutdown temporarily before a reset of the process is attempted for the set number of retries.
UDP Port	Set the port of the server resource dedicated to receiving EX3500 switch SNMP traps. The default port is port 162.

Version	Set whether SNMP version 1, 2 or 3 is used with this dedicated host. Versions 1 and 2 provide no data security. SNMPv3 adds security and remote configuration capabilities to previous versions. The SNMPv3 architecture introduces the <i>user-based security model</i> (USM) for message security and the <i>view-based access control model</i> (VACM) for access control.

12.2.6 EX3500 SNMP Users

An EX3500 SNMP management session utilizes unique SNMP users with specific authentication and privacy parameters.

To administrate EX3500 SNMP users and their permissions:

- 1 Select **Configuration** from the Web UI.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **EX3500 Management Policy**.
- 4 The screen lists those EX3500 management policies created thus far. Select **Add** to create a new EX3500 management policy, **Edit** to modify an existing policy or **Delete** to remove an obsolete policy. Existing lists can be copied or renamed as needed.
- 5 Select the **SNMP User** tab.

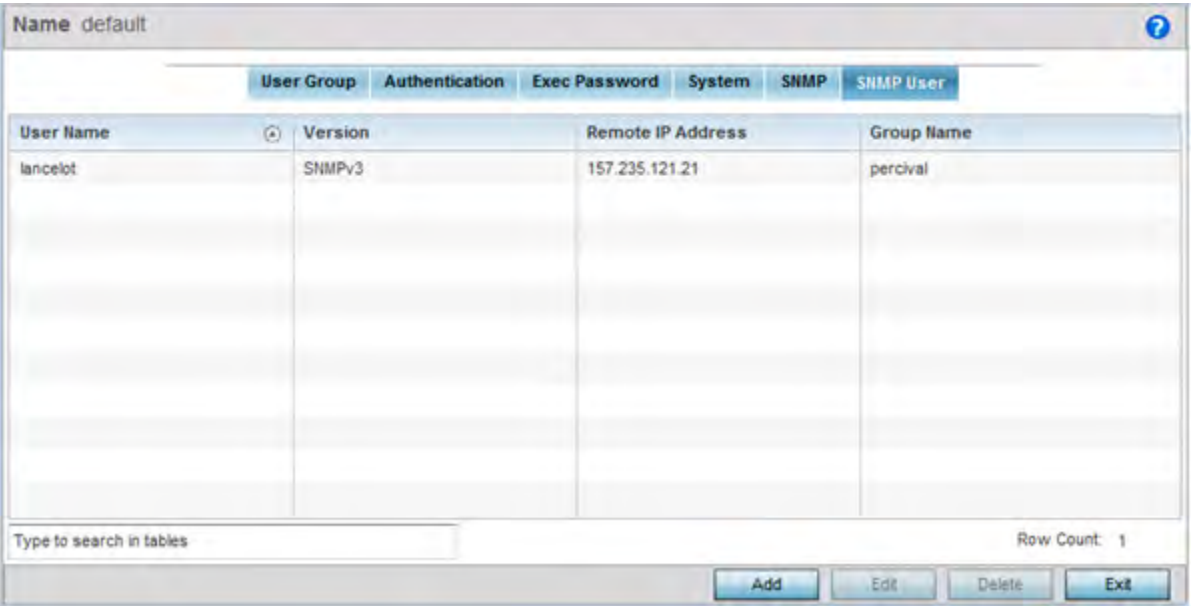


Figure 12-20 EX3500 SNMP User screen

- 6 Review the following EX3500 SNMP user credentials to determine whether a new user requires creation on an existing user configuration needs modification:

User Name	Displays the 32 character maximum SNMP user name assigned the specific SNMP version and remote SNMP server resource listed. More than one user can be assigned to the same EX3500 SNMP user group.

Version	Lists whether SNMPv1, SNMPv2 or SNMPv3 is applied to this EX3500 SNMP user. SNMP v2 is identical to version 1, but it adds support for 64 bit counters. Most devices support SNMP v2c automatically. However, there are some devices that require you to explicitly enable v2, and that poses no risk. SNMP v3 adds security to the 64 bit counters provided with SNMP v2. SNMP v3 adds both encryption and authentication, which can be used together or separately. Its setup is more complex than just defining a community string. But if you require security, SNMP v3 is recommended.
Remote IP Address	Lists the remote server resource designated for receiving SNMP trap and inform event messages for the listed SNMP user.
Group Name	Lists the 32 character maximum name assigned to this SNMP group, as SNMP access rights are organized by groups. The trap group name can be any string and is embedded in the community name field of a trap. A maximum of 17 groups can be set for EX3500 model switches.

- 7 Select **Add** to create a new user configuration or **Edit** to modify the attributes of an existing EX3500 SNMP user configuration.

Figure 12-21 EX3500 SNMP User Add/Edit screen

- 8 Set the following SNMP user credentials for the EX3500 SNMP user:.

User Name	Enter a 32 character maximum SNMP user name for EX3500 SNMP session management.
Version	Use the drop-down menu to define whether SNMPv1, SNMPv2 or SNMPv3 is applied to this EX3500 SNMP user configuration. SNMP v2 is identical to version 1, but it adds support for 64 bit counters. Most devices support SNMP v2c automatically. However, there are some devices that require you to explicitly enable v2, and that poses no risk. SNMP v3 adds security to the 64 bit counters provided with SNMP v2. SNMP v3 adds both encryption and authentication, which can be used together or separately. Its setup is more complex than just defining a community string. But if you require security, SNMP v3 is recommended.

Remote IP Address	Set the remote server resource IP address designated for receiving SNMP trap and inform event messages for this SNMP user.
Group Name	Enter a 32 character maximum for a SNMP group. The group name can be any string and is embedded in the community name field of a SNMP trap.
Encryption	When using SNMPv3, the <i>Encryption</i> option becomes available to scramble packet contents and prevent them from exposure to unauthorized sources.
Authentication	When using SNMPv3, the <i>Authentication</i> option becomes available to ensure messaging is from a valid source. SNMPv3 uses the <i>user-based security model</i> (USM) for message security and the <i>view-based access control model</i> (VACM) for access control. USM specifies authentication and encryption. VACM specifies access-control rules.
Authentication Password	Enter a 8 - 40 character ASCII authentication password. The selected authentication password ensures only trusted and authorized users can access an EX3500 SNMP management session.
Private Type	Use the drop-down menu to specify the privacy type. The <i>Advanced Encryption Standard</i> (AES) is utilized as one of the privacy protocol options for SNMPv3 messages in either an <i>aes128</i> , <i>aes192</i> or <i>aes256</i> format and are recommended. <i>3DES</i> and <i>des56</i> are also options, but are considered somewhat insecure and vulnerable to <i>brute-force-attacks</i> .
Private Password	Enter a 8 - 64 character ASCII password to secure the privacy type selected.

- 9 Select **OK** when completed to update the EX3500 SNMP user settings. Select **Reset** to revert the screen back to its last saved configuration.

12.3 Hierarchical Tree

Tree Setup is unique because it is not a policy (which is reused in other objects), but rather a global configuration that represents the tree displayed for *Dashboard*, *Operations* and *Statistics*. However since it is set as a configuration, it follows the standard configuration methods, and requires a *Commit* before it taking effect and a *Save* to become persistent across reboots.

ADSP can run as a virtual machine on NX9500 and NX9510 model service platforms. WiNG communicates with ADSP using a *single sign-on* (SSO) authentication mechanism. Once the user is logged in, WiNG gains access to ADSP without being prompted to login again at ADSP. There is no synchronization between the WiNG and ADSP databases. ADSP has its own user database stored locally within its virtual machine. This local database is accessed if a user logs directly into ADSP.

WiNG and ADSP must be consistent in the manner events are reported up through a network hierarchy to ensure optimal interoperability and event reporting. To provide such consistency, WiNG has added support for an ADSP-like hierarchal tree. The tree resides within WiNG, and ADSP reads it from WiNG and displays the network hierarchy in its own ADSP interface. The hierarchal tree can also be used to launch ADSP modules (like Spectrum Analyzer) directly from WiNG.



NOTE: The Hierarchical tree is available on both controllers and service platforms, but not Access Points.

WiNG uses the following *containers* within the tree to be consistent with ADSP's hierarchy conventions:

- *Country*
- *Region*
- *City*
- *Campus*

Hierarchy rules are enforced in the containers. For example, a *city* can be created under a *country* or *region*, but not vice versa. An RF Domain can be placed in any container. However, there cannot be any additional containers under the RF Domain.

WiNG's RF Domain's already use *areas* and *floors*, and these will continue to work as they currently do. Floors are also numbered to be consistent with ADSP's usage.

To configure a hierarchal tree to use with ADSP:

- 1 Select **Configuration**.
- 2 Select **Management**.
- 3 Refer to the upper, left-hand, portion of the UI and select **Tree Setup**.

The **Tree Setup** screen displays with a System node that requires population with the containers to represent the deployment shared between WiNG and ADSP.

The *Country*, *Region*, *City* and *Campus* containers can be defined in any order, but at least one of these containers is required within the hierarchy before the RF Domain can be added and the hierarchy defined as valid.

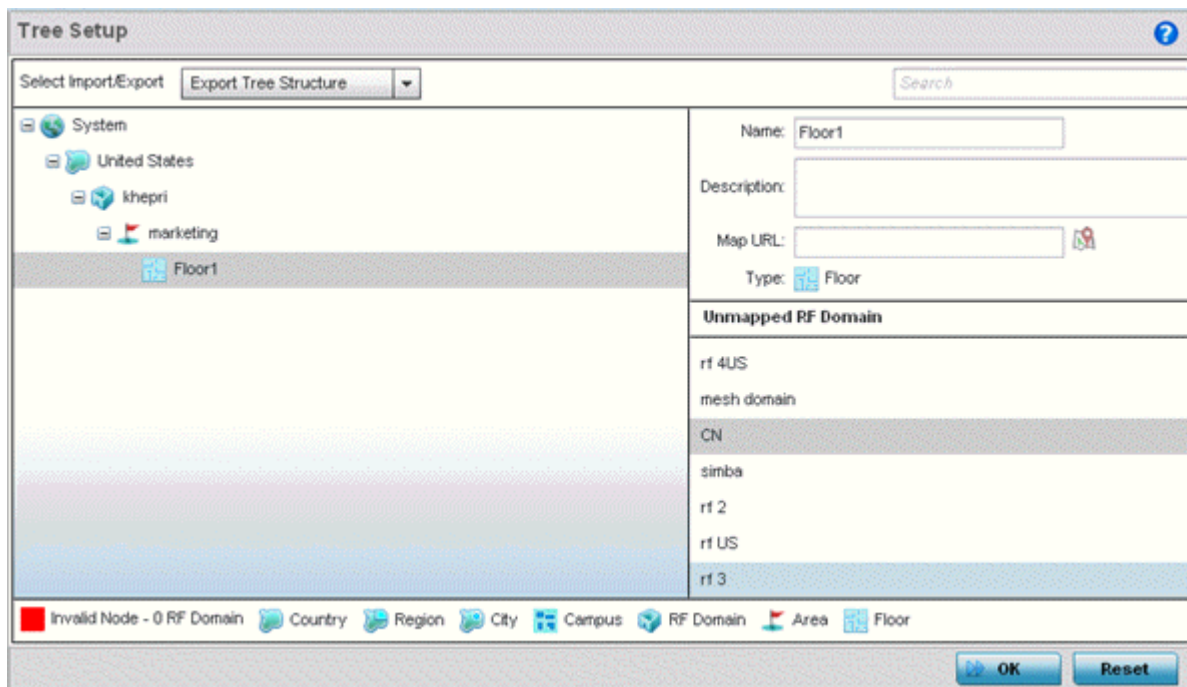


Figure 12-22 Hierarchal Tree screen

- 4 To add a *Country*, *Region*, *City* or *Campus* to the tree, select **System** from the upper, left-hand, portion of the Tree Setup screen. An **add child** link displays on the right-hand side of the display.

If adding a **Country**, select a deployment country from the **Type** drop-down menu and use the **Name** drop-down menu to scroll to the country of deployment where the RF Domain resides. Adding a country first is a good idea since regions, city and campus can all be added as child items in the tree structure. However, the selected country is an invalid tree node until a RF Domain is applied.

If adding a region, select **Region** from the **Type** drop-down menu and use the **Name** parameter to enter its name. Select **Add** to display the region. A city and campus can be added as child items in the tree structure under a region. An RF Domain can be mapped anywhere down the hierarchy for a region and not just directly under a Country. For example, a region can have city and campus and one RF Domain mapped.

If adding a **City**, select City from the **Type** drop-down menu and use the **Name** parameter to enter its name. Select **Add** to display the city. Only a campus can be added as a child item under a city. The city is an invalid tree node until a RF Domain is applied somewhere within the directory tree.

If adding a **Campus**, select Campus from the **Type** drop-down menu and use the **Name** parameter to enter its name. Select **Add** to display the campus. A Campus is the last node in the hierarchy before A RF Domain, and it cannot be valid unless it has a RF Domain mapped to it.



NOTE: If a complete tree configuration has been saved and exported for archive to remote location, it can be imported back into the Tree Setup screen and utilized without having to re-configure the containers and RF Domain of that tree. Select **Import** to utilize an existing tree configuration.



NOTE: If a tree container (country, region, city or campus) has a red box around it, it either has invalid attributes or a RF Domain requires addition.

- 5 Select the **add RF Domain** link at the right-hand side of any container to display an **Unmapped RF Domain** screen.
- 6 Provide the default RF Domain name whose deployment area and floor is mapped graphically, and whose events are shared between WiNG and ADSP. Select **Add** to display the RF Domain within its respective place in the tree hierarchy. A default RF Domain can also be dragged into the tree from the right-hand side of the screen.

Once the RF Domain is in the tree, select the **add child** link at the right-hand side of the RF Domain to display a screen where the RF Domain deployment **Area** and **Floor** are defined. Once defined, select **Add** to populate the tree with the Area and Floor.

Provide the **Map URL** to upload the floor plan created under an Area. Each area can have multiple floors



NOTE: While the MAP URL graphic file represents the RF Domain's physical device deployment area, devices cannot be dragged into topology or manipulated. To define a network topology that allows an administrator to add devices and manipulate locations, refer to [Network View on page 4-27](#).

- 7 Edit a tree node at any time by selecting it from amongst the Tree Setup screen, and referring to the right-hand side of the screen where a field displays to modify the container.
- 8 Optionally, select **Tree Import Export Template** to upload a *template.csv* file if one is needed for container configuration.

A sample of the tree template is provided here for reference.

Row Description

record type (folder),server,Name,Description,Type,Floor Number,Path(slash delimited),Command(add|delete)

Actual Row is CSV file


```

folder,localhost,US,Country Description,Country,,
folder,localhost,Southeast,Region Description,Region,,US
folder,localhost,Alpharetta,City Description,City,,US/Southeast
folder,localhost,Sanctuary Park,Campus Description,Campus,,US/Southeast/Alpharetta
folder,localhost,The Falls 1125,Domain Description,RFDomain,,US/Southeast/Alpharetta/Sanctuary Park
folder,localhost,Queens,,Area,,US/Southeast/Alpharetta/Sanctuary Park/The Falls 1125
folder,localhost,FloorQLab,,Floor,1,US/Southeast/Alpharetta/Sanctuary Park/The Falls 1125/Queens
folder,localhost,FloorSLab,,Floor,2,US/Southeast/Alpharetta/Sanctuary Park/The Falls 1125/Queens
folder,localhost,FloorTLab,,Floor,3,US/Southeast/Alpharetta/Sanctuary Park/The Falls 1125/Queens

```

In the CSV file, configure specific tree node properties.

Index 1 : Record Type. This value is always 'folder'. Import/export allows the configuration of folder nodes only. Leaf nodes cannot be configured like devices.

Index 2 : Server Name. This value is always 'localhost' as we are supporting the import/export from localhost only.

Index 3 : Name. This configures the name/label of the tree node. This is the value which is visible to the user in Tree node.

Index 4 : Description. This configures the additional information in form, which user wants to store with the Tree node.

Index 5 : Type. This configures the type of the Tree node. Type can take one of the value "country, region, city, campus, rfdomain, area, floor".

Index 6 : Floor Number. This is configures the floor number. This is applicable only for the floor node.

Index 7 : Path. This is /(slash delimited) from the 'root'.

Index 8 : add|delete. Allows manipulation of the node. If no value is specified, the default is 'add' . If value is 'delete' then reference node is removed.

- 9 Select **Import Tree Structure** to optionally import a .csv file with pre-defined the containers and RF Domain. Importing an existing tree saves an administrator from creating a new one from the beginning.
- 10 Once the tree topology is defined to your satisfaction, select **Export Tree Structure** to archive the tree topology (in .csv file format) to a defined location.
The exported tree topology can be re-imported and automatically displayed within the Tree Setup screen at any time.
- 11 Select **OK** to update the tree setup configuration. Select **Reset** to revert to the last saved configuration.



NOTE: Since the tree is set as a configuration, it follows standard configuration methods, and requires a *Commit* before it taking effect and A *Save* to become persistent across reboots.

12.4 Management Access Deployment Considerations

Before defining a access control configuration as part of a Management Access policy, refer to the following deployment guidelines to ensure the configuration is optimally effective:

- Unused management protocols should be disabled to reduce a potential attack against managed resources. For example, if a device is only being managed by the Web UI and SNMP, there is no need to enable CLI interfaces.
- Use management interfaces providing encryption and authentication. Management services like HTTPS, SSH and SNMPv3 should be used when possible, as they provide both data privacy and authentication.
- By default, SNMPv2 community strings on most devices are set to *public* for the read-only community string and *private* for the read-write community string. Legacy devices may use other community strings by default.
- SNMPv3 should be used for SNMP device management, as it provides both encryption, and authentication.
- Enabling SNMP traps can provide alerts for isolated attacks at both small managed radio deployments or distributed attacks occurring across multiple managed sites.
- Whenever possible, centralized RADIUS management should be enabled. This provides better management and control of management usernames and passwords and allows administrators to quickly change credentials in the event of a security breach.

13 Diagnostics

Resident diagnostic capabilities enable administrators to understand how devices are performing and troubleshoot issues impacting device performance. Performance and diagnostic information is collected and measured on controllers and service platforms for any anomalies potentially causing a key processes to fail.

Numerous tools are available within the Diagnostics menu. Some filter events, others allow you to view logs and manage files generated when hardware or software issues are detected.

The diagnostics are managed as follows:

- *Fault Management*
- *Crash Files*
- *Advanced Diagnostics*

13.1 Fault Management

Fault management enables user's administering multiple sites to assess how individual devices are performing and review issues impacting the network. Use the Fault Management screens to administrate errors generated by the controller or service platform, Access Point or wireless client.

To assess the Fault Management configuration:

- 1 Select **Diagnostics > Fault Management**.

The **Filter Events** screen displays by default. Use this screen to configure how events are tracked. By default, all events are enabled, and an administrator has to turn off events that do not require tracking.

Severity	Module	Source	Message Substring	Remove Filter
All Severities	test	Allow All		Click to Remove
All Severities	All Modules	Allow All		Click to Remove
Critical	All Modules	Allow All		Click to Remove

Figure 13-1 Fault Management Filter Events screen

Use the **Filter Events** screen to create filters for managing detected events. Events can be filtered based on severity, module received, source MAC, device MAC and client MAC address.

- 2 Define the following **Customize Event Filters** parameters for the Fault Management configuration:

Severity	Set the filtering severity. Select from the following: <i>All Severities</i> – All events are displayed, irrespective of their severity <i>Critical</i> – Only critical events are displayed <i>Error</i> – Only errors and above are displayed <i>Warning</i> – Only warnings and above are displayed <i>Informational</i> – Only informational and above events are displayed
Module	Select the module from which events are tracked. When a module is selected, events from other modules are not tracked. Remember this when interested in events generated by a particular module. Individual modules can be selected (such as <i>TEST</i> , <i>LOG</i> , <i>FSM</i> etc.) or all modules can be tracked by selecting <i>All Modules</i> .
Source	Set the MAC address of the source device to be tracked. Setting a MAC address of 00:00:00:00:00:00 allows all devices to be tracked.
Message Substring	Optionally append a text message (substring) to the event filter to assist the administrator in distinguishing this filter from others with similar attributes.



NOTE: Leave the fields to a default value of 00:00:00:00:00:00 to track all MAC addresses.

- 3 Select the **Add to Active Filters** button to create a new filter and add it to the **Active Event Filters** table. When added, the filter uses the current configuration defined in the Customize Event Filters field.
- 4 Refer to the **Active Event Filters** table to set the following parameters for the Fault Management configuration:
- To activate all the events in the Active Events Filters table, select the **Enable All Events** button. To stop event generation, select **Disable All Events**.
 - To enable an event in the Active Event Filters table, click the event to select it. Then, select the **Activate Defined Filter(s)** button.



NOTE: Filters cannot be persisted across sessions. They have to be created every time a new session is established.

- 5 Select **View Events** from the upper, left-hand, side of the **Diagnostics > Fault Management** menu.

Use the **View Events** screen to track and troubleshoot events using the source and severity levels defined in the Configure events screen.

Timestamp	Displays the Timestamp (time zone specific) when the fault occurred.
Module	Displays the module used to track the event. Events detected by other module are not tracked.
Message	Displays error or status messages for each event listed.
Severity	Displays the severity of the event as defined for tracking from the Configuration screen. Severity options include: <i>All Severities</i> – All events are displayed irrespective of their severity <i>Critical</i> – Only critical events are displayed <i>Error</i> – Only errors and above are displayed <i>Warning</i> – Only warnings and above are displayed <i>Info</i> – Only informational and above events are displayed
Source	Displays the MAC address of the tracked source device.
Hostname	Lists the administrator assigned hostname of the tracked source device.

- Wireless Controller and Service Platform System Reference Guide

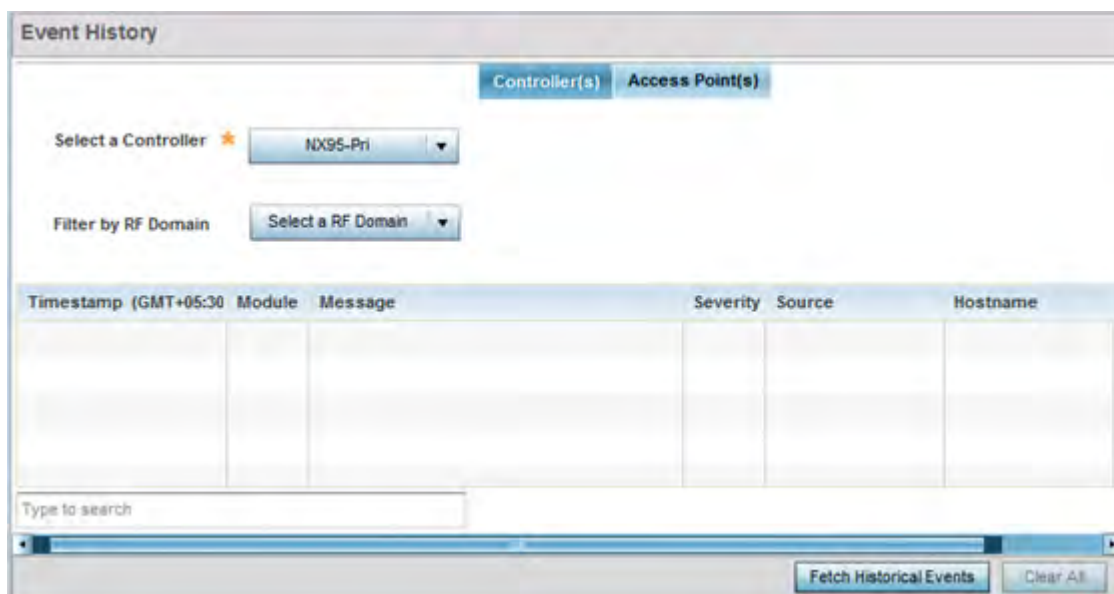


Figure 13-3 Fault Management Event History screen

The **Event History** screen displays events for controllers, service platforms and Access Points. The **Controller(s)** tab displays by default. Information on this tab can be filtered by controllers and service platforms, then further by a RF Domain. Similarly, the **Access Point(s)** tab displays information for each RF Domain on the Access Point and this information can be further filtered on the devices adopted by this Access Point.

- 9 Within the *Controller(s)* tab, select the controller from the **Select a Controller** field to filter events to display. To filter messages further, select a RF Domain from the **Filter by RF Domain** field.
- 10 Within the *Access Point(s)* tab, select the RF Domain from the **Select a RF Domain** field to filter events to display. To filter messages further, select a device from the **Filter by Device** field.
- 11 Select **Fetch Historical Events** from the lower, right-hand, side of the UI to populate the table with either device or RF Domain events. The following event data is fetched and displayed:

Timestamp	Displays the Timestamp (time zone specific) when the fault occurred.
Module	Displays the module used to track the event. Events detected by other module are not tracked.
Message	Displays error or status messages for each event listed.
Severity	Displays the severity of the event as defined for tracking from the Configuration screen. Severity options include: <i>All Severities</i> – All events are displayed irrespective of their severity <i>Critical</i> – Only critical events are displayed <i>Error</i> – Only errors and above are displayed <i>Warning</i> – Only warnings and above are displayed <i>Info</i> – Only informational and above events are displayed
Source	Displays the MAC address of the source device tracked by the selected module.
Hostname	Lists the administrator assigned hostname of the source device tracked by the selected module.

RF Domain	Displays the RF Domain membership of the source device tracked by the selected module.

- 12 Select **Clear All** to clear events and begin new event data gathering.

13.2 Crash Files

Use the **Crash Files** screen to review files created when a controller or service platform encounters a critical error or malfunction. Use crash files to troubleshoot issues specific to the device on which a crash event was generated. These are issues impacting the core (distribution layer). Once reviewed, files can be deleted or transferred for archive. Crash files can be sent to a support team to expedite issues with the reporting device.

- 1 Select **Diagnostics** > **Crash Files** to display the crash file information.
Once a target device has been selected its crash file information displays in the viewer on the right.

File Name	Size	Last Modified	Actions
flash:/crashinfo/cfgd.lc	11679	2017-04-20 10:54:59	
flash:/crashinfo/cfgd.lc	60750	2017-04-20 11:19:28	
flash:/crashinfo/cfgd.lc	22165	2017-04-20 10:54:57	

Copy Delete

Figure 13-4 Crash Files information

- 2 Refer to the following crash file information for the selected device.

File Name	Displays the name of the file generated when a crash event occurred. This is the file available for copy to an external location for archive and remote administration.
Size	Lists the size of the crash file, as this information is often needed when copying files to an external location.
Last Modified	Displays the Timestamp (time zone specific) when the most recent update to the file occurred.
Actions	Displays the action taken in direct response to the detected crash event.

- 3 Select **Copy** to copy a selected crash file to an external location. Select **Delete** to remove a selected crash file.

13.3 Advanced Diagnostics

Refer to Advanced UI Diagnostics to review and troubleshoot any potential issue with the resident *User Interface* (UI). The UI Diagnostics screen provides diagnostic tools to identify and correct issues with the UI. Diagnostics can also be performed at the device level for the Access Point radios and connected clients.

13.3.1 UI Debugging

► Advanced Diagnostics

Use the UI Debugging screen to view debugging information for a selected device.

To review device debugging information:

- 1 Select **Diagnostics > Advanced > UI Debugging** to display the UI Debugging menu options.
The UI debugging information displays within the **NETCONF Viewer** by default.

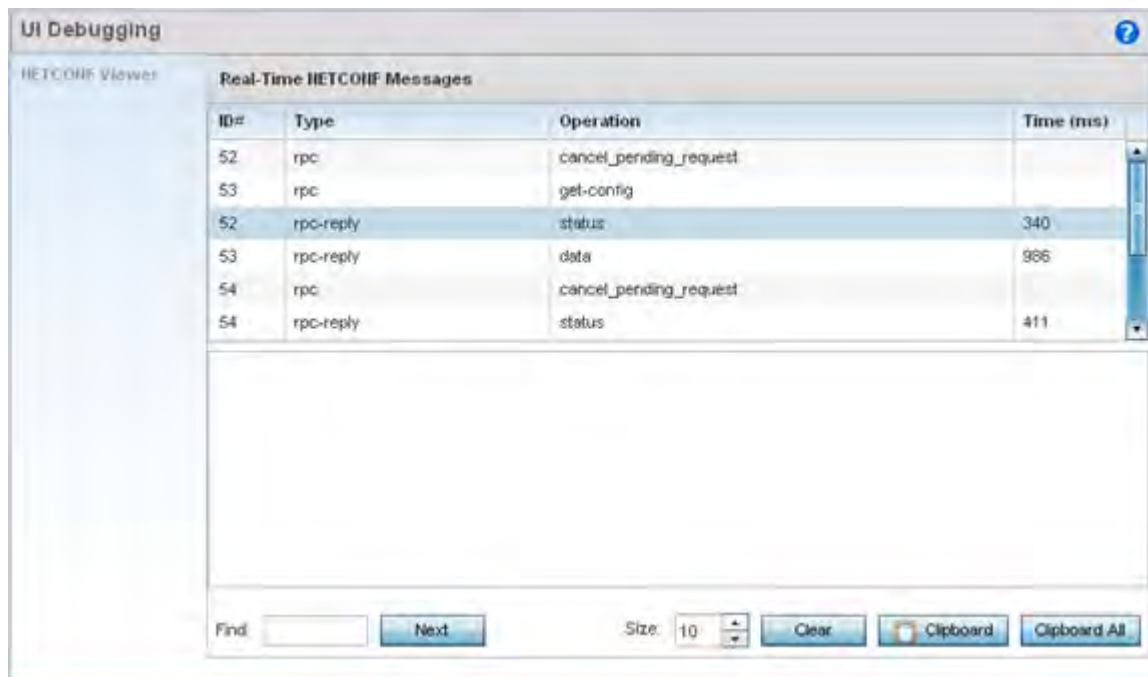


Figure 13-5 UI Debugging screen - NETCONF Viewer

- 2 Use the **NETCONF Viewer** to review NETCONF information. NETCONF is a proprietary tag-based configuration protocol for devices. Messages are exchanged using XML tags.
- 3 The **Real Time NETCONF Messages** area lists an XML representation of any message generated by the system. The main display area of the screen is updated in real time.
- 4 Refer to the **Request Response** and **Time Taken** fields on the bottom of the screen to assess the time to receive and respond to requests. The time is displayed in microseconds.
- 5 Use the **Clear** button to clear the contents of the Real Time NETCONF Messages area. Use the **Find** parameter and the **Next** button to search for message variables in the Real Time NETCONF Messages area.

13.3.2 Viewing UI Logs

► Advanced Diagnostics

Use the UI logs to periodically assess *user interface* (UI) events by type, category and severity to assess whether any administrative corrective actions are warranted.

To view UI log information:

- 1 Select **Diagnostics** > **Advanced** > **View UI Logs** to display the *Flex Logs* and *Error Logs* screens. The Flex Logs screen displays by default, but both tabs list the same information for either UI logs or UI error logs respectively.

View UI Logs				
Flex Logs Error Logs				
Seq	Date/Time	Type	Category	Message
0	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer set destination to 'Default'
1	3/14/2016 07:25	INFO	mx.messaging.Channel	'direct_http_channel' channel endpoint set to http://157.235.95.23/
2	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer sending message '5D575'
3	3/14/2016 07:25	DEBUG	mx.messaging.Channel	'direct_http_channel' channel sending message:
4	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer connected.
5	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer acknowledge of '5D575B'
6	3/14/2016 07:25	INFO	mx.rpc.http.HTTPService	Decoding HTTPService response
7	3/14/2016 07:25	DEBUG	mx.rpc.http.HTTPService	Processing HTTPService response message:
8	3/14/2016 07:25	INFO	mx.messaging.Producer	'B32327BC-B34C-EF7D-E5DE-7584BE3B1CCE' producer set destination to 'Default'
9	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer sending message '0A2F8'
10	3/14/2016 07:25	DEBUG	mx.messaging.Channel	'direct_http_channel' channel sending message:
11	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer acknowledge of '0A2F83'
12	3/14/2016 07:25	INFO	mx.rpc.http.HTTPService	Decoding HTTPService response
13	3/14/2016 07:25	DEBUG	mx.rpc.http.HTTPService	Processing HTTPService response message:
14	3/14/2016 07:25	INFO	mx.messaging.Producer	'4960288F-8C20-1314-ECF5-7584BD361E94' producer sending message '00A22'
15	3/14/2016 07:25	DEBUG	mx.messaging.Channel	'direct_http_channel' channel sending message:

Figure 13-6 View UI Logs screen - Flex Logs tab

- 2 Refer to the following UI event or error log parameters:

Sequence	Displays a numeric number for the generation of the listed UI events. If changing the data display from a sequential display, these numbers can be used to assess the chronology of the UI event generation.
Date/Time	Lists the date and time when each listed UI log event occurred. Use this information to assess whether time was factor in the generation of one or more events and whether their timestamp increases their significance.
Type	Displays each listed log entry's event or error type. Some events are DEBUG while others are INFO. Categorize collectively as specific events warrant additional administration.
Category	Lists each event or error's system defined category as a means of further filtering specific events or system collected error logs. This is helpful when assess whether specific events or errors impact multiple UI functions.

Message	Displays the system generated message for the functions impacted by each listed UI or error. Use this data in combination with the date, type and category to assess whether specific messages are related and their significance worthy of immediate administration.

- 3 Select **Clear All** to remove all the log or error entries from the screen and begin a new data collection.

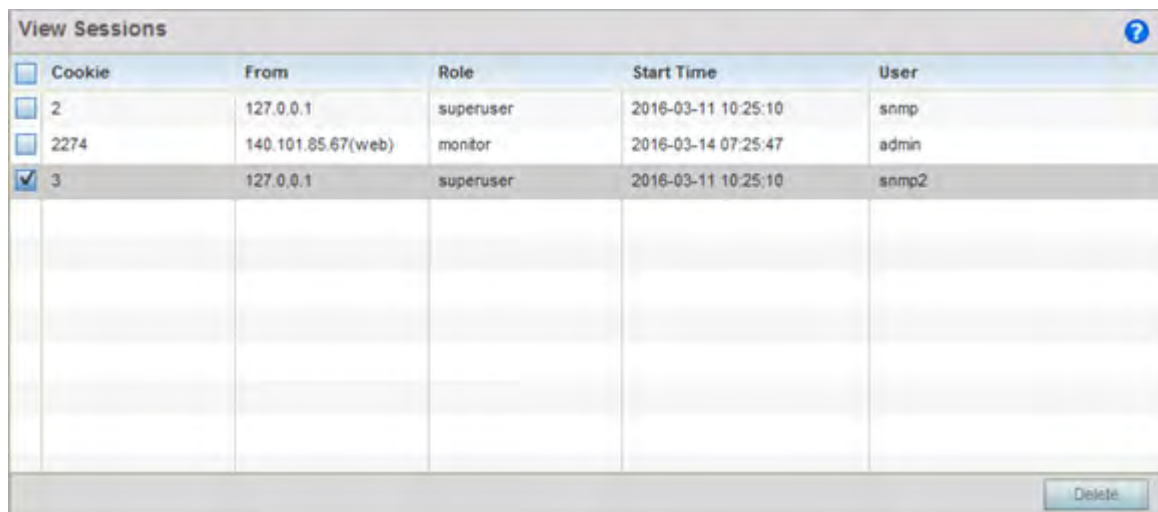
13.3.3 Viewing UI Sessions

► Advanced Diagnostics

Refer to the **View Sessions** screen to assess specific user interface sessions by individual users.

To view UI session information:

- 1 Select **Diagnostics > Advanced > View Sessions**.



The screenshot shows the 'View Sessions' screen with a table of user sessions. The table has columns for Cookie, From, Role, Start Time, and User. Three sessions are listed: session 2 (snmp), session 2274 (admin), and session 3 (snmp2). Session 3 is selected with a checkmark. A 'Delete' button is visible at the bottom right.

Cookie	From	Role	Start Time	User
2	127.0.0.1	superuser	2016-03-11 10:25:10	snmp
2274	140.101.85.67(web)	monitor	2016-03-14 07:25:47	admin
3	127.0.0.1	superuser	2016-03-11 10:25:10	snmp2

Figure 13-7 View Sessions Screen

- 2 Refer to the following UI session data to assess its significance:

Cookie	Displays a numeric session cookie which identifies the session corresponding to it. This information can be used to further filter specific user sessions to the network route used.
From	Lists the numeric IP address used by each listed user as their network identifier into the WiNG user interface.
Role	Displays each user's defined administrative role. Each role has different access and administrative privileges.
Start Time	Lists the time each listed user began their WiNG interface UI session. Does this start time correspond to a known UI event or error condition?
User	Displays each user's SNMP administrative access protocol and their session permissions.

- 3 Select a specific user session and **Delete** to remove the selected session from those listed for administration.

14 Operations

The functions within the controller or service platform's *Operations* menu allow firmware and configuration files management and certificate generation for managed devices. In a clustered environment, these operations can be performed on one controller or service platform, then propagated to each member of the cluster and onwards to the devices managed by each cluster member.

A certificate links identity information with a public key enclosed in the certificate. Device certificates can be imported and exported to and from the controller or service platform to a secure remote location for archive and retrieval as they are required for application to other managed devices.

Self Monitoring At Run Time RF Management (Smart RF) is an innovation designed to simplify RF configurations for new deployments, while (over time) providing on-going deployment optimization and radio performance improvements. The Smart RF functionality scans the managed network to determine the best channel and transmit power for each managed Access Point radio. Smart RF policies can be applied to specific RF Domains, to add site specific deployment configurations and self recovery values to groups of devices within pre-defined physical RF coverage areas.

For more information, refer to the following:

- [Device Operations](#)
- [Certificates](#)
- [Smart RF](#)

14.1 Device Operations

Updated device firmware and configuration files are periodically released to the Support Web site. If an Access Point's (or its associated device's) firmware is older than the version on the Web site, update to the latest firmware version for full feature functionality and optimal controller or service platform utilization. Additionally, selected devices can either have a primary or secondary firmware image applied or fallback to a selected firmware image if an error occurs in the update process.

For more information, refer to the following:

- [Operations Summary on page 14-1](#)
- [Adopted Device Upgrades](#)
- [Using the File Management Browser](#)
- [Restarting Adopted Devices](#)
- [Captive Portal Configuration](#)
- [Crypto CMP Certificate](#)
- [RAID Operations](#)
- [Re-elect Controller](#)

14.1.1 Operations Summary

► [Device Operations](#)

The **Summary** screen displays by default when **Operations** is selected from the controller or service platform's main menu bar.

The **Summary** screen displays firmware information for a specific device selected from either the RF Domain or Network tabs on the left-hand side of the screen.



NOTE: When displaying the **Summary** screen at the RF Domain level of the UI's hierarchal tree, the screen does not display a field for a device's **Primary** and **Secondary** firmware image. At the RF Domain level, the Summary screen just lists the *Hostname*, *MAC Address*, *Online* status, *Device Type* and *Is Controller* designations for the devices comprising the selected RF Domain. A RF Domain must be selected from the hierarchal tree and expanded to list the devices comprising the RF Domain. From there, individual controllers, service platforms and Access Points can be selected and their properties modified.

	Primary	Secondary
Version	5.8.4.0-006D	5.8.3.0-041R
Build Date	04/16/2016 11:33:46	03/30/2016 00:35:00
Install Date	04/19/2016 07:33:32	03/31/2016 07:40:58

FailBack: Enabled
 Current Boot: primary
 Upgrade Status: Successful
 2016-04-19 07:33:32

[Firmware Upgrade](#)
[Reload](#)

Device Type	Is Controller	Online	Offline	Total
nx9000	Yes	1	0	1

Figure 14-1 *Device Details screen*

- 1 Refer to the following to determine whether a firmware image needs to be updated for the selected device, or a device requires a restart or revert to factory default settings.

Version	Displays the primary and secondary firmware image version from the wireless controller.
Build Date	Displays the date the primary and secondary firmware image was built for the selected device.
Install Date	Displays the date the firmware was installed for the selected device.
Fallback	Lists whether fallback is currently enabled for the selected device. When enabled, the device reverts back to the last successfully installed firmware image if something were to happen in its next firmware upgrade that would render the device inoperable.
Current Boot	Lists firmware image for the device on the current boot.
Upgrade Status	Displays the status of the last firmware upgrade performed for each listed device managed by this controller or service platform.
Firmware Upgrade	Select this option to display the firmware upgrade window for the selected device. Select the <i>Apply</i> button to perform the function.
Reload	Select this option to restart the selected device. Selecting this option restarts the target device using the specified options in the settings window. Restarting a device resets all data collection values to zero. Select the <i>Reload</i> button to perform the function.

- 2 Refer to the device table for basic information for known device types. The device table displays the **Device Type**, **Controller** status, **Online**, **Offline** and **Total** device counts.

14.1.1.1 Upgrading Device Firmware

► Operations Summary

Controllers and service platforms can conduct firmware updates on behalf of their managed devices.

To update the firmware of a managed device:

- 1 Select a device from the browser.
- 2 Select the **Firmware Upgrade** button.

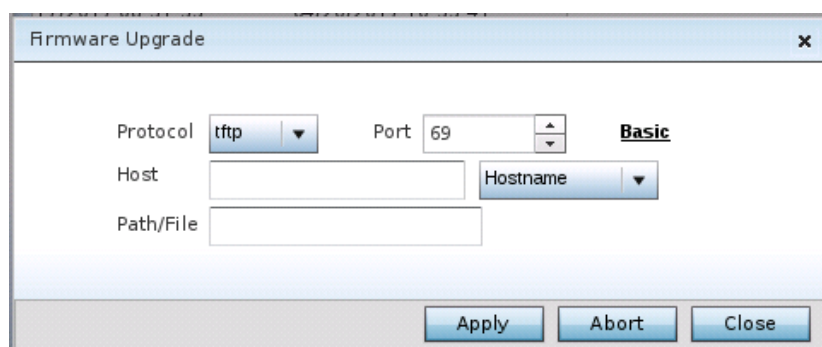


Figure 14-2 *Firmware Update screen*

- 3 By default, the **Firmware Upgrade** screen displays the server parameters for the target device firmware file.

- 4 Provide the following information to accurately define the location of the target device firmware file:

Protocol	Select the protocol used for updating the device firmware. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control or manually enter the value to define the port used by the protocol for firmware updates. This option is not valid for <i>cf</i> or <i>usb1-4</i> .
Host	Provide the hostname or numeric IPv4 or IPv6 formatted address of the server used to update the firmware. This option is not valid for <i>cf</i> and <i>usb1-4</i> . A hostname cannot contain an underscore.
User Name	Define the user name used to access either a FTP or SFTP server.
Password	Specify the password for the user account to access a FTP or a SFTP server.
Path/File	Specify the path to the firmware file. Enter the complete relative path to the file on the server.

- 5 Select **Apply** to start the firmware update. Select **Abort** to terminate the firmware update. Select **Close** to close the upgrade popup. The upgrade continues in the background.

14.1.2 Adopted Device Upgrades

► Device Operations

An administrator can designate controllers, service platforms or Access Points as RF Domain managers capable of receiving firmware files from the NOC (NX7500 or NX9000 series service platforms) then provisioning other devices within their same RF Domain. Controllers, service platforms and Access Points can now all update the firmware of different device models within their RF Domain. However, firmware updates cannot be made simultaneously to devices in different site deployments.

To administer a device upgrade and administrate upgrade status and history:

- 1 Select the **Operations**.
- 2 Ensure **Devices** is selected from the Operations menu on the top, left-hand, side of the screen.
- 3 Expand the System node on the left-hand side of the screen, select a RF Domain and one of its member devices.
- 4 Select the **Adopted Device Upgrade** tab. The screen displays with the **Device Upgrade List** selected by default.

Figure 14-3 *Device Upgrade List screen*

- 5 Select a controller, service platform or Access Point model from the **Device Type List** drop-down menu. This is the device model intended to provision firmware to the devices selected within the **All Devices** table below.



NOTE: If selecting the **Device Upgrade** screen from the RF Domain level of the UI's hierarchal tree, there's an additional **Upgrade from Controller** option to the right of the **Device Type List**. Select this option to provision selected device models within the same RF Domain from this RF Domain manager. If expanding a RF Domain and selecting a member device, the upgrade tab is entitled **Adopted Device Upgrade**, as an upgrade is made from an elected RF Domain Manager device. There's also an additional **Device Image File** screen to select the device image type and set the transfer protocol.

- 6 Use the **Scheduled Upgrade Time** option to set when the upgrade occurs. To perform an upgrade immediately, select **Now**. To schedule the upgrade to take place at a specified time, enter a date and time in the appropriate fields.
- 7 Refer to the **Scheduled Reboot Time** option to schedule when an updated device is rebooted to implement the updated firmware. To reboot immediately, select **Now**. To schedule the reboot to take place at a future time to keep the device in service, enter a date and time in the appropriate fields.

Use the **No Reboot** option to keep from rebooting after an upgrade. Select **Staggered Reboot** to avoid upgrading devices simultaneously and risk bringing down the network. When selected, devices are rebooted incrementally to preserve network availability. Select **Force Upgrade** to initiate an Access Point firmware upgrade and reboot at the present time.



NOTE: The **Scheduled Upgrade Time** and **Scheduled Reboot Time** are your local system's time. They're not the Access Point, controller, service platform or VX time and are not synched with the device.

Use the **All Devices** table to select controller, service platform and Access Point models for firmware updates from the device model selected from the Device Type List.

Refer to the **MAC Address** and **Device Type** values to help determine the specific models available for upgrade within the RF domain. Use the **Version** and **Upload Version** values to assess each listed device's current firmware as well as the firmware version available to a device upgrade.

8 Select **Device Image File**.

The screenshot shows the 'Adopted Device Upgrade' window with the 'Device Image File' tab selected. The 'Device Image Type' is set to 'NX9000'. The 'Protocol' is 'tftp', 'Port' is '69', and the 'Basic' link is selected. The 'Host' field is empty, and the 'Path/File' field is empty. A 'Load Image' button is at the bottom. On the right, the 'Images On Device' table lists various device types and their current versions.

Device Type	Version
AP71XX	5.8.0.0-027D
AP6522	5.8.0.0-027D
AP6562	5.8.0.0-027D
NX75XX	none
RFS6000	none
AP6521	5.8.0.0-027D
NX5500	none
VX9000	none
AP6511	5.8.0.0-027D
RFS7000	none
AP6532	5.8.0.0-027D

Figure 14-4 Device Image File screen

- 9 Select a controller, service platform or Access Point model from the **Device Image Type** drop-down menu. Selecting **All** makes each controller, service platform and Access Point model images available for updates on those specific models.
- 10 Select the **Basic** link to enter a **URL** pointing to the location of the controller, service platform or Access Point image files for the device update(s).
- 11 Selecting **Advanced** lists additional options for the device's firmware image file location:

Protocol	Select the protocol for device firmware file management and transfer. Available options include: tftp ftp sftp http cf
Port	Designate the port for transferring the firmware files used in the upgrade operation. Enter the port number directly or use the spinner control.

Host	Specify a numerical <i>IP address</i> or textual <i>Hostname</i> of the resource used to transfer files to the devices designated for a firmware update. A hostname cannot contain an underscore.
Path / File	Define the path to the file on the file repository resource. Enter the complete relative path to the file.

- 12 Select the **Load Image** button to upload the device firmware in preparation of an upgrade.

The firmware image is loaded to the flash/upgrade directory (not the flash/cache directory). If the NOC pushes the image, then it is loaded to flash/cache/upgrade.

- 13 Select **Upgrade Status** to assess the administration, scheduling and progress of device firmware updates.

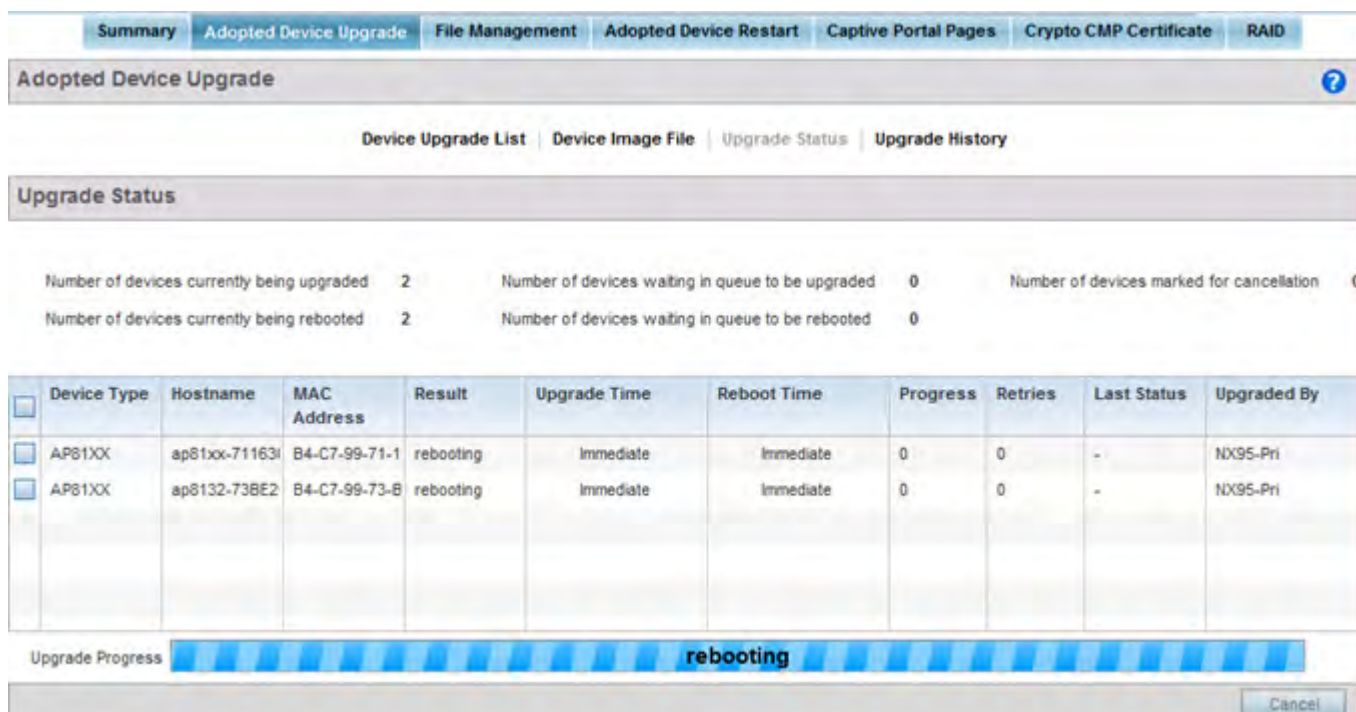


Figure 14-5 Upgrade Status screen

- 14 Refer to the **Upgrade Status** field to assess the completion of in-progress upgrades.

Number of devices currently being upgraded	Lists the number of firmware upgrades currently in-progress and downloading for selected devices. Once the device has the image it requires a reboot to implement the firmware image.
Number of devices currently being booted	Lists the number devices currently booting after receiving an upgrade image. The reboot is required to implement the new image and renders the device offline during that period. Using the <i>Device Upgrade List</i> , reboots can be staggered or placed on hold to ensure device remains in service.
Number of devices waiting in queue to be upgraded	Lists the number of devices waiting to receive a firmware image from their provisioning controller, service platform or Access Point. Each device can have its own upgrade time defined, so the upgrade queue could be staggered.

Number of devices waiting in queue to be upgraded	Lists the number of devices waiting to reboot before actively utilizing its upgraded image. The <i>Device Upgrade List</i> list allows an administrator to disable or stagger a reboot time, so device reboots may not occur immediately after an upgrade. The reboot operation renders the device offline until completed so reboots can be scheduled for periods of reduced load.
Number of devices marked for cancellation	Lists the number of upgrades that have been manually cancelled during the upgrade operation.

15 Refer to the following status reported for each current or scheduled upgrade operation:

Device Type	Displays the model number of devices pending an upgrade. Each listed device is provisioned an image file unique to that model.
Hostname	Lists the factory encoded MAC address of a device either currently upgrading or in the queue of scheduled upgrades.
MAC Address	Lists the factory encoded MAC address of a device either currently upgrading or in the queue of scheduled upgrades.
Result	Lists the state of an upgrade operation (<i>downloading, waiting for a reboot</i> etc.).
Upgrade Time	Displays whether an upgrade is immediate or set by an administrator for a specific time. Staggering upgrades is helpful to ensure a sufficient number of devices remain in service at any given time while others are upgrading.
Reboot Time	Displays whether a reboot is immediate or time set by an administrator for a specific time. Reboots render the device offline, so planning reboots carefully is central to ensuring a sufficient number of devices remain in service.
Progress	Lists the number of specific device types currently upgrading.
Retries	Displays the number of retries, if any, needed for an in-progress firmware upgrade operation.
Last Status	Lists the last reported upgrade and reboot status of each listed in progress or planned upgrade operation.
Upgraded By	Lists the model of the controller, service platform or Access Point RF Domain manager that's provisioning an image to a listed device.

16 Optionally select **Cancel** (from the lower, right-hand corner of the screen) to cancel the upgrade of devices under the selected RF Domain. The Cancel button is enabled only if there are devices undergoing upgrade and they're selected for cancellation.

17 Select **Upgrade History**.

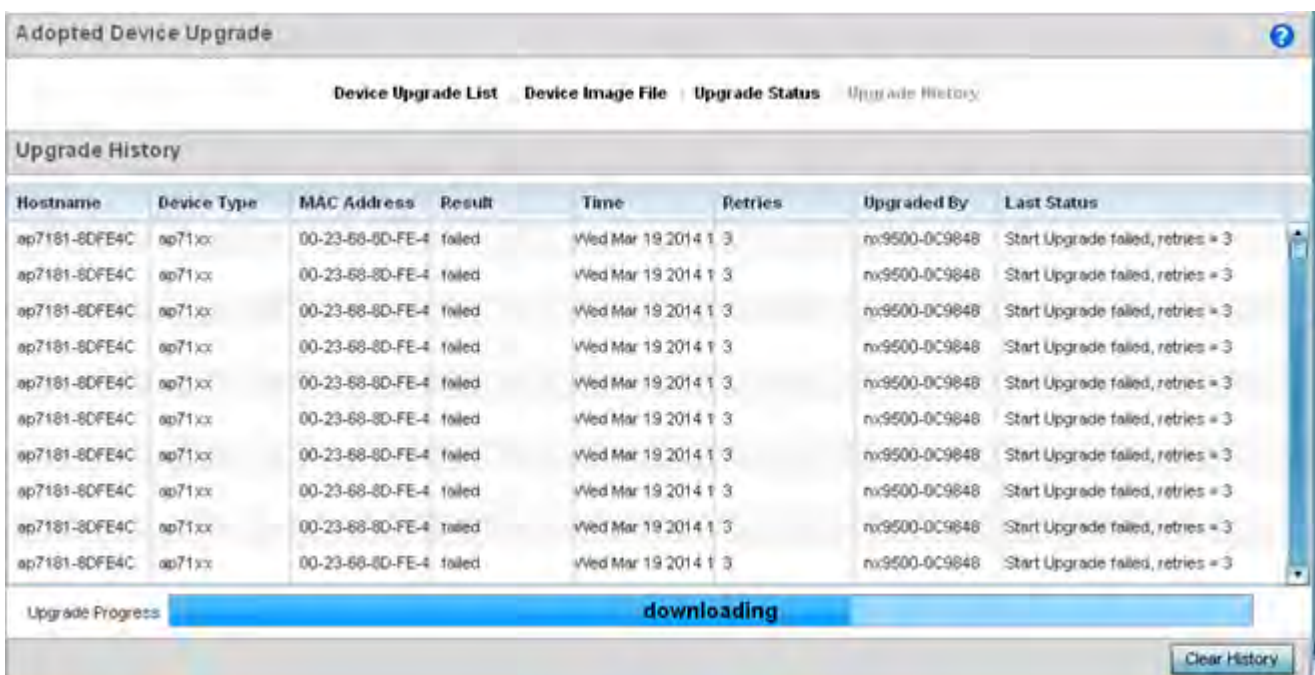


Figure 14-6 Upgrade History screen

18 Refer to the following **Upgrade History** status:

Hostname	Displays the administrator assigned Hostname for each listed controller, service platform or Access Point that's received an update.
Device Type	Displays the controller, service platform or Access Point model upgraded by a firmware update operation.
MAC Address	Displays the device <i>Media Access Control</i> (MAC) or hardware address for a device that's received an update.
Result	Displays the upgrade result for each listed device.
Time	Displays the time and date of the last status received from an upgraded device.
Retries	Displays the number of retries, if any, needed for the firmware upgrade operation.
Upgraded By	Displays the administrator credentials responsible for initiating each listed upgrade operation.
Last Status	Displays the last status update received for devices that have been upgraded.

19 Select the **Clear History** button to clear the current update information for each listed device and begin new data collections.

14.1.3 Using the File Management Browser

► Device Operations

Controllers and service platforms maintain a File Browser allowing an administrator to review the files residing on a controller or service platform's internal or external memory resource. Directories can be created and maintained for each File Browser location and folders and files can be moved and deleted as an administrator interprets necessary.



NOTE: The **File Management** tab is not available at the RF Domain level of the UI's hierarchal tree. A RF Domain must be selected and expanded to display the RF Domain's member devices. Once expanded, selected a RF Domain member device to ensure the File Management UI option is available.

To administer files for managed devices and memory resources:

- 1 Select the **Operations > Devices > File Management**.

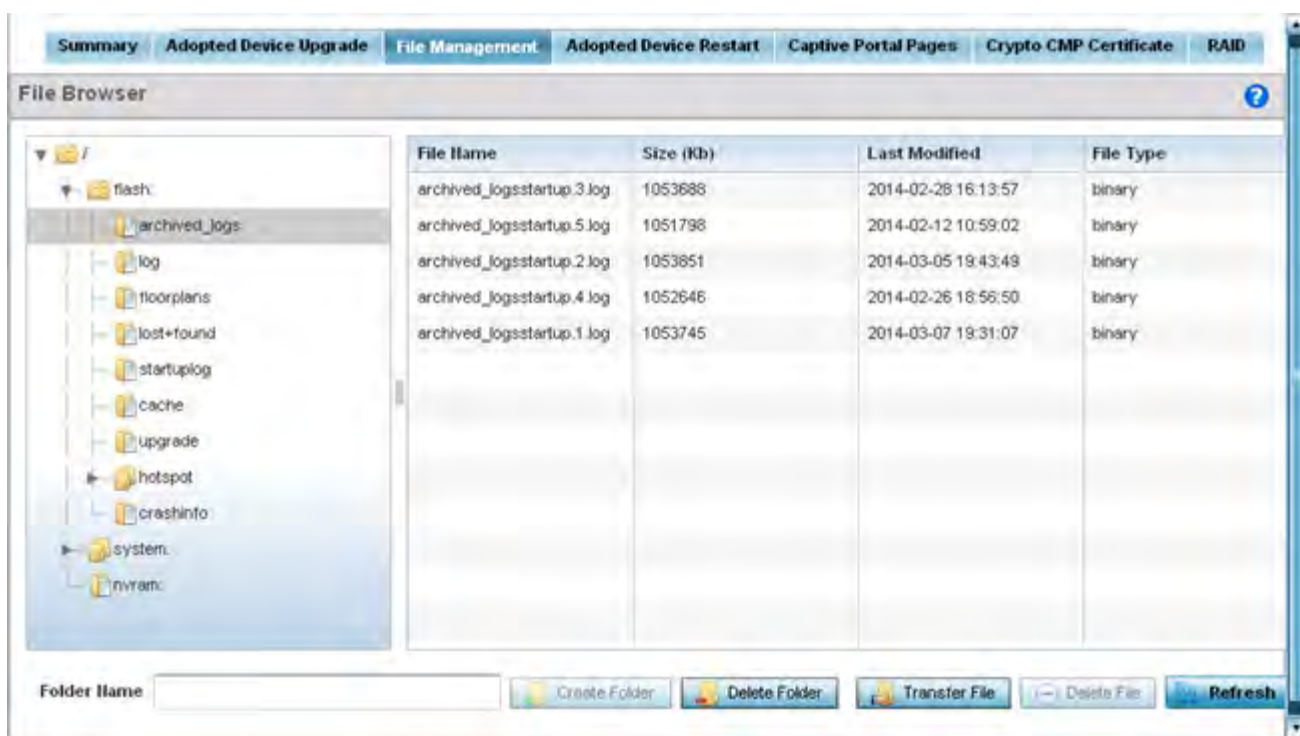


Figure 14-7 File Browser screen - flash

- 2 Refer to the following to determine whether a file needs to be deleted or included in a new folder for the selected internal (flash, system, nvram) or external (cf, USB1-4) memory resource. The following display for each available memory resource:

File Name	Displays the name of the file residing on the selected <i>flash</i> , <i>system</i> , <i>nvram</i> or <i>usb1-4</i> location. The name cannot be modified from this location.
Size (Kb)	Displays the size of the file in kb. Use this information to help determine whether the file should be moved or deleted in respect to available system memory.

Last Modified	Lists a timestamp for the last time each listed file was modified. Use this information to determine the file's relevance or whether it should be deleted.
File Type	Displays the type for each file including binary, text or empty.

- If needed, use the **Create Folder** utility to create a folder that serves as a directory for some or all of the files for a selected memory resource.
- Select **Transfer File** to invoke a subscreen where the local or server file *source* and *target* (destination) are defined as well as the file transfer protocol and external destination location or resource. For more information, see *Managing File Transfers on page 14-11*.
- Optionally, use the **Delete Folder** or **Delete File** buttons to remove a folder or file from within the controller, service platform or Access Point's current memory resource.

14.1.3.1 Managing File Transfers

► Device Operations

Controllers and service platforms can administer files on managed devices. Transfer files from a device to this controller, to a remote server or from a remote server to the controller. An administrator can transfer logs, configurations and crash dumps.

To administer files for managed devices:

- Select the **Operations > Devices > File Management**
- Select the **Transfer File** button.

Figure 14-8 File Transfers screen

- 3 Set the following file management source and target directions as well as the configuration parameters of the required file management activity:

Source	Select the source of the file transfer. Select <i>Server</i> to indicate the source of the file is a remote server. Select <i>Local</i> to indicate the source of the file is local to this controller or service platform.
File	If the source is <i>Local</i> , enter the name of the file to be transferred.
Protocol	Select the protocol for file management. Available options include: tftp ftp sftp http cf usb1-4 This parameter is required only when <i>Server</i> is selected as the <i>Source</i> .
Port	Specify the port for transferring files. This option is not available for <i>cf</i> , and <i>usb1-4</i> . Enter the port number directly or use the spinner control. This parameter is required only when <i>Server</i> is selected as the <i>Source</i> .
Host	If needed, specify a hostname or numeric IP address of the server transferring the file. This option is not valid for <i>cf</i> and <i>usb1-4</i> . If a hostname is provided, an <i>IP Address</i> is not needed. A hostname cannot contain an underscore. This field is only available when <i>Server</i> is selected in the <i>From</i> field.
User Name	Provide a user name to access a FTP or a SFTP server. This parameter is required only when <i>Server</i> is selected as the <i>Source</i> , and the selected protocol is <i>ftp</i> or <i>sftp</i> .
Password	Provide a password to access the FTP or SFTP server. This parameter is required only when <i>Server</i> is selected as the <i>Source</i> , and the selected protocol is <i>ftp</i> or <i>sftp</i> .
Path / File	Define the path to the file on the server. Enter the complete relative path to the file. This parameter is required only when <i>Server</i> is selected as the <i>Source</i> .
Target	Select the target destination to transfer the file. Select <i>Server</i> if the destination is a remote server, then provide a URL to the location of the server resource or select <i>Advanced</i> and provide the same network address information described above. Select <i>Local</i> if the destination is this controller or service platform.

- 4 Select **Copy** to begin the file transfer. Selecting **Reset** reverts the screen to its last saved configuration.

14.1.4 Restarting Adopted Devices

► Device Operations

Adopted devices may periodically require restarting to implement firmware updates or other maintenance activities.



NOTE: The **Adopted Device Restart** tab is not available at the RF Domain level of the UI's hierarchical tree. A RF Domain must be selected and expanded to display the RF Domain's member devices. Once expanded, selected a RF Domain member device to ensure the Adopted Device Restart option is available.

To restart controller or service platform adopted Access Points:

- 1 Select the **Operations > Devices > Adopted Device Restart**.

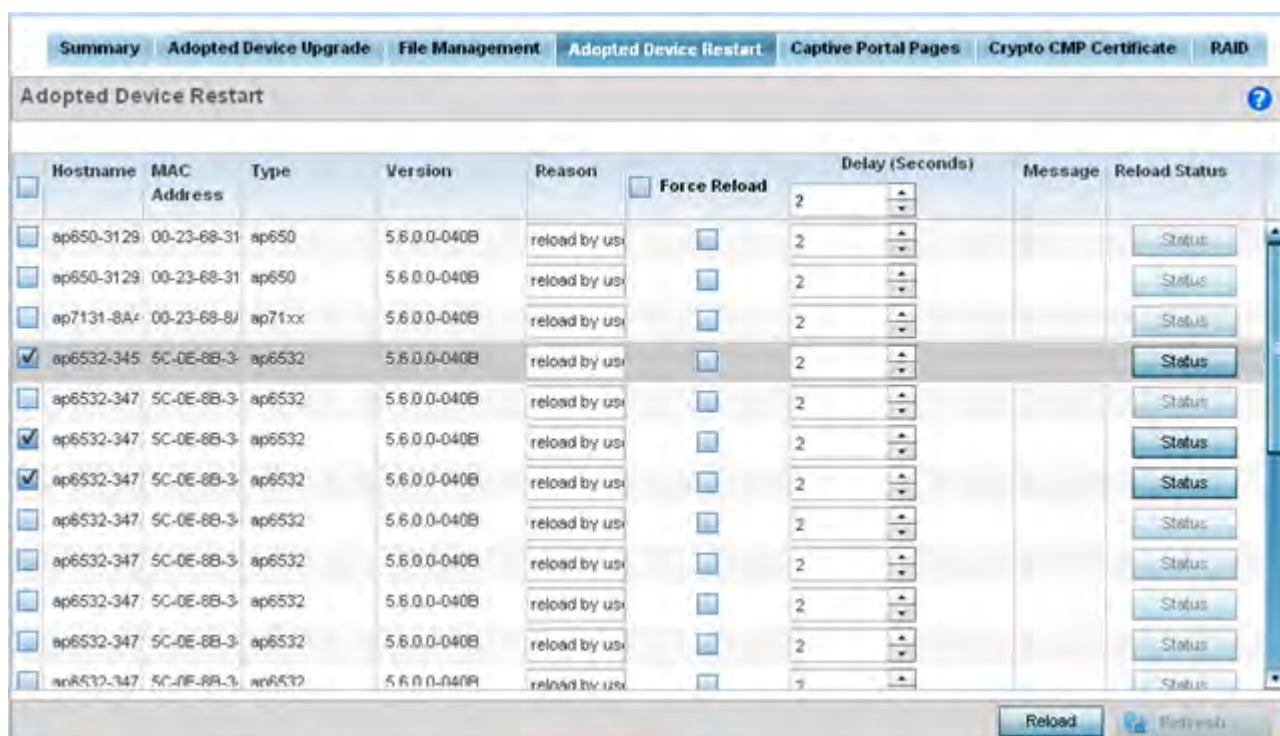


Figure 14-9 Adopted Device Restart screen

- 2 The **Adopted AP Restart** table displays the following information for each Adopted AP:

Hostname	Displays the specified Hostname for each known Access Point.
MAC Address	Displays the primary <i>Media Access Control</i> (MAC) or hardware address for each known Access Point.
Type	Displays the Access Point model number for each adopted Access Point.
Version	Displays the current firmware version for each adopted Access Point.
Reason	Lists the administrator defined reason an adopted device has been queued for a restart.

- 3 To restart an Access Point (or Access Points), select the checkbox to the left of each Access Point to restart and configure the following options:

Force Reload	To force a reload of an Access Point or Access Points, select the <i>Force Reload</i> checkbox next to each AP.
Delay (Seconds)	Specify the amount of time, in seconds, before the Access Point restart should be executed. Delaying the restart may allow a selected Access Point to complete its current duty cycle.
Message	Displays any messages associated with each adopted Access Point
Reload Status	Click the <i>Reload Status</i> button next to each adopted Access Point to display their current status information.

14.1.5 Captive Portal Configuration

► Device Operations

A captive portal is an access policy that provides temporary and restrictive access to the controller or service platform managed wireless network.

A captive portal policy provides secure authenticated access using a standard Web browser. Captive portals provide authenticated access by capturing and re-directing a wireless user's Web browser session to a captive portal login page where the user must enter valid credentials to access the wireless network. Once logged into the captive portal, additional *Terms and Agreement*, *Welcome*, *Fail* and *No Service* pages provide the administrator with a number of options on screen flow and appearance.

Captive portal authentication is used primarily for guest or visitor access to the network, but is increasingly used to provide authenticated access to private network resources when 802.1X EAP is not a viable option. Captive portal authentication does not provide end-user data encryption, but it can be used with static WEP, WPA-PSK or WPA2-PSK encryption.

The **Captive Portal Pages** enable the management of the client access request pages and their transfer to the controller or service platform managed wireless network.

To manage captive portal pages:

- 1 Select the **Operations > Devices > Captive Portal Pages**. The **AP Upload List** displays by default.

Use the AP Upload List to provide connected Access Points with specific captive portal configurations so they can successfully provision login, welcome and condition pages to requesting clients attempting to access the wireless network using a captive portal.

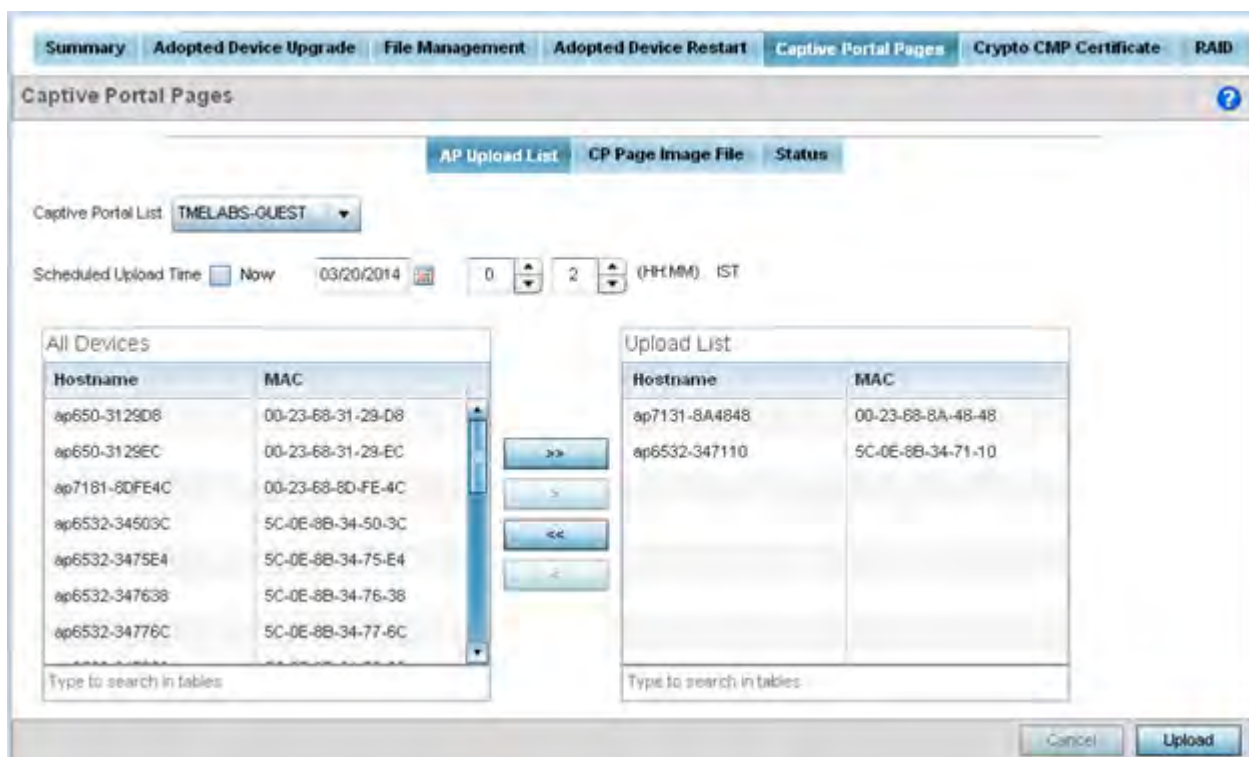


Figure 14-10 Captive Portal Pages - AP Upload List screen

- 2 Use the **Captive Portal List** drop-down menu to select an existing captive portal configuration to upload to an Access Point and display to requesting client devices as they login and adhere to the terms required set for access.



NOTE: If selecting the **Captive Portal Pages** screen from the System and RF Domain levels of the UI's hierarchal tree, there's an additional **Upload from Controller** option to the right of the *Captive Portal List* drop-down menu. Select this option to upload existing captive portal pages from this device's managing controller or service platform.

- 3 Use **Scheduled Upload Time** to set the time of the captive portal page upload. Select **Now** to immediately start. Use the date, hour and minute spinner controls to set a future date and time for the upload.



NOTE: The **Scheduled Upload Time** is your local system's time. It's not the Access Point, controller, service platform or VX time and it is not synched with the device.

The **All Devices** table lists the hostname and MAC address of devices adopted by this Access Point.

- 4 At the device level, use the arrow buttons (>> > < <<) to move selected devices from the **All Devices** table to the **Upload List** table. The Upload List table displays the Access Points to which the captive portal pages are applied.
- 5 Select **Upload** from the lower right-hand side of the screen to upload the captive portal pages to the designated Access Points.
- 6 Select the **CP Pages Image File** tab.

The screenshot shows the 'Captive Portal Pages' configuration window. The 'CP Page Image File' tab is active. It features a 'Captive Portal List' dropdown menu currently showing 'CP8'. Below this, there are configuration fields: 'Protocol' is set to 'tftp', 'Port' is set to '69', 'Host' is set to '0.0.0.0', and 'Path/File' is an empty text box. To the right of these fields is a 'Basic' button. At the bottom right of the window is a 'Load Image' button.

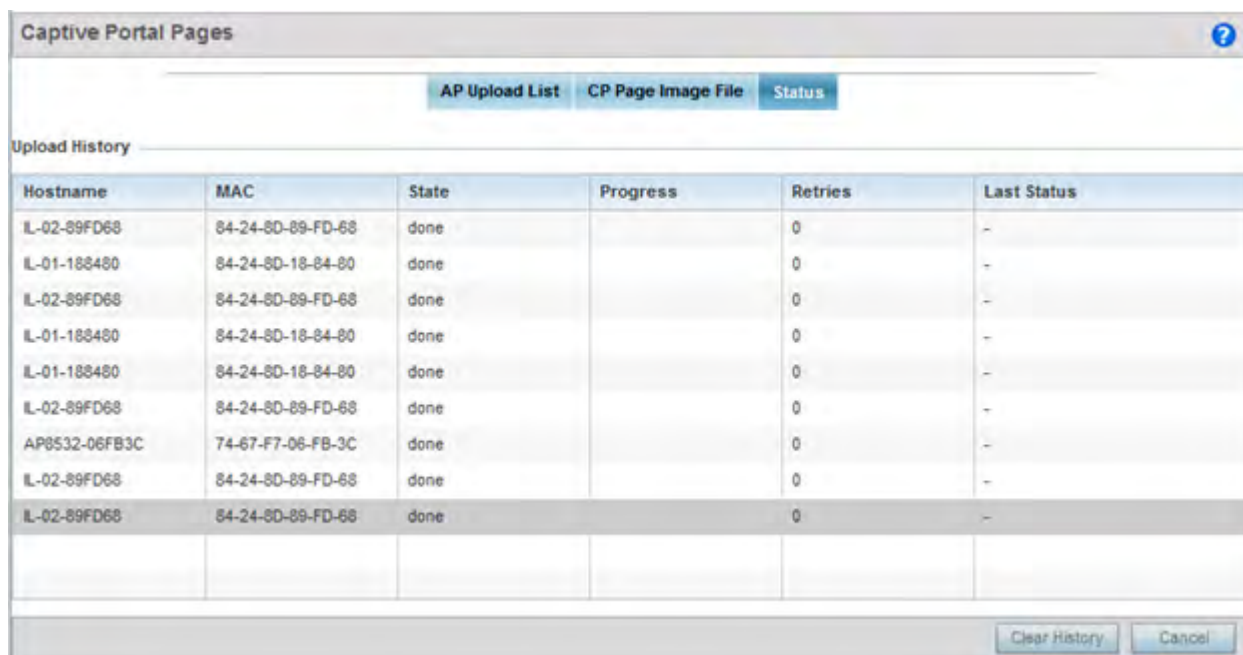
Figure 14-11 *Captive Portal Pages - CP Page Image File screen*

- 7 Use the **Captive Portal List** drop-down menu to select an existing policy. This policy contains the image (or set of login and conditions pages) requesting clients will navigate and complete before granted access to the network using the unique permissions of the captive portal.
- 8 Set the following protocols, ports and network address information for sending image files to captive portal provisioning Access Points:

Protocol	Define the protocol (transfer medium) used to forward the image files to the Access Points provisioning captive portal files to requesting clients. Available options include: • tftp • ftp • sftp • http The protocol parameter is required only when Server is selected as the Source and the Advanced option is used.
Host	If needed, specify a Hostname of the server transferring the file. This option is not valid for cf, usb1, and usb2. If a hostname is provided, an <i>IP Address</i> is not needed. A hostname cannot contain an underscore. This field is only available when Server is selected in the <i>From</i> field.
Port	Specify the port for transferring files. Enter the port number directly or use the spinner control.
User Name	Provide a user name to access the FTP or SFTP server. This parameter is required only when the selected protocol is <i>ftp</i> or <i>sftp</i>.

Password	Provide a password to access the FTP or SFTP server. This parameter is required only when the selected protocol is <i>ftp</i> or <i>sftp</i> .
Path/File	Define the path to the file on the server. Enter the complete relative path to the file.

- 9 Select **Load Image** to upload the image file. Optionally, refer to the **Load Image Status** field to review the status of the current upload.
- 10 Select the **Status** tab.



Captive Portal Pages					
AP Upload List CP Page Image File Status					
Upload History					
Hostname	MAC	State	Progress	Retries	Last Status
IL-02-89FD68	84-24-8D-89-FD-68	done		0	-
IL-01-188480	84-24-8D-18-84-80	done		0	-
IL-02-89FD68	84-24-8D-89-FD-68	done		0	-
IL-01-188480	84-24-8D-18-84-80	done		0	-
IL-01-188480	84-24-8D-18-84-80	done		0	-
IL-02-89FD68	84-24-8D-89-FD-68	done		0	-
AP8532-06FB3C	74-67-F7-06-FB-3C	done		0	-
IL-02-89FD68	84-24-8D-89-FD-68	done		0	-
IL-02-89FD68	84-24-8D-89-FD-68	done		0	-

Clear History Cancel

Figure 14-12 Captive Portal Pages - Status screen

- 11 Refer to the **Status** tab to review the progress of Captive Portal Pages upload.

Hostname	Displays the hostname of the recipient device to which the captive portal files are directed.
MAC	Displays the factory encoded MAC address of the recipient device.
State	Displays the target device's current operational state within the controller or service platform managed network.
Progress	Displays the completion progress of each captive portal upload operation.
Retries	Lists the number of retries needed to upload the captive portal files to each listed device.
Last Status	Displays the last known status of the captive portal page uploaded to each listed device.

- 12 Select **Clear History** to clear the history displayed in the Status tab and begin new data collections.

14.1.6 Crypto CMP Certificate

► Device Operations

Certificate Management Protocol (CMP) is an Internet protocol to obtain and manage digital certificates in a *Public Key Infrastructure* (PKI) network. A *Certificate Authority* (CA) issues the certificates using the defined CMP.

Using CMP, a device can communicate to a CMP supported CA server, initiate a certificate request and download the required certificates from the CA server. CMP supports multiple request options through for device communicating to a CMP supported CA server. The device can initiate a request for getting the certificates from the server. It can also auto update the certificates which are about to expire.

The CMP client on the controller, service platform or Access Point triggers a request for the configured CMS CA server. Once the certificate is validated and confirmed from the CA server it is saved on the device and becomes part of the trustpoint. During the creation of the CMP policy the trustpoint is assigned a name and client information. An administrator can use a manually created trustpoint for one service (like HTTPs) and use the CMP generated trustpoint for RADIUS EAP certificate based authentication.

To assess existing certificates and, if necessary, renew a certificate:

- 1 Select **Operations > Devices > Crypto CMP Certificate**. This option is selectable at the controller level.

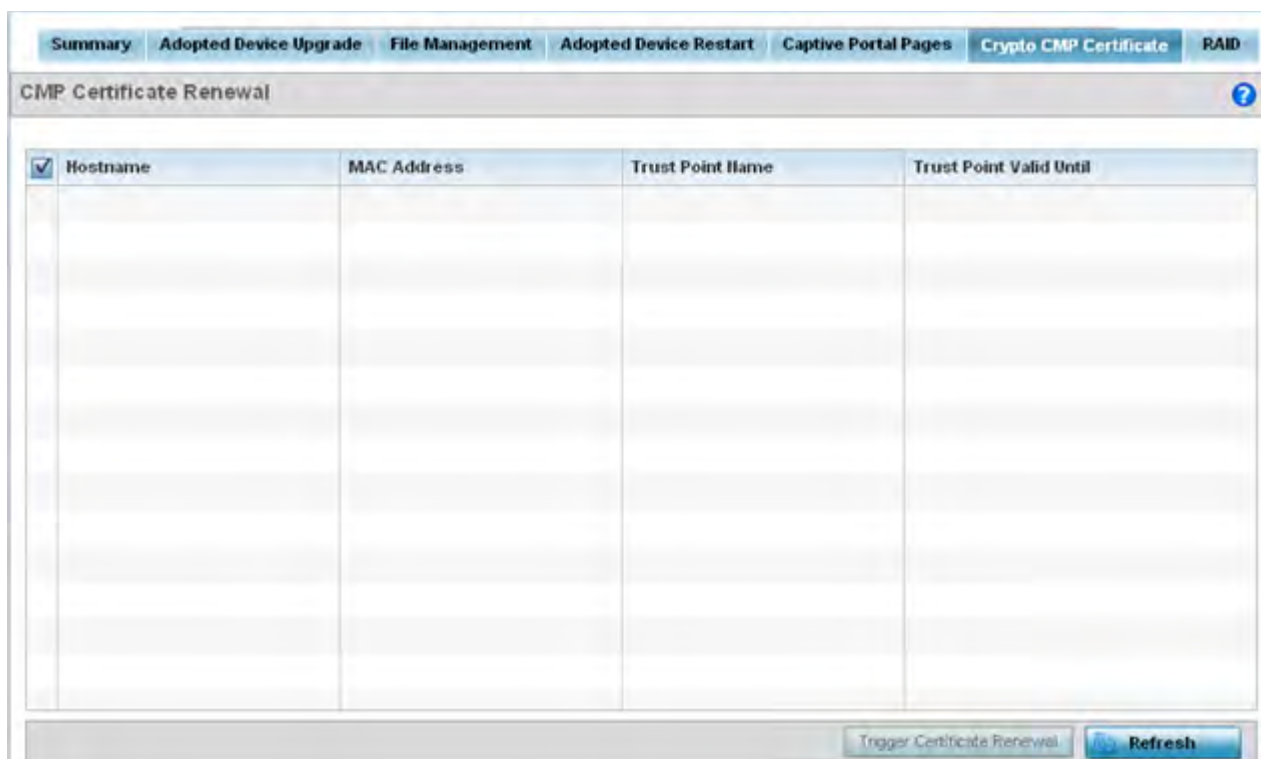


Figure 14-13 *Crypto CMP Certificate screen*

- 2 Review the following Crypto CMP certificate information to assess whether a certificate requires renewal:

Hostname	Lists the administrator assigned hostname of the CMP resource requesting a certificate renewal from the CMP CA server.
MAC Address	Lists the hardware encoded MAC address of the CMP server resource.

Trust Point Name	Lists the 32 character maximum name assigned to the target trustpoint. A trustpoint represents a CA/identity pair containing the identity of the CA, CA specific configuration parameters, and an association with an enrolled identity certificate.
Trust Point Valid Until	The expiration of the CMP certificate is checked once a day. When a certificate is about to expire a certificate renewal can initiated with the server via an existing IPsec tunnel. If the tunnel is not established, the CMP renewal request is not sent.

- 3 Select **Trigger Certificate Renewal** to begin update the credentials of the certificate. If a renewal succeeds, the newly obtained certificate overwrites an existing certificate. If the renewal fails, an error is logged.
- 4 Select **Refresh** to update the screen to the last saved configuration.

14.1.7 RAID Operations

► Device Operations

An administrator can configure a NX7530 or a NX9000 series RAID supported service platform with respect to both its collective drive array as well as individual drive behavior and diagnostics. The service platform's array alarm can be silenced, drive LEDs can be illuminated and stopped, drive consistency (integrity) checks can be made and the array can be prepared for drive replacements.



NOTE: RAID controller drive arrays are available within NX7530 and NX9000 series service platforms (NX9000, NX9500 and NX9510 models) only. However, they can be administrated on behalf of a profile by a different model service platform or controller.

To administrate the service platform's drive array and its member drives:



NOTE: The **RAID** tab is not available at the RF Domain level of the UI's hierarchal tree. A RF Domain must be selected and expanded to display the RF Domain's member devices. Once expanded, selected a RF Domain member NX7530, NX9000, NX9500 or NX9510 model device to ensure the RAID option is available.

- 1 Select **Operations > Devices > RAID**.



Figure 14-14 RAID screen

- 2 Conduct the following array diagnostic operations from within the **RAID Manage Array** field:

silence	Select <i>silence</i> to stop (silence) the service platform's RAID controller array alarm. When a drive is rendered offline for any reason, the service platform's array controller alarm is invoked.
locate-stop	Select <i>locate-stop</i> to stop the LEDs of all the drives within the array.
check-start	Select <i>check-start</i> to initiate a consistency check on the RAID array.

- 3 Conduct the following drive diagnostic operations from within the **RAID Manage Drive** field:

remove	Select <i>remove</i> to prepare a selected drive for physically removing it from the drive array. The remove command can be applied to either an online or hot spare drive.
install	Once a new drive is installed, it must be prepared for active array utilization. Select <i>install</i> to dedicate a selected drive to repair a degraded array and begin an array rebuild operation.
spare	Select <i>spare</i> to define a selected unused drive as a hot spare that can be dedicate as an active array drive if one of the two online array drives were to fail.
locate	Select <i>locate</i> to flash a selected drive's LED so it can easily located within the drive array.

- 4 Select **Execute** to initiate the selected command from either the RAID Manage Array or RAID Manage Drive fields.

To view the service platform's current RAID array status, drive utilization and consistency check information, refer to *RAID Statistics on page 15-114*.

14.1.8 Re-elect Controller

► *Device Operations*

Use the **Controller Re-election** screen to identify available Access Point resources within a selected RF Domain and optionally make some, or all, of the Access Points available to initiate tunnel connections.



NOTE: Take care when selecting Access Points for controller re-election, as client connections may be broken on upon re-election. Ensure an elected Access Point's client load can be compensated by another Access Point in the same RF Domain.

To re-elect controller adoption resources for tunnel establishment:



NOTE: The **Re-elect Controller** tab is only available at the RF Domain level of the UI's hierarchal tree and is not available for individual controllers, service platforms and Access Points.

- 1 Select **Operations**.
- 2 Ensure a **RF Domain** is selected from the Operations menu on the top, left-hand, side of the screen. Otherwise, the Re-elect Controller screen cannot be located, as it does not display at either the system or device levels of the hierarchal tree.
- 3 Select the **Re-elect Controller** tab.

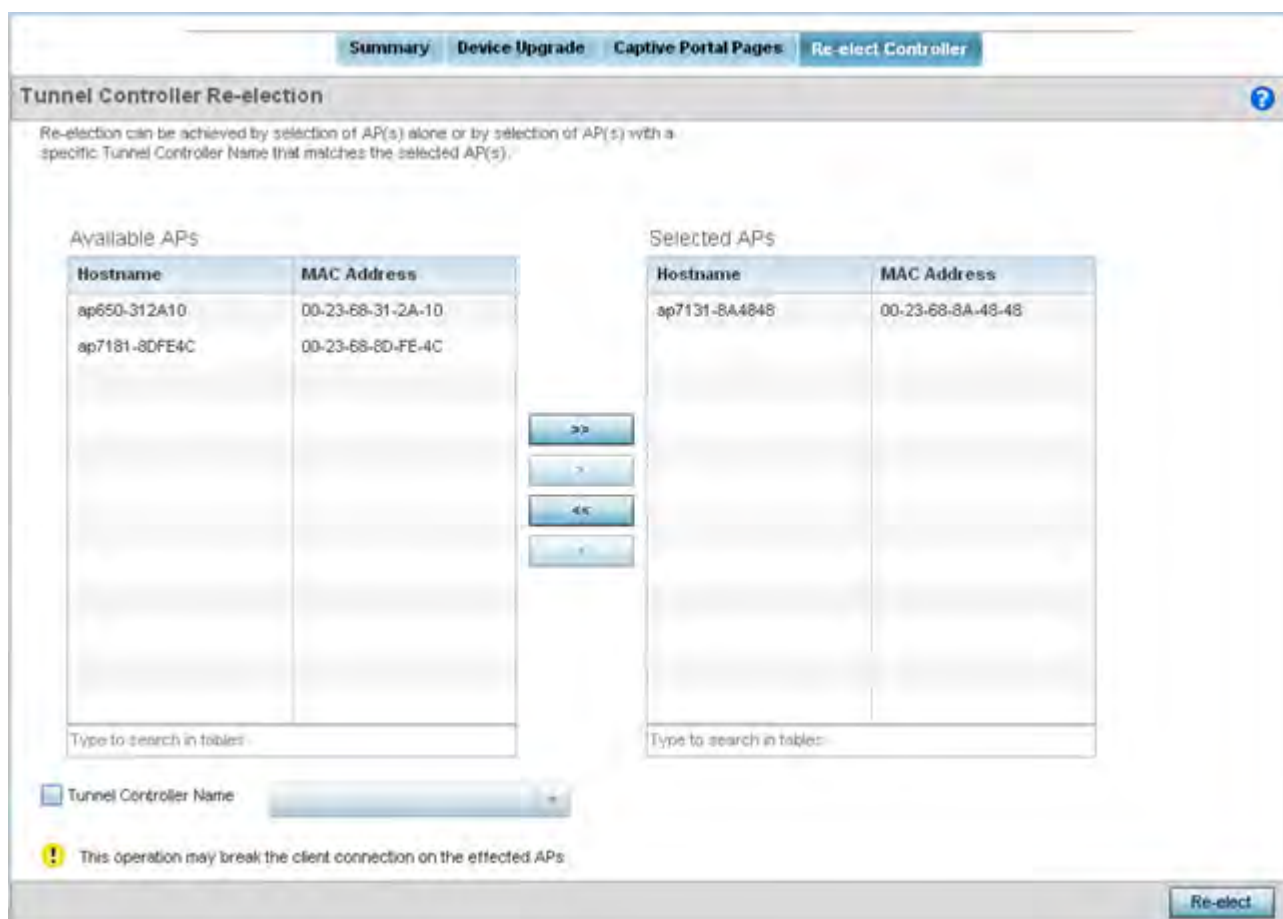


Figure 14-15 *Re-elect Controller screen*

- 4 Refer to the **Available APs** column, and use the **>** button to move the selected Access Point into the list of **Selected APs** available for RF Domain Manager candidacy. Use the **>>** button to move all listed Access Points into the Selected APs table.

The re-election process can be achieved through the selection of an individual Access Point, or through the selection of several Access Points with a specific Tunnel Controller Name matching the selected Access Points.

- 5 Select **Re-elect** to designate the Selected AP(s) as resources capable of tunnel establishment.

14.2 Certificates

A certificate links identity information with a public key enclosed in the certificate.

A *certificate authority* (CA) is a network authority that issues and manages security credentials and public keys for message encryption. The CA signs all digital certificates it issues with its own private key. The corresponding public key is contained within the certificate and is called a CA certificate. A browser must contain this CA certificate in its Trusted Root Library so it can trust certificates *signed* by the CA's private key.

Depending on the public key infrastructure, the digital certificate includes the owner's public key, the certificate expiration date, the owner's name and other public key owner information.

Each certificate is digitally signed by a *trustpoint*. The trustpoint signing the certificate can be a certificate authority, corporation or individual. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters and an association with an enrolled identity certificate.

SSH keys are a pair of cryptographic keys used to authenticate users instead of, or in addition to, a username/password. One key is private and the other is public key. *Secure Shell* (SSH) public key authentication can be used by a client to access managed resources, if properly configured. A RSA key pair must be generated on the client. The public portion of the key pair resides with the controller or service platform, while the private portion remains on a secure local area of the client.

For more information on the certification activities support by the controller or service platform, refer to the following:

- [Certificate Management](#)
- [RSA Key Management](#)
- [Certificate Creation](#)
- [Generating a Certificate Signing Request](#)

14.2.1 Certificate Management

► [Certificates](#)

If not wanting to use an existing certificate or key with a selected device, an existing *stored* certificate can be leveraged from a different managed device for use with the target device. Device certificates can be imported and exported to and from the controller or service platform to a secure remote location for archive and retrieval as they are required for application to other managed devices.

To configure trustpoints for use with certificates:

- 1 Select **Operations > Manage Certificates**.
- 2 Select a device from amongst those displayed in either the RF Domain or Network panes on the left-hand side of the screen.

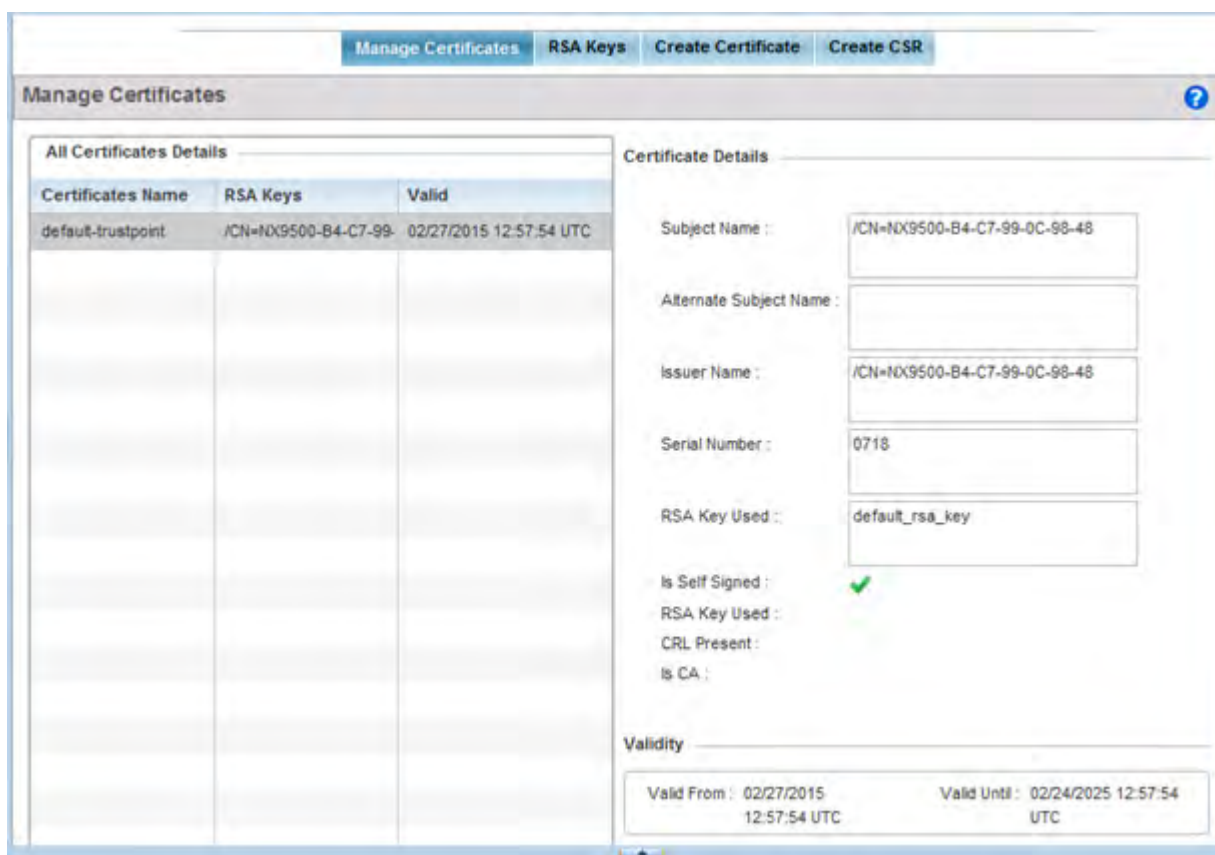


Figure 14-16 *Manage Certificates screen*

- 3 Select a device from amongst those displayed to review its certificate usage within the controller or service platform managed network.
- 4 Refer to the **All Certificate Details** to review the certificate's properties, self-signed credentials, validity period and CA information.
- 5 To import a certificate to the controller or service platform, select the **Import** button from the bottom of the Manage Certificates screen.

An **Import New Trustpoint** screen displays where CA certificates, CRLs and signed certificates can optionally be imported to the controller or service platform once the network credentials of the file transfer have been defined.

Import New Trustpoint

☒ Import ⓘ
☐ Import CA ⓘ
☐ Import CRL ⓘ
☐ Import Signed Cert ⓘ

Trustpoint Name ★

Location of Trustpoint

☒ From Network

Protocol: http Port: 69 Basic

Host: Hostname: Enter Valid HostName

Path/File:

OK Cancel

Figure 14-17 *Import New Trustpoint screen*

- 6 To optionally import a CA certificate to the controller or service platform, select the **Import CA** button from the **Import New Trustpoint** screen.

A CA is a network authority that issues and manages security credentials and public keys for message encryption. The CA signs all digital certificates it issues with its own private key. The corresponding public key is contained within the certificate and is called a CA certificate.

Figure 14-18 *Import New Trustpoint - Import CA screen*

7 Define the following configuration parameters required for the **Import CA** of the CA certificate:

Trustpoint Name	Enter the 32 character maximum name assigned to the target trustpoint signing the certificate. A trustpoint represents a CA/identity pair containing the identity of the CA, CA specific configuration parameters, and an association with an enrolled identity certificate.
URL	Provide the complete URL to the location of the trustpoint. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the target trustpoint. The number of additional fields populating the screen is dependent on the selected protocol.
Advanced / Basic	Click the <i>Advanced</i> or <i>Basic</i> link to switch between a basic URL and an advanced location to specify trustpoint location.
Protocol	Select the protocol used for importing the target CA certificate. Available options include: tftp ftp sftp http cf usb 1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1 - 4</i> .

Host	Provide the hostname or numeric IP4 or IPv6 formatted IP address of the server used to export the trustpoint. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for cf and usb1-4. A hostname cannot contain an underscore.
Path/File	Specify the path or filename of the CA certificate. Enter the complete relative path to the file on the server.
Cut and Paste	Select the <i>Cut and Paste</i> radio button to simply copy an existing trustpoint into the cut and paste field. When pasting, no additional network address information is required.

- 8 Select **OK** to import the defined CA certificate. Select **Cancel** to revert the screen to its last saved configuration.
- 9 Select the **Import CRL** button from the **Import New Trustpoint** screen to optionally import a CRL to the controller or service platform.

If a certificate displays within the Certificate Management screen with a CRL, that CRL can be imported into the controller or service platform. A *certificate revocation list* (CRL) is a list of certificates that have been revoked or are no longer valid. A certificate can be revoked if the CA had improperly issued a certificate, or if a private-key is compromised. The most common reason for revocation is the user no longer being in sole possession of the private key.

For information on creating a CRL to use with a trustpoint, refer to [Setting the Profile's Certificate Revocation List \(CRL\) Configuration on page 8-166](#).

Figure 14-19 *Import New Trustpoint - Import CRL screen*

10 Define the following configuration parameters required for the **Import** of the CRL:

Trustpoint Name	Enter the 32 character maximum name assigned to the target trustpoint signing the certificate. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters, and an association with an enrolled identity certificate.
From Network	Select the <i>From Network</i> radio button to provide network address information to the location of the target CRL. The number of additional fields that populate the screen is also dependent on the selected protocol. This is the default setting.
URL	Provide the complete URL to the location of the CRL. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the CRL. The number of additional fields that populate the screen is also dependent on the selected protocol.
Protocol	Select the protocol used for importing the CRL. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1-4</i> .
Host	Provide the hostname or numeric IP4 or IPv6 formatted IP address of the server used to export the trustpoint. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPV6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for <i>cf</i> and <i>usb1-4</i> . A hostname cannot contain an underscore.
Path/File	Specify the path to the CRL. Enter the complete relative path to the file on the server.
Cut and Paste	Select the <i>Cut and Paste</i> radio button to simply copy an existing CRL into the cut and paste field. When pasting a CRL, no additional network address information is required.

11 Select **OK** to import the CRL. Select **Cancel** to revert the screen to its last saved configuration.

12 To import a signed certificate to the controller or service platform, select **Import Signed Cert** from the **Import New Trustpoint** screen.

Signed certificates (or root certificates) avoid the use of public or private CAs. A self-signed certificate is an identity certificate signed by its own creator, thus the certificate creator also signs off on its legitimacy. The lack of mistakes or corruption in the issuance of self signed certificates is central.

Self-signed certificates cannot be revoked which may allow an attacker who has already gained access to monitor and inject data into a connection to spoof an identity if a private key has been compromised. However, CAs have the ability to revoke a compromised certificate, preventing its further use.

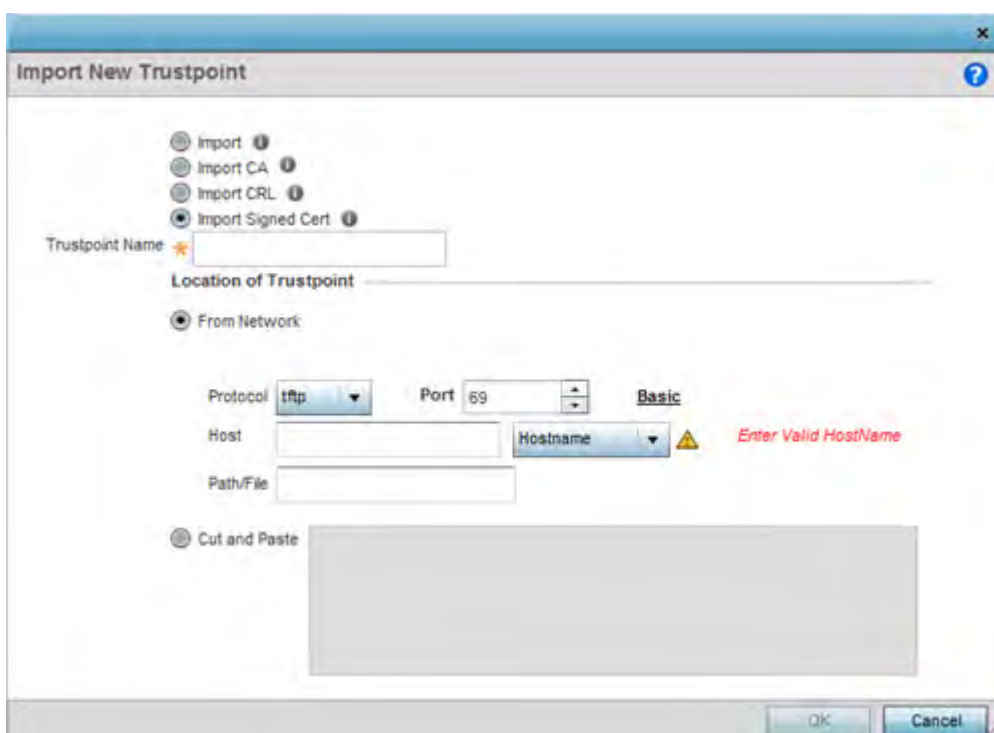


Figure 14-20 *Import New Trustpoint - Import Signed Cert*

13. Define the following parameters required for the **Import** of the Signed Certificate:

Trustpoint Name	Enter the 32 character maximum trustpoint name with which the certificate should be associated.
From Network	Select the <i>From Network</i> radio button to provide network address information to the location of the signed certificate. The number of additional fields that populate the screen is dependent on the selected protocol. From Network is the default setting.
URL	Provide the complete URL to the location of the signed certificate. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the signed certificate. The number of additional fields populating the screen is dependent on the selected protocol.
Protocol	Select the protocol for importing the signed certificate. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1-4</i> .

Host	Provide the hostname or numeric IP4 or IPv6 formatted IP address of the server used to import the trustpoint. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for cf and usb1-4. A hostname cannot contain an underscore.
Path/File	Specify the path to the signed certificate. Enter the complete relative path to the file on the server.
Cut and Paste	Select the <i>Cut and Paste</i> radio button to simply copy an existing signed certificate into the cut and paste field. When pasting a signed certificate, no additional network address information is required.

14 Select **OK** to import the signed certificate. Select **Cancel** to revert the screen to its last saved configuration.

15 To optionally export a trustpoint from the controller or service platform to a remote location, select the **Export** button from the Certificate Management screen.

Once a certificate has been generated on the controller or service platform's authentication server, export the self signed certificate. A digital CA certificate is different from a self signed certificate. The CA certificate contains the public and private key pairs. The self certificate only contains a public key. Export the self certificate for publication on a Web server or file server for certificate deployment or export it in to an active directory group policy for automatic root certificate deployment.

Figure 14-21 *Certificate Management - Export Trustpoint screen*

16 Define the following configuration parameters required for the **Export** of the trustpoint.

Trustpoint Name	Enter the 32 character maximum name assigned to the trustpoint. The trustpoint signing the certificate can be a certificate authority, corporation or individual.

URL	Provide the complete URL to the location of the trustpoint. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the trustpoint. The number of additional fields that populate the screen is dependent on the selected protocol.
Protocol	Select the protocol used for exporting the target trustpoint. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1-4</i> .
Host	Provide the hostname or numeric IPv4 or IPv6 formatted address of the server used to export the trustpoint. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPV6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for <i>cf</i> and <i>usb1-4</i> . A hostname cannot contain an underscore.
Path/File	Specify the path to the trustpoint. Enter the complete relative path to the file on the server.

- 17 Select **OK** to export the defined trustpoint. Select **Cancel** to revert the screen to its last saved configuration.
- 18 To optionally delete a trustpoint, select the **Delete** button from within the Certificate Management screen. Provide the trustpoint name within the **Delete Trustpoint** screen and optionally select **Delete RSA Key** to remove the RSA key along with the trustpoint. Select **OK** to proceed with the deletion, or **Cancel** to revert to the Certificate Management screen.

14.2.2 RSA Key Management

► Certificates

Refer to the RSA Keys screen to review existing RSA key configurations applied to managed devices. If an existing key does not meet the needs of a pending certificate request, generate a new key or import/export an existing key to and from a remote location.

Rivest, Shamir, and Adleman (RSA) is an algorithm for public key cryptography. It's an algorithm that can be used for certificate signing and encryption. When a device trustpoint is created, the RSA key is the private key used with the trustpoint.

To review existing device RSA key configurations, generate additional keys or import/export keys to and from remote locations:

- 1 Select **RSA Keys** tab from the Certificate Management screen.

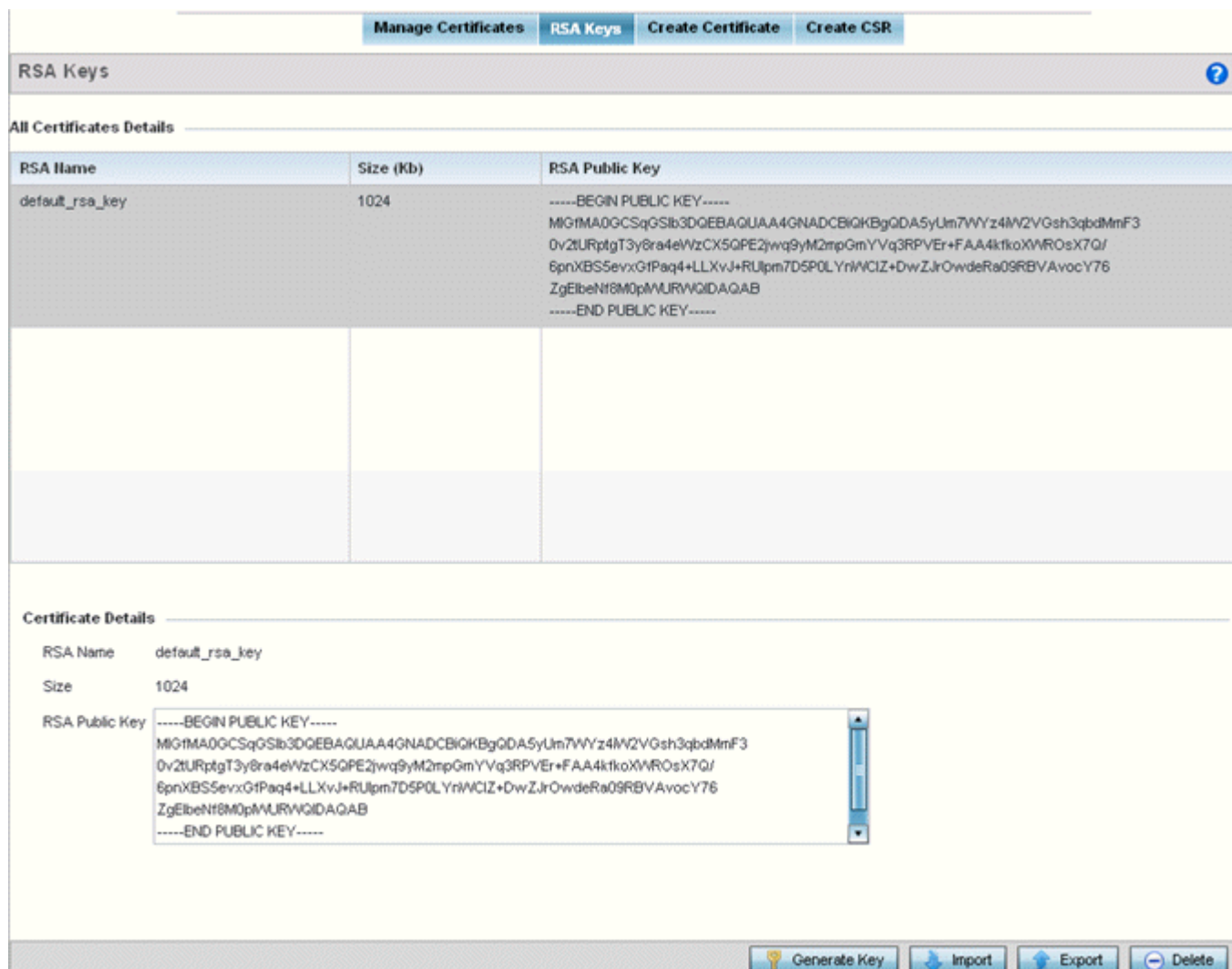


Figure 14-22 Certificate Management - RSA Keys screen

- 2 Select a listed device to review its current RSA key configuration.
Each key can have its size and character syntax displayed. Once reviewed, optionally generate a new RSA key, import a key from a selected device, export a key from the controller or service platform to a remote location or delete a key from a selected device.
- 3 Select **Generate Key** to create a new key with a defined size.

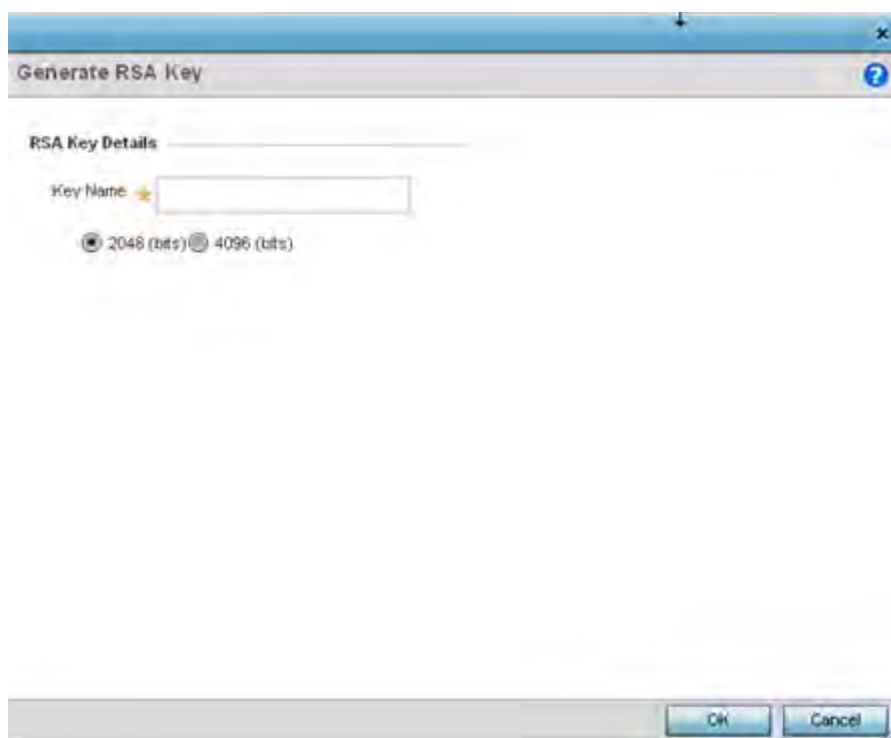


Figure 14-23 *Certificate Management - Generate RSA Keys screen*

- 4 Define the following configuration parameters required for the **Import** of the key:

Key Name	Enter the 32 character maximum name assigned to the RSA key.
Key Size	Set the size of the key as either <i>2048 (bits)</i> or <i>4096 (bits)</i> . Leaving this value at the default setting of 2048 is recommended to ensure optimum functionality.

- 5 Select **OK** to generate the RSA key. Select **Cancel** to revert the screen to its last saved configuration.
- 6 To optionally import a CA certificate to the controller or service platform, select the **Import** button from the Certificate Management > RSA Keys screen.

Figure 14-24 Certificate Management - Import New RSA Key screen

7 Define the following parameters required for the **Import** of the RSA key:

Key Name	Enter the 32 character maximum name assigned to identify the RSA key.
Key Passphrase	Define the key used by both the controller or service platform and the server (or repository) of the RSA key. Select the <i>Show</i> to expose the actual characters used in the passphrase. Leaving the Show unselected displays the passphrase as a series of asterisks “*”.
URL	Provide the complete URL to the location of the RSA key. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the target key. The number of additional fields that populate the screen is dependent on the selected protocol.
Advanced / Basic	Select either the <i>Advanced</i> or <i>Basic</i> link to switch between a basic URL and an advanced location to specify key location.
Protocol	Select the protocol used for importing the target key. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1-4</i> .

Host	Provide the hostname or numeric IPv4 or IPv6 formatted address of the server used to import the RSA key. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPV6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for cf and usb1-4. A hostname cannot contain an underscore.
Path/File	Specify the path to the RSA key. Enter the complete relative path to the key on the server.

8 Select **OK** to import the defined RSA key. Select **Cancel** to revert the screen to its last saved configuration.

9 To optionally export a RSA key from the controller or service platform to a remote location, select the **Export** button from the Certificate Management > RSA Keys screen.

Export the key to a redundant RADIUS server to import it without generating a second key. If there's more than one RADIUS authentication server, export the certificate and don't generate a second key unless you want to deploy two root certificates.

Figure 14-25 Certificate Management - Export RSA Key screen

10 Define the following configuration parameters required for the **Export** of the RSA key.

Key Name	Enter the 32 character maximum name assigned to the RSA key.
Key Passphrase	Define the key passphrase used by both the controller or service platform and the server. Select <i>Show</i> to expose the actual characters used in the passphrase. Leaving the Show unselected displays the passphrase as a series of asterisks “*”.

URL	Provide the complete URL to the location of the key. If needed, select <i>Advanced</i> to expand the dialog to display network address information to the location of the target key. The number of additional fields that populate the screen is dependent on the selected protocol.
Protocol	Select the protocol used for exporting the RSA key. Available options include: tftp ftp sftp http cf usb1-4
Port	Use the spinner control to set the port. This option is not valid for <i>cf</i> and <i>usb1-4</i> .
Host	Provide the hostname or numeric IPv4 or IPv6 formatted address of the server used to export the RSA key. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPV6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Providing a host is not required for <i>cf</i> and <i>usb1-4</i> . A hostname cannot contain an underscore.
Path/File	Specify the path to the key. Enter the complete relative path to the key on the server.

- 11 Select **OK** to export the defined RSA key. Select **Cancel** to revert the screen to its last saved configuration.
- 12 To optionally delete a key, select the **Delete** button from within the Certificate Management > RSA Keys screen. Provide the key name within the **Delete RSA Key** screen and select **Delete Certificates** to remove the certificate. Select **OK** to proceed with the deletion, or **Cancel** to revert back to the Certificate Management screen.

14.2.3 Certificate Creation

► Certificates

The **Create Certificate** screen provides the facility for creating new self-signed certificates. Self signed certificates (often referred to as root certificates) do not use public or private CAs. A self signed certificate is a certificate signed by its own creator, with the certificate creator responsible for its legitimacy.

To create a self-signed certificate that can be applied to a managed device:

- 1 Select the **Create Certificate** tab the Certificate Management screen.

Figure 14-26 *Certificate Management - Create Certificate screen*

- 2 Define the following configuration parameters required to **Create New Self-Signed Certificate**:

Certificate Name	Enter the 32 character maximum name assigned to identify the name of the trustpoint associated with the certificate. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters, and an association with an enrolled identity certificate.
RSA Key	To create a new RSA key, select <i>Create New</i> to define a 32 character maximum name used to identify the RSA key. Set the size of the key (2048, 4096 bits). Leave this value at the default setting of 2048 to ensure optimum functionality. To use an existing key, select <i>Use Existing</i> and select a key from the drop-down menu.

- 3 Set the following **Certificate Subject Name** parameters required for the creation of the certificate:

Certificate Subject Name	Select either <i>auto-generate</i> to automatically create the certificate's subject credentials or <i>user-configured</i> to manually enter the credentials of the self signed certificate. The default setting is auto-generate.
Country (C)	Define the <i>Country</i> used in the certificate. The field can be modified by the user to other values. This is a required field and must not exceed 2 characters.

State (ST)	Enter a <i>State/Prov.</i> for the state or province name used in the certificate. This is a required field.
City (L)	Enter a <i>City</i> to represent the city used in the certificate. This is a required field.
Organization (O)	Define an <i>Organization</i> for the organization represented in the certificate. This is a required field.
Organizational Unit (OU)	Enter an <i>Org. Unit</i> for the organization unit represented in the certificate. This is a required field.
Common Name (CN)	If there's a common name (IP address) for the organizational unit issuing the certificate, enter it here.

- 4 Select the following **Additional Credentials** required for the generation of the self signed certificate:

Email Address	Provide an <i>Email Address</i> used as the contact address for issues relating to this certificate request.
Domain Name	Enter a <i>fully qualified domain name</i> (FQDN) is an unambiguous domain name that specifies the node's position in the DNS tree hierarchy absolutely. To distinguish an FQDN from a regular domain name, a trailing period is added. For example, <i>somehost.example.com.</i> An FQDN differs from a regular domain name by its absoluteness, since a suffix is not added.
IP Address	Specify the IP address used as the destination for certificate requests.

- 5 Select the **Generate Certificate** button at the bottom of the Create Certificate screen to produce the certificate.

14.2.4 Generating a Certificate Signing Request

► Certificates

A *certificate signing request* (CSR) is a message from a requestor to a certificate authority to apply for a digital identity certificate. The CSR is composed of a block of encrypted text generated on the server the certificate will be used on. It contains information included in the certificate, including organization name, common name (domain name), locality, and country.

A RSA key must be either created or applied to the certificate request before the certificate can be generated. A private key is not included in the CSR, but is used to digitally sign the completed request. The certificate created with a particular CSR only worked with the private key generated with it. If the private key is lost, the certificate is no longer functional. The CSR can be accompanied by other identity credentials required by the certificate authority, and the certificate authority maintains the right to contact the applicant for additional information.

If the request is successful, the CA sends an identity certificate digitally signed with the private key of the CA.

To create a CSR:

- 1 Select **Operations > Certificates**.
- 2 Select a device from amongst those displayed in either the RF Domain or Network panes on the left-hand side of the screen.
- 3 Select **Create CSR**.

Figure 14-27 Create CSR screen

- 4 Define the following configuration parameters required to **Create New Certificate Signing Request (CSR)**:

RSA Key	To create a new RSA key, select <i>Create New</i> to define a 32 character maximum name used to identify the RSA key. Set a 2,048 bit key. To use an existing key, select <i>Use Existing</i> and select a key from the drop-down menu.

- 5 Set the following **Certificate Subject Name** parameters:

Certificate Subject Name	Select either the <i>auto-generate</i> radio button to automatically create the certificate's subject credentials or select <i>user-configured</i> to manually enter the credentials of the self signed certificate. The default setting is auto-generate.
Country (C)	Define the <i>Country</i> used in the CSR. The field can be modified by the user to other values. This is a required field and must not exceed 2 characters.
State (ST)	Enter a <i>State/Prov.</i> for the state or province name used in the CSR. This is a required field.
City (L)	Enter a <i>City</i> to represent the city name used in the CSR. This is a required field.
Organization (O)	Define an <i>Organization</i> for the organization used in the CSR. This is a required field.

Organizational Unit (OU)	Enter an <i>Org. Unit</i> for the name of the organization unit used in the CSR. This is a required field.
Common Name (CN)	If there's a common name (IP address) for the organizational unit issuing the certificate, enter it here.

6 Select the following **Additional Credentials** required for the generation of the CSR:

Email Address	Provide an email address used as the contact address for issues relating to this CSR.
Domain Name	Enter a <i>fully qualified domain name</i> (FQDN) is an unambiguous domain name that specifies the node's position in the DNS tree hierarchy absolutely. A trailing period is added to distinguish an FQDN from a regular domain name. For example, <i>somehost.example.com</i> . An FQDN differs from a regular domain name by its absoluteness, since a suffix is not added.
IP Address	Specify the IP address used as the controller or service platform destination for certificate requests.

7 Select the **Generate CSR** button at the bottom of the screen to produce the CSR.

14.3 Smart RF

Self Monitoring At Run Time RF Management (Smart RF) is an innovation designed to simplify RF configurations for new deployments, while (over time) providing on-going deployment optimization and radio performance improvements.

The Smart RF functionality scans the managed network to determine the best channel and transmit power for each wireless controller managed Access Point radio. Smart RF policies can be applied to specific RF Domains, to apply site specific deployment configurations and self recovery values to groups of devices within pre-defined physical RF coverage areas.

Smart RF also provides self recovery functions by monitoring the managed network in real-time and provides automatic mitigation from potentially problematic events such as radio interference, coverage holes and radio failures. Smart RF employs self recovery to enable a WLAN to better maintain wireless client performance and site coverage during dynamic RF environment changes, which typically require manual reconfiguration to resolve.

Smart RF is supported in standalone and clustered environments. In standalone environments, the individual controller or service platform manages the calibration and monitoring phases. In clustered environments, a single controller or service platform is elected a Smart Scan master and the remaining cluster members operate as Smart RF clients. In cluster operation, the Smart Scan master coordinates calibration and configuration and during the monitoring phase receives information from the Smart RF clients. Smart RF calibration can be triggered manually or continues at run-time, all the time.

Smart RF is supported on wireless controllers managing Access Points in either standalone or clustered environments.

Within the Operations node, Smart RF is managed within selected RF Domains, using the Access Points that comprise the RF Domain and their respective radio and channel configurations as the basis to conduct Smart RF calibration operations.

14.3.1 Managing Smart RF for an RF Domain

► Smart RF

When calibration is initiated, Smart RF instructs adopted radios (within a selected RF Domain) to beacon on a specific legal channel, using a specific transmit power setting. Smart RF measures the signal strength of each beacon received from both managed and unmanaged neighboring APs to define a RF map of the neighboring radio coverage area. Smart RF uses this information to calculate each managed radio's RF configuration as well as assign radio roles, channel and power.

Within a well planned RF Domain, any associated radio should be reachable by at least one other radio. The Smart RF feature records signals received from its neighbors. Access Point to Access Point distance is recorded in terms of signal attenuation. The information is used during channel assignment to minimize interference.

To conduct Smart RF calibration for an RF Domain:

- 1 Select **Operations > Smart RF**.
- 2 Expand the System mode in the upper, left-hand, side of the user interface to display the RF Domains available for Smart RF calibration.
- 3 Select a RF Domain from amongst those displayed.

The Smart RF screen displays information specific to the devices within the selected RF Domain using data from the last interactive calibration.

Hostname	AP MAC Address	Radio MAC Address	Radio Index	Old Channel	Channel	Old Power	Power	Smart Sensor	State	Type
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	1			0 dBm	0 dBm	✗	Sensor	802.11an
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	1	0 dBm	7 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	1	0	100w	0 dBm	10 dBm	✗	Normal	802.11an
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	1	0	108w	0 dBm	5 dBm	✗	Normal	802.11an
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	11	0 dBm	10 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	11	0 dBm	10 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	11	0 dBm	10 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	11	0 dBm	10 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	0	0	11	0 dBm	10 dBm	✗	Normal	802.11bgn
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	1	0	149w	0 dBm	17 dBm	✗	Normal	802.11an
ap6532-347	5C-0E-8B-3	5C-0E-8B-2	1	0	44w	0 dBm	11 dBm	✗	Normal	802.11an

Type to search in tables

Row Count: 14

Refresh Clear Config Clear History

Figure 14-28 Smart RF screen

- 4 Refer to the following to determine whether a Smart RF calibration or an interactive calibration is required:

Hostname	Displays the assigned Hostname for each member of the RF Domain.
AP MAC Address	Displays the hardware encoded MAC address assigned to each Access Point radio within the selected RF Domain. This value cannot be modified as past of a calibration activity.

Radio MAC Address	Displays the hardware encoded MAC address assigned to each Access Point radio within the selected RF Domain. This value cannot be modified as part of a calibration activity.
Radio Index	Displays a numerical index assigned to each listed Access Point radio when it was added to the managed network. This index helps distinguish this radio from others within this RF Domain with similar configurations. This value is not subject to change as a result of a calibration activity, but each listed radio index can be used in Smart RF calibration.
Old Channel	Lists the channel originally assigned to each listed Access Point MAC address within this RF Domain. This value may have been changed as part of an Interactive Calibration process applied to this RF Domain. Compare this Old Channel against the Channel value to right of it (in the table) to determine whether a new channel assignment was warranted to compensate for a coverage hole.
Channel	Lists the current channel assignment for each listed Access Point, as potentially updated by an Interactive Calibration. Use this data to determine whether a channel assignment was modified as part of an Interactive Calibration. If a revision was made to the channel assignment, a coverage hole was detected on the channel as a result of a potentially failed or under performing Access Point radio within this RF Domain.
Old Power	Lists the transmit power assigned to each listed Access Point MAC address within this RF Domain. The power level may have been increased or decreased as part of an Interactive Calibration process applied to this RF Domain. Compare this Old Power level against the Power value to right of it (in the table) to determine whether a new power level was warranted to compensate for a coverage hole.
Power	This column displays the transmit power level for the listed Access Point MAC address after an Interactive Calibration resulted in an adjustment. This is the new power level defined by Smart RF to compensate for a coverage hole.
Smart Sensor	Defines whether a listed Access Point is smart sensor on behalf of the other Access Point radios comprising the RF Domain.
State	Displays the current state of the Smart RF managed Access Point radio. Possible states include: <i>Normal</i> , <i>Offline</i> and <i>Sensor</i> .
Type	Displays the radio type (802.11an, 802.11bgn etc.) of each listed Access Point radio within the selected RF Domain.

- 5 Select the **Refresh** button to (as needed) to update the contents of the Smart RF screen and the attributes of the devices within the selected RF Domain.
- 6 Select the **Clear Config** button to remove a displayed Smart RF configuration.
- 7 Select the **Clear History** button to revert the statistics counters to zero to begin a new assessment.

15 Statistics

This chapter describes statistics displayed by the *graphical user interface* (GUI). Statistics are available for controllers or service platforms and their managed devices.

A Smart RF statistical history is available to assess adjustments made to device configurations to compensate for detected coverage holes or device failures.

Statistics display detailed information about controller or service platform peers, health, device inventories, wireless clients associations, adopted AP information, rogue APs and WLANs.

Access Point statistics can be exclusively displayed to validate connected Access Points, their VLAN assignments and their current authentication and encryption schemes.

Wireless client statistics are available for an overview of client health. Wireless client statistics includes RF quality, traffic utilization and user details. Use this information to assess if configuration changes are required to improve network performance.

Guest access statistics are also available for the periodic review of wireless clients requesting the required pass code, authentication and access into the WiNG managed guest network.

For more information, see:

- [System Statistics](#)
- [RF Domain Statistics](#)
- [Controller Statistics](#)
- [Access Point Statistics](#)
- [Wireless Client Statistics](#)
- [Guest Access Statistics](#)



NOTE: NOC controllers (NX9000, NX9500, NX9510, NX7500, and RFS6000) can utilize an analytics developer interface as an additional tool available to administrators to review specific APIs in granular detail. For more information, see [Analytics Developer Interface on page 15-332](#).

15.1 System Statistics

► [Statistics](#)

The **System** screen displays information supporting managed devices or peer controllers. Use this information to assess the overall state of the devices comprising the system. Systems data is organized as follows:

- [Health](#)
- [Inventory](#)
- [Adopted Devices](#)
- [Pending Adoptions](#)
- [Offline Devices](#)
- [Device Upgrade](#)
- [Licenses](#)
- [WIPS Summary](#)

15.1.1 Health

► System Statistics

The *Health* screen displays the overall performance of the controller or service platform managed network (system). This includes device availability, overall RF quality, resource utilization and network threat perception.

To display the health of the wireless controller managed network:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Health** from the left-hand side of the UI.

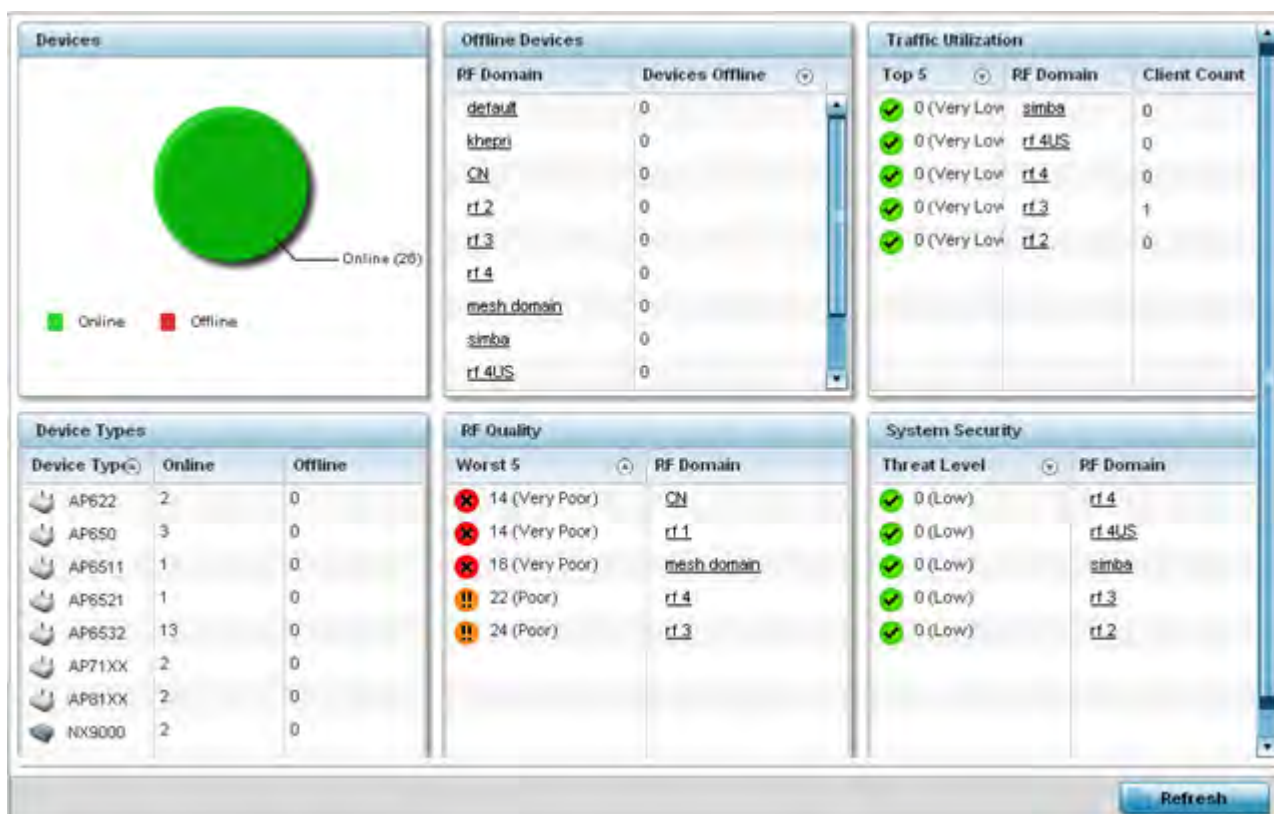


Figure 15-1 System - Health screen

- 4 The **Devices** field displays the total number of devices in the controller or service platform managed network. The pie chart is a proportional view of how many devices are functional and currently online. Green indicates online devices and red offline devices detected within the controller or service platform managed network.
- 5 The **Offline Devices** table displays a list of detected devices in the network that are currently offline but available as potential managed resources.
The table displays the number of offline devices within each impacted RF Domain. Assess whether the configuration of a particular RF Domain is contributing to an excessive number of offline devices.

- 6 The **Traffic Utilization** table displays the top 5 RF Domains with the most effective resource utilization. Utilization is dependent on the number of devices connected to the RF Domain.

Top 5	Displays the top 5 RF Domains in terms of usage index. Utilization index is a measure of how efficiently the domain is utilized. This value is defined as a percentage of current throughput relative to the maximum possible throughput. The values are: 0-20 – Very low utilization 20-40 – Low utilization 40-60 – Moderate utilization 60 and above – High utilization
RF Domain	Displays the name of the RF Domain.
Client Count	Displays the number of wireless clients associated with the RF Domain.

- 7 The **Device Types** table displays the kinds of devices detected within the system. Each device type displays the number currently online and offline.
- 8 Use the **RF Quality** table to isolate poorly performing radio devices within specific RF Domains. This information is a starting point to improving the overall quality of the wireless controller managed network. The **RF Quality** area displays the RF Domain performance. Quality indices are:

- 0 – 50 (Poor)
- 50 – 75 (Medium)
- 75 – 100 (Good).

The RF Quality field displays the following:

Worst 5	Displays five RF Domains with the lowest quality indices in the wireless controller managed network. The value can be interpreted as: 0-50 – Poor quality 50-75 – Medium quality 75-100 – Good quality
RF Domain	Displays the name of the RF Domain wherein system statistics are polled for the poorly performing device.

- 9 The **System Security** table defines a Threat Level as an integer value indicating a potential threat to the system. It's an average of the threat indices of all the RF Domains managed by the wireless controller.

Threat Level	Displays the threat perception value. This value can be interpreted as: 0-2 – Low threat level 3-4 – Moderate threat level 5 – High threat level
RF Domain	Displays the name of the target RF Domain for which the threat level is displayed.

- 10 Select **Refresh** at any time to update the statistics counters to their latest values.

15.1.2 Inventory

► System Statistics

The *Inventory* screen displays information about the physical hardware managed within the system by its member controller or service platforms. Use this information to assess the overall performance of wireless controller managed devices.

To display the inventory statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Inventory** from the left-hand side of the UI.

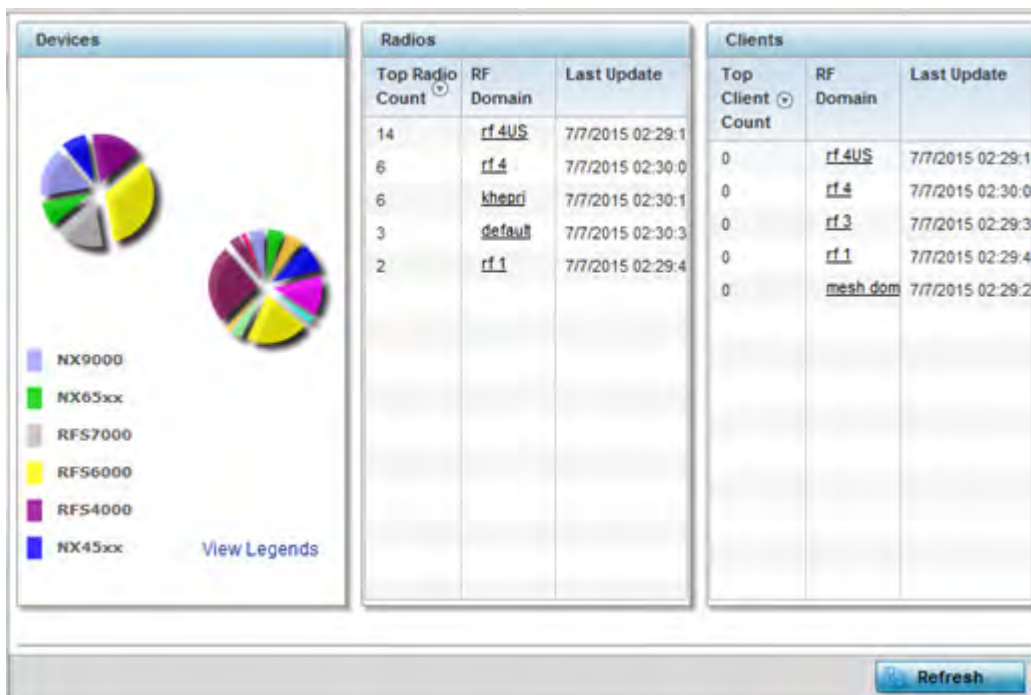


Figure 15-2 System - Inventory screen

- 4 The **Devices** field displays an exploded pie chart depicting controller, service platform and Access Point device type distribution by model. The device on the left displays managing controller models. Select **View Legends** to assess connected Access Points. Use this information to assess whether these are the correct models for the original deployment objective.
- 5 The **Radios** table displays radios deployed within the wireless controller managed network. This area displays the total number of managed radios and top 5 RF Domains in terms of radio count. The Total Radios value is the total number of radios in this system.

Top Radio Count	Displays the radios index of each listed top radio.
RF Domain	Displays the name of the RF Domain the listed radios belong. The RF Domain displays as a link that can be selected to display configuration and network address information in greater detail.
Last Update	Displays the UTC timestamp when each listed client was last seen on the network.

- 6 The **Clients** table displays the total number of wireless clients managed by the controller or service platform. This Top Client Count table lists the top 5 RF Domains, in terms of the number of wireless clients adopted:

Top Client Count	Displays the client index of each listed top performing client.
RF Domain	Displays the name of the client RF Domain.
Last Update	Displays the UTC timestamp when the client count was last reported.

- 7 Select **Refresh** to update the statistics counters to their latest values.

15.1.3 Adopted Devices

► System Statistics

The *Adopted Devices* screen displays a list of devices adopted to the wireless controller managed network (entire system). Use this screen to view a list of devices and their current status.

To view adopted AP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Adopted Devices** from the left-hand side of the UI.

Adopted Device	Type	RF Domain Name	Model Number	Config Status	Config Errors	Adopter Hostname	Adoption Time	Startup Time
ap622-57F5F0	AP622	simba	AP-0622-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap622-5864A0	AP622	simba	AP-0622-Bi	configured		rx9500-0C9848	Tue May 14	Tue May 14 20
ap650-312908	AP650	rf.4	AP-0650-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap650-3129EC	AP650	rf.4	AP-0650-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap650-312A10	AP650	default	AP-0650-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6511-8A4B15	AP651	rf.3	AP-6511-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6521-970CC6	AP652	CN	AP-6521-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-3118E0	AP653	rf.2	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-34503C	AP653	rf.1	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347110	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-3475E4	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347638	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-34776C	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347800	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347830	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347854	AP653	mesh domain	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20
ap6532-347B7C	AP653	rf.4US	AP-6532-Bi	configured		rx9500-0C9848	Mon May 13	Mon May 13 20

Type to search in tables: Row Count: 24

Refresh

Figure 15-3 System - Adopted Devices screen

The **Adopted Devices** screen provides the following:

Adopted Device	Displays administrator assigned hostname of the adopted device. Select the adopted device link to display configuration and network address information in greater detail.
Type	Displays the adopted Access Point's model type.

RF Domain Name	Displays the domain the adopted AP has been assigned to. Select the RF Domain to display configuration and network address information in greater detail.
Model Number	Lists the model number of each AP that's been adopted to the controller or service platform since this screen was last refreshed.
Config Status	Displays the configuration file version in use by each listed adopted device. Use this information to determine whether an upgrade would increase the functionality of the adopted device.
Config Errors	Lists any errors encountered when the listed device was adopted by the controller or service platform.
Adopter Hostname	Lists the administrator hostname assigned to the adopting controller or service platform.
Adoption Time	Displays a timestamp for each listed device that reflects when the device was adopted by the controller or service platform.
Startup Time	Provides a date stamp when the adopted device was restarted post adoption.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.1.4 Pending Adoptions

► *System Statistics*

The *Pending Adoptions* screen displays those devices detected within the controller or service platform coverage area, but have yet to be adopted by the controller or service platform. Review these devices to assess whether they could provide radio coverage to wireless clients needing support.

To view pending AP adoptions to the controller or service platform:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Pending Adoptions** from the left-hand side of the UI.

	MAC Address	Type	IP Address	VLAN	Reason	Discovery Option	Last Seen
	00-23-68-8D-FE-4C	AP71xx	172.168.1.102	5	Auto-Provisioning	tqdn: ap7181-80f	5/15/2013 08:31:23 PM 

Type to search in tables

Row Count: 1

Add to Devices

Refresh

Figure 15-4 *System - Pending Adoptions screen*

The **Pending Adoptions** screen displays the following:

MAC Address	Displays the MAC address of the device pending adoption. Select the MAC address to view device configuration and network address information in greater detail.
Type	Displays the AP type.
IP Address	Displays the current IP Address of the device pending adoption.
VLAN	Displays the VLAN the device pending adoption will use as a virtual interface with its adopting controller or service platform.
Reason	Displays a status (reason) as to why the device is pending adoption.
Discovery Option	Displays the discovery option code for each AP listed pending adoption.
Last Seen	Displays the date and time stamp of the last time the device was seen. Click the arrow next to the date and time to toggle between standard time and UTC.
Add to Devices	Select a listed AP and select the <i>Add to Devices</i> button to begin the adoption process for this detected AP.
Refresh	Click the <i>Refresh</i> button to update the list of pending adoptions.

15.1.5 Offline Devices

► *System Statistics*

The *Offline Devices* screen displays a list of devices in the controller or service platform managed network or RF Domain that are currently offline. Review the contents of this screen to help determine whether an offline status is still warranted.

To view offline device potentially available for adoption by the controller or service platform:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Offline Devices** from the left-hand side of the UI.

Hostname	MAC Address	Type	RF Domain Name	Reporter	Area	Floor	Connected To	Last Update
ap622-57F5F	B4-C7-99-57	AP622	simba	nx9500-0C				8/16/2013 12:28:18 PM
ap622-5854A	B4-C7-99-58	AP622	simba	nx9500-0C				8/16/2013 12:28:18 PM
ap650-3129C	00-23-68-31	AP650	rf_4	nx9500-0C				8/16/2013 12:28:18 PM
ap650-3129E	00-23-68-31	AP650	rf_4	nx9500-0C				8/16/2013 12:28:18 PM
ap650-312A1	00-23-68-31	AP650	default	nx9500-0C				8/16/2013 12:28:18 PM
ap6511-8A4E	5C-0E-8B-8A	AP6511	rf_3	nx9500-0C				8/16/2013 12:28:18 PM
ap6521-970C	5C-0E-8B-97	AP6521	CN	nx9500-0C				8/16/2013 12:28:18 PM
ap6522-5A84	B4-C7-99-5A	AP6522	default	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3118	00-23-68-31	AP6532	rf_2	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3450	5C-0E-8B-34	AP6532	rf_1	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3471	5C-0E-8B-34	AP6532	rf_4US	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3475	5C-0E-8B-34	AP6532	rf_4US	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3476	5C-0E-8B-34	AP6532	rf_4US	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3477	5C-0E-8B-34	AP6532	rf_4US	nx9500-0C				8/16/2013 12:28:18 PM
ap6532-3478	5C-0E-8B-34	AP6532	rf_4US	nx9500-0C				8/16/2013 12:28:18 PM

Type to search in tables: Row Count: 27

Refresh

Figure 15-5 System - Offline Devices screen

The **Offline Devices** screen provides the following:

Hostname	Lists the administrator assigned hostname provided when the device was added to the controller or service platform managed network.
MAC Address	Displays the factory encoded MAC address of each listed offline device.
Type	Displays the offline Access Point's model type.
RF Domain Name	Displays the name of the offline device's RF Domain membership, if applicable. Select the RF Domain to display configuration and network address information in greater detail.
Reporter	Displays the hostname of the device reporting the listed device as offline. Select the reporting device name to display configuration and network address information in greater detail.
Area	Lists the administrator assigned deployment area where the offline device has been detected.
Floor	Lists the administrator assigned deployment floor where the offline device has been detected.
Connected To	Lists the offline's device's connected controller, service platform or peer model Access Point.
Last Update	Displays the date and time stamp of the last time the device was detected within the controller or service platform managed network. Click the arrow next to the date and time to toggle between standard time and UTC.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

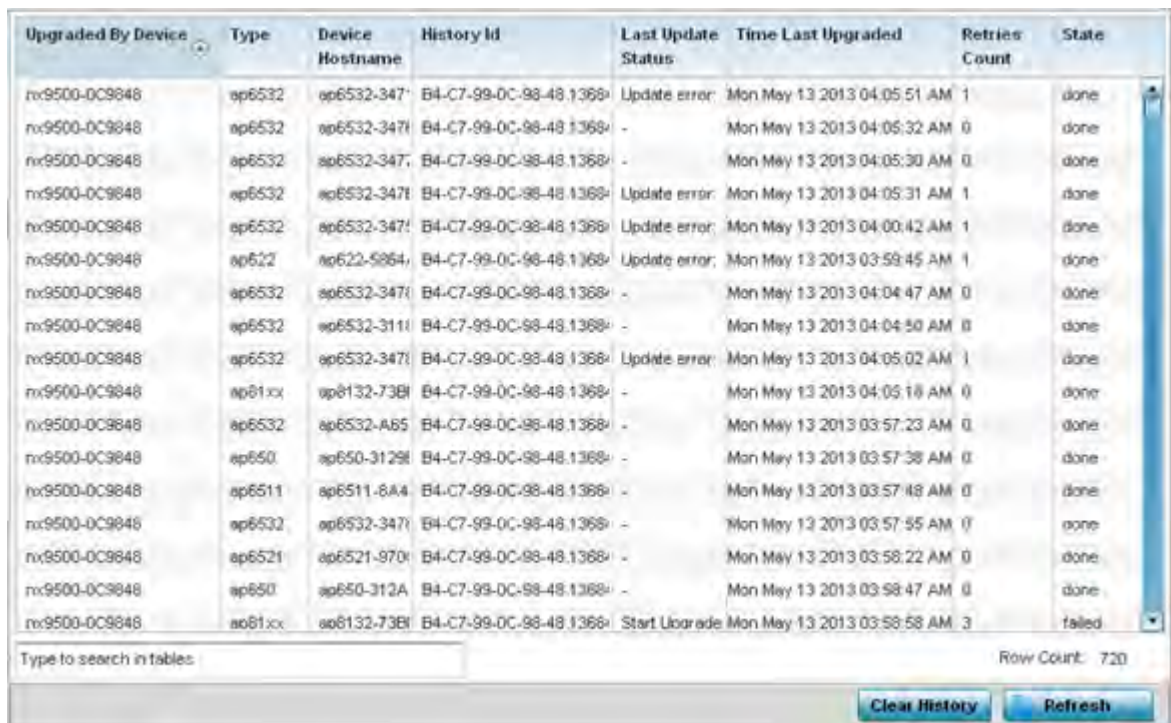
15.1.6 Device Upgrade

► System Statistics

The *Device Upgrade* screen displays available licenses for devices within a cluster. It displays the total number of AP licenses.

To view a licenses statistics within the controller or service platform managed network:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Device Upgrade** from the left-hand side of the UI.



Upgraded By Device	Type	Device Hostname	History Id	Last Update Status	Time Last Upgraded	Retries Count	State
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	Update error:	Mon May 13 2013 04:05:51 AM	1	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 04:05:32 AM	0	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 04:05:30 AM	0	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	Update error:	Mon May 13 2013 04:05:31 AM	1	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	Update error:	Mon May 13 2013 04:00:42 AM	1	done
rx9500-0C9848	ap6522	ap6522-5864	B4-C7-99-0C-98-48.1368	Update error:	Mon May 13 2013 03:59:45 AM	1	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 04:04:47 AM	0	done
rx9500-0C9848	ap6532	ap6532-311	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 04:04:50 AM	0	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	Update error:	Mon May 13 2013 04:05:02 AM	1	done
rx9500-0C9848	ap81xx	ap8132-73B	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 04:05:18 AM	0	done
rx9500-0C9848	ap6532	ap6532-A85	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:57:23 AM	0	done
rx9500-0C9848	ap650	ap650-3129	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:57:38 AM	0	done
rx9500-0C9848	ap6511	ap6511-8A4	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:57:48 AM	0	done
rx9500-0C9848	ap6532	ap6532-347	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:57:55 AM	0	done
rx9500-0C9848	ap6521	ap6521-970	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:58:22 AM	0	done
rx9500-0C9848	ap650	ap650-312A	B4-C7-99-0C-98-48.1368	-	Mon May 13 2013 03:58:47 AM	0	done
rx9500-0C9848	ap81xx	ap8132-73B	B4-C7-99-0C-98-48.1368	Start Upgrade	Mon May 13 2013 03:58:58 AM	3	failed

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Clear History Refresh

Figure 15-6 System - Device Upgrade screen

- 4 Select **Device Upgrade** from the left-hand side of the UI.

Upgraded By Device	Displays the MAC address of the controller, service platform or peer model Access Point that performed an upgrade.
Type	Displays the model type of the adopting controller, service platform or Access Point. An updating Access Point must be of the same model as the Access Point receiving the update.
Device Hostname	List the administrator assigned hostname of the device receiving an update.
History ID	Displays a unique timestamp for the upgrade event.
Last Update Status	Displays the initiation, completion or error status of each listed upgrade operation.
Time Last Upgraded	Lists the date and time of each upgrade operation.
Retries Count	Displays the number of retries required in an update operation.

State	Displays the <i>done</i> or <i>failed</i> state of an upgrade operation.
Clear History	Select <i>Clear History</i> to clear the screen of its current status and begin a new data collection.
Refresh	Select <i>Refresh</i> to update the screen's statistics counters to their latest values.

15.1.7 Licenses

► System Statistics

The *Licenses* statistics screen displays available licenses for devices within a cluster. It displays the total number of AP licenses. **Native** (local) and **Guest** license utilization can now be separately tracked as well.

To view a licenses statistics within the controller or service platform managed network:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **Licenses** from the left-hand side of the UI.

Native

Guest

Summary

Details

Local Licenses

Cluster/ Hostname	AP Licenses	Lent AP License..	Total AP Licenses	AP Licenses Usage	Remainin...	AAP License s	Lent AAP License	Total AAP...	AAP License...	Remaining AAP Licenses	Validity
▼  MAR1	48	0	48	0	48	10496	0	10496	27	10469	Current
 48	48	0	48	0		10240	0	10240	27		
 0	0	0	0	0		256	0	256	0		

Global Licenses

Cluster AP Adoption Licenses	0
Cluster Total AP Licenses	48
Cluster AAP Adoption Licenses	27
Cluster Total AAP Licenses	10496

AP Licenses

Cluster Maximum APs	10544

Feature Licenses

Hostname	Advanced Security	Hotspot Analytics
NX95-Pri	✓	✓

AP Licenses Installed	Lists the number of Access Point connections available to this controller or service platform under the terms of the current license.
Lent AP Licenses	Displays the number of Access Point licenses lent (from this controller or service platform) to a cluster member to compensate for an Access Point's license deficiency.
Total AP Licenses	Displays the total number of Access Point connection licenses currently available to this controller or service platform.
AP License Usage	Lists the number of Access Point connections currently utilized by this controller or service platform out of the total available under the terms of the current license.
Remaining AP Licenses	Lists the remaining number of AP licenses available from the pooled license capabilities of all the members of the cluster.
AAP Licenses Installed	Lists the number of Adaptive Access Point connections available to this controller or service platform under the terms of the current license.
Lent AAP Licenses	Displays the number of Adaptive Access Point licenses lent (from this controller or service platform) to a cluster member to compensate for an Access Point licenses deficiency.
Total AAP Licenses	Displays the total number of Adaptive Access Point connection licenses currently available to this controller or service platform.
AAP Licenses Usage	Lists the number of Adaptive Access Point connections currently utilized by this controller or service platform out of the total available under the terms of the current license.
Remaining AAP Licenses	Lists the remaining number of AAP licenses available from the pooled license capabilities of all the members of the cluster.
Validity	Displays validity information for the license's legal usage with the controller or service platform.

5 The **Global Licenses** table provides the following information:

Cluster AP Adoption Licenses	Displays the current number of Access Point adoption licenses utilized by controller or service platform connected Access Points within a cluster.
Cluster Total AP Licenses	Displays the total number of Access Point adoption licenses available to controller or service platform connected Access Points within a cluster.
Cluster AAP Adoption Licenses	Displays the current number of Adaptive Access Point adoption licenses utilized by controller or service platform connected Access Points within a cluster.
Cluster Total AAP Licenses	Displays the total number of Adaptive Access Point adoption licenses available to controller or service platform connected Access Points within a cluster.

6 The **AP Licenses** table provides the following information:

Cluster Maximum AP	Lists the maximum number of Access Points permitted in a cluster under the terms of the current license.

7 The **Featured Licenses** area provides the following information:

Hostname	Displays the administrator assigned hostname of the controller, service platform or Access Point whose potentially implemented a advanced security, WIPS or Analytics feature licenses.

Advanced Security	Displays whether the separately licensed Advanced Security application is installed for each hostname.
Hotspot Analytics	Displays whether a separately licensed Analytics application is installed for supported NX9500 and NX9510 service platforms.

- 8 Select the **Details** tab.

Refer to the **Details** screen to further assess the total number of cluster member licenses available, cluster memberships, current utilization versus total licenses available, borrowed licenses, remaining licenses and license validity.

- 9 Refer to the following license utilization data:

Cluster/Hostname	Lists the administrator assigned cluster hostname whose license count and utilization is listed and tallied for member controllers, service platforms or Access Points.
AP Licenses Installed	Lists the number of Access Point connections available to this controller or service or peer Access Point under the terms of the current license.
Borrowed AP Licenses	Displays the number of Access Point licenses temporarily borrowed from a cluster member to compensate for an AP license deficiency.
Total AP Licenses	Displays the total number of Access Point connection licenses currently available to clustered devices.
AP Licenses Usage	Lists the number of Access Point connections currently utilized out of the total available under the terms of current licenses.
Remaining AP Licenses	Lists the remaining number of AP licenses available from the pooled license capabilities of cluster members.
AAP Licenses Installed	Lists the number of Adaptive Access Point connections available under the terms of current licenses.
Borrowed AAP Licenses	Displays the number of Adaptive Access Point licenses temporarily borrowed from a cluster member to compensate for an AAP license deficiency.
Total AAP Licenses	Displays the total number of Adaptive Access Point connection licenses currently available to clustered devices.
AAP Licenses Usage	Lists the number of Adaptive Access Point connections currently utilized out of the total available under the terms of the current licenses.
Remaining AAP Licenses	Lists the remaining number of AAP licenses available from the pooled license capabilities of all the members of the cluster.
Validity	Displays validity information for the license's legal usage by cluster member devices.
Refresh	Select <i>Refresh</i> to update the screen's statistics counters to their latest values.

15.1.8 WIPS Summary

► *System Statistics*

The *Wireless Intrusion Protection System* (WIPS) provides continuous protection against wireless threats and acts as an additional layer of security complementing wireless VPNs and existing encryption and authentication policies. Controllers and service platforms support WIPS through the use of dedicated sensor devices, designed to

actively detect and locate unauthorized AP devices. After detection, they use mitigation techniques to block devices using manual termination, air lockdown or port suppression.

The **WIPS Summary** screen lists RF Domains residing in the system and reports the number of unauthorized and interfering devices contributing to the potential poor performance of the RF Domain's network traffic. Additionally, the number of WIPS events reported by each RF Domain is also listed to help an administrator better mitigate risks to the network.

To review and assess the impact of rogue and interfering Access Points, as well as the occurrence of WIPS events within the controller or service platform's managed system:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the **System** node from the left navigation pane.
- 3 Select **WIPS Summary** from the left-hand side of the UI.

RF Domain	Number Of Rogue APs	Number Of Interfering APs	Number Of WIPS Events
7502	0	57	54
all			
CN	0	0	0
default			
khepri	0	153	1,024
mesh domain	0	58	1,024
Oak	0	331	17
rf 1	0	387	911
rf 2			
rf 3	0	70	270
rf 4	0	358	1,024
rf 4US	0	219	1,024
rf US			
simba			
sitecon			

Type to search in tables

Row Count: 15

WIPS Report Refresh

Figure 15-8 System - WIPS Summary screen

- 4 Refer to the following WIPS data reported for each RF Domain in the system:

RF Domain	Lists the RF Domain within the system reporting rogue and interfering Access Point event counts. Use this information to assess whether a particular RF Domain is reporting an excessive number of events or a large number of potentially invasive rogue Access Points versus the other RF Domains within the controller, service platform or Access Point managed system.
Number of Rogue APs	Displays the number of unsanctioned devices in each listed RF Domain. Unsanctioned devices are those devices detected within the listed RF Domain, but have not been deployed by an administrator as a known and approved controller or service platform managed device.

Number of Interfering APs	Displays the number of devices exceeding the interference threshold in each listed RF Domain. Each RF Domain utilizes a WIPS policy with a set interference threshold (from -100 to -10 dBm). When a device exceeds this <i>noise</i> value, its defined as an interfering Access Point capable of disrupting the signal quality of other sanctioned devices operating below an approved RSSI maximum value.
Number of WIPS Events	Lists the number of devices triggering a WIPS event within each listed RF Domain. Each RF Domain utilizes a WIPS policy where excessive, MU and AP events can have their individual values set for event generation. An administrator can <i>enable</i> or <i>disable</i> the filtering of each listed event and set the thresholds required for the generation of the event notification and filtering action.

- 5 Select the **WIPS Report** button to launch a sub-screen to filter how WIPS reports are generated for the system.



Figure 15-9 System - WIPS Summary screen

Select **Summary** to capture all WIPS data or just select *Only Rogue APs*, *Only Interferer APs* for *All APs* to refine event reporting to a specific type of WIPS activity. Select **Generate Report** to compile and archive the results of the query.

- 6 Select **Refresh** to update the screen's statistics counters to their latest values.

15.2 RF Domain Statistics

► Statistics

The **RF Domain** screens display status for a selected RF domain. This includes the RF Domain *health* and *device inventory*, *wireless clients* and *Smart RF* functionality. RF Domains allow administrators to assign regional, regulatory and RF configuration to devices deployed in a common coverage area such as on a building floor, or site. Each RF Domain contains regional, regulatory and sensor server configuration parameters and may also be assigned policies that determine Access, SMART RF and WIPS configuration.

Use the following information to obtain an overall view of the performance of the selected RF Domain and troubleshoot issues with the domain or any member device.

- *Health*
- *Inventory*
- *Devices*
- *AP Detection*
- *Wireless Clients*
- *Device Upgrade*
- *Wireless LANs*

- *Radios*
- *Bluetooth*
- *Mesh*
- *Mesh Point*
- *SMART RF*
- *WIPS*
- *Captive Portal*
- *Application Visibility (AVC)*
- *Coverage Hole Summary*
- *Coverage Hole Details*

15.2.1 Health

▶ *RF Domain Statistics*

The *Health* screen displays general status information for a selected RF Domain, including data polled from all its members.

To display the health of a controller or service platform's RF Domain:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Health** from the RF Domain menu.

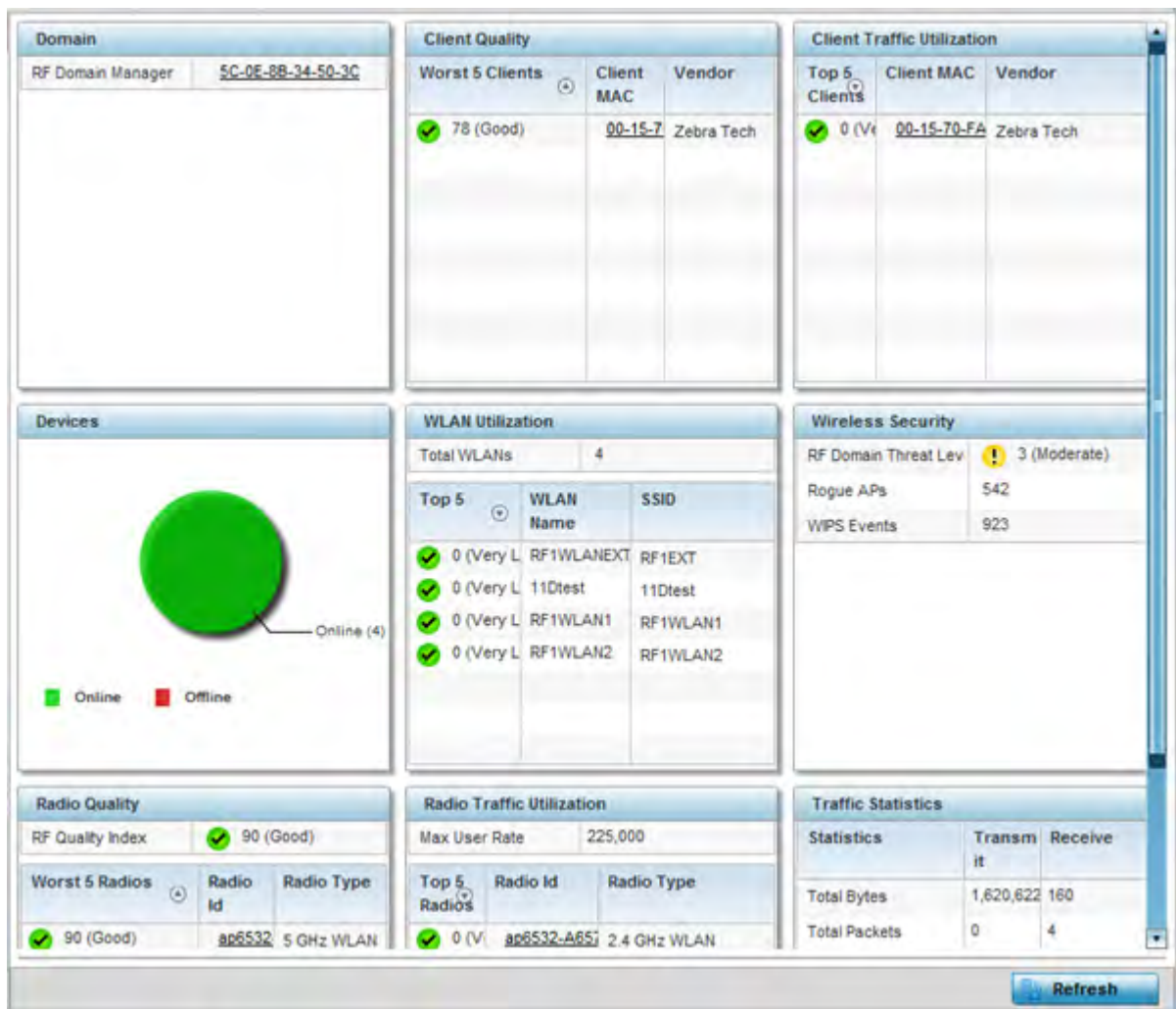


Figure 15-10 RF Domain - Health screen

- 4 The **Domain** field displays the name of the RF Domain manager. The RF Domain manager is the focal point for the radio system and acts as a central registry of applications, hardware and capabilities. It also serves as a mount point for all the different pieces of the hardware system file.
- 5 The **Devices** field displays the total number of online versus offline devices in the RF Domain, and an exploded pie chart depicts their status.
- 6 The **Radio Quality** field displays information on the RF Domain's RF quality. The RF quality index is the overall effectiveness of the RF environment as a percentage of the connect rate in both directions, as well as the retry and error rate. This area also lists the worst 5 performing radios in the RF Domain.

The RF Quality Index can be interpreted as:

- 0-20 – Very poor quality
- 20-40 – Poor quality
- 40-60 – Average quality
- 60-100 – Good quality

- 7 Refer to the **Radio Quality** table for RF Domain member radios requiring administration to improve performance:

Worst 5 Radios	Displays five radios with the lowest average quality in the RF Domain.
Radio ID	Lists each radio's administrator defined hostname and its radio designation (radio 1, radio 2 or radio 3).
Radio Type	Displays the radio type as either 5 GHz or 2.4 GHz.

- 8 Refer to the **Client Quality** table for RF Domain connected clients requiring administration to improve performance:

Worst 5 Clients	Displays the five clients having the lowest average quality indices.
Client MAC	Displays the hardcoded radio MAC of the wireless client.
Vendor	Displays the vendor name of the wireless client.

- 9 Refer to the **WLAN Utilization** field to assess the following:

Total WLANs	Displays the total number of WLANs managed by RF Domain member Access Points.
Top 5	Displays the five RF Domain utilized WLANs with the highest average quality indices.
WLAN Name	Displays the WLAN Name for each of the Top 5 WLANs in the Access Point RF Domain.
SSID	Lists the SSD utilized by each listed top 5 performing RF Domain WLANs.

- 10 The **Radio Traffic Utilization** area displays the following:

Max. User Rate	Displays the maximum recorded user rate in kbps.
Top 5 Radios	Displays five radios with the best average quality in the RF Domain.
Radio ID	Lists each radio's administrator defined hostname and its radio designation (radio 1, radio 2 or radio 3).
Radio Type	Displays the radio type as either 5 GHz or 2.4 GHz.

- 11 Refer to the **Client Traffic Utilization** table:

Top 5 Clients	Displays the five clients having the highest average quality indices.
Client MAC	Displays the client's hardcoded MAC address used a hardware identifier.
Vendor	Lists each client's manufacturer.

- 12 The **Wireless Security** area indicates the security of the transmission between WLANs and the wireless clients they support. This value indicates the vulnerability of the WLANs.

RF Domain Threat Level	Indicates the threat from the wireless clients trying to find network vulnerabilities within the Access Point RF Domain. The threat level is represented by an integer.

Rogue APs	Lists the number of unauthorized Access Points detected by RF Domain member devices.
WIPS Events	Lists the number of WIPS events generated by RF Domain member devices.

13 The **Traffic Statistics** statistics table displays the following information for transmitted and received packets:

Total Bytes	Displays the total bytes of data transmitted and received within the Access Point RF Domain.
Total Packets	Lists the total number of data packets transmitted and received within the Access Point RF Domain.
User Data Rate	Lists the average user data rate within the Access Point RF Domain.
Bcast/Mcast Packets	Displays the total number of broadcast/multicast packets transmitted and received within the Access Point RF Domain.
Management Packets	This is the total number of management packets processed within the Access Point RF Domain.
Tx Dropped Packets	Lists total number of dropped data packets within the Access Point RF Domain.
Rx Errors	Displays the number of errors encountered during data transmission within the Access Point RF Domain. The higher the error rate, the less reliable the connection or data transfer.

14 The **SMART RF Activity** area displays the following:

Time Period	Lists the time period when Smart RF calibrations or adjustments were made to compensate for radio coverage holes or interference.
Power Changes	Displays the total number of radio transmit power changes that have been made using SMART RF within the Access Point RF Domain.
Channel Changes	Displays the total number of radio transmit channel changes that have been made using SMART RF within the Access Point RF Domain.
Coverage Changes	Displays the total number of radio coverage area changes that have been made using SMART RF within the Access Point RF Domain.

15.2.2 Inventory

► RF Domain Statistics

The *Inventory* screen displays an inventory of RF Domain member Access Points, connected wireless clients, wireless LAN utilization and radio availability.

To display RF Domain inventory statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Inventory** from the RF Domain menu.

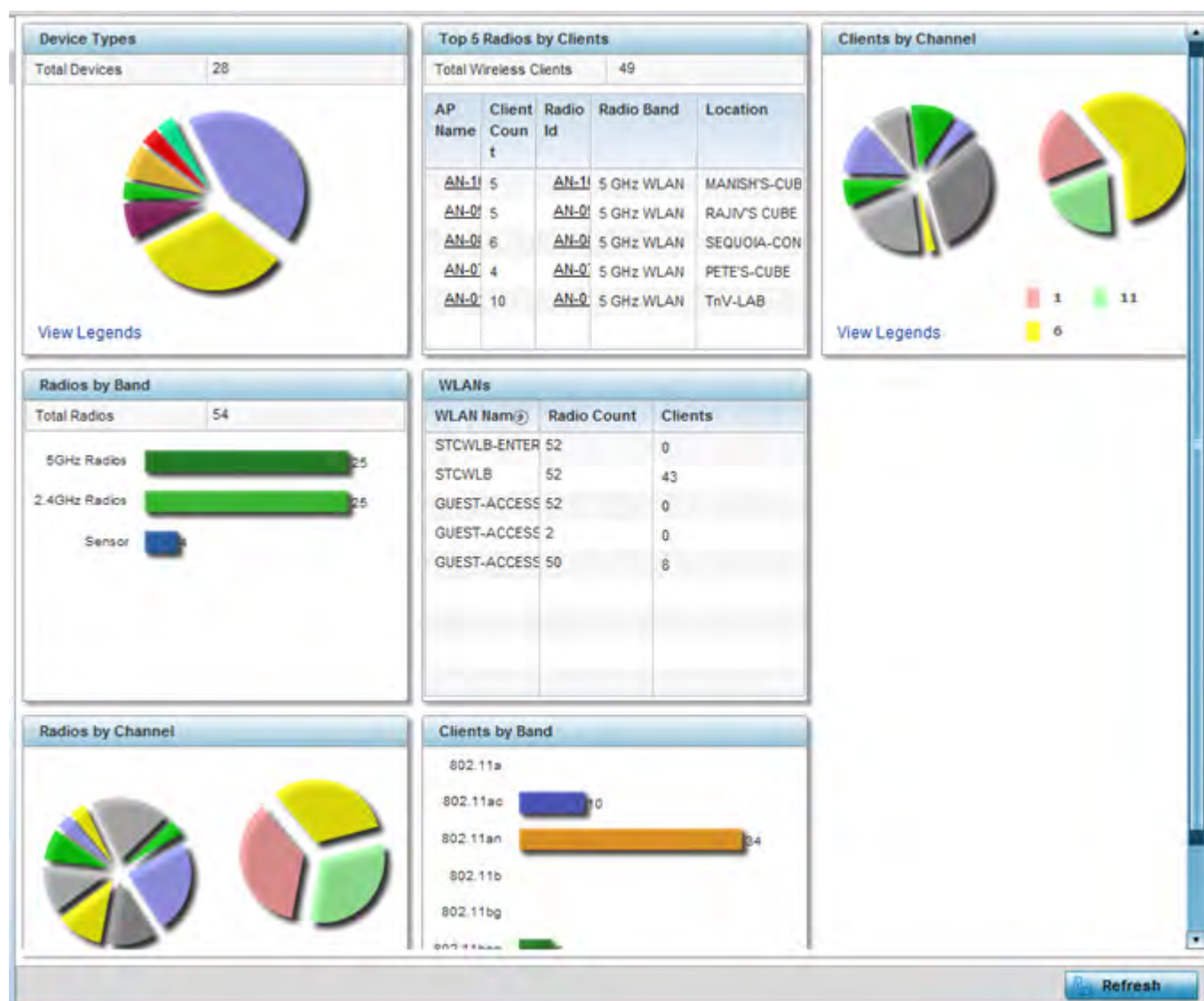


Figure 15-11 RF Domain - Inventory screen

- The **Device Types** table displays the total members in the RF Domain. The exploded pie chart depicts the distribution of RF Domain members by controller and Access Point model type.
- The **Radios by Band** field displays the total number of radios using 802.11an and 802.11bgn bands within the RF Domain. The number of radios designated as sensors is also represented.
- The **Radios by Channel** field displays the radio channels utilized by RF Domain member devices in two separate charts. One chart displays for 5 GHz channels and the other for 2.4 GHz channels.
- The **Top 5 Radios by Clients** table displays the highest 5 performing wireless clients connected to RF Domain members.

Total Wireless Clients	Displays the total number of clients connected to RF Domain members.
AP Name	Displays the clients connected and reporting Access Point. The name displays as a link that can be selected to display Access Point data in greater detail.

Client Count	List the number of connected clients to each listed RF Domain member Access Point.
Radio Id	Lists each radio's administrator defined hostname and its radio designation (radio 1, radio 2 etc.). The name displays as a link that can be selected to display Access Point data in greater detail.
Radio Band	Lists each client's operational radio band.
Location	Displays system assigned deployment location for the client.

- 8 Refer to the **WLANs** table to review RF Domain WLAN, radio and client utilization. Use this information to help determine whether the WLANs within this RF Domain have an optimal radio and client utilization.
- 9 The **Clients by Band** bar graph displays the total number of RF Domain member clients by their IEEE 802.11 radio type.
- 10 The **Clients by Channel** pie charts displays the channels used by RF Domain member clients using 5GHz and 2.4GHz radios.
- 11 Periodically select **Refresh** to update the contents of the screen to their latest values.

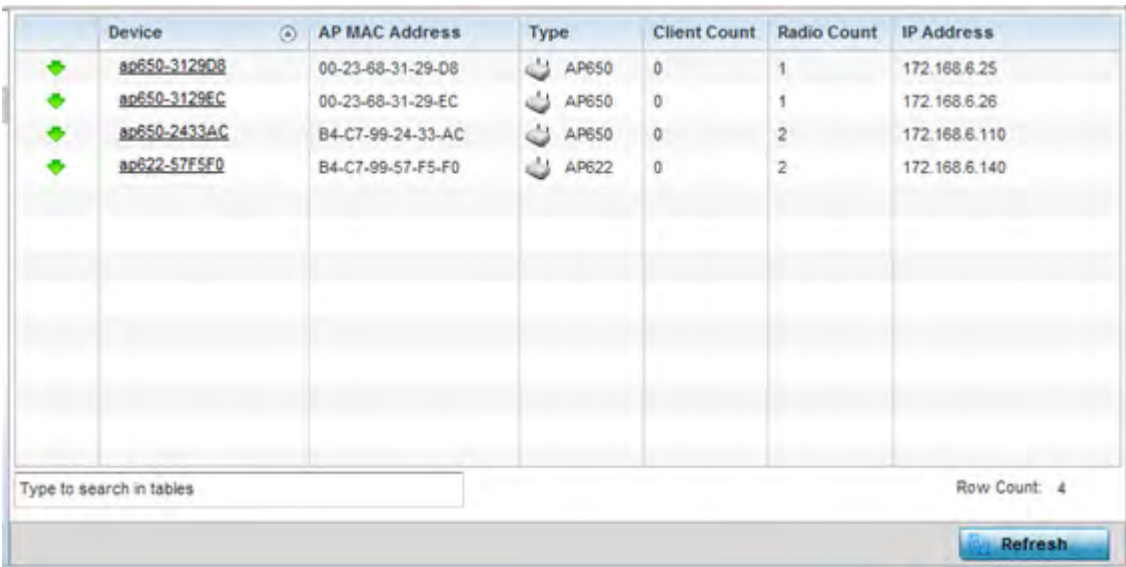
15.2.3 Devices

▶ *RF Domain Statistics*

The **Devices** screen displays RF Domain member hardware data, connected client counts, radio data and network IP address.

To display RF Domain member device statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Devices** from the RF Domain menu.



Device	AP MAC Address	Type	Client Count	Radio Count	IP Address
ap650-3129D8	00-23-68-31-29-D8	AP650	0	1	172.168.6.25
ap650-3129EC	00-23-68-31-29-EC	AP650	0	1	172.168.6.26
ap650-2433AC	B4-C7-99-24-33-AC	AP650	0	2	172.168.6.110
ap622-57F5F0	B4-C7-99-57-F5-F0	AP622	0	2	172.168.6.140

Type to search in tables

Row Count: 4

Refresh

Figure 15-12 RF Domain - Devices screen

Device	Displays the system assigned name of each device that's a member of the RF Domain. The name displays as a link that can be selected to display configuration and network address information in greater detail.
AP MAC Address	Displays each device's factory encoded MAC address as its hardware identifier.
Type	Displays each device model within the selected RF Domain.
Client Count	Displays the number of clients connected with each listed device. Supported Access Point models support up to 256 clients per Access Point, with the exception of AP6521 model, which only supports 128.
Radio Count	Displays the number of radios on each listed device.
IP Address	Displays the IP address each listed device is using as a network identifier.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.4 AP Detection

► RF Domain Statistics

The *AP Detection* screen displays information about detected Access Points that are not members of a RF Domain. They could be authorized devices or potential rogue devices.

To view device information on detected Access Points:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **AP Detection** from the RF Domain menu.

Select AP Type: All

MAC Address	Channel	SSID	First Seen	Top Reporter Hostname	Vendor	Vlan	RSSI	Is Interferer	Is Rogue	Termination Active
00-11-3F-DE-A	11	checksum	25m 15s	ap6532-345i	Alcatel-Luce	NA	-64 dB	✓	✗	✗
00-11-3F-DE-A	149	starttest1	25m 15s	ap6532-345i	Alcatel-Luce	NA	-59 dB	✓	✗	✗
00-11-3F-DE-B	149	testvianwimod	25m 15s	ap6532-345i	Alcatel-Luce	NA	-61 dB	✓	✗	✗
00-11-3F-DE-B	149	test-rohini	25m 16s	ap6532-345i	Alcatel-Luce	NA	-73 dB	✓	✗	✗
00-11-3F-DE-B	6	traffic_shaping	21m 56s	ap6532-345i	Alcatel-Luce	NA	-78 dB	✗	✗	✗
00-11-3F-DE-B	149	ipsectest1	25m 15s	ap6532-345i	Alcatel-Luce	NA	-60 dB	✓	✗	✗
00-11-3F-E3-2i	149	SR7750	25m 16s	ap6532-345i	Alcatel-Luce	NA	-70 dB	✓	✗	✗
00-11-3F-E3-4i	100	traffic_shaping	25m 11s	ap6532-345i	Alcatel-Luce	NA	-60 dB	✓	✗	✗
00-14-C2-AB-F	153	aaa	23m 37s	ap6532-345i	Hewlett Pack	NA	-44 dB	✓	✗	✗
00-15-70-AE-3	6	M-Wireless	23m 37s	ap6532-345i	Zebra Tech	NA	-61 dB	✓	✗	✗

Type to search in tables

Row Count: 350

[Terminate](#)
[Clear All](#)
[WIPS Report](#)
[Refresh](#)

Figure 15-13 RF Domain - AP Detection screen

The **AP Detection** screen displays the following:

MAC Address	Displays the hardware encoded MAC address of each listed Access Point detected by a RF Domain member device. The MAC address is set at the factory and cannot be modified via the management software. The MAC address displays as a link that can be selected to display RF Domain member device information in greater detail.
Channel	Displays the channel of operation used by the detected Access Point. The channel must be utilized by both the Access Point and its connected client and be approved for the target deployment country.
SSID	Displays the <i>Service Set ID</i> (SSID) of the network to which the detected Access Point belongs.
First Seen	Provides a timestamp when the detected Access Point was first detected by a RF Domain member device.
Top Reporter Hostname	Lists the administrator assigned hostname of the top performing RF Domain member detecting the listed Access Point MAC address. Consider this top performer the best resource for information on the detected Access Point and its potential threat.
Vendor	Lists the manufacturer of the detected Access Point as an additional means of assessing its potential threat to the members of this RF Domain and its potential for interoperability with RF Domain device members.
VLAN	Lists the numeric VLAN ID (virtual interface) the detected Access Point was detected on by members of this RF Domain.
RSSI	Displays the <i>Received Signal Strength Indicator</i> (RSSI) of the detected Access Point. Use this variable to help determine whether a device connection would improve network coverage or add noise.
Is Interferer	Lists whether the detected device exceeds the administrator defined RSSI threshold (from -100 to -10 dBm) determining whether a detected Access Point is classified as an interferer.

Is Rogue	Displays whether the detected device has been classified as a rogue device whose detection threatens the interoperation of RF Domain member devices.
Termination Active	Lists whether Air Termination is active and applied to the detected Access Point. Air termination lets you terminate the connection between your wireless LAN and any Access Point or client associated with it. If the device is an Access Point, all clients dis-associated with the Access Point. If the device is a client, its connection with the Access Point is terminated. Air Termination is disabled by default.
Terminate	Select the <i>Terminate</i> button to remove the selected Access Point from RF Domain membership.
Clear All	Select <i>Clear All</i> to reset the statistics counters to zero and begin a new data collection.
WIPS Report	Select <i>WIPS Report</i> launch a subscreen to save a WIPS report (in PDF format) to a specified location. This is a recommended practice to capture RF Domain member Access Point client connection terminations in a format that can be archived externally.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.5 Wireless Clients

► RF Domain Statistics

The *Wireless Clients* screen displays device information for wireless clients connected to RF Domain member Access Points. Review this content to determine whether a client should be removed from Access Point association within the selected RF Domain.

To review a RF Domain's connected wireless clients:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Wireless Clients** from the RF Domain menu.

VLAN	Displays the VLAN ID the client's connected Access Point has defined for use as a virtual interface.
Last Active	Displays the time when this wireless client was last detected by a RF Domain member.
RF Domain Name	Lists each client's RF Domain membership as defined by its connected Access Point and associated controller or service platform.
Disconnect All Clients	Select the <i>Disconnect All Clients</i> button to terminate each listed client's connection and RF Domain membership.
Disconnect Client	Select a specific client MAC address and select the <i>Disconnect Client</i> button to terminate this client's connection and RF Domain membership.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.6 Device Upgrade

► RF Domain Statistics

The *Device Upgrade* screen reports information about devices receiving updates the RF Domain member provisioning the device. Use this screen to assess version data and upgrade status.

To view wireless device upgrade data for RF Domain members:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Device Upgrade** from the RF Domain menu.

Upgraded By	Type	Device Hostname	History Id	Last Update Status	Time Last Upgraded	Retries Count	State
ap6532-34503C	ap6532	ap6532-A6572C	5C-0E-8B-34-50-3	-	Fri Oct 4 2013 02:24:05 AM	0	done
ap6532-34503C	ap6532	ap6532-A6572C	5C-0E-8B-34-50-3	Reboot failed, re	Fri Nov 2 2012 05:39:37 AM	1	done
ap6532-34503C	ap6532	ap6532-3118E0	5C-0E-8B-34-50-3	-	Fri Nov 2 2012 05:29:31 AM	0	done
ap6532-34503C	ap6532	ap6532-A65738	5C-0E-8B-34-50-3	-	Tue Aug 28 2012 02:39:53 AM	0	done
ap6532-34503C	ap6532	ap6532-3118E0	5C-0E-8B-34-50-3	-	Tue Aug 28 2012 02:39:41 AM	0	done
ap6532-34503C	ap6532	ap6532-A65724	5C-0E-8B-34-50-3	-	Sun Aug 26 2012 04:51:35 AM	0	done
ap6532-34503C	ap6532	ap6532-3118E0	5C-0E-8B-34-50-3	-	Sun Aug 26 2012 04:50:26 AM	0	done
ap6532-34503C	ap6532	ap6532-A65724	5C-0E-8B-34-50-3	-	Fri Aug 24 2012 05:32:42 AM	0	done
ap6532-34503C	ap6532	ap6532-3118E0	5C-0E-8B-34-50-3	-	Fri Aug 24 2012 05:32:19 AM	0	done
ap6532-34503C	ap6532	ap6532-3118E0	5C-0E-8B-34-50-3	-	Fri Aug 24 2012 04:06:22 AM	0	done no-reboot
ap6532-34503C	ap6532	ap6532-A65724	5C-0E-8B-34-50-3	-	Fri Aug 24 2012 04:06:10 AM	0	done no-reboot
ap6532-34503C	ap6532	ap6532-A6572C	5C-0E-8B-34-50-3	-	Fri Aug 24 2012 03:37:29 AM	0	done

Type to search in tables

Row Count: 58

Clear History Refresh

Figure 15-15 RF Domain - Device Upgrade screen

The **Device Upgrade** screen displays the following for RF Domain member devices:

Upgraded By	Lists the name of the device performing an update on behalf of a RF Domain member peer device.

Type	Displays the model of the device receiving an update. An updating Access Point must be of the same model as the Access point receiving the update.
Device Hostname	Lists the administrator assigned hostname of each device receiving an update from a RF Domain member.
History Id	Lists the RF Domain member device's MAC address along with a history ID appended to it for each upgrade operation.
Last Update Status	Displays the last status message from the RF Domain member device performing the upgrade operation.
Time Last Upgrade	Displays a timestamp for the last successful upgrade.
Retries Count	Lists the number of retries needed for each listed RF Domain member update operation.
State	Lists whether the upgrade operation is completed, in-progress, failed or whether an update was made without a device reboot.
Clear History	Select <i>Clear History</i> to remove the upgrade records for RF Domain member devices. Unlike the Refresh function (that updates existing data), Clear History removes the update record from the screen.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.7 Wireless LANs

► RF Domain Statistics

The *Wireless LANs* screen displays the name, network identification and radio quality information for the WLANs currently being utilized by RF Domain members.

To view wireless LAN statistics for RF Domain members:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Wireless LANs** from the RF Domain menu.

	WLAN Name	SSID	Traffic Index	Radio Count	Tx Bytes	Tx User Data Rate	Rx Bytes	Rx User Data Rate
+	11Dtest	11Dtest	0 (Very Low)	2	0	0 kbps	0	0 kbps
+	RF1WLAN2	RF1WLAN2	0 (Very Low)	2	0	0 kbps	0	0 kbps
+	RF1WLANEXT	RF1EXT	0 (Very Low)	2	0	0 kbps	0	0 kbps

Type to search in tables

Row Count: 3

Disconnect All Clients Refresh

Figure 15-16 RF Domain - Wireless LANs screen

The **Wireless LANs** screen displays the following:

WLAN Name	Displays the name assigned to each WLAN upon its creation within the controller or service platform managed network.
SSID	Displays the <i>Service Set ID</i> (SSID) assigned to the WLAN upon its creation within the controller or service platform managed network.
Traffic Index	Displays the traffic utilization index of each listed WLAN, which measures how efficiently the traffic medium is used. It's defined as the percentage of current throughput relative to the maximum possible throughput. Traffic indices are: 0 – 20 (very low utilization), 20 – 40 (low utilization), 40 – 60 (moderate utilization), and 60 and above (high utilization).
Radio Count	Displays the number of radios deployed in each listed WLAN by RF Domain member devices.
Tx Bytes	Displays the average number of packets (in bytes) sent on each listed RF Domain member WLAN.
Tx User Data Rate	Displays the average data rate per user for packets transmitted on each listed RF Domain member WLAN.
Rx Bytes	Displays the average number of packets (in bytes) received on each listed RF Domain member WLAN.
Rx User Data Rate	Displays the average data rate per user for packets received on each listed RF Domain member WLAN.
Disconnect All Clients	Select the <i>Disconnect All Clients</i> button to terminate each listed client's WLAN membership from this RF Domain.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.8 Radios

► RF Domain Statistics

The **Radio** screens displays information on RF Domain member Access Point radios. Use these screens to troubleshooting radio issues negatively impacting RF Domain performance.

For more information, refer to the following:

- [Status](#)
- [RF Statistics](#)
- [Traffic Statistics](#)

15.2.8.1 Status

To view the RF Domain radio statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Expand **Radios** from the RF Domain menu and select **Status**.

Radio	Radio MAC	Radio Type	Access Point	AP Type	State	Channel Current(Config)	Power Current(Config)	Clients
ap6532-34503C-R1	5C-0E-8B-21-	2.4 GHz WLA	ap6532-34503C-R1	AP6532	On	6 (smt)	10 (smt)	0
ap6532-34503C-R2	5C-0E-8B-21-	5 GHz WLAN	ap6532-34503C-R2	AP6532	On	60w (smt)	17 (smt)	0
ap6532-A65724-R1	5C-0E-8B-C3-	2.4 GHz WLA	ap6532-A65724-R1	AP6532	On	1 (smt)	10 (smt)	0
ap6532-A65724-R2	5C-0E-8B-C3-	5 GHz WLAN	ap6532-A65724-R2	AP6532	On	44w (smt)	23 (smt)	1
ap6532-A65738-R1	5C-0E-8B-C3-	2.4 GHz WLA	ap6532-A65738-R1	AP6532	On	11 (smt)	10 (smt)	0
ap6532-A65738-R2	5C-0E-8B-C3-	5 GHz WLAN	ap6532-A65738-R2	AP6532	On	52w (smt)	17 (smt)	0

Type to search in tables Row Count: 6

[Refresh](#)

Figure 15-17 RF Domain - Radio Status screen

The **Radio Status** screen displays the following:

Radio	Displays the name assigned to each listed RF Domain member Access Point radio. Each name displays as a link that can be selected to display radio information in greater detail.
Radio MAC	Displays the MAC address as a numerical value factory hardcoded to each listed RF Domain member Access Point radio.
Radio Type	Defines whether the radio is operating within the 2.4 or 5 GHz radio band.
Access Point	Displays the user assigned name of the RF Domain member Access Point to which the radio resides.
AP Type	Lists the model type of each RF Domain member Access Point.
State	Displays the radio's current operational state.

Channel Current (Config)	Displays the current channel each listed RF Domain member Access Point radio is broadcasting on.
Power Current (Config)	Displays the current power level the radio is using for its transmissions.
Clients	Displays the number of clients currently connected to each listed RF Domain member Access Point radio. Supported models can manage up to 256 clients per radio.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.8.2 RF Statistics

To view the RF Domain radio statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Expand **Radios** from the RF Domain menu and select **RF Statistics**.

Radio	Signal	Noise	SNR	Tx Physical Layer Rate	Rx Physical Layer Rate	Avg. Retry Number	Error Rate	RF Quality Index
ap8132-738E2C.R1	N/A	-102 dbm	N/A	0 Mbps	0 Mbps	0	0 pps	(Off)
ap8132-738E2C.R2	N/A	-98 dbm	N/A	0 Mbps	0 Mbps	0	1 pps	100 (Good)
ap81xx-711630.R1	N/A	-94 dbm	N/A	0 Mbps	0 Mbps	0	16 pps	100 (Good)
ap81xx-711630.R2	N/A	-96 dbm	N/A	0 Mbps	17 Mbps	0	2 pps	100 (Good)
ap8232-7F0DE4.R1	N/A	-102 dbm	N/A	0 Mbps	0 Mbps	0	0 pps	(Off)
ap8232-7F0DE4.R2	N/A	0 dbm	N/A	0 Mbps	0 Mbps	0	0 pps	(Off)

Type to search in tables Row Count: 6

Refresh

Figure 15-18 RF Domain - Radio RF Statistics screen

The **RF Statistics** screen displays the following:

Radio	Displays the name assigned to each listed RF Domain member radio. Each name displays as a link that can be selected to display radio information in greater detail.
Signal	Displays the power of listed RF Domain member radio signals in dBm.
Noise	Lists the level of noise (in - X dbm format) reported by each listed RF Domain member Access Point.
SNR	Displays the <i>signal to noise ratio</i> (SNR) of each listed RF Domain member radio.
Tx Physical Layer Rate	Displays the data transmit rate for each RF Domain member radio's physical layer. The rate is displayed in Mbps.

Rx Physical Layer Rate	Displays the data receive rate for each RF Domain member radio's physical layer. The rate is displayed in Mbps.
Avg Retry Number	Displays the average number of retries for each RF Domain member radio.
Error Rate	Displays the average number of retries per packet. A high number indicates possible network or hardware problems.
RF Quality Index	Displays an integer (and performance icon) that indicates the overall RF performance for each listed radio. The RF quality indices are: 0 - 50 (Poor) 50 - 75 (Medium) 75 - 100 (Good)
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.8.3 Traffic Statistics

The **Traffic Statistics** screen displays transmit and receive data as well as data rate and packet drop and error information for RF Domain member radios. Individual RF Domain member radios can be selected and to information specific to that radio as troubleshoot requirements dictate.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Expand **Radios** from the RF Domain menu and select **Traffic Statistics**.

Radio	Tx Bytes	Rx Bytes	Tx Packets	Rx Packets	Tx User Data Rate	Rx User Data Rate	Tx Dropped	Traffic Index
ap6532-34776C-R2	0	0	4,659	11,696,011	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347800-R1	0	0	14	29,780,817	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347800-R2	0	0	25,676	5,713,869	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347830-R1	0	0	0	20,684,459	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347830-R2	0	0	2,852	9,430,729	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347854-R1	0	0	0	26,455,429	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347854-R2	0	0	16,400	11,290,166	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347B7C-R1	0	0	0	28,106,250	0 kbps	0 kbps	0	0 (Very Lo)
ap6532-347B7C-R2	0	0	1,311	23,108,674	0 kbps	0 kbps	0	0 (Very Lo)
ap7131-135884-R1	0	0	0	0	0 kbps	0 kbps	0	(Off)
ap7131-135884-R2	0	0	0	0	0 kbps	0 kbps	0	(Off)
ap7502-BC1340-R1	0	0	15,214	12,337,344	0 kbps	0 kbps	0	0 (Very Lo)
ap7502-BC1340-R2	0	0	0	0	0 kbps	0 kbps	0	0 (Very Lo)
ap7532-1601A8-R1	0	0	15,959	22,728,619	0 kbps	0 kbps	14,917	0 (Very Lo)

Type to search in tables

Row Count: 36

Refresh

Figure 15-19 RF Domain - Radio Traffic Statistics screen

The **Radio Traffic** screen displays the following:

Radio	Displays the name assigned to each listed RF Domain member Access Point radio. Each name displays as a link that can be selected to display radio information in greater detail.

Tx Bytes	Displays the total number of bytes transmitted by each RF Domain member Access Point radio. This includes all user data as well as any management overhead data.
Rx Bytes	Displays the total number of bytes received by each RF Domain member Access Point radio. This includes all user data as well as any management overhead data.
Tx Packets	Displays the total number of packets transmitted by each RF Domain member Access Point radio. This includes all user data as well as any management overhead packets.
Rx Packets	Displays the total number of packets received by each RF Domain member Access Point radio. This includes all user data as well as any management overhead packets.
Tx User Data Rate	Displays the rate (in kbps) user data is transmitted by each RF Domain member Access Point radio. This rate only applies to user data and does not include any management overhead.
Rx User Data Rate	Displays the rate (in kbps) user data is received by each RF Domain member Access Point radio. This rate only applies to user data and does not include any management overhead.
Tx Dropped	Displays the total number of transmitted packets which have been dropped by each RF Domain member Access Point radio. This includes all user data as well as any management overhead packets that were dropped.
Traffic Index	Displays the traffic utilization index of RF Domain member Access Point radios, which measures how efficiently the traffic medium is utilized within this RF Domain. It's defined as the percentage of current throughput relative to the maximum possible throughput. Traffic indices are: 0 – 20 (very low utilization), 20 – 40 (low utilization), 40 – 60 (moderate utilization) and 60 and above (high utilization).
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.9 Bluetooth

► RF Domain Statistics

AP-8432 and AP-8533 model Access Points utilize a built in Bluetooth chip for specific Bluetooth functional behaviors in a WiNG managed network. AP-8432 and AP-8533 models support both Bluetooth *classic* and Bluetooth *low energy* technology. These platforms can use their Bluetooth classic enabled radio to sense other Bluetooth enabled devices and report device data (MAC address, RSSI and device calls) to an ADSP server for intrusion detection. If the device presence varies in an unexpected manner, ADSP can raise an alarm.

AP-8432 and AP-8533 model Access Points support Bluetooth beaconing to emit either iBeacon or Eddystone-URL beacons. The Access Point's Bluetooth radio sends non-connectable, undirected *low-energy* (LE) advertisement packets on a periodic basis. These advertisement packets are short, and sent on Bluetooth advertising channels that conform to already-established iBeacon and Eddystone-URL standards.

To view Bluetooth radio statistics for RF Domain member Access Points:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.

3 Select **Bluetooth**.



Figure 15-20 RF Domain - Bluetooth screen

The RF Domain **Bluetooth** screen displays the following:

Name	Lists the name of the Access Point's Bluetooth radio.
Alias	If an alias has been defined for the Access Point its listed here. The alias value is expressed in the form of <hostname>: B<Bluetooth_radio_number>. If the administrator has defined a hostname for the Access Point, it's used in place of the Access Point's default hostname.
Radio State	Displays the current operational state (On/Off) of the Bluetooth radio.
Off Reason	If the Bluetooth radio is offline, this field states the reason.
Radio MAC	Lists the Bluetooth radio's factory encoded MAC address serving as this device's hardware identifier on the network.
Hostname	Lists the hostname set for the Access Point as its network identifier.
Device MAC	Lists the Access Point's factory encoded MAC address serving as this device's hardware identifier on the network.
AP Location	Lists the Access Point's administrator assigned deployment location.
Radio Mode	Lists an Access Point's Bluetooth radio functional mode as either <i>bt-sensor</i> or <i>le-beacon</i> .
Beacon Period	Lists the Bluetooth radio's beacon transmission period from 100 -10,000 milliseconds.
Beacon Type	Lists the type of beacon currently configured.
Last Error	Lists descriptive text on any error that's preventing the Bluetooth radio from operating.
Refresh	Select <i>Refresh</i> to update the screen's statistics counters to their latest values.

15.2.10 Mesh

► RF Domain Statistics

Mesh networking enables users to wirelessly access broadband applications anywhere (even in a moving vehicle). Initially developed for secure and reliable military battlefield communications, mesh technology supports public safety, public access and public works. Mesh technology reduces the expense of wide-scale networks, by leveraging Wi-Fi enabled devices already deployed.

To view Mesh statistics for RF Domain member Access Point and their connected clients:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Mesh**.

[illegible]

Figure 15-21 *RF Domain - Mesh screen*

The RF Domain **Mesh** screen displays the following:

Client	Displays the configured hostname for each mesh client connected to a RF Domain member Access Point.
Client Radio MAC	Displays the hardware encoded MAC address for each mesh client connected to a RF Domain member Access Point.
Portal	Displays a numerical portal Index ID for the each mesh client connected to a RF Domain member Access Point.
Portal Radio MAC	Displays the hardware encoded MAC address for each radio in the RF Domain mesh network.
Connect Time	Displays the total connection time for each listed client in the RF Domain mesh network.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.11 Mesh Point

► RF Domain Statistics

To view *Mesh Point* statistics for RF Domain member Access Point and their connected clients:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Mesh Point**.

The **MCX Geographical View** displays by default.

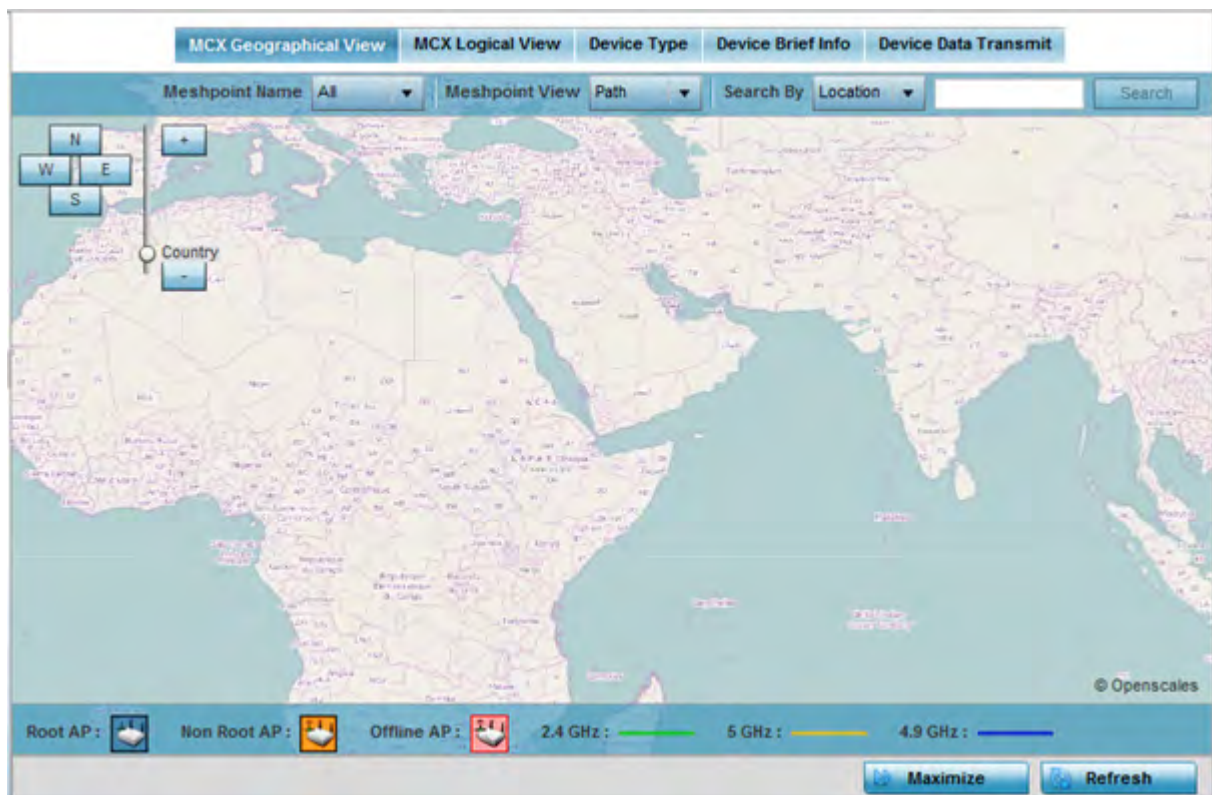


Figure 15-22 RF Domain - Mesh Point MCX Geographical View screen

The **MCX Geographical View** screen displays a map where icons of each device in the RF Domain are overlaid. This provides a geographical overview of the location of each RF Domain member device.

- 4 Use the *N*, *W*, *S* and *E* buttons to move the map in the North, West, South and East directions respectively. The slider next to these buttons enables zooming in and out of the view. The available fixed zoom levels are *World*, *Country*, *State*, *Town*, *Street* and *House*.
- 5 Use the **Maximize** button to maximize this view to occupy the complete screen. Use the **Refresh** button to update the status of the screen.
- 6 Select the **MCX Logical View** tab to view a logical representation of the Meshpoint.

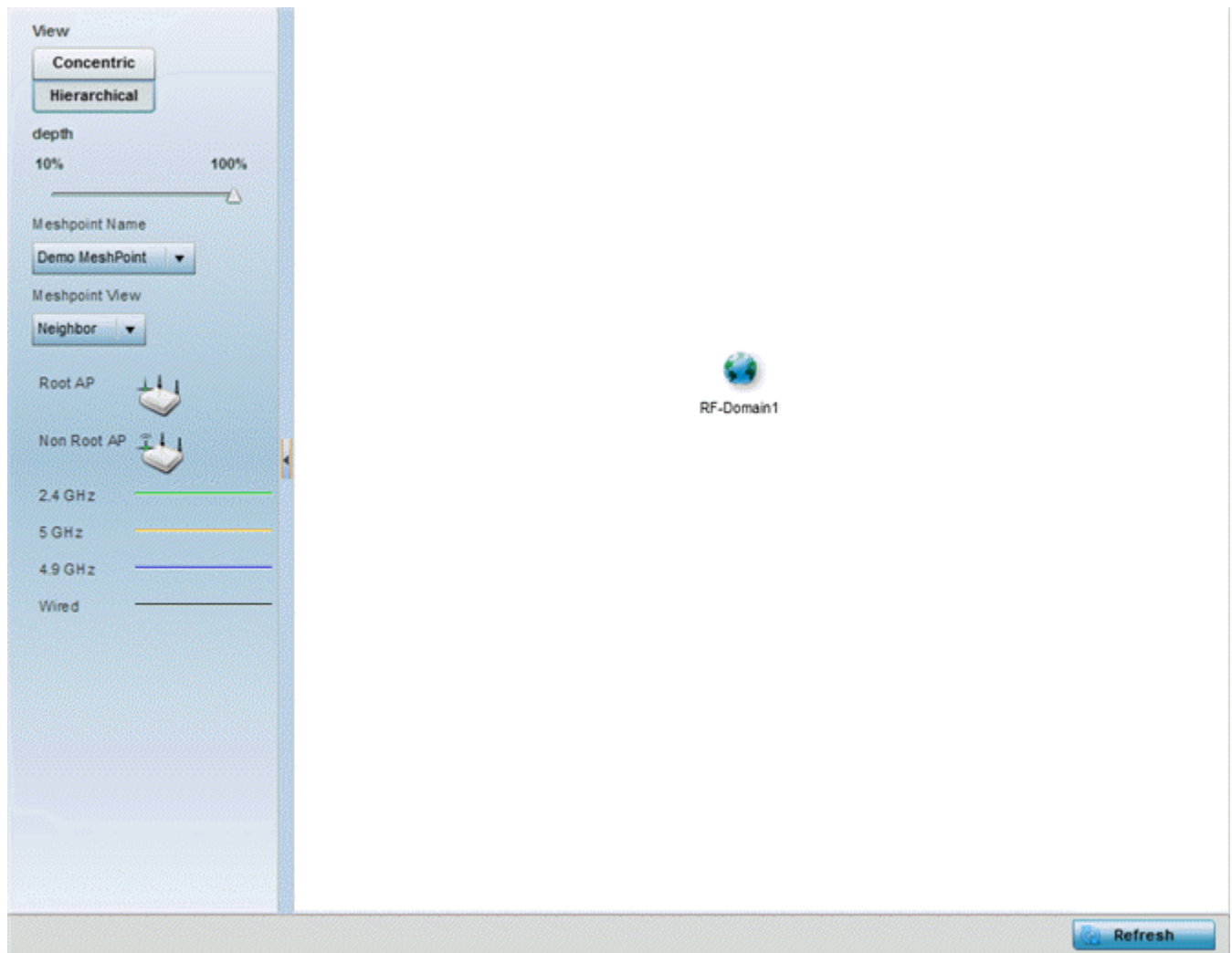


Figure 15-23 RF Domain - Mesh Point MCX Logical View screen

The **Concentric** and **hierarchical** buttons define how the mesh point is displayed in the MCX Logical View screen. In the Concentric mode, the mesh is displayed as a concentric arrangement of devices with the root mesh at the centre and the other mesh device arranged around it.

In the hierarchical arrangement, the root node of the mesh is displayed at the top of the mesh tree and the relationship of the mesh nodes are displayed as such.

Use the **Meshpoint Name** drop down to select a mesh point to see the graphical representation of that mesh point. The view can further be filtered based on the values Neighbor or Path selected in the Meshpoint View field.

- 7 Select the **Device Type** tab.

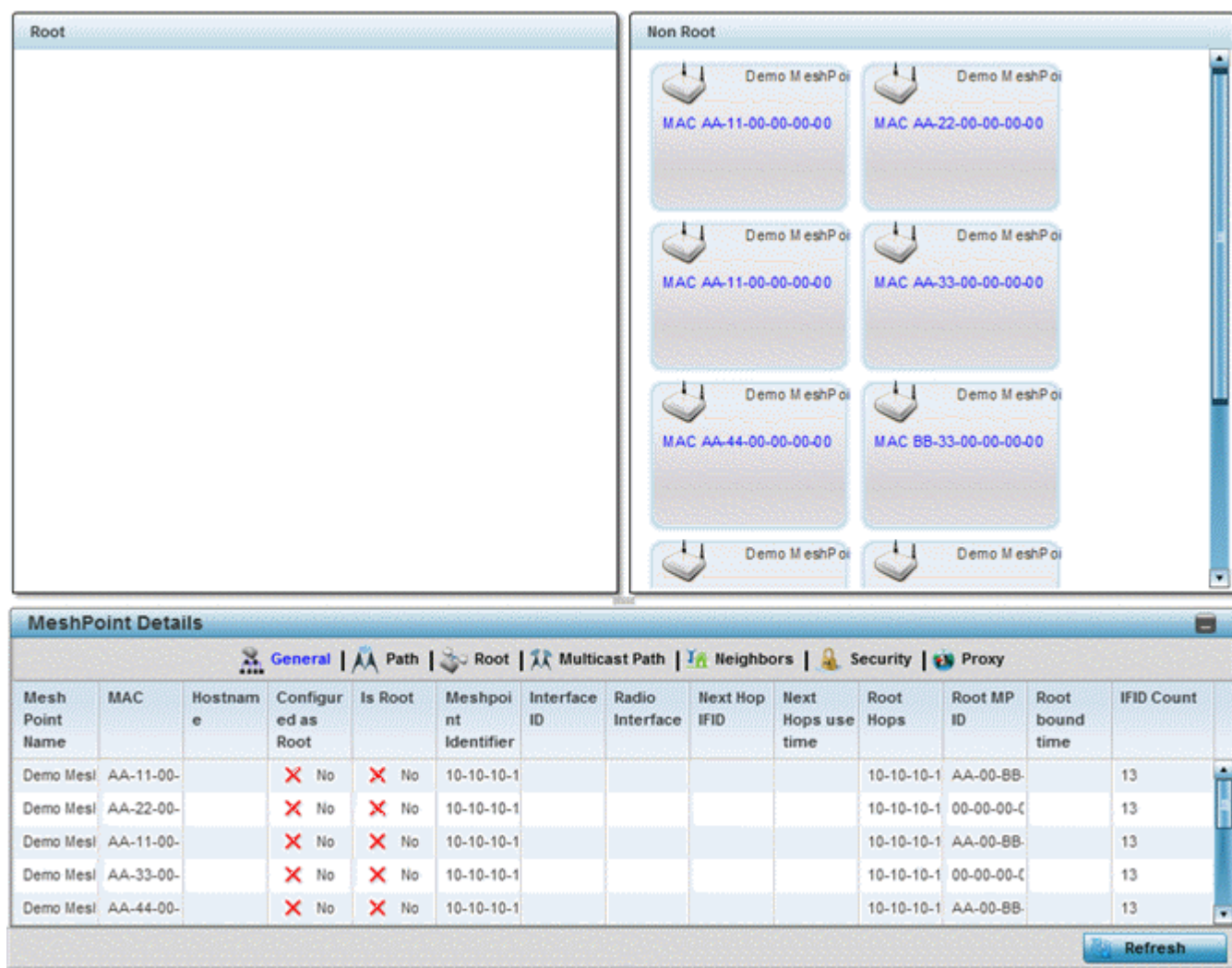


Figure 15-24 RF Domain - Mesh Point Device Type screen

The **Root** field displays the Mesh ID and MAC Address of the configured root mesh points in the RF Domain.

- 8 The **Non Root** field displays the Mesh ID and MAC Address of all configured non-root mesh points in the RF Domain.
- 9 The **Mesh Point Details** field on the bottom portion of the screen displays tabs for *General*, *Path*, *Root*, *Multicast Path*, *Neighbors*, *Security* and *Proxy*. Refer to the following:

The **General** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
MAC	Displays the MAC Address of each configured mesh point in the RF Domain.
Hostname	Displays the administrator assigned hostname for each configured mesh point in the RF Domain.
Configured As Root	Indicates whether a mesh point is configured to act as a root device. (Yes/No).
Is Root	A root mesh point is defined as a mesh point connected to the WAN and provides a wired backhaul to the network (Yes/No).

Meshpoint Identifier	The MP identifier is used to distinguish between other mesh points both on the same device and on other devices. This is used by a user to setup the preferred root configuration.
Interface ID	The IFID uniquely identifies an interface associated with the MPID. Each mesh point on a device can be associated with one or more interfaces.
Radio Interface	Uniquely identifies the radio interface on which the Mesh Point operates.
Next Hop IFID	Lists the ID of the interface on which the next hop for the mesh network can be found.
Next Hops Use Time	Lists the time when the next hop in the mesh network topology was last utilized.
Root Hops	Number of hops to a root and should not exceed 4 in general practice. If using the same interface to both transmit and receive, then you will get approximately half the performance every additional hop out.
Root MP ID	Displays the ID of the root device for this mesh point.
Root Bound Time	Displays the duration this mesh point has been connected to the mesh root.
IFID Count	Displays the number of <i>Interface IDs</i> (IFIDs) associated with all the configured mesh points in the RF Domain.

The **Path** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Meshpoint Identifier	The identifier is used to distinguish between other mesh points both on the same device and on other devices. This is used by a user to setup the preferred root configuration.
Destination Addr	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Next Hop IFID	The Interface ID of the mesh point that traffic is being directed to.
Is Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network (Yes/No).
MiNT ID	Displays the MiNT Protocol ID for the global mint area identifier. This area identifier separates two overlapping mint networks and need only be configured if the administrator has two mint networks that share the same packet broadcast domain.
Hops	Number of hops to a root and should not exceed 4 in general practice. If using the same interface to both transmit and receive, then you will get approximately half the performance every additional hop out.
Mobility	Displays whether the mesh point is a mobile or static node. Displays <i>True</i> when the device is mobile and <i>False</i> when the device is not mobile.
Metric	A measure of the quality of the path. A lower value indicates a better path.
State	Indicates whether the path is currently Valid of Invalid.
Binding	Indicates whether the path is bound or unbound.

Timeout	The timeout interval in mili-seconds. The interpretation this value will vary depending on the value of the state.
Sequence	The sequence number also known as the destination sequence number. It is updated whenever a mesh point receives new information about the sequence number from RREQ, RREP, or RERR messages that may be received related to that destination.

The **Root** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Recommended	Displays the root that is recommended by the mesh routing layer.
Root MPID	The MP identifier is used to distinguish between other mesh points both on the same device and on other devices. This is used by a user to setup the preferred root configuration.
Next Hop IFID	The IFID of the next hop. The IFID is the MAC Address on the destination device.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Bound	Indicates whether the root is bound or unbound.
Metric	Displays the computed path metric between the neighbor and their root mesh point.
Interface Bias	This field lists any bias applied because of the Preferred Root Interface Index.
Neighbor Bias	This field lists any bias applied because of the Preferred Root Next-Hop Neighbor IFID.
Root Bias	This field lists any bias applied because of the Preferred Root MPID.

The **Multicast Path** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Subscriber Name	The identifier is used to distinguish between other mesh points both on the same device and on other devices. This is used by a user to setup the preferred root configuration.
Subscriber MPID	Lists the subscriber ID to distinguish between other mesh point neighbor devices in the RF Domain.
Group Address	Displays the MAC address used for the Group in the mesh point.
Timeout	The timeout interval in seconds. The interpretation this value will vary depending on the value of the state. If the state is Init or In Progress, the timeout duration has no significance. If the state is Enabled, the timeout duration indicates the amount of time left before the security validity check is initiated. If the state is Failed, the timeout duration is the amount of time after which the system will retry.

The **Neighbors** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.

Destination Addr	Displays the MeshID (MAC Address) of each mesh point in the RF Domain.
Neighbor MP ID	The MAC Address that the device uses to define the mesh point in the device that the neighbor is a part of. It is used to distinguish the device that is the neighbor.
Neighbor IFID	The MAC Address used by the interface on the neighbor device to communicate with this device. This may define a particular radio or Ethernet port that communicates with this device over the mesh.
Root MP ID	The MAC Address of the neighbor's root mesh point.
Is Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network. Yes if the mesh point that is the neighbor is a root mesh point or No if the mesh point that is the neighbor is not a root mesh point.
Mobility	Displays whether the Mesh Point is a mobile or static node. Displays <i>True</i> when the device is mobile and <i>False</i> when the device is not mobile.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Mesh Root Hops	The number of devices between the neighbor and its root mesh point. If the neighbor is a root mesh point, this value will be 0. If the neighbor is not a root mesh point but it has a neighbor that is a root mesh point, this value will be 1. Each mesh point between the neighbor and its root mesh point is counted as 1 hop.
Resourced	Displays whether the mesh point has been resourced or not. The Mesh Connex neighbor table can contain more neighbors than the AP supports. If the neighbor is resourced, it will take away a one of the resources for a wireless client device to be used for meshing. Displays <i>True</i> when the device is resourced and <i>False</i> when the device is not.
Link Quality	An abstract value depicting the quality of the mesh link between the device and the neighbor. The range is from 0 (weakest) to 100 (strongest).
Link Metric	This value shows the computed path metric from the device to the neighbor mesh point using this interface. The lower the number the better the possibility that the neighbor will be chosen as the path to the root mesh point.
Root Metric	The computed path metric between the neighbor and their root mesh point.

Rank	The rank is the level of importance and is used for automatic resource management. 8 - The current next hop to the recommended root. 7 - Any secondary next hop to the recommended root to has a good potential route metric. 6 - A next hop to an alternate root node. 5 - A downstream node currently hopping through to get to the root. 4 - A downstream node that could hop through to get to the root, but is currently not hopping through any node (look at authentication, as this might be an issue). 3 - A downstream node that is currently hopping through a different node to get to the root, but could potentially have a better route metric if it hopped through this node. 2 - Reserved for active peer to peer routes and is not currently used. 1 - A neighbor bound to the same recommended root but does not have a potential route metric as good as the neighbors ranked 8 and 7. 0 - A neighbor bound to a different root node. -1 - Not a member of the mesh as it has a different mesh ID. All client devices hold a rank of 3 and can replace any mesh devices lower than that rank.
Age	Displays the number of milliseconds since the mesh point last heard from this neighbor.

The **Security** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Mesh Point Identifier	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Interface ID	The IFID uniquely identifies an interface associated with the MPID. Each mesh point on a device can be associated with one or more interfaces.
State	Displays the Link State for each mesh point: <i>Init</i> - indicates the link has not been established or has expired. <i>Enabled</i> - indicates the link is available for communication. <i>Failed</i> - indicates the attempt to establish the link failed and cannot be retried yet. <i>In Progress</i> - indicates the link is being established but is not yet available.
Timeout	Displays the maximum value in seconds that the link is allowed to stay in the <i>In Progress</i> state before timing out.

Keep Alive	Yes indicates that the local MP will act as a supplicant to authenticate the link and not let it expire (if possible). No indicates that the local MP does not need the link and will let it expire if not maintained by the remote MP.

The **Proxy** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Destination Addr	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Proxy Address	Displays the MAC Address of the proxy used in the mesh point.
Age	Displays the age of the proxy connection for each of the mesh points in the RF Domain.
Proxy Owner	The owner's (MPID) is used to distinguish the neighbor device.
Persistence	Displays the persistence (duration) of the proxy connection for each of the mesh points in the RF Domain.
VLAN	The VLAN ID used as a virtual interface with this proxy. A value of 4095 indicates that there is no VLAN ID.

10 Select the **Device Brief Info** tab from the top of the screen.

The Device Brief Info screen is divided into 2 fields, **All Roots and Mesh Points** and **MeshPoint Details**.

All Roots and Mesh Points							
MAC	Mesh Point Name	Hostname	Configured as Root	Is Root	Meshpoint Identifier	Root Hops	IFID Count
AA-11-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-AA-	10-10-10-10-11-11	13
AA-22-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-11-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-33-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-44-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
BB-33-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-11-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-33-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
AA-55-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
BB-33-00-00-00-00	Demo MeshPoint		✗ No	✗ No	10-10-10-10-10-AA-	10-10-10-10-11-11	13
RowCount: 10							

MeshPoint Details											
AA-11-00-00-00-00		Hostname		General		Path		Root		Multicast Path	
										Neighbors	
										Security	
										Proxy	
Mesh Point Name	MAC	Hostname	Configured as Root	Is Root	Meshpoint Identifier	Next Hop IFID	Next Hops use time	Root Hops	Root MP ID	Root bound time	IFID Count
Demo MeshP	AA-11-00-00		✗ No	✗ No	10-10-10-10-			10-10-10-10-	AA-00-BB-1		13
Demo MeshP	AA-22-00-00		✗ No	✗ No	10-10-10-10-			10-10-10-10-	00-00-00-00-		13
Demo MeshP	AA-11-00-00		✗ No	✗ No	10-10-10-10-			10-10-10-10-	AA-00-BB-1		13
Refresh											

Figure 15-25 RF Domain - Mesh Point Device Brief Info screen

The **All Roots and Mesh Points** field displays the following:

MAC	Displays the MAC Address of each configured mesh point in the RF Domain.
Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Hostname	Displays the administrator assigned hostname for each configured mesh point in the RF Domain.
Configured as Root	A root mesh point is defined as a mesh point connected to the WAN, providing a wired backhaul to the network (Yes/No).
Is Root	Indicates whether the current mesh point is a root meshpoint (Yes/No).
Destination Addr	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Root Hops	The number of devices between the selected mesh point and the destination device.
IFID Count	Displays the number of Interface IDs (IFIDs) associated with all the configured mesh points in the RF Domain.

- 11 The **MeshPoint Details** field on the bottom portion of the screen displays tabs for *General*, *Path*, *Root*, *Multicast Path*, *Neighbors*, *Security* and *Proxy*. Refer to the following:

The **General** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
MAC	Displays the MAC Address of each configured mesh point in the RF Domain.
Hostname	Displays the hostname for each configured mesh point in the RF Domain.
Configured as Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network (Yes/No).
Is Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network (Yes/No).
Mesh Point Identifier	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Next Hop IFID	Identifies the ID of the interface on which the next hop for the mesh network can be found.
Next Hops Use Time	Lists the time when the next hop in the mesh network topology was last utilized.
Root Hops	Number of hops to a root and should not exceed 4 in general practice. If using the same interface to both transmit and receive, then you will get approximately half the performance every additional hop out.
Root MP ID	Lists the interface ID of the interface on which the next hop for the mesh network can be found.
Root Bound time	Displays the duration this mesh point has been connected to the mesh root.
IFID Count	Displays the number of <i>Interface IDs</i> (IFIDs) associated with all the configured mesh points in the RF Domain.

The **Path** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Destination Addr	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Destination	The MAC Address used by the interface on the neighbor device to communicate with this device. This may define a particular radio or Ethernet port that communicates with this device over the mesh.
Is Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network (Yes/No).
MiNT ID	Displays the MiNT Protocol ID for the global mint area identifier. This area identifier separates two overlapping mint networks and need only be configured if the administrator has two mint networks that share the same packet broadcast domain.
Next Hop IFID	The Interface ID of the mesh point that traffic is being directed to.
Hops	Number of hops to a root and should not exceed 4 in general practice. If using the same interface to both transmit and receive, then you will get approximately half the performance every additional hop out.

Mobility	Displays whether the mesh point is a mobile or static node. Displays <i>True</i> when the device is mobile and <i>False</i> when the device is not mobile.
Metric	A measure of the quality of the path. A lower value indicates a better path.
State	Indicates whether the path is currently Valid or Invalid.
Binding	Indicates whether the path is bound or unbound.
Timeout	The timeout interval in seconds. The interpretation this value will vary depending on the value of the state. If the state is Init or In Progress, the timeout duration has no significance. If the state is Enabled, the timeout duration indicates the amount of time left before the security validity check is initiated. If the state is Failed, the timeout duration is the amount of time after which the system will retry.
Sequence	The sequence number also known as the destination sequence number. It is updated whenever a mesh point receives new information about the sequence number from RREQ, RREP, or RERR messages that may be received related to that destination.

The **Root** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Recommended	Displays the root that is recommended by the mesh routing layer.
Root MPID	The MP identifier is used to distinguish between other mesh points both on the same device and on other devices. This is used by a user to setup the preferred root configuration.
Next Hop IFID	The IFID of the next hop. The IFID is the MAC Address on the destination device.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Bound	Indicates whether the root is <i>bound</i> or <i>unbound</i> .
Metric	Displays the computed path metric between the neighbor and their root mesh point.
Interface Bias	This field lists any bias applied because of the preferred root Interface Index.
Neighbor Bias	This field lists any bias applied because of the preferred root next-hop Neighbor IFID.
Root Bias	This field lists any bias applied because of the preferred root MPID.

The **Multicast Path** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Subscriber Name	Lists the subscriber name is used to distinguish between other mesh point neighbors both on the same device and on other devices.
Subscriber MPID	Lists the subscriber ID to distinguish between other mesh point neighbors both on the same device and on other devices.
Group Address	Displays the MAC address used for the Group in the mesh point.

Path Timeout	The timeout interval in seconds. The interpretation this value will vary depending on the value of the state. If the state is <i>Init</i> or <i>In Progress</i> , the timeout duration has no significance. If the state is <i>Enabled</i> , the timeout duration indicates the amount of time left before the security validity check is initiated. If the state is <i>Failed</i> , the timeout duration is the amount of time after which the system will retry.

The **Neighbors** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Mesh Point Identifier	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Neighbor MP ID	The MAC Address that the device uses to define the mesh point in the device that the neighbor is a part of. It is used to distinguish the device that is the neighbor.
Neighbor IFID	The MAC Address used by the interface on the neighbor device to communicate with this device. This may define a particular radio or Ethernet port that communicates with this device over the mesh.
Root MP ID	The mesh point ID of the neighbor's root mesh point.
Is Root	A root mesh point is defined as a mesh point that is connected to the WAN and provides a wired backhaul to the network. Yes if the mesh point that is the neighbor is a root mesh point or No if the mesh point that is the neighbor is not a root mesh point.
Mobility	Displays whether the mesh point is a mobile or static node. Displays <i>True</i> when the device is mobile and <i>False</i> when the device is not mobile.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Mesh Root Hops	The number of devices between the neighbor and its root mesh point. If the neighbor is a root mesh point, this value will be 0. If the neighbor is not a root mesh point but it has a neighbor that is a root mesh point, this value will be 1. Each mesh point between the neighbor and its root mesh point is counted as 1 hop.
Resourced	Displays whether the mesh point has been resourced or not. The Mesh Connex neighbor table can contain more neighbors than the AP supports. If the neighbor is resourced, it will take away a one of the resources for a wireless client device to be used for meshing. Displays <i>True</i> when the device is resourced and <i>False</i> when the device is not.
Link Quality	An abstract value depicting the quality of the mesh link between the device and the neighbor. The range is from 0 (weakest) to 100 (strongest).
Link Metric	This value shows the computed path metric from the device to the neighbor mesh point using this interface. The lower the number the better the possibility that the neighbor will be chosen as the path to the root mesh point.
Root Metric	The computed path metric between the neighbor and their root mesh point.

Rank	The rank is the level of importance and is used for automatic resource management. 8 – The current next hop to the recommended root. 7 – Any secondary next hop to the recommended root to has a good potential route metric. 6 – A next hop to an alternate root node. 5 – A downstream node currently hopping through to get to the root. 4 – A downstream node that could hop through to get to the root, but is currently not hopping through any node (look at authentication, as this might be an issue). 3 – A downstream node that is currently hopping through a different node to get to the root, but could potentially have a better route metric if it hopped through this node. 2 – Reserved for active peer to peer routes and is not currently used. 1 – A neighbor bound to the same recommended root but does not have a potential route metric as good as the neighbors ranked 8 and 7. 0 – A neighbor bound to a different root node. -1 – Not a member of the mesh as it has a different mesh ID. All client devices hold a rank of 3 and can replace any mesh devices lower than that rank.
Age	Displays the number of milliseconds since the mesh point last heard from this neighbor.

The **Security** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Mesh Point Identifier	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Radio Interface	This indicates the interface that is used by the device to communicate with this neighbor. The values are 2.4 and 5.8, indicating the frequency of the radio that is used to communicate with the neighbor.
Interface ID	The IFID uniquely identifies an interface associated with the MPID. Each mesh point on a device can be associated with one or more interfaces.
State	Displays the Link State for each mesh point: <i>Init</i> - indicates the link has not been established or has expired. <i>Enabled</i> - indicates the link is available for communication. <i>Failed</i> - indicates the attempt to establish the link failed and cannot be retried yet. <i>In Progress</i> - indicates the link is being established but is not yet available.
Timeout	Displays the maximum value in seconds that the link is allowed to stay in the In Progress state before timing out.

Keep Alive	Yes indicates the local MP acts as a supplicant to authenticate the link and not let it expire (if possible). <i>No</i> indicates that the local MP does not need the link and will let it expire if not maintained by the remote MP.

The **Proxy** tab displays the following:

Mesh Point Name	Displays the name of each configured mesh point in the RF Domain.
Mesh Point Identifier	The destination is the endpoint of mesh path. It may be a MAC address or a mesh point ID.
Proxy Address	Displays the MAC Address of the proxy used in the mesh point.
Age	Displays the age of the proxy connection for each of the mesh points in the RF Domain.
Proxy Owner	The owner (MPID) is used to distinguish the device that is the neighbor.
VLAN	The VLAN ID used as a virtual interface with this proxy. A value of 4095 indicates that there is no VLAN ID.

12 Select **Device Data Transmit**.

Data Bytes (Bytes)		Data Packets Dropped & Errors	
Transmitted Bytes		Tx Dropped	
Received Bytes		Rx Errors	
Total Bytes			

Data Packets Throughput (Kbps)		Broadcast Packets	
Transmitted Packets		Tx Bcast/Mcast Pkts	
Received Packets		Rx Bcast/Mcast Pkts	
Total Packets		Total Bcast/Mcast Pkts	

Data Rates (bps)		Management Packets	
Transmit Data Rate		Transmitted by the node	
Receive Data Rate		Received by the node	
Total Data Rate		Total Through the domain	

Packets Rate (pps)		Data Indicators	
Transmitting packet rate		Traffic Index	✗ No
Receiving packet rate		Max User Rate	
Total packet rate			

Data Distribution	
Neighbor Count	
Radio Count	

Figure 15-26 RF Domain - Mesh Point Device Data Transmit screen

13 Review the following transmit and receive statistics for Mesh nodes:

Data Bytes (Bytes): Transmitted Bytes	Displays the total amount of data, in Bytes, transmitted by mesh points in the RF Domain.
Data Bytes (Bytes): Received Bytes	Displays the total amount of data, in Bytes, received by mesh points in the RF Domain.
Data Bytes (Bytes): Total Bytes	Displays the total amount of data, in Bytes, transmitted and received by mesh points in the RF Domain.
Data Packets Throughput (Kbps): Transmitted Packets	Displays the total amount of data, in packets, transmitted by mesh points in the RF Domain.
Data Packets Throughput (Kbps): Received Packets	Displays the total amount of data, in packets, received by mesh points in the RF Domain.
Data Packets Throughput (Kbps): Total Packets	Displays the total amount of data, in packets, transmitted and received by mesh points in the RF Domain.

Data Rates (bps): Transmit Data Rate	Displays the average data rate, in kbps, for all data transmitted by mesh points in the RF Domain.
Data Rates (bps): Receive Data Rate	Displays the average data rate, in kbps, for all data received by mesh points in the RF Domain.
Data Rates (bps): Total Data Rate	Displays the average data rate, in kbps, for all data transmitted and received by mesh points in the RF Domain.
Packets Rate (pps): Transmitting Packet rate	Displays the average packet rate, in packets per second, for all data transmitted and received by mesh points in the RF Domain.
Packets Rate (pps): Received Packet rate	Displays the average packet rate, in packets per second, for all data received and received by mesh points in the RF Domain.
Packets Rate (pps): Total Packet Rate	Displays the average data packet rate, in packets per second, for all data transmitted and received by mesh points in the RF Domain.
Data Packets Dropped and Errors: Tx Dropped	Displays the total number of transmissions that were dropped mesh points in the RF Domain.
Data Packets Dropped and Errors: Rx Errors	Displays the total number of receive errors from mesh points in the RF Domain.
Broadcast Packets: Tx Bcast/Mcast Pkts	Displays the total number of broadcast and multicast packets transmitted from mesh points in the RF Domain.
Broadcast Packets: Rx Bcast/Mcast Pkts	Displays the total number of broadcast and multicast packets received from mesh points in the RF Domain.
Broadcast Packets: Total Bcast/Mcast Pkts	Displays the total number of broadcast and multicast packets transmitted and received from mesh points in the RF Domain.
Management Packets: Transmitted by the node	Displays the total number of management packets transmitted through the mesh point node.
Management Packets: Received by the node	Displays the total number of management packets received through the mesh point node.
Management Packets: Total Through the domain	Displays the total number of management packets that were transmitted and received through the mesh point node.
Data Indicators: Traffic Index	Displays <i>True</i> or <i>False</i> to indicate whether or not a traffic index is present.
Data Indicators: Max User Rate	Displays the maximum user throughput rate for mesh points in the RF Domain.
Data Distribution: Neighbor Count	Displays the total number of neighbors known to the mesh points in the RF Domain.
Data Distribution: Radio Count	Displays the total number of neighbor radios known to the mesh points in the RF Domain.

15.2.12 SMART RF

► RF Domain Statistics

When invoked by an administrator, *Self-Monitoring At Run Time* (Smart RF) instructs Access Point radios to change to a specific channel and begin beaconing using the maximum available transmit power. Within a well-planned deployment, any RF Domain member Access Point radio should be reachable by at least one other radio. Smart RF records signals received from its neighbors as well as signals from external, un-managed radios. AP-to-

AP distance is recorded in terms of signal attenuation. The information from external radios is used during channel assignment to minimize interference.

To view the Smart RF summary for RF Domain member Access Point radios:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **SMART RF** from the RF Domain menu.
- 4 Expand the SMART RF menu and select **Summary**.

The summary screen enables administrators to assess the efficiency of RF Domain member device channel distributions, sources of interference potentially requiring Smart RF adjustments, top performing RF Domain member device radios and the number of power, channel and coverage changes required as part of a Smart RF performance compensation activity.

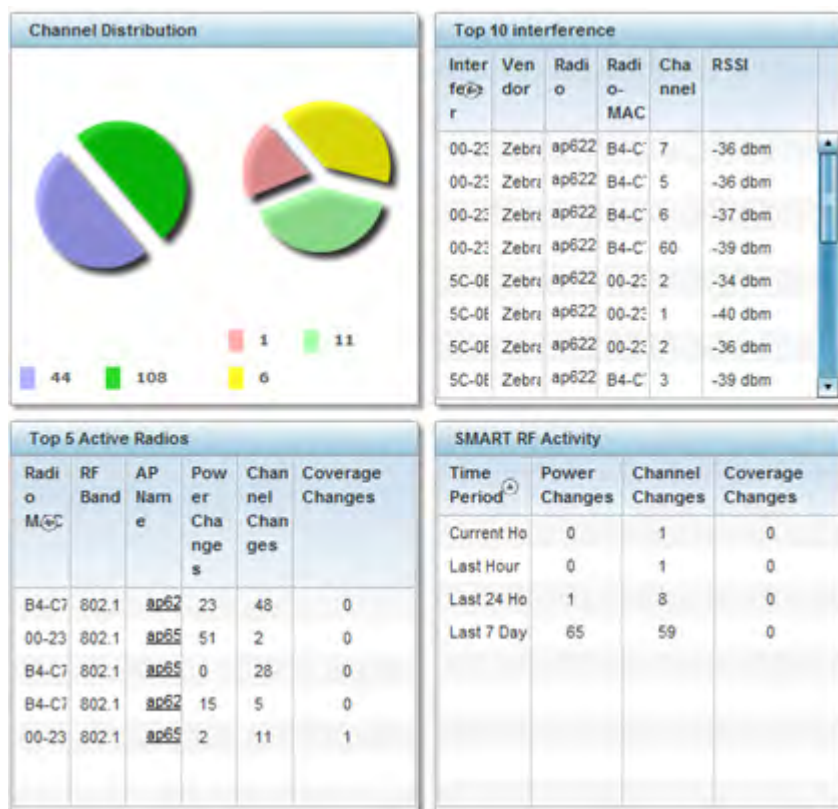


Figure 15-27 RF Domain - Smart RF Summary screen

- 5 The **Channel Distribution** field lists how RF Domain member devices are utilizing different channels to optimally support connect devices and avoid congestion and interference with neighboring devices. Assess whether the channel spectrum is being effectively utilized and whether channel changes are warranted to improve RF Domain member device performance.
- 6 Review the **Top 10 interference** table to assess RF Domain member devices whose level of interference exceeds the threshold set (from -100 to -10 dBm) for acceptable performance.

Interferer	Lists the administrator defined name of the interfering RF Domain member device.

Vendor	Displays the vendor name (manufacturer) of the interfering RF Domain member device radio.
Radio	Lists each offending device's radio name contributing to the top 10 interference listing.
Radio MAC	Displays the factory encoded hardware MAC address assigned to the RF Domain member device radio.
Channel	Displays the channel each of the 10 poorly performing RF Domain member devices was detected on. Numerous interfering devices on the same channel could define the need for better channel segregation to reduce the levels of detected interference.
RSSI	Lists a <i>relative signal strength indication</i> (RSSI) in dBm for those RF Domain member devices falling into the poorest performing 10 devices based on the administrator defined threshold value.

- 7 Review the **Top 5 Active Radios** to assess the significance of any Smart RF initiated compensations versus their reported top performance.

Radio MAC	Lists the hardware encoded MAC address of each listed top performing RF Domain member device radio.
RF Band	Displays the top performing radio's operation band. This may help administrate whether more changes were required in the 2.4 GHz band then 5 GHz or vice versa.
AP Name	Lists the administrator assigned Access Point name used to differentiate from other RF Domain member Access Point radios. The name displays in the form of a link that can be selected to display device information in greater detail.
Power Changes	Displays the number of Smart RF initiated power level changes reported for this top performing RF Domain member radio.
Channel Changes	Displays the number of Smart RF initiated channel changes reported for this top performing RF Domain member radio.
Coverage Changes	Displays the number of Smart RF initiated coverage changes reported for this top performing RF Domain member radio.

- 8 Refer to the **SMART RF Activity** table to view the trending of Smart RF compensations.

Time Period	Lists the frequency Smart RF activity is trended for the RF Domain. Trending periods include the <i>Current Hour</i> , <i>Last 24 Hours</i> or the <i>Last Seven Days</i> . Comparing Smart RF adjustments versus the last seven days enables an administrator to assess whether periods of interference and poor performance were relegated to just specific periods.
Power Changes	Displays the number of Smart RF initiated power level changes needed for RF Domain member devices during each of the three trending periods. Determine whether power compensations were relegated to known device outages or if compensations were consistent over the course of a day or week.

Channel Changes	Lists the number of Smart RF initiated channel changes needed for RF Domain member devices during each of the three trending periods. Determine if channel adjustments were relegated to known device count increases or decreases over the course of a day or week.
Coverage Changes	Displays the number of Smart RF initiated coverage changes needed for RF Domain member devices during each of the three trending periods. Determine if coverage changes were relegated to known device failures or known periods of interference over the course of a day or week.

9 Select **Refresh** to update the Summary to its latest RF Domain Smart RF information.

10 Select **Details** from the RF Domain menu.

Refer to the **General** field to review the radio's factory encoded hardware MAC address, the radio index assigned by the administrator, the 802.11 radio type, its current operational state, the radio's AP hostname assigned by an administrator, its current operating channel and power.

AP Hostname	Radio MAC Address	Radio Type	State	Channel	Power
ap6511-8A4	5C-0E-8B-8E-2F-E	11bgn	offline		0
ap621-E9F8	5C-0E-8B-F3-2B-C	11bgn	offline		0
ap6532-347	5C-0E-8B-22-DD-4	11an	normal	52w	4
ap81xx-711	B4-C7-99-78-61-E	11an	offline		0
ap6532-347	5C-0E-8B-21-77-7	11bgn	normal	1	10
ap6532-347	5C-0E-8B-22-DF-4	11bgn	normal	1	10
ap6532-347	5C-0E-8B-22-A2-1	11bgn	normal	1	10
ap6532-347	5C-0E-8B-22-64-C	11bgn	normal	1	10
ap6532-347	5C-0E-8B-22-06-E	11an	normal	100w	17
ap650-2433	B4-C7-99-18-62-F	11an	offline		0
ap8232-7F0	FC-0A-81-8D-2E-1	11an	offline		0
ap650-2433	B4-C7-99-18-4A-J	11bgn	offline		0
ap7131-135	B4-C7-99-EC-96-C	11an	offline		0
ap7532-160	FC-0A-81-A3-10-1	11an	normal	36	17
	5C-0F-8B-21-78-4	11an	normal	108w	4

Details **Energy Graph**

General

Radio MAC Address: 5C-0E-8B-21-56-00
Radio Index: 0
Radio Type: 11bgn
State: normal

AP Hostname: ap6532-347854
Channel: 1
Power: 10

Neighbors

AP Hostname	Attenuation	Channel	Radio MAC Address	Power	Radio id
ap7502-B	87	11	FC-0A-81-E	10	0

Refresh

Figure 15-28 RF Domain - Smart RF Details screen

Refer to the **Neighbors** table to review the attributes of neighbor radio resources available for Smart RF radio compensations for other RF Domain member device radios. Individual Access Point hostnames can be selected and the RF Domain member radio can be reviewed in greater detail. *Attenuation* is a measure of the reduction of signal strength during transmission. Attenuation is the opposite of amplification, and is normal when a signal is sent from one point to another. If the signal attenuates too much, it becomes unintelligible. Attenuation is measured in decibels. The radio's current operating channel is also displayed, as is the radio's hard coded MAC address transmit power level and administrator assigned ID. Select **Refresh** at any time to update the Details screen to its latest values.

11 Select the **Energy Graph** tab

Use the **Energy Graph** to review the radio's operating channel, noise level and neighbor count. This information helps assess whether Smart RF neighbor recovery is needed in respect to poorly performing radios.

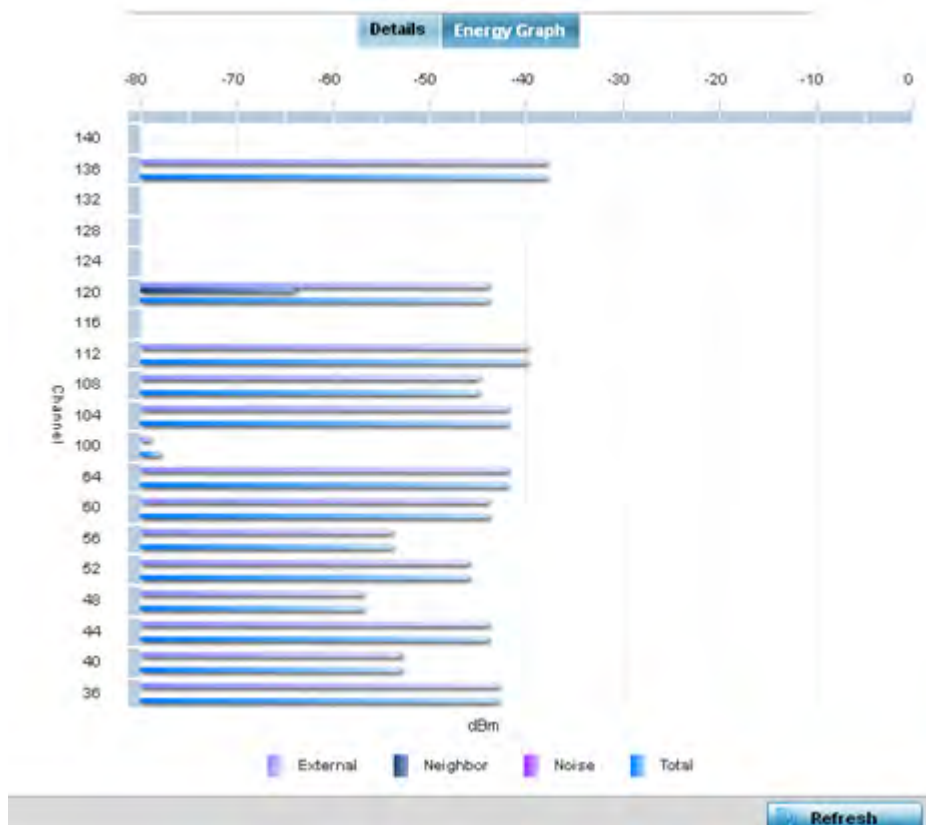


Figure 15-29 RF Domain - Smart RF Energy Graph

- 12 Select **Smart RF History** to review the descriptions and types of Smart RF events impacting RF Domain member devices.

Time	Type	Description
5/17/2013 12:54:52 AM	Interference Recovery	ap622-5864A0 Radio 2 (B4-C7-99-58-62-F0) channel changed from 136 to 112
5/17/2013 01:22:14 AM	AP Unadopted	ap622-5864A0 AP B4-C7-99-58-64-A0 master connectivity lost
5/13/2013 03:59:06 AM	AP Adopted	ap622-5864A0 AP B4-C7-99-58-64-A0 master connectivity established
5/13/2013 03:59:06 AM	Radio Added	ap622-5864A0 Radio 1 (B4-C7-99-58-61-10) added
5/13/2013 03:59:06 AM	Radio Added	ap622-5864A0 Radio 2 (B4-C7-99-58-62-F0) added
5/13/2013 04:01:24 AM	AP Unadopted	ap622-5864A0 AP B4-C7-99-58-64-A0 master connectivity lost
5/13/2013 04:01:24 AM	Radio Removed	ap622-5864A0 Radio 1 (B4-C7-99-58-61-10) removed
5/13/2013 04:01:24 AM	Radio Removed	ap622-5864A0 Radio 2 (B4-C7-99-58-62-F0) removed
5/13/2013 04:02:05 AM	AP Adopted	ap622-5864A0 AP B4-C7-99-58-64-A0 master connectivity established
5/13/2013 04:02:05 AM	Radio Added	ap622-5864A0 Radio 1 (B4-C7-99-58-61-10) added
5/13/2013 04:02:05 AM	Radio Added	ap622-5864A0 Radio 2 (B4-C7-99-58-62-F0) added
5/17/2013 01:22:14 AM	Radio Removed	ap622-5864A0 Radio 1 (B4-C7-99-58-61-10) removed
5/17/2013 01:25:38 AM	Interference Recovery	ap622-5864A0 Radio 2 (B4-C7-99-58-62-F0) channel changed from 112 to 120
5/19/2013 11:58:06 PM	Interference Recovery	ap622-5864A0 Radio 1 (B4-C7-99-58-61-10) channel changed from 4 to 8

Type to search in table: Row Count: 303

Figure 15-30 RF Domain - Smart RF History screen

The **SMART RF History** screen displays the following RF Domain member historical data:

Time	Displays a time stamp when Smart RF status was updated on behalf of a Smart RF adjustment within the selected RF Domain.
Type	Lists a high-level description of the Smart RF activity initiated for a RF Domain member device.
Description	Provides a more detailed description of the Smart RF event in respect to the actual Smart RF calibration or adjustment made to compensate for detected coverage holes and interference.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.13 WIPS

► *RF Domain Statistics*

Refer to the *Wireless Intrusion Protection Software* (WIPS) screens to review a client blacklist and events reported by a RF Domain member Access Point.

For more information, see:

- *WIPS Client Blacklist*
- *WIPS Events*

15.2.13.1 WIPS Client Blacklist

► *WIPS*

The *Client Blacklist* displays clients detected by WIPS and removed from RF Domain utilization. Blacklisted clients are not allowed to associate to RF Domain member Access Point radios.

To view the WIPS client blacklist:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Expand the **WIPS** menu item and select **Client Blacklist**.

Event Name	Blacklisted Client	Time Blacklisted	Total Time	Time Left
dos-eapol-start-storm	44-55-44-55-44-55	Thu Jun 10 2012 12:26:26	2h 0m 0s	1h 0m 0s
null-probe-response	44-55-44-55-44-55	Thu Jun 10 2012 12:26:26	40m 0s	20m 0s

Type to search in tables
Row Count: 2

Refresh

Figure 15-31 *RF Domain - WIPS Client Blacklist screen*

The WIPS **Client Blacklist** screen displays the following:

Event Name	Displays the name of the blacklisting wireless intrusion event detected by a RF Domain member Access Point.
Blacklisted Client	Displays the MAC address of the unauthorized (blacklisted) client intruding the RF Domain.
Time Blacklisted	Displays the time when the wireless client was blacklisted by a RF Domain member Access Point.
Total Time	Displays the time the unauthorized (now blacklisted) device remained in the RF Domain.
Time Left	Displays the time the blacklisted client remains on the list.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

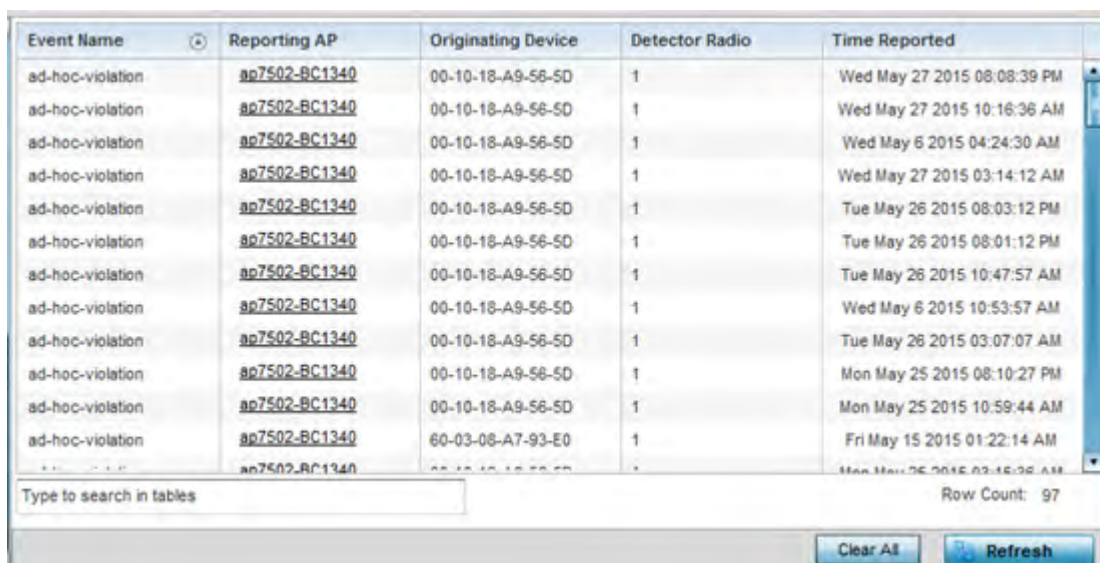
15.2.13.2 WIPS Events

► *WIPS*

Refer to the *WIPS Events* screen to assess WIPS events detected by RF Domain member Access Point radios and reported to the controller or service platform.

To view the rogue Access Point statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Expand the **WIPS** menu item and select **WIPS Events**.



Event Name	Reporting AP	Originating Device	Detector Radio	Time Reported
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 08:08:39 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 10:16:36 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 04:24:30 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 03:14:12 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:03:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:01:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 10:47:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 10:53:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 03:07:07 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 08:10:27 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 10:59:44 AM
ad-hoc-violation	ap7502-BC1340	60-03-08-A7-93-E0	1	Fri May 15 2015 01:22:14 AM
	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 26 2015 03:15:36 AM

Type to search in tables

Row Count: 97

Clear All Refresh

Figure 15-32 RF Domain - WIPS Events screen

The **WIPS Events** screen displays the following:

Event Name	Displays the event name of the intrusion detected by a RF Domain member Access Point.
Reporting AP	Displays the MAC address of the RF Domain member Access Point reporting the event.
Originating Device	Displays the MAC address of the device generating the event.
Detector Radio	Displays the radio number detecting the WIPS event.
Time Reported	Displays a time stamp of when the event was reported by the RF Domain member Access Point radio.
Clear All	Select the <i>Clear All</i> button to clear the statistics counters and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.14 Captive Portal

► RF Domain Statistics

A captive portal is guest access policy for providing guests temporary and restrictive access to the controller or service platform managed wireless network. Captive portal authentication is used primarily for guest or visitor access to the network, but is increasingly being used to provide authenticated access to private network resources when 802.1X EAP is not a viable option. Captive portal authentication does not provide end-user data encryption, but it can be used with static WEP, WPA-PSK or WPA2-PSK encryption.

To view the RF Domain captive portal statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Captive Portal** from the RF Domain menu.

Client MAC	Hostname	Client IP	Client IPv6	Captive Portal	Port Name	Authentication	WLAN	VLAN	Remaining Time
04-E5-36-29-2B-F1		172.16.1.8		ALPHANET-G		Pending	GUEST-ACC	666	0s
24-A0-74-12-4B-2D	VINHS-iPhone	157.235.100.	fe80::cce:a8f	ALPHANET-G		Pending	GUEST-ACC	666	0s
40-0E-85-0B-D9-49		172.16.1.9		ALPHANET-G		Pending	GUEST-ACC	666	0s
54-26-96-54-A0-A5		172.16.1.163		ALPHANET-G		Pending	GUEST-ACC	666	0s
54-44-09-3E-00-98		172.16.1.38		ALPHANET-G		Pending	GUEST-ACC	666	0s
54-79-75-B8-A5-80	Windows-Ph	157.235.100.		ALPHANET-G		Pending	GUEST-ACC	666	0s
70-3E-AC-44-D9-C6	Azif-Iphone6	172.16.1.134	fe80::4d0:7c5	ALPHANET-G		Pending	GUEST-ACC	666	0s
90-3C-92-06-5C-F3		0.0.0.0		ALPHANET-G		Pending	GUEST-ACC	666	0s
9C-03-5B-97-D3-87		172.16.1.77		ALPHANET-G		Pending	GUEST-ACC	666	0s
9C-F3-87-4C-F6-F6		0.0.0.0		ALPHANET-G		Pending	GUEST-ACC	666	0s
A4-D1-D2-55-2D-CA		172.16.1.161		ALPHANET-G		Pending	GUEST-ACC	666	0s
C0-33-5E-2B-36-B7	StephenSurfi	172.16.1.139	fe80::4081:b6	ALPHANET-G		Success	GUEST-ACC	666	4h 15m 38s
C4-43-8F-F5-B2-F5		172.16.1.80		ALPHANET-G		Pending	GUEST-ACC	666	0s
DB-50-E6-7F-79-04		172.16.1.196		ALPHANET-G		Pending	GUEST-ACC	666	0s
EB-50-8B-80-CF-E0		172.16.1.111		ALPHANET-G		Pending	GUEST-ACC	666	0s

Type to search in tables

Row Count: 16

Refresh

Figure 15-33 RF Domain - Captive Portal

The screen displays the following **Captive Portal** data for requesting clients:

Client MAC	Displays the MAC address of each listed client requesting captive portal access to the controller or service platform managed network. This address can be selected to display client information in greater detail.
Hostname	Lists the administrator assigned hostname of the device requesting captive portal access to network's RF Domain resources.
Client IP	Displays the IPv4 formatted address of each listed client using its connected RF Domain member Access Point for captive portal access.
Client IPv6	Displays any IPv6 formatted address of any listed client using its connected RF Domain member Access Point for captive portal access. IPv6 is the latest revision of the <i>Internet Protocol</i> (IP) designed to replace IPv4. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
Captive Portal	Lists the name of the RF Domain captive portal currently utilized by each listed client.
Port Name	Lists the name virtual port used for captive portal session direction.
Authentication	Displays the authentication status of requesting clients attempting to connect to the controller or service platform via the captive portal.
WLAN	Displays the name of the WLAN the requesting client would use for interoperation with the controller or service platform.
VLAN	Displays the name of the VLAN the client would use as a virtual interface for captive portal operation with the controller or service platform.

Remaining Time	Displays the time after which a connected client is disconnected from the captive portal.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.15 Application Visibility (AVC)

► RF Domain Statistics

RF Domain member devices inspect every byte of each application header packet allowed to pass through the WiNG managed network. When an application is recognized and classified by the WiNG application recognition engine, administrator defined actions can be applied to that specific application. For information on categorizing, filtering and logging the application data allowed to proliferate the WiNG managed network, refer to [Application Policy on page 7-54](#) and [Application on page 7-58](#).

To view the RF Domain application utilization statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Application Visibility (AVC)** from the RF Domain menu.

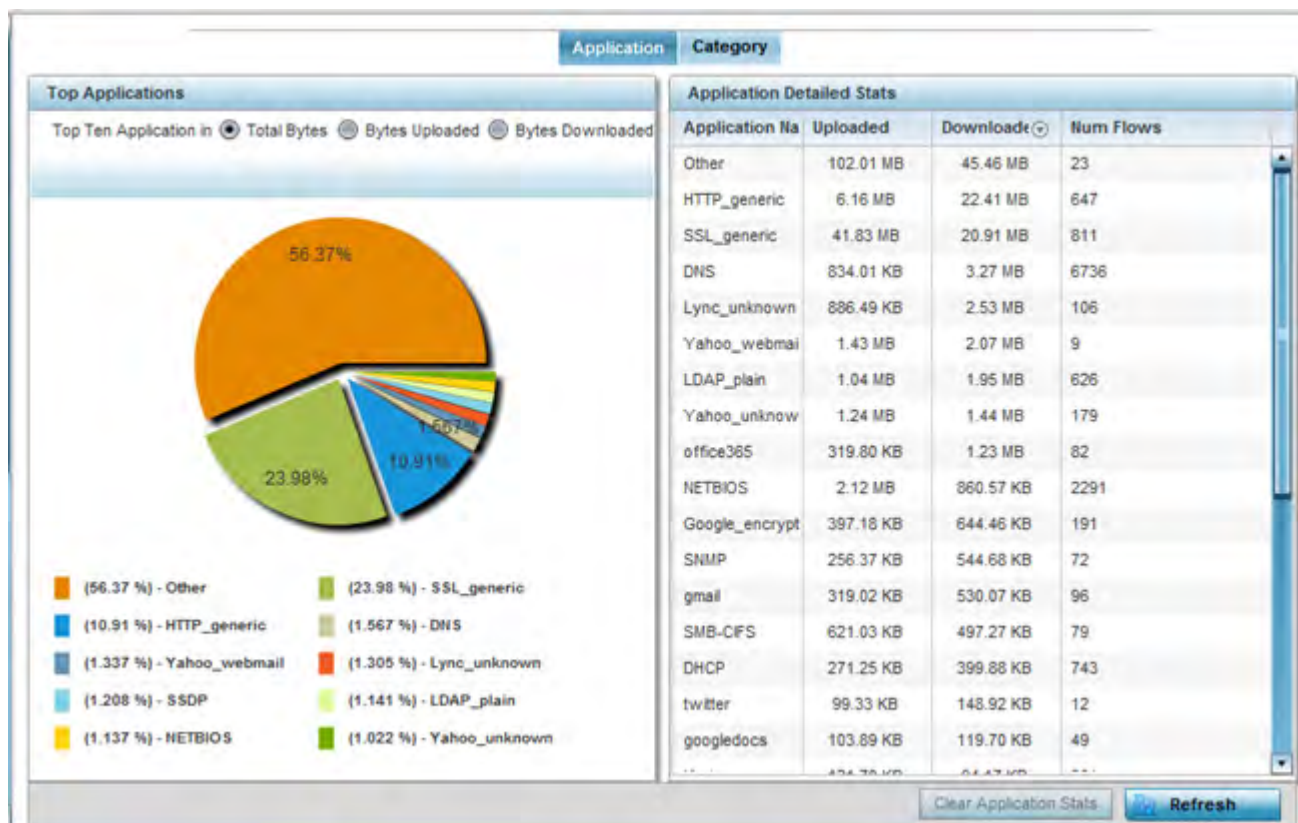


Figure 15-34 RF Domain - Application Visibility

- 4 Refer to the **Top Applications** graph to assess the most prolific, and allowed, application data passing through RF Domain member devices.

Total Bytes	Displays the top ten RF Domain member utilized applications in respect to total data bytes passing through the RF Domain member WiNG managed network. These are only the administrator <i>allowed</i> applications approved for proliferation within the RF Domain member device.
Bytes Uploaded	Displays the top ten RF Domain member applications in respect to total data bytes uploaded through the RF Domain member WiNG managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten RF Domain member applications in respect to total data bytes downloaded from the RF Domain member WiNG managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).

- 5 Refer to the **Application Detailed Stats** table to assess specific application data utilization:

Application Name	Lists the RF Domain member allowed application name whose data (bytes) are passing through the WiNG managed network.
Uploaded	Displays the number of uploaded application data (in bytes) passing the through the WiNG managed network.
Downloaded	Displays the number of downloaded application data (in bytes) passing the through the WiNG managed network.
Num Flows	Lists the total number of application data flows passing through RF Domain member devices for each listed application. An application flow can consist of packets in a specific connection or media stream. Application packets with the same source address/port and destination address/port are considered one flow.
Clear Application Stats	Select this option to clear the application assessment data counters and begin a new assessment.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

- 6 Select the **Category** tab.

Categories are existing WiNG or user defined application groups (video, streaming, mobile, audio etc.) that assist administrators in filtering (allowing or denying) application data. For information on categorizing application data, refer to [Application Policy on page 7-54](#) and [Application on page 7-58](#).

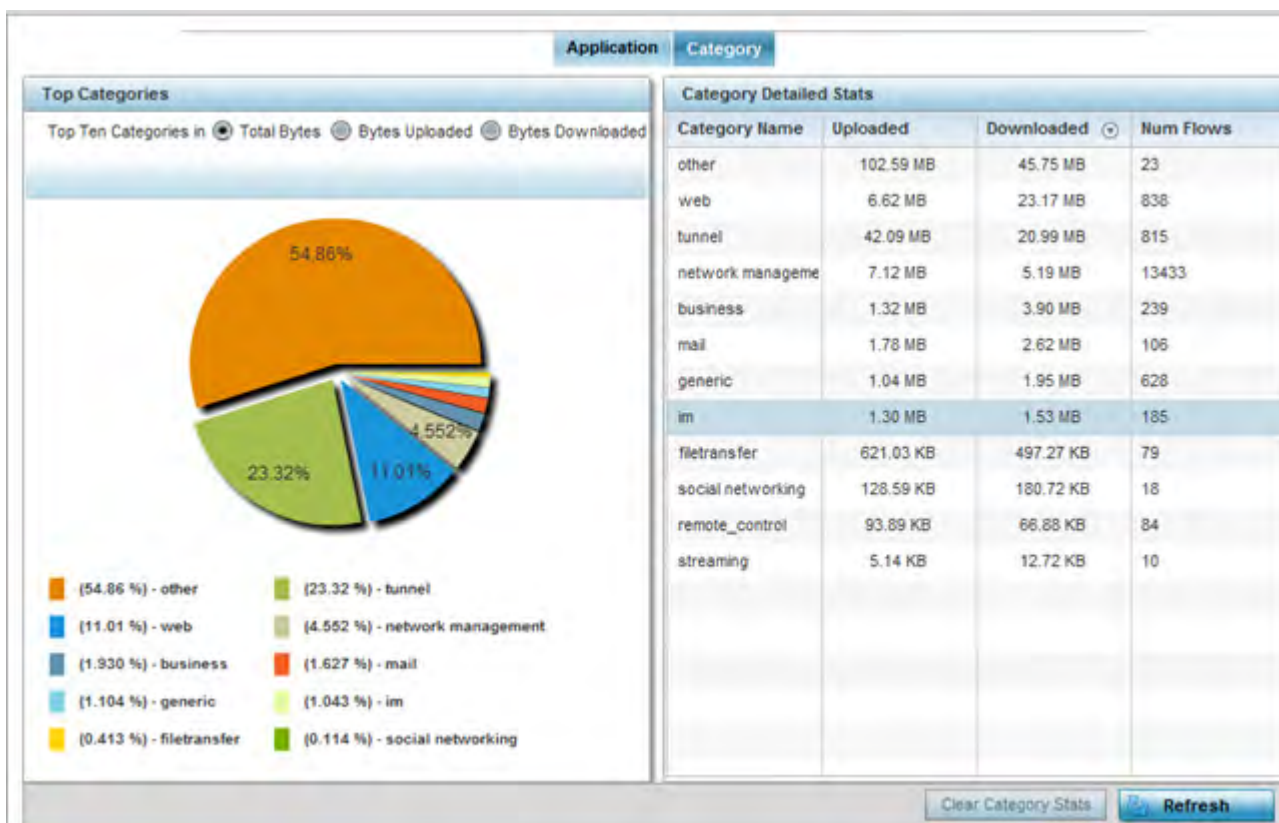


Figure 15-35 RF Domain - Application Category Visibility

- 7 Refer to the **Top Categories** graph to assess the most prolific, and allowed, application data categories utilized by RF Domain member devices.

Total Bytes	Displays the top ten RF Domain member application categories in respect to total data bytes passing through the RF Domain member WiNG managed network. These are only the administrator <i>allowed</i> application categories approved for proliferation within the RF Domain.
Bytes Uploaded	Displays the top ten RF Domain member application categories in respect to total data bytes uploaded through the RF Domain member WiNG managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten RF Domain member application categories in respect to total data bytes downloaded from the RF Domain member WiNG managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories and categories or adjusting their precedence (priority).

- 8 Refer to the **Category Detailed Stats** table to assess specific application category data utilization:

Category Name	Lists the RF Domain member allowed category whose application data (in bytes) is passing through the WiNG managed network.

Uploaded	Displays the number of uploaded application category data (in bytes) passing the through the WiNG managed network.
Downloaded	Displays the number of downloaded application category data (in bytes) passing the through the WiNG managed network.
Num Flows	Lists the total number of application category data flows passing through RF Domain member devices. A category flow can consist of packets in a specific connection or media stream. Packets with the same source address/port and destination address/port are considered one flow.
Clear Application Stats	Select this option to clear the application category assessment data counters and begin a new assessment.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.16 Coverage Hole Summary

► RF Domain Statistics

Periodically refer to a selected RF Domain's coverage hole summary to assess the RF Domain member Access Point radios reporting coverage hole adjustments. When coverage hole recovery is enabled and a deployment area radio coverage hole is detected, Smart RF determines the radio's power increase compensation required based on a reporting client's *signal to noise* (SNR) ratio. If a client's SNR is above the administrator threshold, its connected Access Point's transmit power is increased until the noise rate falls below the threshold.

To view a RF Domain's coverage hole summary:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a RF Domain from under the System node on the top, left-hand side, of the screen.
- 3 Select **Coverage Hole Detection** from the RF Domain menu and expand this item to display its submenu options.
- 4 Select **Summary**.

AP Hostname	Coverage Hole Incidents Count
ap650-3129D8	0
ap650-3129EC	0
ap6532-347110	0
ap6532-3475E4	0
ap6532-347638	0
ap6532-34776C	0
ap6532-347800	0
ap6532-347830	0
ap6532-347854	0
ap6532-347B7C	0
ap6511-8A4B15	0
ap621-E9F899	0
ap7532-1601A8	0
ap650-2433AC	0

Clear Coverage Incidents

Refresh

Figure 15-36 RF Domain - Coverage Hole Summary

The screen displays the following RF Domain coverage hole summarization data:

AP Hostname	Displays each RF Domain member Access Point hostname reporting a coverage hole compensation event. This can be helpful in assessing whether specific Access Points consistently report coverage holes and whether additional Access Point placements are required to compensate for poorly performing radios.
Coverage Hole Incidents Count	Lists each reporting Access Point's coverage hole incident count since the screen was last cleared. Periodically assess whether a specific Access Point's high incident count over a trended repeatable period warrants additional Access Point placements in that same radio coverage area to reduce a coverage hole.
Clear Coverage Incidents	Select this option to clear the statistics counters and begin a new coverage hole summary for RF Domain member Access Point radios.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.2.17 Coverage Hole Details

► RF Domain Statistics

In addition to the RF Domain's Coverage Hole Summary, a specific Access Point's coverage hole history can be reviewed in detail. Consider using different RF Domain member Access Points or their connected clients to help validate the data reported before compensating for the coverage hole by increasing the radio transmit power of neighboring Access Points.

To review specific RF Domain member Access Point coverage hole information:

- 1
- Select the **Statistics** menu from the Web UI.
- 2
- Select a RF Domain from under the System node on the top, left-hand side, of the screen.

- 3 Select **Coverage Hole Detection** from the RF Domain menu and expand this item to display its submenu options.
- 4 Select **Detail**.

Figure 15-37 RF Domain - Coverage Hole Details

- 5 Use the **Filtered By** option to define whether the RF Domain's coverage hole details are provided by a selected Access Point (**AP**) or by a specific RF Domain member Access Point's connected **Client**. Consider filtering by different RF Domain member devices to validate the accuracy of a reported coverage hole before increasing the transmit power of neighboring radios to compensate.
- 6 Refer to the **Enter MAC Address** parameter to define a RF Domain member Access Point MAC address or Hostname or just a client MAC address. This is the selected device reporting coverage hole details to the listed RF Domain member Access Point.
- 7 Select **Filter** to begin the coverage hole data collection using the Access Point or client details provided. Refer to the following to review the data reported:

Hostname	Lists the administrator assigned hostname used as each listed Access Point's network identifier. This is the Access Point whose client(s) are reporting coverage hole RSSI data.
Radio	Lists the Access Point radio receiving and reporting coverage hole RSSI data from the listed client MAC. Each supported Access Point has at least two radios, with the exception of AP6521 model, which is a single-radio model.
BSSID	Displays the <i>basic service set identifier</i> (BSSID) included in an Access Point's wireless packet transmissions. Packets need to go to their correct destination. While a SSID keeps packets within the correct WLAN there's usually multiple Access Points within each WLAN. A BSSID identifies the correct Access Point and its connected clients.
Client MAC	Lists each connected client's hardware encoded MAC address. This is the client reporting coverage hole RSSI data to its connected Access Point radio.
RSSI	Displays the <i>Received Signal Strength Indicator</i> (RSSI) of the detecting Access Radio or client.

Date-Time	Displays the date and time when each listed Access Point received its coverage hole indecent information.
Clear Coverage Incidents	Select this option to clear the statistics counters and begin a new coverage hole assessment for RF Domain member Access Point radios.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.3 Controller Statistics

► *Statistics*

The Wireless Controller screen displays information about peer controllers or service platforms and their connected Access Points. As members of a cluster, a controller or service platform manages its own network and is ready to assume the load of an offline peer. The screen displays detailed statistics which include network health, inventory of devices, wireless clients, adopted APs, rogue APs and WLANs. For more information, refer to the following:

- *Health*
- *Device*
- *Cluster Peers*
- *Web-Filtering*
- *Application Visibility (AVC)*
- *Application Policy*
- *Device Upgrade*
- *Mirroring*
- *Adoption*
- *AP Detection*
- *Guest User*
- *Wireless LANs*
- *Policy Based Routing*
- *Radios*
- *Mesh*
- *Interfaces*
- *RAID Statistics*
- *Border Gateway Protocol (BGP) Statistics*
- *Power Status*
- *PPPoE*
- *OSPF*
- *L2TPv3*
- *VRRP*
- *Critical Resources*
- *LDAP Agent Status*
- *Mint Links*
- *Guest Users*
- *GRE Tunnels*
- *Dot1x*
- *Network*
- *DHCPv6 Relay & Client*

- *DHCP Server*
- *Firewall*
- *VPN*
- *Viewing Certificate Statistics*
- *WIPS Statistics*
- *Sensor Server*
- *Bonjour Services*
- *Captive Portal Statistics*
- *Network Time*

15.3.1 Health

► *Controller Statistics*

The *Health* screen displays details such as hostname, device name, RF Domain name, radio RF quality and client RF quality.

To view controller or service platform device health data:

- 1 Select the [Statistics](#) tab from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select [Health](#) from the left-hand side of the UI.

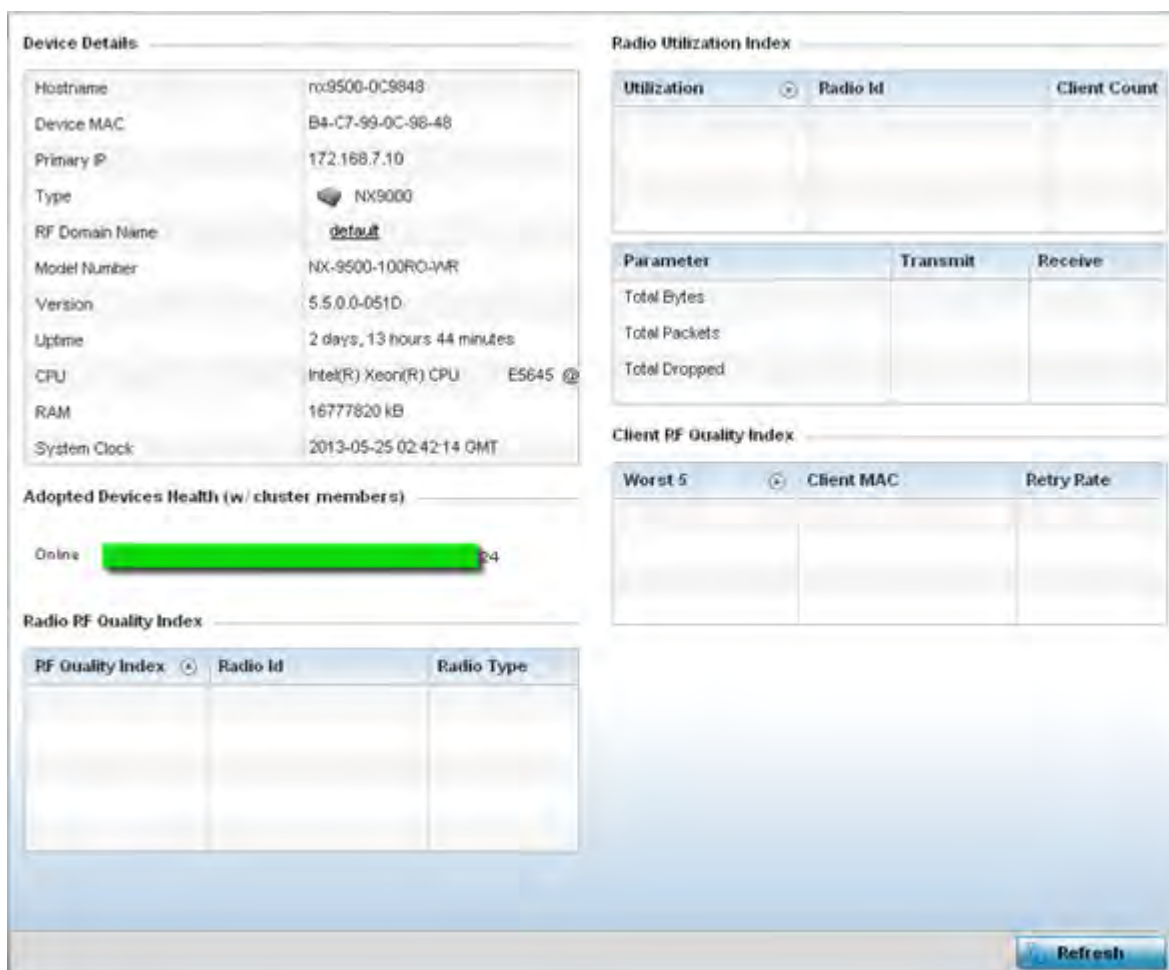


Figure 15-38 *Wireless Controller - Health screen*

The **Device Details** field displays the following:

Hostname	Displays the administrator assigned hostname of the controller or service platform.
Device MAC	Displays the MAC address of the controller.
Primary IP	Lists the network address used by this controller or service platform as a network identifier.
Type	Displays the RFS series controller or NX series service platform type.
RF Domain Name	Displays the controller's domain membership. The name displays in the form of a link that can be selected to display a detailed description of the RF Domain configuration.
Model Number	Displays the RFS series controller or NX series service platform type.
Version	Displays the version of the image running on the controller or service platform.
Uptime	Displays the cumulative time since the controller or service platform was last rebooted or lost power.
CPU	Displays the controller or service platform processor name.
RAM	Displays the CPU memory in use.

System Clock	Displays the system clock information.

The Access Point **Health (w/ cluster members)** chart shows how many Access Points are online and how many are offline. These are APs with cluster members directly managed by the wireless controller. This data does not include Access Points associated to other controllers or service platforms in the same cluster.

The **Radio RF Quality Index** field displays RF quality (overall effectiveness of the RF environment). Use this table to assess radio performance for improvement ideas.

The **RF Quality Index** field displays the following:

RF Quality Index	Displays the five radios with the lowest average quality.
Radio Id	Displays the hardware encoded MAC address of the radio.
Radio Type	Displays the radio type used by this Access Point.

The **Radio Utilization Index** field measures how efficiently the traffic medium is used. It's defined as the percentage of the current throughput relative to the maximum relative possible throughput:

Total Bytes	Displays the total bytes of data transmitted and received by the controller or service platform since the screen was last refreshed.
Total Packets	Lists the total number of data packets transmitted and received by the controller or service platform since the screen was last refreshed.
Total Dropped	List the number of dropped data packets by a controller or service platform managed Access Point radio since the screen was last refreshed.

The **Client RF Quality Index** field displays the RF quality of the clients. Use this table to troubleshoot radios not optimally performing:

Worst 5	Displays the five client radios with the lowest quality indices.
Client MAC	Displays the MAC address of the client.
Retry Rate	Displays the excessive retry rate of each listed controller or service platform managed client.

- 4 Select **Refresh** to update the statistics counters to their latest values.

15.3.2 Device

► *Controller Statistics*

The *Device* statistics screen provides detailed information about the selected device.

To view controller or service platform device statistics:

- 1 Select the **Statistics** tab from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Device** from the left-hand side of the UI.

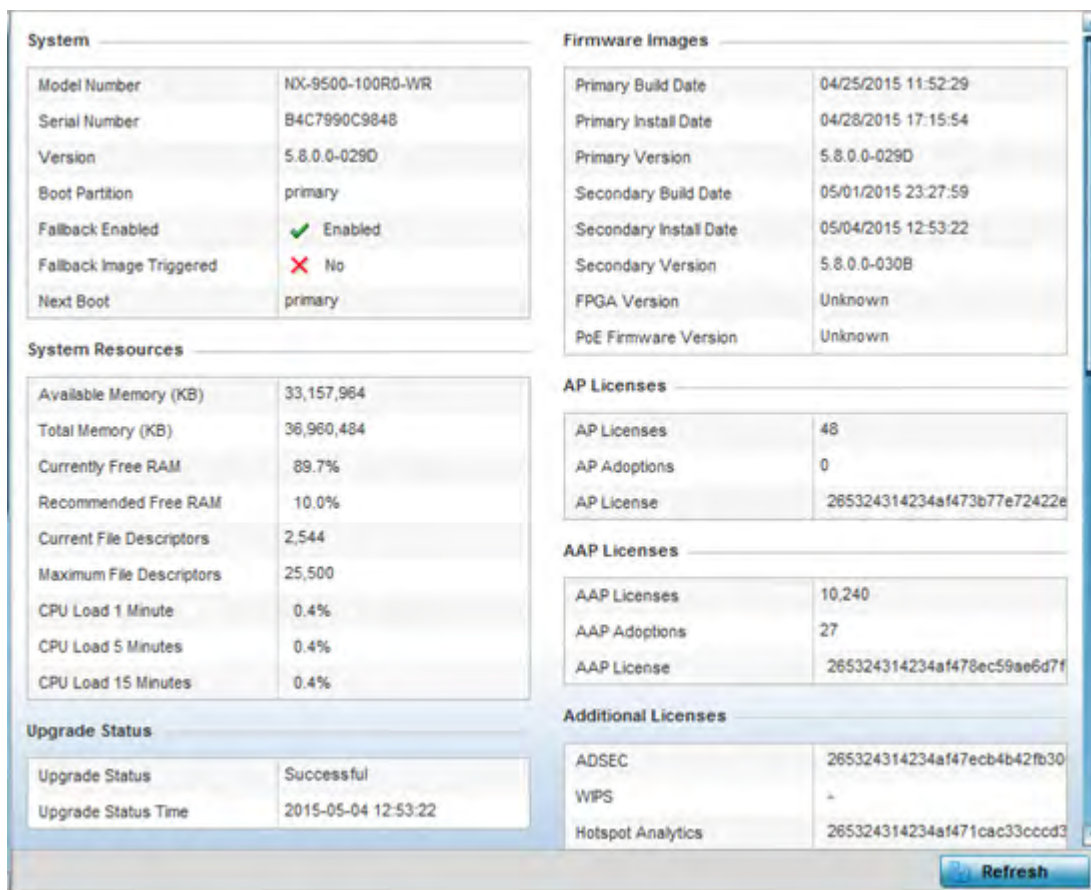


Figure 15-39 *Wireless Controller - Device screen*

The **System** field displays the following:

Model Number	Displays the model number for the selected controller or service platform.
Serial Number	Displays the serial number factory encoded on the controller or service platform at the factory.
Version	Displays the unique alphanumeric firmware version name for the controller or service platform firmware.
Boot Partition	Displays the boot partitioning type.
Fallback Enabled	Displays whether fallback is enabled. The fallback feature enables a user to store both a legacy and new firmware version in memory. You can test the new software and use an automatic fallback mechanism, which loads the old version, if the new version fails.
Fallback Image Triggered	Displays whether the fallback image has been triggered. The fallback is a legacy software image stored in device memory. This allows an user to test a new version and revert to the older version if needed.
Next Boot	Designates this version as the version used the next time the controller or service platform is booted.

The **System Resources** field displays the following:

Available Memory (MB)	Displays the available memory (in MB) available on the selected controller or service platform.

Total Memory (MB)	Displays the controller or service platform's total memory.
Currently Free RAM	Displays the Access Point's free RAM space. If its very low, free up some space by closing some processes.
Recommended Free RAM	Displays the recommended RAM required for routine operation.
Current File Descriptors	Displays the controller or service platform's current file description.
Maximum File Current File Descriptors	Displays the controller or service platform's maximum file description.
CPU Load 1 Minute	Lists the typical controller or service platform processor load over 1 minute.
CPU Load 5 Minutes	Lists the typical controller or service platform processor load over 5 minutes.
CPU Load 15 Minutes	Lists the typical controller or service platform processor load over 15 minutes.

The **Upgrade Status** field displays firmware upgrade statistics. The table provides the following:

Upgrade Status	Displays whether the image upgrade was successful.
Upgrade Status Time	Displays the time of the upgrade.

The **IP Domain** field displays the following:

IP Domain Name	Displays the name of the IP Domain service used with the selected controller or service platform.
IP Domain Lookup state	Lists the current state of the lookup operation.

The **Fan Speed** field displays the following:

Number	Displays the number of fans supported on the this controller or service platform.
Speed (Hz)	Displays the fan speed in Hz.

The **Temperature** field displays the following:

Number	Displays the number of temperature elements used by the controller or service platform.
Temperature	Displays the current temperature (in Celsius) to assess a potential Access Point overheat condition.

The **Kernal Buffers** field displays the following:

Buffer Size	Lists the sequential buffer size.
Current Buffers	Displays the current buffers available to the selected controller or service platform.
Maximum Buffers	Lists the maximum buffers available to the selected controller or service platform.

The **Firmware Images** field displays the following:

Primary Build Date	Displays the build date when this version was created.
Primary Install Date	Displays the date this version was installed on the controller or service platform.
Primary Version	Displays the primary version string.
Secondary Build Date	Displays the build date when this secondary version was created.
Secondary Install Date	Displays the date this secondary version was installed on the controller or service platform.
Secondary Version	Displays the secondary version string.
FGPA Version	Displays the version of FGPA firmware used by the controller or service platform.
PoE Version Firmware	Lists the <i>Power-Over-Ethernet</i> (PoE) version firmware.

The **AP Licenses** field displays the following:

AP Licenses	Displays the number of AP licenses currently available on the controller or service platform. This value represents the maximum number of licenses the controller or service platform can adopt.
AP Adoptions	Displays the number of Access Points adopted by this controller or service platform.
AP License	Displays the license string of the AP.

The **AAP Licenses** field displays the following:

AAP Licenses	Displays the number of AAP licenses currently available on the controller or service platform. This value represents the maximum number of licenses the controller or service platform can adopt.
AAP Adoptions	Displays the number of adaptive Access Points adopted by this controller or service platform.
AAP License	Displays the license string of the adaptive Access Point.

The **Additional Licenses** area displays the following information:

ADSEC	Displays Advanced Security licenses. This enables the Role Based firewall and increases the number of IP Sec VPN tunnels. The maximum number of IP Sec VPN tunnels varies by platform.
WIPS	Displays the number of WIPS licenses utilized by the controller or service platform.
Hotspot Analytics	Displays whether an advanced hotspot analytics license is in use and applied to the controller or service platform.

The **IP Name Servers** table displays the following:

Name Server	Displays any custom Name Server mappings on the controller or service platform.
Type	Displays the type of DNS mapping, if any, on the controller or service platform.

The **IPv6 Name Servers** table displays the following:

Name Server	Displays any custom IPv6 formatted IP address Name Server mappings on the controller or service platform.
Type	Displays the type of DNS mapping, if any, on the controller or service platform.

The **IPv6v Hop Limit** table displays the following:

Hop Limit	Lists the maximum number of times IPv6 traffic can hop. The IPv6 header contains a hop limit field that controls the number of hops a datagram can be sent before being discarded (similar to the TTL field in an IPv4 header).

The **IPv6 Delegated Prefixes** table displays the following:

IPv6 Delegated Prefix	If IPv6, prefix delegation is used to assign a network address prefix, configuring the controller or service platform with the prefix.
Prefix Name	Lists the 32 character maximum name for the IPv6 delegated prefix used as an easy to remember alias for an entire IPv6 address.
DHCPv6 Client State	Displays the current DHCPv6 client state as impacted by the IPv6 delegated prefix.
Interface Name	Lists the interface over which IPv6 prefix delegation occurs.
T1 timer (seconds)	Lists the amount of time in seconds before the DHCP T1 (delay before renew) timer expires.
T2 timer (seconds)	Lists the amount of time in seconds before the DHCP T2 (delay before rebind) timer expires.
Last Refreshed (seconds)	Lists the time, in seconds, since IPv6 prefix delegation has been updated.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the IPv6 formatted addresses remains in a preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime.
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the IPv6 formatted address remains in a valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

15.3.3 Cluster Peers

► *Controller Statistics*

Refer to the *Cluster Peers* screen to review device address and version information for peer devices within a cluster.

To view controller or service platform cluster peer statistics:

- 1 Select the **Statistics** tab from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Cluster Peers** from the left-hand side of the UI.

Wireless Controller	MAC Address	Type	RF Domain Name	Online	Version
<u>SJCALPHAWLC-S</u>	84-24-8D-7F-34-23	NX9600	<u>CA107-SJC</u>	✓	5.8.3.0-031D

Row Count: 1

[Refresh](#)

Figure 15-40 *Wireless Controller - Cluster Peers screen*

The **Cluster Peers** screen displays the following:

Wireless Controller	Displays the IP addresses of current cluster member controller or service platform. The name displays in the form of a link that can be selected to display a detailed description of the controller or service platform's configuration.
MAC Address	Displays the MAC addresses of current cluster members.
Type	Displays the type of cluster peer (by controller or service platform model).
RF Domain Name	Displays each member's RF Domain name. The name displays in the form of a link that can be selected to display a detailed description of the RF Domain's configuration.
Online	Displays whether a controller or service platform is online. If online, a green check mark displays, if it is offline a red X displays.
Version	Displays the numeric firmware version currently running on the controller or service platform. Use this version as the basis for comparison on whether newer versions are available from the support site that may provide increased functionality and a broader feature set.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.4 Web-Filtering

► *Controller Statistics*

The *Web-Filtering* screen displays information on Web requests for content and whether the requests were blocked or approved based on URL filter settings defined for the selected controller or service platform. A URL filter is comprised of several filter rules. A whitelist bans all sites except the categories and URL lists defined in the whitelist. The blacklist allows all sites except the categories and URL lists defined in the blacklist.

To view this controller's Web filter statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Web-Filtering**.

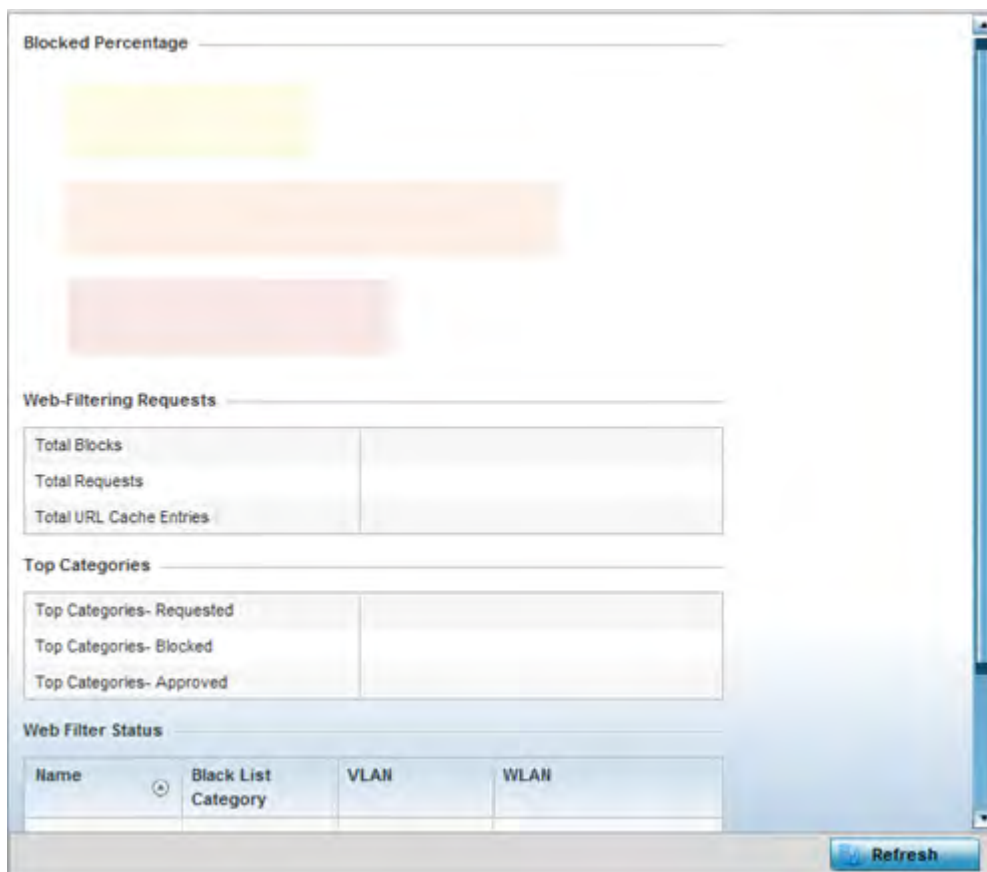


Figure 15-41 Wireless Controller - Web Filtering screen

The **Web-Filtering Requests** field displays the following information:

Total Blocks	Lists the number of Web request hits against content blocked in the URL blacklist.
Total Requests	Lists the total number of requests for URL content cached locally on this controller or service platform.
Total URL Cache Entries	Displays the number of chached URL data entries made on this controller or service platform on the request of requesting clients requiring URL data managed by the controller or service platform and their respective whitelist or blacklist.

The **Top Categories** field helps administrators assess the content most requested, blocked and approved based on the defined whitelist and blacklist permissions:

Top Categories - Requested	Lists those Web content categories most requested by clients managed by this controller or service platform. Use this information to assess whether the permissions defined in the blacklist and whitelist optimally support these client requests for cached Web content.

Top Categories - Blocked	Lists those Web content categories blocked most often for requesting clients managed by this controller or service platform. Use this information to periodically assess whether the permissions defined in the blacklist and whitelist still restrict the desired cached Web content from requesting clients. Remember, a whitelist bans all sites except the categories and URL lists defined in the whitelist. The blacklist allows all sites except the categories and URL lists defined in the blacklist.
Top Categories - Approved	Lists those Web content categories approved most often on behalf of requesting clients managed by this controller or service platform. Periodically review this information to assess whether this cached and available Web content still adhere's to your organization's standards for client access.

The **Web Filter Status** field displays the following information:

Name	Displays the name of the filter whose URL rule set has been invoked.
Blacklist Category	Lists the blacklist category whose URL filter rule set has caused data to be filtered to a requesting client. Periodically assess whether these rules are still relevant to the data requirements of requesting clients.
VLAN	Lists the impacted controller or service platform VLAN whose Web data traffic has been filtered based on the restrictions in the listed blacklist category.
WLAN	Lists the impacted controller or service platform WLAN whose Web data traffic has been filtered based on the restrictions in the listed blacklist category. Periodically assess whether clients are segregated to the correct WLAN based on their cached Web data requirements and impending filter rules.

4 Periodically select **Refresh** to update this screen to its latest values.

15.3.5 Application Visibility (AVC)

► *Controller Statistics*

Controllers and service platforms can inspect every byte of each application header packet allowed to pass their managed radio devices. When an application is recognized and classified by the WiNG application recognition engine, administrator defined actions can be applied to that specific application. For information on categorizing, filtering and logging the application data allowed to proliferate the controller or service platform managed network, refer to *Application Policy on page 7-54* and *Application on page 7-58*.

To view controller or service platform application utilization statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Application Visibility (AVC)**.

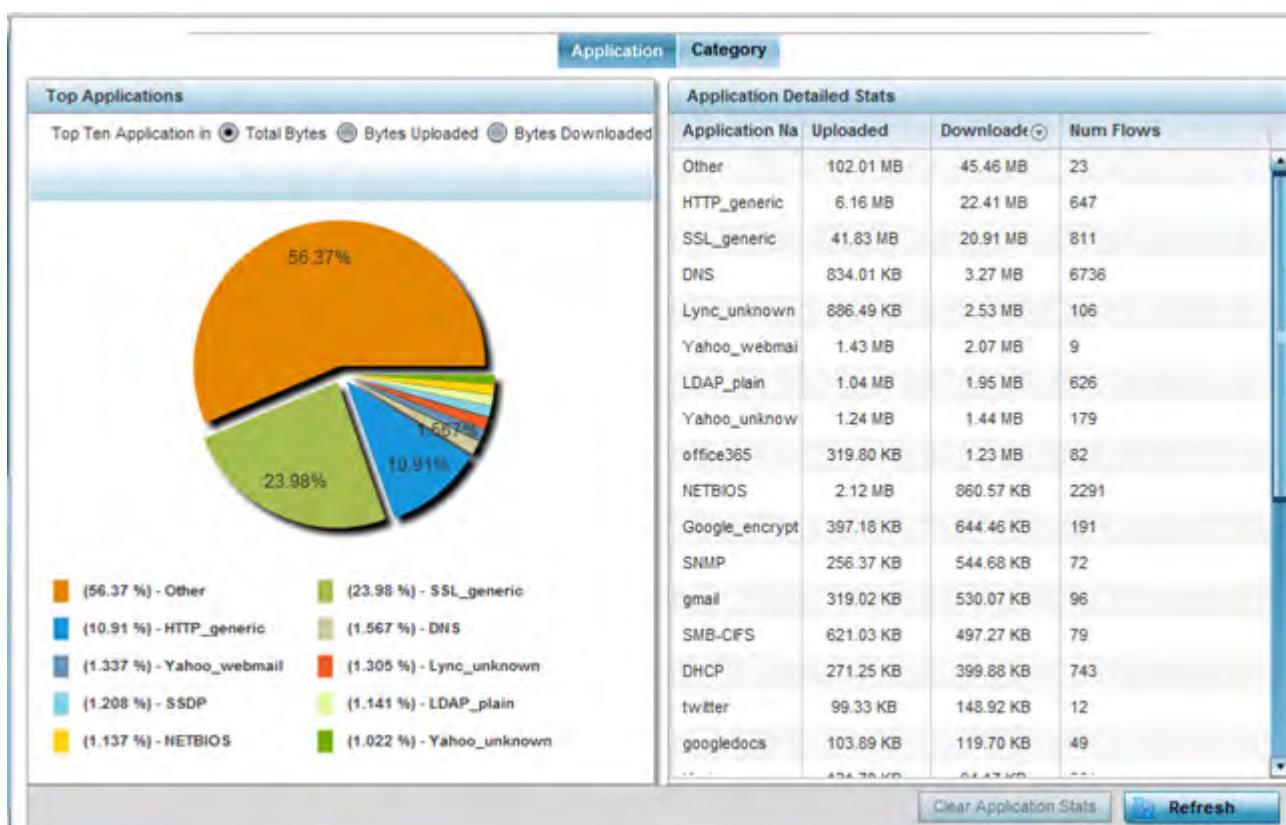


Figure 15-42 Controller - Application Visibility

- 4 Refer to the **Top Applications** graph to assess the most prolific, and allowed, application data passing through the controller and service platform.

Total Bytes	Displays the top ten utilized applications in respect to total data bytes passing through the controller or service platform managed network. These are only the administrator <i>allowed</i> applications approved for proliferation within the controller or service platform managed network.
Bytes Uploaded	Displays the top ten applications in respect to total data bytes uploaded through the controller or service platform managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten applications in respect to total data bytes downloaded from the controller or service platform managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).

- 5 Refer to the **Application Detailed Stats** table to assess specific application data utilization:

Application Name	Lists the allowed application name whose data (bytes) are passing through the controller or service platform managed network
Uploaded	Displays the number of uploaded application data (in bytes) passing through the controller or service platform managed network.

Downloaded	Displays the number of downloaded application data (in bytes) passing through the controller or service platform managed network.
Num Flows	Lists the total number of application data flows passing through the controller or service platform for each listed application. An application flow can consist of packets in a specific connection or media stream. Application packets with the same source address/port and destination address/port are considered one flow.
Clear Application Stats	Select this option to clear the application assessment data counters and begin a new assessment. Selecting this option will not clear category stats, just application stats.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

6 Select the **Category** tab.

Categories are existing WiNG or user defined application groups (video, streaming, mobile, audio etc.) that assist administrators in filtering (allowing or denying) application data. For information on categorizing application data, refer to [Application Policy on page 7-54](#) and [Application on page 7-58](#).

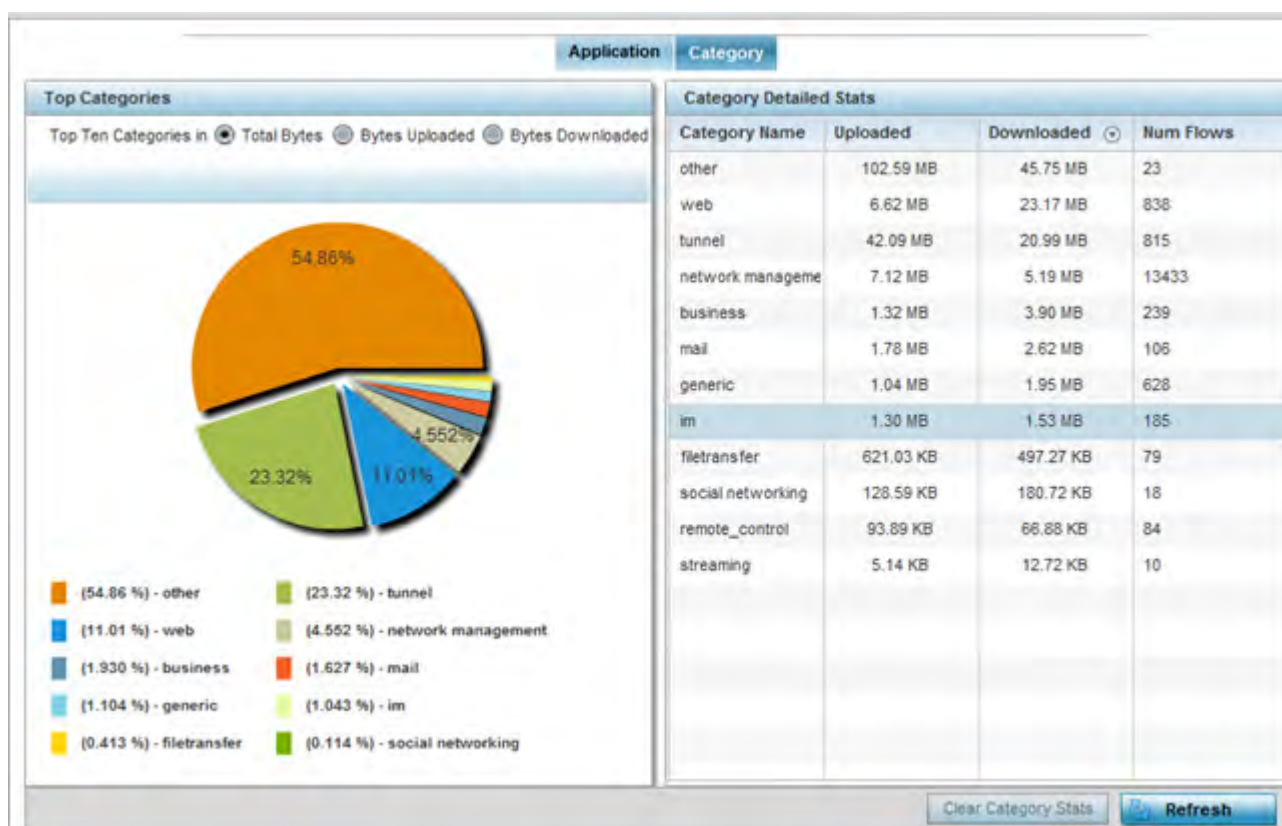


Figure 15-43 Controller - Application Category Visibility

- 7 Refer to the **Top Categories** graph to assess the most prolific, and allowed, application data categories utilized by the controller or service platform.

Total Bytes	Displays the top ten application categories in respect to total data bytes passing through the controller or service platform managed network. These are only the administrator <i>allowed</i> application categories approved for proliferation within the controller or service platform managed network.
Bytes Uploaded	Displays the top ten application categories in respect to total data bytes uploaded through the controller or service platform managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten application categories in respect to total data bytes downloaded from the controller or service platform managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories and categories or adjusting their precedence (priority).

- 8 Refer to the **Category Detailed Stats** table to assess specific application category data utilization:

Category Name	Lists the allowed category whose application data (in bytes) is passing through the controller or service platform network.
Uploaded	Displays the number of uploaded application category data (in bytes) passing the through the controller or service platform managed network.
Downloaded	Displays the number of downloaded application category data (in bytes) passing the through the controller or service platform managed network.
Num Flows	Lists the total number of application category data flows passing through controller or service platform managed devices. A category flow can consist of packets in a specific connection or media stream. Packets with the same source address/port and destination address/port are considered one flow.
Clear Category Stats	Select this option to clear the application category assessment data counters and begin a new assessment. Selecting this option will not clear application stats, just category stats.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.3.6 Application Policy

► *Controller Statistics*

When an application is recognized and classified by the WiNG application recognition engine, administrator defined actions can be applied to that specific application. An application policy defines the rules or actions executed on recognized HTTP (Facebook), enterprise (Webex) and peer-to-peer (gaming) applications or application-categories.

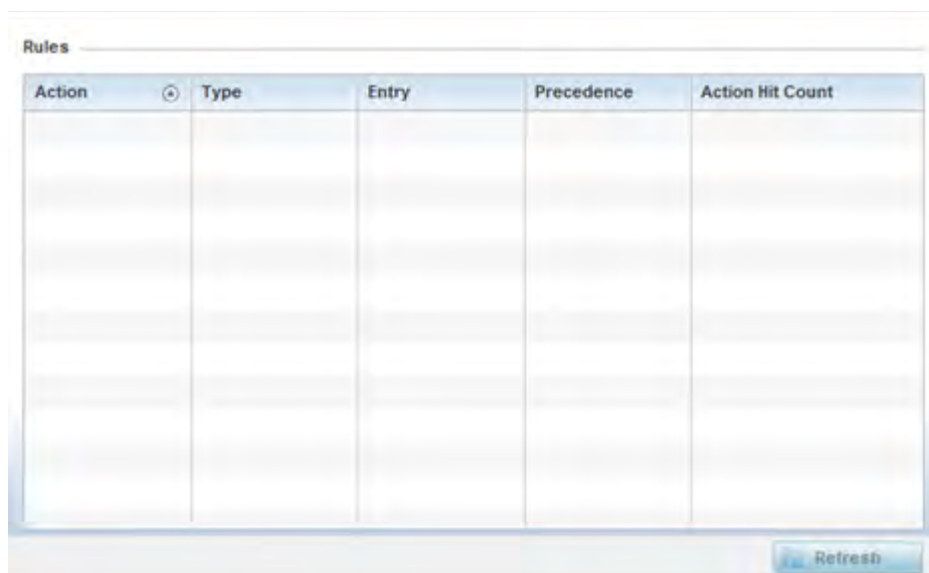
For each rule defined, a precedence is assigned to resolve conflicting rules for applications and categories. A deny rule is exclusive, as no other action can be combined with a deny. An allow rule is redundant with other actions,

since the default action is allow. An allow rule is useful when wanting to deny packets for a category, but wanting to allow a few applications in the same category to proceed. In such a cases, add an allow rule for applications with a higher precedence then a deny rule for that category.

Mark actions mark packets for a recognized application and category with DSCP/8021p values used for QoS. Rate-limits create a rate-limiter applied to packets recognized for an application and category. Ingress and egress rates need to be specified for the rate-limiter, but both are not required. Mark and rate-limit are the only two actions that can be combined for an application and category. All other combinations are invalid.

To view controller or service platform application policy statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Application Policy**.



Action	Type	Entry	Precedence	Action Hit Count

Figure 15-44 Controller - Application Policy

- 4 Refer to the **Rules** table to review the results of the application policies put in place thus far from this managing controller or service platform.

Action	Displays the action executed on the listed application. <i>Allow</i> - Allows packets for a specific application and its defined category type (social networking etc.). This is the default <i>Deny</i> - Denies (restricts) the action applied to a specific application or a specific application category <i>Mark</i> - Marks recognized packets with DSCP/8021p value <i>Rate-limit</i> - Rate limits packets from specific application types.
Type	Displays the application policy type applied.
Precedence	Lists the priority (from 1 - 256) for the application policy rule. The lower the value, the higher the priority assigned to this rule's enforcement action and the category and application assigned. A precedence also helps resolve conflicting rules for applications and categories.

Action Hit Count	Displays the number of times each listed application policy action has been triggered.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.3.7 Device Upgrade

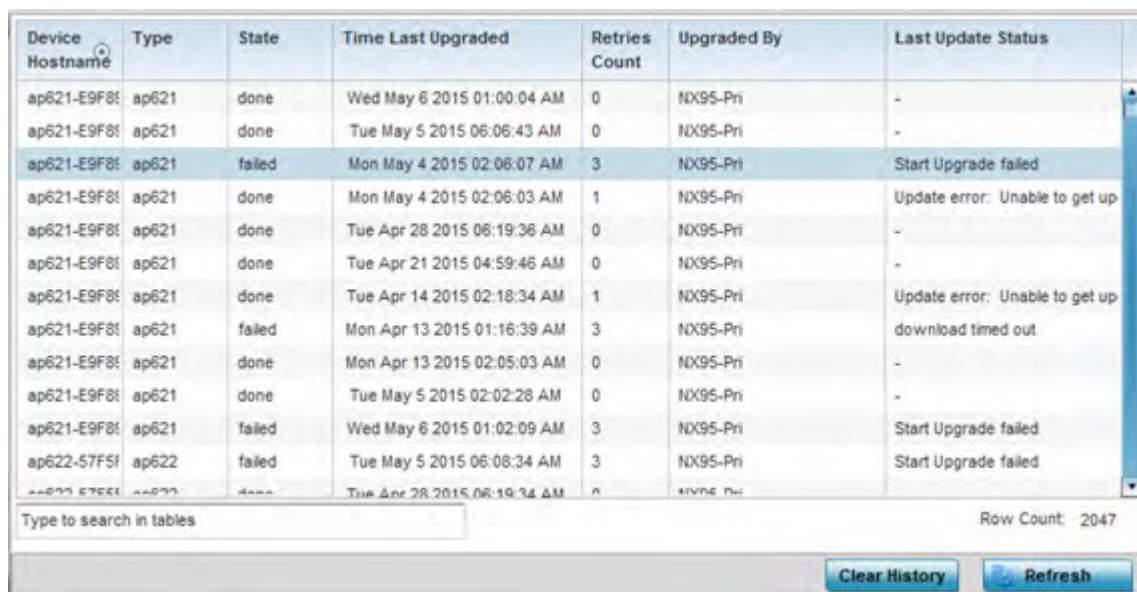
► Controller Statistics

The *Device Upgrade* screen displays information about the devices receiving updates within the controller or service platform managed network. Use this screen to gather version data, install firmware images, boot an image and upgrade status.

Controllers, service platforms or Access Points can be RF domain managers capable of receiving device firmware files from the NOC (NX7500 or NX9000 series service platforms) then provisioning other devices within their same RF domain. Controllers, service platforms and Access Points can now all update the firmware of different device models within their RF domain. However, firmware updates cannot be made simultaneously to devices in different site deployments.

To view the upgrade statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Device Upgrade**.



Device Hostname	Type	State	Time Last Upgraded	Retries Count	Upgraded By	Last Update Status
ap621-E9F8f	ap621	done	Wed May 6 2015 01:00:04 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	done	Tue May 5 2015 06:06:43 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	failed	Mon May 4 2015 02:08:07 AM	3	NX95-Pri	Start Upgrade failed
ap621-E9F8f	ap621	done	Mon May 4 2015 02:06:03 AM	1	NX95-Pri	Update error: Unable to get up
ap621-E9F8f	ap621	done	Tue Apr 28 2015 06:19:36 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	done	Tue Apr 21 2015 04:59:46 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	done	Tue Apr 14 2015 02:18:34 AM	1	NX95-Pri	Update error: Unable to get up
ap621-E9F8f	ap621	failed	Mon Apr 13 2015 01:16:39 AM	3	NX95-Pri	download timed out
ap621-E9F8f	ap621	done	Mon Apr 13 2015 02:05:03 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	done	Tue May 5 2015 02:02:28 AM	0	NX95-Pri	-
ap621-E9F8f	ap621	failed	Wed May 6 2015 01:02:09 AM	3	NX95-Pri	Start Upgrade failed
ap622-57F5f	ap622	failed	Tue May 5 2015 06:08:34 AM	3	NX95-Pri	Start Upgrade failed
ap622-57F5f	ap622	done	Tue Apr 28 2015 06:19:34 AM	0	NX95-Pri	-

Type to search in tables

Row Count: 2047

Clear History Refresh

Figure 15-45 Wireless Controller - Device Upgrade screen

The **Upgrade** screen displays the following information:

Device Hostname	Displays the administrator assigned hostname of the device receiving the update.
Type	Displays the model type of the device receiving a firmware update from the provisioning controller or service platform.
State	Displays the current state of the Access Point upgrade (<i>done</i> , <i>failed</i> etc.).

Time Last Upgraded	Displays the date and time of the last successful upgrade operation.
Retries Count	Displays the number of retries made in an update operation.
Upgraded By	Displays the MAC address of the controller or service platform that performed the upgrade operation.
Last Update Status	Displays the status of the last upgrade operation (Start Upgrade, Update error etc.).
Clear History	Select the <i>Clear History</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.8 Mirroring

► *Controller Statistics*

NX4524 and NX6524 model service platforms have the ability to mirror data packets transmitted or received on any of their GE ports (GE port 1 - 24). Both transmit and receive packets can be mirrored from a source to a destination port as needed to provide traditional spanning functionality on the 24 GE ports.

Port mirroring is not supported on NX4500 or NX6500 models, as they only utilize GE ports 1 - 2. Additionally, port mirroring is not supported on uplink (up) ports or wired ports on any controller or service platform model.

To view NX4524 or NX6524 model service platform port mirroring statistics:

- 1 Select the **Statistics** tab from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Mirroring** from the left-hand side of the UI.

[illegible]

Figure 15-46 *Wireless Controller - Mirroring screen*

The **Mirroring** screen displays the following statistical data:

Source	Lists the GE port (1 - 24) used as the data source to span packets to the selected destination port. The packets spanned from the selected source to the destination depend on whether <i>Inbound</i> , <i>Outbound</i> or <i>Any</i> was selected as the direction. A source port cannot be a destination port.
Destination	Displays the GE port (1 - 24) used as the port destination to span packets from the selected source. The destination port serves as a duplicate image of the source port and can be used to send packets to a network diagnostic without disrupting the behavior on the original port. The destination port transmits only mirrored traffic and does not forward received traffic. Additionally, address learning is disabled on the destination port.
Direction	Lists the direction data packets are spanned from the selected source to the defined destination. Packets spanned from the source to the destination depend on whether <i>Inbound</i> (received packets only), <i>Outbound</i> (transmitted packets only) or <i>Any</i> (packets in either direction) was selected.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.9 Adoption

► *Controller Statistics*

The *Adoption* screens lists Access Points adopted by the controller or service platform, and includes model, RF Domain membership, configuration status and device uptime information. For additional AP adoption information, including an adoption history and pending adoptions, see:

- *AP Adoption History*
- *Pending Adoptions*

To view device adoption statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Adoption > Adopted Devices** from the left-hand side of the UI.

Device	Type	RF Domain Name	Model Number	Status	Errors	Adopter Hostname	Adoption Time	Startup Time
ap622-57F5F0	AP62	simba	AP-0622-I	configured		rx9500-0C9848	Fri May 24 20:13:00	Fri May 24 20:13:00
ap622-58E4A0	AP62	simba	AP-0622-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap650-312808	AP65	rt 4	AP-0650-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap650-3129EC	AP65	rt 4	AP-0650-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap650-312A10	AP65	default	AP-0650-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap6511-8A4B15	AP65	rt 3	AP-6511-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap6521-970CC6	AP65	CN	AP-6521-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap6532-3118E0	AP65	rt 2	AP-6532-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap6532-34503C	AP65	rt 1	AP-6532-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00
ap6532-347110	AP65	rt 4US	AP-6532-I	configured		rx9500-0C9848	Wed May 22 10:13:00	Wed May 22 10:13:00

Type to search in tables

Row Count: 24

Refresh

Figure 15-47 Wireless Controller - Adopted Devices screen

The **Adopted Devices** screen displays the following:

Device	Displays the name assigned to the adopted device by the management software. The Access Point name displays as a link that can be selected to display configuration and network address information in greater detail.
Type	Lists the model type of each Access Point managed by the selected controller or service platform (the controller or service platform listed in the Adopter Hostname column).
RF Domain Name	Displays the RF Domain memberships of each listed adopted device.
Model Number	Displays the model number of the adopted device.
Status	Lists whether an adopted Access Point has been configured (provisioned) by its connected Access Point or service platform.
Errors	Lists any errors encountered when the each listed Access Point was adopted by the controller or service platform.
Adopter Hostname	Lists the hostname assigned to the adopting controller or service platform.
Adoption Time	Displays a timestamp for each listed Access Point reflecting when the device was adopted by the controller or service platform.
Startup Time	Lists the time the adopted device was last started up and detected on the network.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

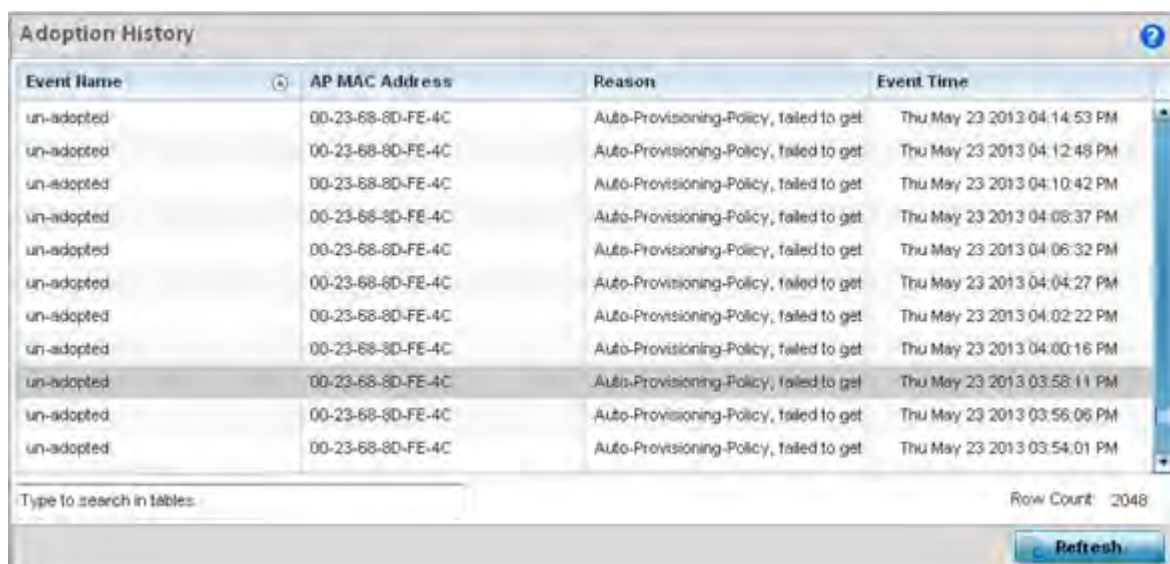
15.3.9.1 AP Adoption History

► Controller Statistics

The *AP Adoption History* screen displays a list of devices adopted to the controller or service platform managed network. Use this screen to view a list of devices and their current status.

To view adopted AP Adoption History statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Adoption > AP Adoption History** from the left-hand side of the UI.



The screenshot shows the 'Adoption History' window with a table containing the following data:

Event Name	AP MAC Address	Reason	Event Time
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:14:53 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:12:48 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:10:42 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:08:37 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:06:32 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:04:27 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:02:22 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 04:00:16 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 03:58:11 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 03:56:06 PM
un-adopted	00-23-68-8D-FE-4C	Auto-Provisioning-Policy, failed to get	Thu May 23 2013 03:54:01 PM

Below the table is a search bar labeled 'Type to search in tables:' and a 'Refresh' button. The 'Row Count' is displayed as 2048.

Figure 15-48 Wireless Controller - AP Adoption History screen

The **AP Adoption History** screen displays the following

Event Name	Displays the current adoption status of each AP as either <i>adopted</i> or <i>un-adopted</i> .
AP MAC Address	Displays the <i>Media Access Control</i> (MAC) address of each Access Point that the controller or service platform has attempted to adopt.
Reason	Displays the adoption reason message string for each event in the adoption history statistics table.
Event Time	Displays the day, date and time for each Access Point adoption attempt by this controller or service platform.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.9.2 Pending Adoptions

► Controller Statistics

The *Pending Adoptions* screen displays devices still pending (awaiting) adoption to the controller or service platform managed network. Review this data to assess whether adoption is still beneficial and to troubleshoot issues preventing adoption.

To view adopted AP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Adoption > Pending Adoptions** from the left-hand side of the UI.

MAC Address	Type	IP Address	VLAN	Reason	Discovery Option	Last Seen
84-24-8D-18	ap7532	10.0.1.120	0	Auto-Provisioning-Poli	fqdn: IL-01-188480.ping	3/1/2016 09:13:19 AM
84-24-8D-89	ap7532	10.80.216.21	0	Auto-Provisioning-Poli	fqdn: IL-02-89FD68.ZEntei	3/1/2016 09:13:10 AM

Type to search in tables

Row Count: 2

Add to Devices Refresh

Figure 15-49 Wireless Controller - Pending Adoptions screen

The **Pending Adoptions** screen provides the following

MAC Address	Displays the MAC address of the device pending adoption.
Type	Displays the AP's model type.
IP Address	Displays the current IP address of the device pending adoption.
VLAN	Displays the current VLAN number (virtual interface ID) of the device pending adoption.
Reason	Displays the status code as to why the device is still pending adoption.
Discovery Option	Displays the discovery option code for each AP listed pending adoption.
Last Seen	Displays the date and time stamp of the last time the device was seen. Click the arrow next to the date and time to toggle between standard time and UTC.
Add to Devices	Select a device from amongst those displayed and select <i>Add to Devices</i> to validate the adoption of the selected device and begin the process of connecting the device to the controller or service platform managed network.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.3.10 AP Detection

► Controller Statistics

The *AP Detection* screen displays potentially hostile Access Points, their SSIDs, reporting AP, and so on. Continuously revalidating the credentials of detected devices reduces the possibility of an Access Point hacking into the controller or service platform managed network.

To view AP detection statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **AP Detection** from the left-hand side of the UI.

Unsanctioned AP	Reporting AP	SSID	AP Mode	Radio Type	Channel	RSSI	Last Seen
 11:22:33:44:55	AP1-ControllerA-AP650	evilbit	Ad Hoc	11a	11	60 dBm	10s

Type to search in tables

Row Count: 0

Clear All
Refresh

Figure 15-50 *Wireless Controller - AP Detection screen*

The **AP Detection** screen displays the following:

Unsanctioned AP	Displays the MAC address of unsanctioned APs detected within the controller or service platform radio coverage area. Unsanctioned APs are detected APs without deployment approval.
Reporting AP	Lists the Access Point whose radio detected the unsanctioned AP. The Access Point displays as a link that can be selected to display configuration and network address information in greater detail.
SSID	Displays the SSID of each unsanctioned AP.
AP Mode	Displays the operating mode of the unsanctioned device.
Radio Type	Displays the unsanctioned AP's radio type. The radio can be 802.11b, 802.11bg, 802.11gn, 802.11a or 802.11an.
Channel	Displays the channel where the unsanctioned AP was detected.
RSSI	Lists the <i>Received Signal Strength Indicator</i> (RSSI) for each listed AP.

Last Seen	Displays when the unsanctioned AP was last seen by the detecting AP.
Clear All	Select <i>Clear All</i> to clear all the screen's statistic counters and begin detecting new Access Points.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

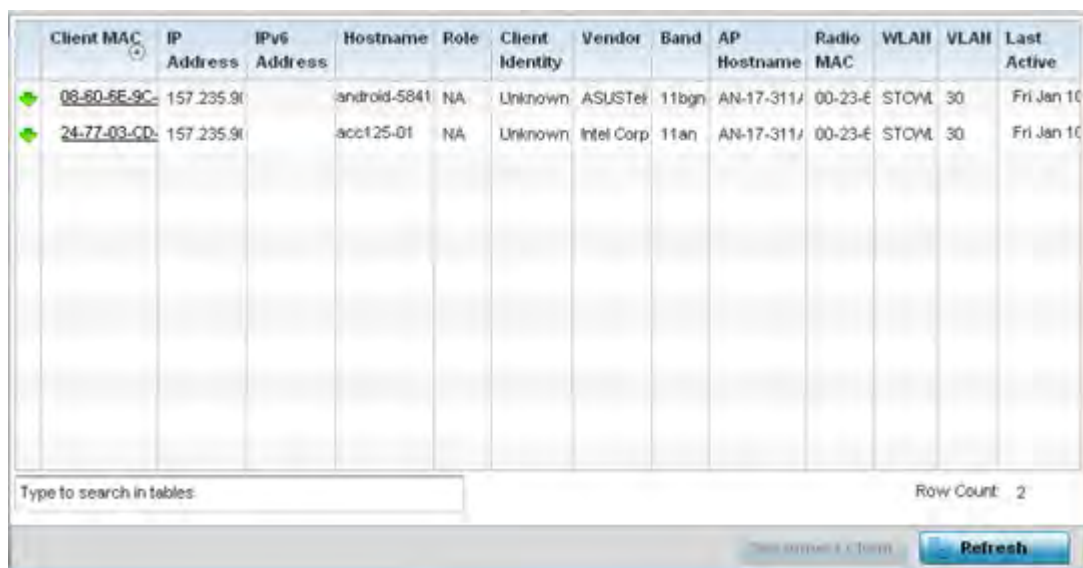
15.3.11 Guest User

► Controller Statistics

The *Guest User* screen displays read only device information for guest clients associated with the selected controller or service platform. Use this information to assess if configuration changes are required to improve network performance.

To view a controller or service platform's connected guest user client statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Guest User** from the left-hand side of the UI.



Client MAC	IP Address	IPv6 Address	Hostname	Role	Client Identity	Vendor	Band	AP Hostname	Radio MAC	WLAN	VLAN	Last Active
08-80-5E-9C-...	157.235.91		android-5841	NA	Unknown	ASUSTek	11bgn	AN-17-311/	00-23-E	STOM	30	Fri Jan 10
24-77-03-CD-...	157.235.91		acct25-01	NA	Unknown	Intel Corp	11an	AN-17-311/	00-23-E	STOM	30	Fri Jan 10

Type to search in tables: Row Count: 2

[Refresh](#)

Figure 15-51 Wireless Controller - Guest User screen

The **Guest User** screen displays the following:

Client MAC	Displays the hardcoded MAC address assigned to the guest client at the factory and can not be modified. The address displays as a link that can be selected to display configuration and network address information in greater detail.
IP Address	Displays the unique IP address of the guest client. Use this address as necessary throughout the applet for filtering and device intrusion recognition and approval.
IPv6 Address	Displays the current IPv6 formatted IP address a listed guest client is using as a network identifier. IPv6 is the latest revision of the <i>Internet Protocol</i> (IP) designed to replace IPv4. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.

Hostname	Displays the hostname (MAC addresses) of connected guest clients. The hostname displays as a link that can be selected to display configuration and network address information in greater detail.
Role	Lists the guest client's defined role within the controller or service platform managed network.
Client Identity	Displays the unique vendor identity of the listed device as it appears to its adopting controller or service platform.
Vendor	Displays the name of the client vendor (manufacturer).
Band	Displays the 2.4 or 5 GHz radio band on which the listed guest client operates.
AP Hostname	Displays the administrator assigned hostname of the Access Point to which this guest client is associated.
Radio MAC	Displays the MAC address of the radio which the guest client is connected.
WLAN	Displays the name of the WLAN the guest client is currently assigned for its Access Point interoperation.
VLAN	Displays the VLAN ID the guest client's connected Access Point has defined as a virtual interface.
Last Active	Displays the time when this guest client was last seen (or detected) by a device within the controller or service platform managed network.
Disconnect Client	Select a specific client and select the <i>Disconnect Client</i> button to terminate this guest client's connection to its controller or service platform connected Access Point radio.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.3.12 Wireless LANs

► *Controller Statistics*

The *Wireless LANs* statistics screen displays performance statistics for each controller or service platform managed WLAN. Use this information to assess if configuration changes are required to improve connected Access Point and client performance.

To view the wireless LAN statistics for the controller or service platform:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Wireless LANs** from the left-hand side of the UI.

WLAN Name	SSID	Traffic Index	Radio Count	Tx Bytes	Tx User Data Rate	Rx Bytes	Rx User Data Rate
GUEST-ACCESS	motorola-guest	0 (Very Low)	0	0	0 kbps	0	0 kbps
STCWLB	stcwlib	0 (Very Low)	0	0	0 kbps	0	0 kbps

Type to search in tables

Row Count: 2

Disconnect All Clients Refresh

Figure 15-52 Wireless Controller - Wireless LANs screen

The **Wireless LANs** screen displays the following:

WLAN Name	Displays the name of the WLANs the controller or service platform is currently utilizing for client connections and QoS segregation.
SSID	Displays the Service Set ID each listed WLAN is using as an identifier.
Traffic Index	Displays the traffic utilization index, which measures how efficiently the traffic medium is used. It's defined as the percentage of current throughput relative to the maximum possible throughput. Traffic indices are: 0 – 20 (very low utilization) 20 – 40 (low utilization) 40 – 60 (moderate utilization) 60 and above (high utilization)
Radio Count	Displays the number of radios currently in use by devices utilizing the listed controller or service platform managed WLAN.
Tx Bytes	Displays data transmit activity (in bytes) on each listed WLAN.
Tx User Data Rate	Displays the average user data rate on each listed WLAN.
Rx Bytes	Displays the data received in bytes on each listed WLAN.
Rx User Data Rate	Displays the average user data rate for packets received by controller or service platform connected devices using this WLAN.
Disconnect All Clients	Select <i>Disconnect All Clients</i> to terminate the all client WLAN memberships.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.3.13 Policy Based Routing

► Controller Statistics

The *Policy Based Routing* statistics screen displays statistics for selective path packet redirection. PBR can optionally mark traffic for preferential services (QoS). PBR is applied to incoming routed packets, and a route-map

is created containing a set of filters and associated actions. Based on the actions defined in the route-map, packets are forwarded to the next relevant hop. Route-maps are configurable under a global policy called *routing-policy*, and applied to profiles and devices.

To review controller PBR statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Policy Based Routing**.

	Precedence	Primary Next Hop IP	Primary Next Hop State	Secondary Next Hop IP	Secondary Next Hop State	Default Next Hop IP	Default Next Hop State
➡	10	22.33.33.11	UP	22.33.33.12	UNREACHABLE	22.33.33.13	UNKNOWN
➡	20	22.33.33.21	UP	22.33.33.22	UNREACHABLE	22.33.33.23	UNKNOWN

Type to search in tables

Row Count: 2

Refresh

Figure 15-53 Wireless Controller - Policy Based Routing screen

The **Policy Based Routing** screen displays the following:

Precedence	Lists the numeric precedence (priority) assigned to each listed PBR configuration. A route-map consists of multiple entries, each carrying a precedence value. An incoming packet is matched against the route-map with the highest precedence (lowest numerical value).
Primary Next Hop IP	Lists the IP address of the virtual resource that, if available, is used with no additional route considerations.
Primary Next Hop State	Displays whether the primary hop is being applied to incoming routed packets.
Secondary Next Hop IP	If the primary hop is unavailable, a second resource is used. This column lists the address set for the alternate route in the election process.
Secondary Next Hop State	Displays whether the secondary hop is being applied to incoming routed packets.

Default Next Hop IP	If a packet subjected to PBR does not have an explicit route to the destination, the configured default next hop is used. This is either the IP address of the next hop or the outgoing interface. Only one default next hop is available. The difference between the next hop and the default next-hop is in case of former, PBR occurs first, then destination based routing. In case of the latter, the order is reverse.
Default Next Hop State	Displays whether the default hop is being applied to incoming routed packets.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

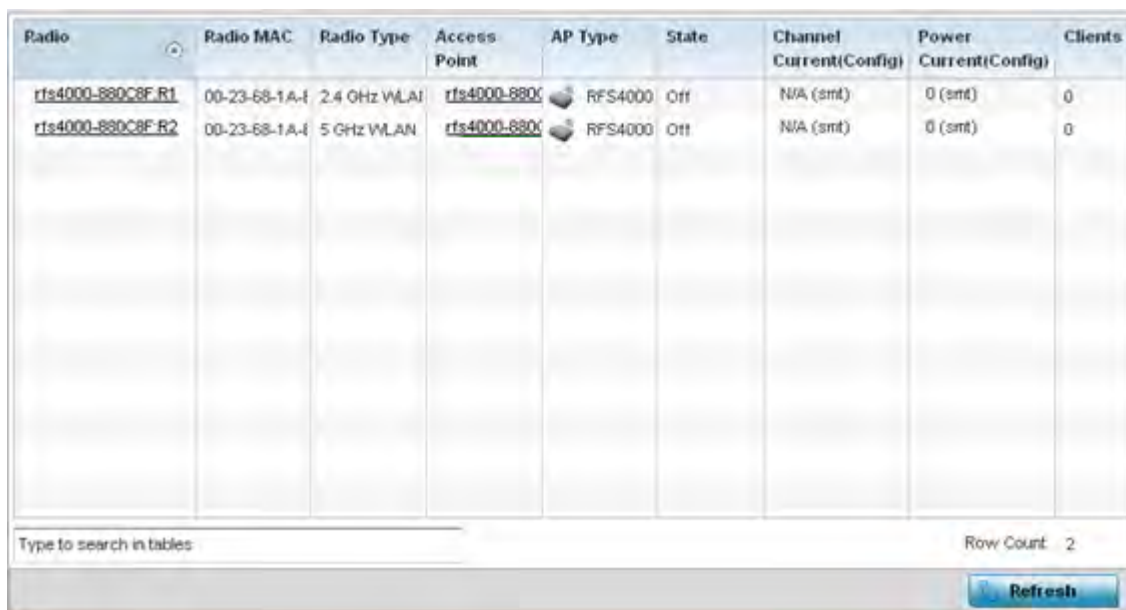
15.3.14 Radios

► Controller Statistics

The radio **Status** screen provides radio association data, including radio ID, connected APs, radio type, quality index and *Signal to Noise Ratio* (SNR).

To view the radio statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Radio** from the left-hand side of the UI.



Radio	Radio MAC	Radio Type	Access Point	AP Type	State	Channel Current(Config)	Power Current(Config)	Clients
rfs4000-880C8F.R1	00-23-68-1A-4	2.4 GHz WLAN	rfs4000-880C	RFS4000	Off	N/A (smf)	0 (smf)	0
rfs4000-880C8F.R2	00-23-68-1A-4	5 GHz WLAN	rfs4000-880C	RFS4000	Off	N/A (smf)	0 (smf)	0

Type to search in tables: _____ Row Count: 2

[Refresh](#)

Figure 15-54 Wireless Controller - Radio Status screen

The **Radios Status** screen provides the following information:

Radio	Displays the model and numerical value assigned to the radio as its unique identifier. Optionally, select the listed radio (it displays as a link) to display radio configuration information in greater detail.
Radio MAC	Displays the MAC address assigned to the radio as its unique hardware identifier.

Error Rate	Displays the average number of retries per packet. A high number indicates possible network or hardware problems.
Quality Index	Displays the client's RF quality. The RF quality index is the overall effectiveness of the RF environment, as a percentage of the connect rate in both directions as well as the retry rate and the error rate. RF quality index value can be interpreted as: 0 – 20 - very poor quality 20 – 40 - poor quality 40 – 60 - average quality 60 – 100 - good quality
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

5 Select **Traffic Statistics** from the expanded **Radios** menu.

Radio	Tx Bytes	Rx Bytes	Tx Packets	Rx Packets	Tx User Data Rate	Rx User Data Rate	Tx Dropped	Traffic Index
ap7532-1601A8.R1	456,625,23	83,719,736	441,152	716,717	0 kbps	0 kbps	6,008	✓ 0 (Very Low)
ap7532-1601A8.R2	24,786,973	356,973,37	288,189,66	363,111,41	0 kbps	0 kbps	104,863	✓ 0 (Very Low)

Type to search in tables

Row Count: 2

Refresh

Figure 15-56 *Wireless Controller - Radio Traffic Statistics screen*

The **Traffic Statistics** screen provides the following information:

Radio	Displays the name assigned to each listed radio. Each radio name displays as a link that can be selected to display radio configuration and network address information in greater detail.
Tx Bytes	Displays the amount of transmitted data in bytes for each radio.
Rx Bytes	Displays the amount of received data in bytes for each radio.
Tx Packets	Displays the amount of transmitted data in packets for each radio.
Rx Packets	Displays the amount of received data in packets for each radio.
Tx User Data Rate	Displays the average speed in kbps of data transmitted to users for each radio.
Rx User Data Rate	Displays the average speed (in kbps of data) received from users for each radio.
Tx Dropped	Displays the number of transmissions (packets) dropped by each listed radio. An excessive number of drops and a high error rate could be an indicator to lighten the radio's current load.

Traffic Index	Displays the traffic utilization index of each listed radio, which measures how efficiently the traffic medium is used. It's defined as the percentage of current throughput relative to the maximum possible throughput. Traffic indices are: <i>0 - 20</i> (very low utilization), <i>20 - 40</i> (low utilization), <i>40 - 60</i> (moderate utilization), and <i>60 and above</i> (high utilization).
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

► Controller Statistics

► Controller Statistics

The *Mesh* screen provides detailed statistics on each of Mesh capable client within the selected controller or service platform's radio coverage area.

To view Mesh statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Mesh** from the left-hand side of the UI.

[illegible]

Figure 15-57 *Wireless Controller - Mesh screen*

The **Mesh** screen displays the following:

Client	Displays the name assigned to each mesh client when added to the controller or service platform managed network.
Client Radio MAC	Displays the factory encoded <i>Media Access Control</i> (MAC) address of each device within the controller or service platform managed mesh network.

Portal	Mesh portals are mesh enabled devices connected to an external network that forward traffic in and out. Mesh devices must find paths to a portal to access the Internet. When multiple portals exist, the Mesh point must select one.
Portal Radio MAC	Lists the MAC addresses of those Access Points serving as mesh portals.
Connect Time	Displays the total (elapsed) connection time for each client within the controller or service platform managed mesh network.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest value.

15.3.16 Interfaces

► Controller Statistics

The *Interface* screen provides detailed statistics on each of the interfaces available on the selected controller or service platform. Use this screen to review the statistics for each interface. Interfaces vary amongst supported hardware model controllers and service platforms.

To review controller or service platform interface statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Interfaces** menu from the left-hand side of the UI.
- 4 Select **General**.



Figure 15-58 Wireless Controller - General Interface screen

Interface Statistics support the following:

- [General Interface Details](#)
- [IPv6 Address](#)
- [Multicast Groups Joined](#)
- [Network Graph](#)

15.3.16.1 General Interface Details

► Interfaces

The *General* tab provides information on a selected controller or service platform interface such as its MAC address, type and TX/RX statistics.

The **General** table displays the following:

Name	Displays the name of the controller or service platform interface ge1, up 1etc.
Interface MAC Address	Displays the MAC address of the interface.
IP Address	IP address of the interface.
IP Address Type	Displays the IP address type, either IPv4 or IPv6.
Secondary IP	Displays a list of secondary IP resources assigned to this interface.
Hardware Type	Displays the networking technology.
Index	Displays the unique numerical identifier for the interface.
Access Setting	Displays the VLAN mode as either <i>Access</i> or <i>Trunk</i> .
Access VLAN	Displays the tag assigned to the native VLAN.
Native VLAN	The native VLAN allows an Ethernet device to associate untagged frames to a VLAN when no 802.1Q frame is included in the frame. Additionally, the native VLAN is the VLAN untagged traffic is directed over when using a port in trunk mode.
Tagged Native VLAN	When a frame is tagged, the 12 bit frame VLAN ID is added to the 802.1Q header so upstream Ethernet devices know which VLAN ID the frame belongs to. The device reads the 12 bit VLAN ID and forwards the frame to the appropriate VLAN. When a frame is received with no 802.1Q header, the upstream device classifies the frame using the default or native VLAN assigned to the Trunk port. A native VLAN allows an Ethernet device to associate untagged frames to a VLAN when no 802.1Q frame is included in the frame.
Allowed VLANs	Displays the list of allowed virtual interface(s) on this interface.
Administrative Status	Displays whether the interface is currently UP or DOWN.
Operational Status	Lists whether the selected interface is currently UP (operational) or DOWN.

The **IPv6 Mode and MTU** table displays the following information:

IPv6 Mode	Lists the current IPv6 mode is utilized.
IPv6 MTU	Lists the IPv6 formatted largest packet size that can be sent over the interface.

The **Specification** table displays the following information:

Media Type	Displays the physical connection type of the interface. Medium types include: <i>Copper</i> - Used on RJ-45 Ethernet ports <i>Optical</i> - Used on fibre optic gigabit Ethernet ports
Protocol	Displays the routing protocol used by the interface.
MTU	Displays the <i>maximum transmission unit</i> (MTU) setting configured on the interface. The MTU value represents the largest packet size that can be sent over the interface. 10/100 Ethernet ports have a maximum setting of 1500.
Mode	The mode can be either: <i>Access</i> - The Ethernet interface accepts packets only from native VLANs. <i>Trunk</i> - The Ethernet interface allows packets from a list of VLANs you can add to the trunk.
Metric	Displays the metric associated with the interface's route.
Maximum Speed	Displays the maximum speed the interface uses to transmit or receive data.
Admin Speed	Displays the speed the port can transmit or receive. This value can be either <i>10</i> , <i>100</i> , <i>1000</i> or <i>Auto</i> . This value is the maximum port speed in Mbps. Auto indicates the speed is negotiated between connected devices.
Operator Speed	Displays the current speed of data transmitted and received over the interface.
Admin Duplex Setting	Displays the administrator's duplex setting.
Current Duplex Setting	Displays the interface as either <i>half duplex</i> , <i>full duplex</i> or <i>unknown</i> .

The **Traffic** table displays the following:

Good Octets Sent	Displays the number of octets (bytes) with no errors sent by the interface.
Good Octets Received	Displays the number of octets (bytes) with no errors received by the interface.
Good Packets Sent	Displays the number of good packets transmitted.
Good Packets Received	Displays the number of good packets received.
Mcast Pkts Sent	Displays the number of multicast packets sent through the interface.
Mcast Pkts Received	Displays the number of multicast packets received through the interface.
Ucast Pkts Sent	Displays the number of unicast packets sent through the interface.
Ucast Pkts Received	Displays the number of unicast packets received through the interface.
Bcast Pkts Sent	Displays the number of broadcast packets sent through the interface.
Bcast Pkts Received	Displays the number of broadcast packets received through the interface.
Packet Fragments	Displays the number of packet fragments transmitted or received through the interface.

Jabber Pkts	Displays the number of packets transmitted through the interface larger than the MTU.

The **Errors** table displays the following:

Bad Pkts Received	Displays the number of bad packets received through the interface.
Collisions	Displays the number of collisions over the selected interface.
Late Collisions	A late collision is any collision that occurs after the first 64 octets of data have been sent. Late collisions are not normal, and usually the result of out of specification cabling or a malfunctioning device.
Excessive Collisions	Displays the number of excessive collisions. Excessive collisions occur when the traffic load increases to the point a single Ethernet network cannot handle it efficiently.
Drop Events	Displays the number of dropped packets transmitted or received through the interface.
Tx Undersize Pkts	Displays the number of undersized packets transmitted through the interface.
Oversize Pkts	Displays the number of oversized packets transmitted through the interface.
MAC Transmit Error	Displays the number of failed transmits due to an internal MAC sublayer error (that's not a late collision), due to excessive collisions or a carrier sense error.
MAC Receive Error	Displays the number of received packets that failed due to an internal MAC sublayer (that's not a late collision), an excessive number of collisions or a carrier sense error.
Bad CRC	Displays the CRC error. The CRC is the 4 byte field at the end of every frame. The receiving station uses it to interpret if the frame is valid. If the CRC value computed by the interface does not match the value at the end of frame, it is considered as a bad CRC.

The **Receive Errors** table displays the following:

Rx Frame Errors	Displays the number of frame errors received at the interface. A frame error occurs when data is received, but not in an expected format.
Rx Length Errors	Displays the number of length errors received at the interface. Length errors are generated when the received frame length was either less or over the Ethernet standard.
Rx FIFO Errors	Displays the number of FIFO errors received at the interface. First-in First-out queueing is an algorithm that involves buffering and forwarding of packets in the order of arrival. FIFO entails no priority. There is only one queue, and all packets are treated equally. An increase in FIFO errors indicates a probable hardware malfunction.
Rx Missed Errors	Displays the number of missed packets. Packets are missed when the hardware received FIFO has insufficient space to store an incoming packet.
Rx Over Errors	Displays the number of overflow errors received. Overflows occur when a packet size exceeds the allocated buffer size.

The **Transmit Errors** field displays the following:

Tx Errors	Displays the number of packets with errors transmitted on the interface.
Tx Dropped	Displays the number of transmitted packets dropped from the interface.
Tx Aborted Errors	Displays the number of packets aborted on the interface because a clear-to-send request was not detected.
Tx Carrier Errors	Displays the number of carrier errors on the interface. This generally indicates bad Ethernet hardware or bad cabling.
Tx FIFO Errors	Displays the number of FIFO errors transmitted at the interface. <i>First-in First-Out</i> queueing is an algorithm that involves the buffering and forwarding of packets in the order of arrival. FIFO uses no priority. There is only one queue, and all packets are treated equally. An increase in the number of FIFO errors indicates a probable hardware malfunction.
Tx Heartbeat Errors	Displays the number of heartbeat errors. This generally indicates a software crash, or packets stuck in an endless loop.
Tx Window Errors	Displays the number of window errors transmitted. TCP uses a sliding window flow control protocol. In each TCP segment, the receiver specifies the amount of additional received data (in bytes) the receiver is willing to buffer for the connection. The sending host can send only up to that amount. If the sending host transmits more data before receiving an acknowledgment, it constitutes a window error.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest value.

15.3.16.2 IPv6 Address

► Interfaces

IPv6 is the latest revision of the *Internet Protocol* (IP) designed to replace IPv4. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.

To view controller or service platform IPv6 address utilization:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Interfaces** menu from the left-hand side of the UI.
- 4 Select the **IPv6 Address** tab.

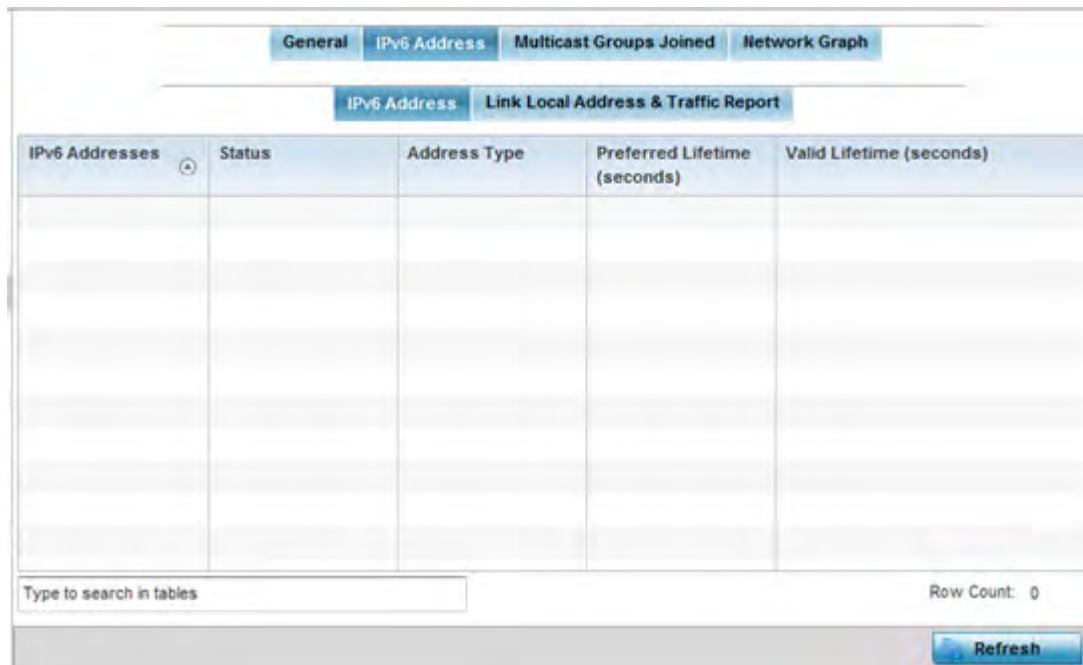


Figure 15-59 *Wireless Controller - Interface IPv6 Address screen*

- 5 The **IPv6 Addresses** table displays the following:

IPv6 Addresses	Lists the IPv6 formatted addresses currently utilized by the controller or service platform in the selected interface.
Status	Lists the current utilization status of each IPv6 formatted address currently in use by this controller or service platform's selected interface.
Address Type	Lists whether the address is unicast or multicast in its utilization over the selected controller or service platform interface.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the IPv6 formatted addresses remains in a preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime.
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the IPv6 formatted address remains in a valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

- 6 Select the **Link Local Address & Traffic Report** tab to assess data traffic and errors discovered in transmitted and received IPv6 formatted data packets.

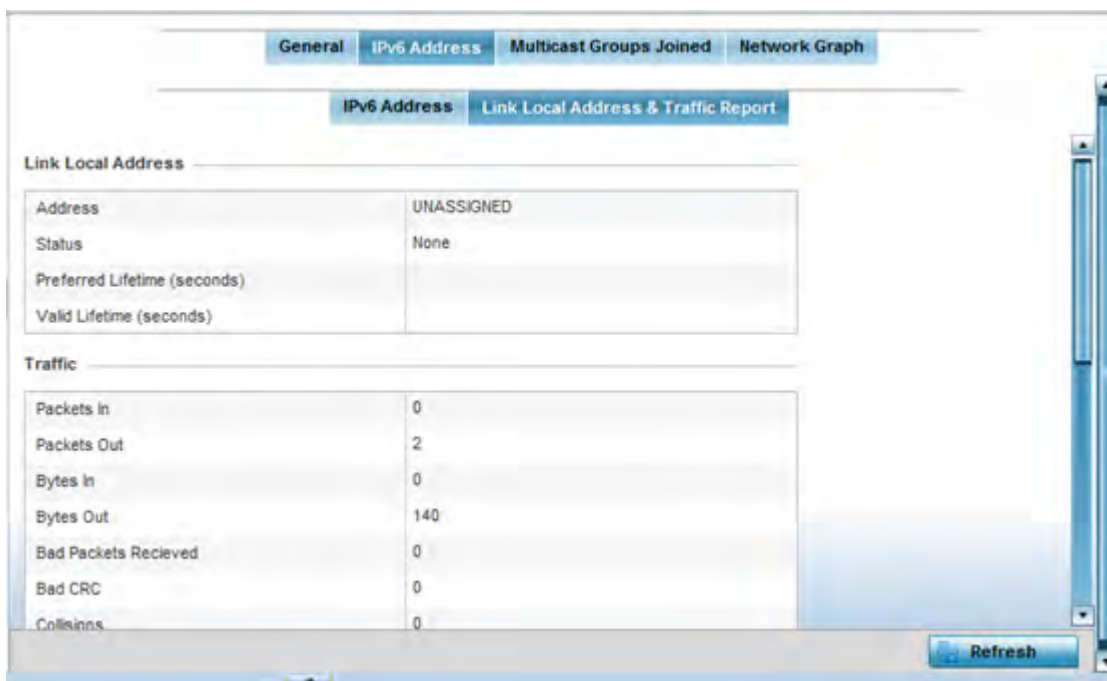


Figure 15-60 Wireless Controller - Interface IPv6 Address screen

7 Verify the following **Local Link Address** data for the IPv6 formatted address:

Address	Lists the IPv6 local link address. IPv6 requires a link local address assigned to every interface the IPv6 protocol is enabled on, even when one or more routable addresses are assigned.
Status	Lists the IPv6 local link address utilization status and its current availability.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the local link addresses remains in the preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime.
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the local link addresses remains in the valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

8 Verify the following IPv6 formatted **Traffic** data:

Packets In	Lists the number of IPv6 formatted data packets received on the selected controller or service platform interface since the screen was last refreshed.
Packets Out	Lists the number of IPv6 formatted data packets transmitted on the selected controller or service platform interface since the screen was last refreshed.
Bytes In	Displays the number of octets (bytes) with no errors received by the selected interface.
Bytes Out	Displays the number of octets (bytes) with no errors sent by the selected interface.

Bad Packets Received	Displays the number of bad IPv6 formatted packets received through the interface.
Bad CRC	Displays the CRC error. The CRC is the 4 byte field at the end of every frame. The receiving station uses it to interpret if the frame is valid. If the CRC value computed by the interface does not match the value at the end of frame, it is considered as a bad CRC.
Collisions	Displays the number of collisions over the selected interface. Excessive collisions occur when the traffic load increases to the point a single Ethernet network cannot handle it efficiently. A late collision is any collision that occurs after the first 64 octets of data have been sent. Late collisions are not normal, and usually the result of out of specification cabling or a malfunctioning device.

9 Review the following **Receive Errors** for IPv6 formatted data traffic:

Receive Length Errors	Displays the number of IPv6 length errors received at the interface. Length errors are generated when the received IPv6 frame length was either less or over the Ethernet standard.
Receive Over Errors	Displays the number of IPv6 overflow errors received. Overflows occur when a packet size exceeds the allocated buffer size.
Receive Frame Errors	Displays the number of IPv6 frame errors received at the interface. A frame error occurs when data is received, but not in an expected format.
Receive FIFO Errors	Displays the number of IPv6 FIFO errors received at the interface. <i>First-in First-out</i> queueing is an algorithm that involves buffering and forwarding of packets in the order of arrival. FIFO entails no priority. There is only one queue, and all IPv6 formatted packets are treated equally. An increase in FIFO errors indicates a probable hardware malfunction.
Receive Missed Errors	Displays the number of missed IPv6 formatted packets. Packets are missed when the hardware received FIFO has insufficient space to store an incoming packet.

10 Review the following **Transmit Errors** for IPv6 formatted data traffic:

Transmit Errors	Displays the number of IPv6 formatted data packets with errors transmitted on the interface.
Transmit Aborted Errors	Displays the number of IPv6 formatted packets aborted on the interface because a clear-to-send request was not detected.
Transmit Carrier Errors	Displays the number of IPv6 formatted carrier errors on the interface. This generally indicates bad Ethernet hardware or bad cabling.
Transmit FIFO Errors	Displays the number of IPv6 formatted FIFO errors transmitted at the interface. <i>First-in First-Out</i> queueing is an algorithm that involves the buffering and forwarding of packets in the order of arrival. FIFO uses no priority. There is only one queue, and all packets are treated equally. An increase in the number of FIFO errors indicates a probable hardware malfunction.
Transmit Heartbeat Errors	Displays the number of IPv6 formatted heartbeat errors. This generally indicates a software crash, or packets stuck in an endless loop.

Transmit Window Errors	Displays the number of IPv6 formatted window errors transmitted. TCP uses a sliding window flow control protocol. In each TCP segment, the receiver specifies the amount of additional received data (in bytes) the receiver is willing to buffer for the connection. The sending host can send only up to that amount. If the sending host transmits more data before receiving an acknowledgment, it constitutes a window error.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest value.

15.3.16.3 Multicast Groups Joined

► Interfaces

Multicast groups scale to a larger set of destinations by *not* requiring prior knowledge of who or how many destinations there are. Multicast devices use their infrastructure efficiently by requiring the source to send a packet only once, even if delivered to a large number of devices. Devices replicate a packet to reach multiple receivers only when necessary.

Controllers and service platforms are free to join or leave a multicast group at any time. There are no restrictions on the location or members in a multicast group. A host may be a member of more than one multicast group at any given time and does not have to belong to a group to send messages to members of a group.

To view the controller or service platform multicast group memberships on the selected interface:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Interfaces** menu from the left-hand side of the UI.
- 4 Select **Multicast Groups Joined**.

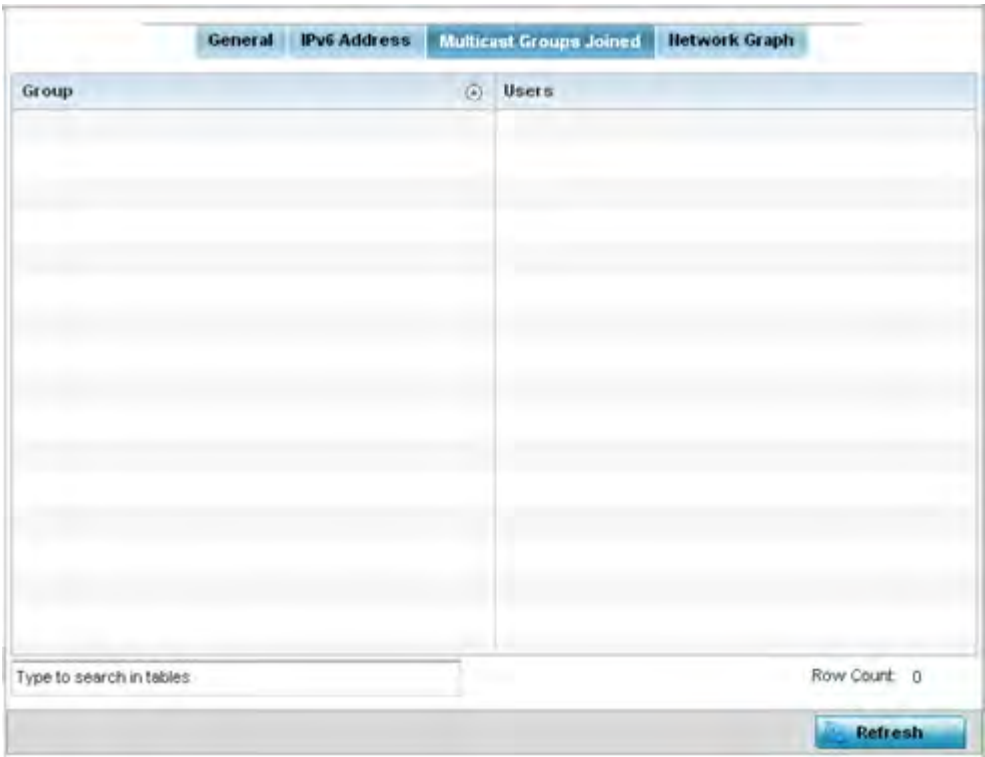


Figure 15-61 *Wireless Controller - Interface Multicast Groups Joined screen*

5 The screen displays the following:

Group	Lists the name of existing multicast groups whose current members share multicast packets with one another on this selected interface as a means of collective interoperation.
Users	Lists the number of devices currently interoperating on this interface in each listed multicast group. Any single device can be a member of more then one group at a time.

6 Periodically select **Refresh** to update the screen’s counters to their latest values.

15.3.16.4 Network Graph

► Interfaces

The *Network Graph* tab displays statistics the controller or service platform continuously collects for its interfaces. Even when the interface statistics graph is closed, data is still collected. Display the interface statistics graph periodically for assessing the latest interface information. Up to three different stats can be selected and displayed within the graph.

To view a detailed graph for an interface, select an interface and drop it on to the graph. The graph displays Port Statistics as the Y-axis and the Polling Interval as the X-axis. Use the **Polling Interval** from the drop-down menu to define the intervals for which data is displayed on the graph.

To view the Interface Statistics graph:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Interfaces** menu from the left-hand side of the UI.
- 4 Select **Network Graph**. Use the **Parameters** drop-down menu to specify what's trended in the graph.

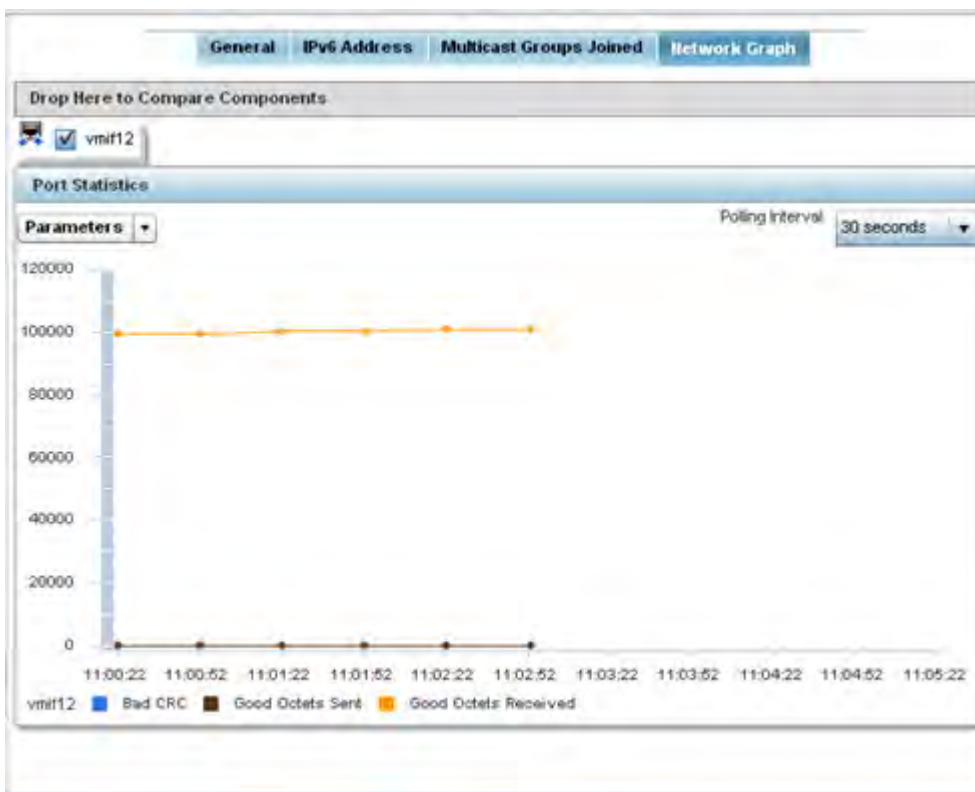


Figure 15-62 Wireless Controller - Interface Network Graph screen

15.3.17 Border Gateway Protocol (BGP) Statistics

► Controller Statistics

Border Gateway Protocol (BGP) is an inter-ISP routing protocol which establishes routes between ISPs. ISPs use BGP to exchange routing and reachability information between *Autonomous Systems* (AS) on the Internet. BGP makes routing decisions based on paths, network policies and/or rules configured by network administrators. The primary role of a BGP system is to exchange network reachability information with other BGP peers. This information includes information on AS that the reachability information traverses. This information is sufficient to create a graph of AS connectivity from which routing decisions can be created and rules enforced.

An *Autonomous System* (AS) is a set of routers under the same administration that use *Interior Gateway Protocol* (IGP) and common metrics to define how to route packets within the AS. AS uses inter-AS routing to route packets to other ASs. For an external AS, an AS appears to have a single coherent interior routing plan and presents a consistent picture of the destinations reachable through it.

Routing information exchanged through BGP supports only destination based forwarding (it assumes a router forwards packets based on the destination address carried in the IP header of the packet).

BGP uses TCP as its transport protocol. This eliminates the need to implement explicit update fragmentation, retransmission, acknowledgement, and sequencing. BGP listens on TCP port 179. The error notification mechanism used in BGP assumes that TCP supports a *graceful* close (all outstanding data is delivered before the connection is closed).



NOTE: BGP is only supported on RFS6000 and NX9500 model controllers and service platforms.

BGP statistics are available to assist an administrator in assessing the status of the service platforms's BGP feature and its neighbor BGP peers. Much of the configuration information can be filtered from the *Route Filters* screen.

To review BGP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **BGP** from the left-hand side of the UI. The BGP **Summary** tab displays by default.

Neighbor	ASN	Msg Sent	Msg Received	In Queue	Out Queue	Status	Uptime
192.168.13.99	199	0	0	0	0	Active	never

Type to search in tables

Row Count: 1

Refresh

Figure 15-63 Wireless Controller - BGP - Summary screen

The **Summary** tab displays the following:

Neighbor	Lists the IP address of neighbor BGP supported devices.
ASN	Lists the <i>Autonomous System Number</i> (ASN) assigned to each listed neighbor BGP peer. ASN is a set of routers under the same administration that use <i>Interior Gateway Protocol</i> (IGP) and common metrics to define how to route packets
Msg Sent	Lists the number of messages sent out of this BGP peer.
Msg Received	Lists the number of messages received by this BGP peer.
In Queue	Lists the number of messages in the controller or service platform queue that have not yet been read (processed).
Out Queue	Lists the number of messages in the controller or service platform queue that have not yet been sent.
Status	Displays the status of each listed BGP neighbor as <i>Active</i> or <i>Disabled</i> .
Uptime	Displays the time duration in <i>HH:MM:SS</i> format since the connection to this neighbor BGP peer was established.

- 4 Periodically select **Refresh** to update the screen's counters to their latest value.
- 5 Select the **Neighbor** tab.



The **Neighbor** tab displays the following BGP neighbor information:

Neighbor	Lists the IP address of neighbor BGP supported peer controllers or service platforms. Each IP address displays as a link to display BGP supported device data in greater detail.
Remote AS	Lists the AS number configured on this BGP neighbor. An <i>Autonomous System</i> (AS) is a set of routers under the same administration that use <i>Interior Gateway Protocol</i> (IGP) and common metrics to define how to route packets within the AS.
Local AS	Lists the AS number (1 - 4,294,967,295) configured on this BGP wireless controller or service platforms.
MD5 Enabled	A green check defines MD5 authentication enabled on the listed BGP neighbor. A red X means disabled. MD5 is a message digest algorithm using a cryptographic hash producing a 128-bit (16-byte) hash value, usually expressed in text as a 32 digit hexadecimal number. MD5 has been utilized in a wide variety of cryptographic applications, and is also commonly used to verify data integrity.
Link Type	Lists the type of BGP link. Displays <i>internal</i> if the link type is iBGP. Displays <i>external</i> if the link type is eBGP. <i>iBGP</i> exchanges routing table information between routers within an autonomous system. <i>eBGP</i> exchanges routing table information between hosts outside an autonomous system.
Status	Displays the current <i>Active</i> or <i>Inactive</i> state of each listed BGP neighbor device.
Uptime	Displays the uptime for each listed BGP neighbor.
Remote Router	Lists the IP address used by the BGP remote router resource as a network identifier.
Hold Time	Displays the duration, in seconds, for the hold (delay) of packet transmissions to each listed BGP neighbor device.
Keepalive	Displays the duration, in seconds, for the keep alive timer used to maintain the connection to each listed BGP neighbor device.

Clear Routes	Select the <i>Clear Retries</i> item (within the table) this to reset and clear all routes received from this BGP neighbor.

- 6 Optionally select the IP address of a listed BGP neighbor device to launch the following screen for more granular device information for the selected peer device:

[illegible]

Figure 15-65 *Wireless Controller - BGP - Neighbor - Statistics screen*

The BGP neighbor **Statistics** screen displays route information for the following kinds of routes:

- *Advertised* – Displays route information for routes advertised to the selected neighbor device.
- *Received* – Displays route information for routes received from the selected neighbor device.
- *Routes* – Displays the route information for routes learned from the selected neighbor device.

- 7 Refer to the following for details on the displayed route. The fields are common to all the screens.

Route Status	Displays the status of this route. Route statuses include: <i>Suppressed</i> – This route has been suppressed. <i>Damped</i> – This route has been damped due to flapping. <i>History</i> – This route is kept in memory to retain flap-dampening statistics. This route is not currently announced by the peer. <i>Valid</i> – This route is a valid route. <i>Best</i> – This route is the best route of all the routes utilized. <i>RIB Failure</i> – A route with better administrative distance is already present, a memory failure exists or the number of routes in <i>VPN routing/forwarding</i> (VRF) exceeds the route-limit configured under the VRF instance. <i>Removed</i> – This route has been removed from the routes list and is no longer available to BGP supported neighbor devices.
Network	Displays network information for this route.
Next Hop	Displays the IP address of the next hop in this route.

Local Pref	Lists the IP address of this controller or service platform's preferred next hop for the route.
Weight	Displays the weight assigned to this route. Weight is used to decide the preferred route when the same route is learned from multiple neighbors. The route with the highest weight is always chosen.
Metric	Lists a measure (metric) of the quality of the path. A lower value indicates a better path.
AS-Path	Displays the AS Path information for this route.
Origin	Displays the IP address of the route's origin.

8 Select the **Refresh** button to update the information displayed in this screen to the latest values. Use the **Exit** button to exit to the **Neighbor** screen.

9 Select **Route Filters** tab.

This screen provides eight (8) different filters for viewing route statistics. Route statistics can be filtered on eight (8) different parameters.

Figure 15-66 Wireless Controller - BGP - Route Filter screen

The Route Filters tab supports the following route filters:

- *BGP Stats Details* – Routes are filtered on BGP statistics details.
- *Community List* – Routes are filtered on the community lists included in each route.
- *Community* – Routes are filtered on the community information included in each route.
- *Expanded Community List* – Routes are filtered on the expanded community information included in each route.
- *Prefix List* – Routes are filtered on the prefix list included in each route.
- *Filter List* – Routes are filtered on the filter list included in each route.
- *Regular Expression* – Routes are filtered based on regular expressions.
- *Route Map* – Routes are filtered on the route map information included in each route.

10 Select **BGP Stats Detail** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type BGP Stats Detail ▼

Type Specific network ☒ IP ☐ Network

Show Details

Figure 15-67 *Wireless Controller - BGP - Route Filter - BGP Stats Detail*

- 11 Use the **Type Specific Network** field to filter statistics based on the provided **IP** or **Network** information. Select **Show Details** to display the list of filtered routes.

Route Status	Displays the status of this route. Route status options include: <i>Suppressed</i> – This route has been suppressed. <i>Damped</i> – This route has been damped due to flapping. <i>History</i> - This route is kept in memory to retain flap-dampening statistics. This route is not currently announced by the peer. <i>Valid</i> – This route is a valid route. <i>Best</i> – This route is the best route of all routes. <i>RIB Failure</i> – A route with better administrative distance is already present, a memory failure exists or the number of routes in <i>VPN routing/forwarding</i> (VRF) exceeds the route-limit configured under the VRF instance. <i>Removed</i> – This route has been removed from the routes list.
Network	Displays network information for this route.
Next Hop	Displays the IP address of the next hop resource utilized in this route.
Local Pref	Lists the IP address of this controller or service platform's preferred next hop for this route. The local preference indicates the preferred path when there are multiple paths to the same destination. The path having the highest preference value is preferred. The preference value is sent to all routers and access servers in the local AS.
Weight	Displays the weight assigned to this route. Weight is used to decide the preferred route when the same route is learned from multiple neighbors. The route with the highest weight is always chosen.
Metric	Lists a measure (metric) of the quality of the path. A lower value indicates a better path. This value is the <i>Multi Exit Discriminator</i> (MED) evaluated by BGP during the best path selection process.
Path	Displays path information for this route.
Origin	Displays the IP address of the origin for this route.

- 12 Select **Community List** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type **Community List** ▼

Type Community list

Figure 15-68 Wireless Controller - BGP - Route Filter - Community List

- 13 Use the **Type Community List** field to filter the statistics based on the community type of the route. Select **Show Details** to display the list of filtered routes.

NOTE: The following table is common to these filter types:



Community List
Community
Prefix List
Filter List
Regular Expression
Route Map

Route Status	Displays the status of this route. The route status could be one of: <i>Suppressed</i> – This route has been suppressed. <i>Damped</i> – This route has been damped due to flapping. <i>History</i> – This route is kept in memory to retain flap-dampening statistics. This route is not currently announced by the peer. <i>Valid</i> – This route is a valid route. <i>Best</i> – This route is the best route of all routes. <i>RIB Failure</i> – A route with better administrative distance is already present, a memory failure exists or the number of routes in <i>VPN routing/forwarding</i> (VRF) exceeds the route-limit configured under the VRF instance. <i>Removed</i> – This route has been removed from the routes list.
Network	Displays network information for this route.
Next Hop	Displays the IP address of the next hop in this route.
Local Pref	Lists the IP address of this controller or service platform's preferred next hop for this route. The local preference indicates the preferred path when there are multiple paths to the same destination. The path having the highest preference value is preferred. This preference value is sent to all routers and access servers in the local AS.
Weight	Displays the weight assigned to this route. Weight is used to decide the preferred route when the same route is learned from multiple neighbors. The route with the highest weight is always chosen.
Metric	Lists a measure of the quality of the path. A lower value indicates a better path. This value is the <i>Multi Exit Discriminator</i> (MED) evaluated by BGP during the best path selection process.
AS-Path	Displays AS path information for this route.
Origin	Displays the IP address of the origin for this route.

Select **Community** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type **Community** ▼

Type Community ▼ **Show Details**

Figure 15-69 *Wireless Controller - BGP - Route Filter - Community*

14 Use the **Type Community** drop-down menu to filter the statistics based on the community of the route. Routes can be filtered on:

- *local-AS* - Displays routes that prevent the transmission of packets outside the local AS.
- *no-advertise* - Displays routes not advertised to any peer, either internal or external.
- *no-export* - Displays routes not advertised to BGP peers, keeping this route within an AS.
- *aa:nn* - Filters routes based on the AS Number specified. The first part (*aa*) represents the AS number. The second part (*nn*) represents a 2-byte number. Routes matching this number are filtered.

15 Select **Show Details** to display the list of filtered routes.

16 Select **Prefix List** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type **Prefix List** ▼

Type Prefix list **Show Details**

Figure 15-70 *Wireless Controller - BGP - Route Filter - Prefix List*

17 Use the **Type Prefix list** field to filter the statistics based on the prefix of the route. Select **Show Details** to display the list of filtered routes.

18 Select **Filter List** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type **Filter List** ▼

Type Filter list **Show Details**

Figure 15-71 *Wireless Controller - BGP - Route Filter - Filter List*

19 Use the **Type Filter List** field to filter the statistics based on the filter list of the route. Select **Show Details** to display the list of filtered routes.

20 Select **Regular Expression** from the **Select Filter Type** list.

Select Filter(s) _____

Select Filter Type **Regular Expression** ▼

Type Regular expression **Show Details**

Figure 15-72 *Wireless Controller - BGP - Route Filter - Regular Expression*

21 Use the **Type Regular Expression** field to filter the routes based on regular expressions. Select **Show Details** to display the list of filtered routes.

22 Select **Route Map** from the **Select Filter Type** list.

The screenshot shows a web interface for configuring route filters. At the top, there is a 'Select Filter(s)' label followed by a horizontal line. Below this, there is a 'Select Filter Type' dropdown menu with 'Route Map' selected. Underneath the dropdown is a text input field labeled 'Type Route map' which is currently empty. To the right of this input field is a button labeled 'Show Details'.

Figure 15-73 *Wireless Controller - BGP - Route Filter - Route Map*

23 Use the **Type Route Map** field to filter the routes based on route maps (enhanced packet filters). Select **Show Details** to display the list of filtered routes.

24 Select **Expanded Community List** from the **Select Filter Type** list.

The screenshot shows the same web interface as Figure 15-73, but with 'Expanded Community List' selected in the 'Select Filter Type' dropdown menu. The 'Type Expanded list' text input field remains empty, and the 'Show Details' button is still present.

Figure 15-74 *Wireless Controller - BGP - Route Filter - Expanded Community*

25 Use the **Type Expanded list** to filter routes based on route-maps. Select **Show Details** to display a list of filtered routes.

26 Select **State** tab.

The screenshot displays the 'State' tab of the BGP configuration page. At the top, there are four tabs: 'Summary', 'Neighbor', 'Route Filters', and 'State', with 'State' being the active tab. Below the tabs is a table with two columns. The first column lists various BGP status metrics, and the second column shows their current values. At the bottom right of the table is a 'Refresh' button.

Maximum routes allowed	10
Routes received	0
Current ignore count	0
Ignore count allowed	5
Reset time	360
Ignore time	60
Current state	Running

Figure 15-75 *Wireless Controller - BGP - State*

The **State** screen displays the following:

Maximum Routes Allowed	Lists the maximum number of routes allowed on the selected BGP wireless controller or service platforms.
Routes Received	Lists the number of routes received from all the BGP peers.
Current Ignore Count	Lists the number of times the BGP daemon has been put in the <i>Ignore</i> state.
Ignore Count Allowed	Lists the maximum number of times the BGP daemon can be put in an <i>Ignore</i> state before entering permanent ignore state.
Reset Time	Lists the time after which ignore state count is reset to 0 and BGP daemon continues in the state it was in previously.

Ignore Time	Lists the time duration after which BGP daemon shall exit the <i>Ignore</i> state.
Current State	Lists the current state of this BGP route utilized on the wireless controller or service platforms.

Select **Refresh** to update the statistic counters to their latest values.

15.3.18 RAID Statistics

► *Controller Statistics*

RAID statistics are available to assist an administrator in assessing the status of the service platform's RAID array, including each physical drive. The information within the RAID statistics screen is polled by the service platform from the RAID controller hardware, then forwarded to the WiNG operating system.



NOTE: RAID controller drive arrays are available within NX7500 and NX9000 series service platforms (NX9000, NX9500 and NX9510 models) only. However, they can be administrated on behalf of a profile by a different model service platform or controller.

For information on setting the service platform drive array configuration as well as the diagnostic behavior of its member drives, refer to *RAID Operations on page 14-19*.

To view RAID statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **RAID** from the left-hand side of the UI.

Status	
Size	930
State	optimal
Alarm Enable	☒

Last Check	
Date	Sun May 26 09:09:36 2013
Result	done
Progress	

Physical Drives	
Slot	State
0	online
1	online
2	not-installed
3	not-installed
4	not-installed

[Refresh](#)

Figure 15-76 Wireless Controller - RAID Status screen

- 4 The **Status** field displays the following:

Size	Lists the size of the RAID drive array. The size is the total physical memory space available on the two physical drives comprising the active RAID controller.
State	Displays whether the drive array is currently in an <i>optimal</i> operation state or <i>degraded</i> , and in need of administration to perform diagnostics and perhaps prepare a standby drive for hot spare replacement.
Alarm Enable	Displays whether the RAID alarm has been enabled to sound the service platform's chassis alarm upon detection of a RAID controller degradation event. The RAID alarm is enabled by default. For information on enabling or disabling the service platform RAID alarm, see General Profile Configuration on page 8-5 .

- 5 Refer to the **Last Check** field to assess the time, progress and results of the RAID array's most recent consistency check:

Date	Lists the date and time of the RAID controller's most recent consistency check on the integrity of the drive array.
Result	Displays <i>true</i> for a successful RAID array consistency check and <i>false</i> for a failed consistency check. A false indication would trigger the service platform's chassis alarm if RAID alarm is enabled.
Progress	Displays the progress of an in process consistency check in both percentage complete and minutes utilized (for example, 78%/116min).

- 6 Use the **Physical Drives** field to assess the RAID array's drive utilization and whether the drives are currently online:

Slot	Lists RAID array's drive slot utilization. Since there is only one RAID array controller reporting status to the service platform, its important to know if other drive slots house <i>hot spare</i> drives available as additional resources should one of the dedicated drives fail.
State	Displays whether a physical slot within the RAID array has a drive installed, and whether the drive is currently online.

- 7 Select **Refresh** at any time to update either the screen's statistic counters to their latest value.

15.3.19 Power Status

► *Controller Statistics*

Periodically review the controller or service platform power status to assess the power budget and PoE capability (if supported).

PoE is supported on RFS4000 and RFS6000 model controllers.

To view Power Status statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Power Status** from the left-hand side of the UI.

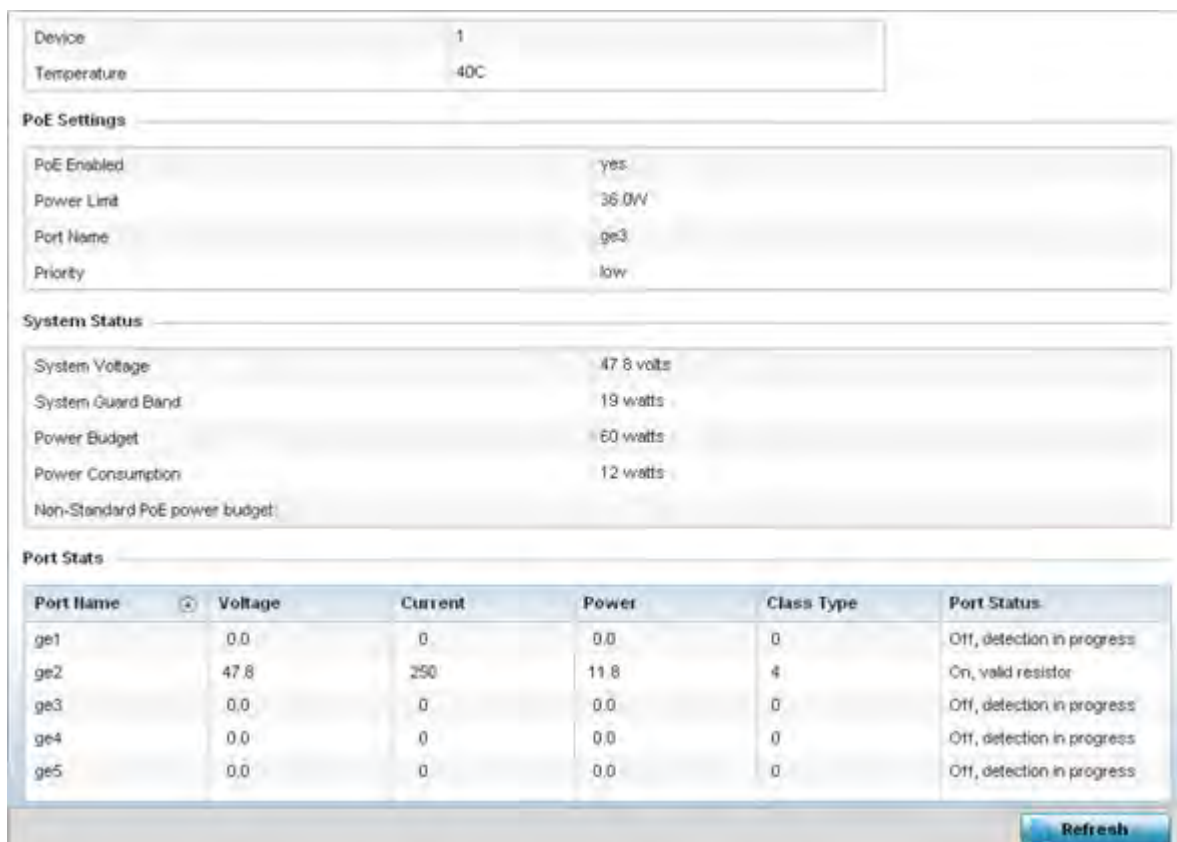


Figure 15-77 Wireless Controller - Power Status screen

The **Power Status** provides the following information for supported controllers or service platforms:

Device	Displays the administrator assigned device name for the controller or service platform.
Temperature	Displays the internal system temperature for the controller or service platform.
PoE Enabled	Displays whether or not <i>Power over Ethernet</i> (PoE) is enabled for the controller or service platform. When enabled, the controller or service platform supports 802.3af PoE on each of its ge ports. The PoE allows users to monitor port power consumption and configure power usage limits and priorities for each ge port.
Power Limit	Displays the total watts available for Power over Ethernet on the controller or service platform. The value should be between 0 - 40 watts.
Port Name	Displays the GE port name on the controller or service platform.
Priority	Displays the power priority for the listed port as either Critical, High or Low. This is the priority assigned to this port versus the power requirements of the other supports available on the controller or service platform.
System Voltage	Displays the total current system voltage for the controller or service platform.

System Guard Band	Displays the amount of voltage allocated to a System Guard Band. A System Guard Band is an amount of voltage allocated to prevent power loss or cycling on connected PoE devices when the power draw goes above the PoE Power Budget.
Power Budget	Displays the total amount of voltage on the controller or service platform allocated for use in Power over Ethernet.
Power Consumption	Displays the current amount of power being consumed by PoE devices on the controller or service platform.
Non-Standard PoE power budget	Displays the amount of voltage allocated to non 802.3af or 802.3at PoE devices.
Port Name	Displays the GE port name for each PoE capable port on the controller or service platform.
Voltage	Displays the voltage in use by each PoE capable port on the controller or service platform.
Current	Displays the amount of current in milliwatts being used by each PoE capable port on the controller or service platform.
Power	Displays whether or not each PoE capable port on the controller or service platform is providing power.
Class Type	Displays the PoE class type including 802.3af, 802.3at and non-standard PoE types.
Port Status	Displays the status of each PoE capable port on the controller or service platform. It will display either <i>Enabled</i> or <i>Disabled</i> .
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest value.

15.3.20 PPPoE

► Controller Statistics

The *PPPoE* statistics screen displays stats derived from the PPPoE capable controller or service platform's access to high-speed data and broadband networks. PPPoE uses standard encryption, authentication, and compression methods as specified by the PPPoE protocol. PPPoE enables point-to-points connection to an ISP over existing Ethernet interface.

Power over Ethernet is supported on RFS4000 and RFS6000 model controllers. When enabled, the controller supports 802.3af PoE on each of its ge ports.

To review a selected controller or service platform's PPPoE statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **PPPoE** from the left-hand side of the UI.

The screenshot displays the 'Wireless Controller - PPPoE' configuration interface. It is divided into two main sections: 'Configuration Information' and 'Connection Status'.

Configuration Information: This section contains a table with the following fields and values:

Shutdown	✓
Service	
DSL Modem Network (VLAN)	vlan1
Authentication Type	pap
Username	
Password	
Client Idle Timeout	600
Keep Alive	✗
Maximum Transmission Unit (MTU)	1,492

Connection Status: This section contains a table with the following columns: Peer MAC Address, SID, Service, Maximum Transmission Unit (MTU), and Status.

Peer MAC Address	SID	Service	Maximum Transmission Unit (MTU)	Status
	0x0		0	Disabled

A 'Refresh' button is located at the bottom right of the Connection Status table.

Figure 15-78 *Wireless Controller - PPPoE screen*

The **Configuration Information** field screen displays the following:

Shutdown	Displays whether a high speed client mode point-to-point connection has been enabled using the PPPoE protocol. A green checkmark defines the connection as enabled. A red X defines the connection as shutdown.
Service	Lists the 128 character maximum PPPoE client service name provided by the service provider.
DSL Modem Network (VLAN)	Displays the PPPoE VLAN (client local network) connected to the DSL modem. This is the local network connected to DSL modem.
Authentication Type	Lists authentication type used by the PPPoE client whose credentials must be shared by its peer. Supported authentication options include <i>None</i> , <i>PAP</i> , <i>CHAP</i> , <i>MSCHAP</i> , and <i>MSCHAP-v2</i> .
Username	Displays the 64 character maximum username used for authentication support by the PPPoE client.
Password	Displays the 64 character maximum password used for authentication by the PPPoE client.
Client Idle Timeout	The controller or service platform uses the listed timeout so it does not sit idle waiting for input from a PPPoE client and the server that may never come.
Keep Alive	If a keep alive is utilized (enabled displays a green checkmark, disabled a red X) the point-to-point connect to the PPPoE client is continuously maintained and not timed out.
Maximum Transmission Unit (MTU)	Displays the PPPoE client <i>maximum transmission unit</i> (MTU) from 500 - 1,492. The MTU is the largest physical packet size in bytes a network can transmit. Any messages larger than the MTU are divided into smaller packets before being sent. A PPPoE client should be able to maintain its point-to-point connection for this defined MTU size.

- 4 Refer to the **Connection Status** field.

The Connection Status table lists the MAC address, SID, Service information, MTU and status of each route destination peer. To provide this point-to-point connection, each PPPoE session learns the Ethernet address of a remote PPPoE client, and establishes a session. PPPoE uses both a discover and session phase to identify a client and establish a point-to-point connection. By using such a connection, a wireless WAN failover is available to maintain seamless network access if the Wired WAN were to fail

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.3.21 OSPF

► *Controller Statistics*

Open Shortest Path First (OSPF) is a *link-state interior gateway protocol (IGP)*. OSPF routes IP packets within a single routing domain (autonomous system), like an enterprise LAN. OSPF gathers link state information from neighbor routers and constructs a network topology. The topology determines the routing table presented to the Internet Layer which makes routing decisions based solely on the destination IP address found in IP packets.

Refer to the following for detailed descriptions of the tabs available within the OSPF statistics screen:

- *OSPF Summary*
- *OSPF Neighbors*
- *OSPF Area Details*
- *OSPF Route Statistics*
- *OSPF Interface*
- *OSPF State*

15.3.21.1 OSPF Summary

► *OSPF*

To view OSPF summary statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.

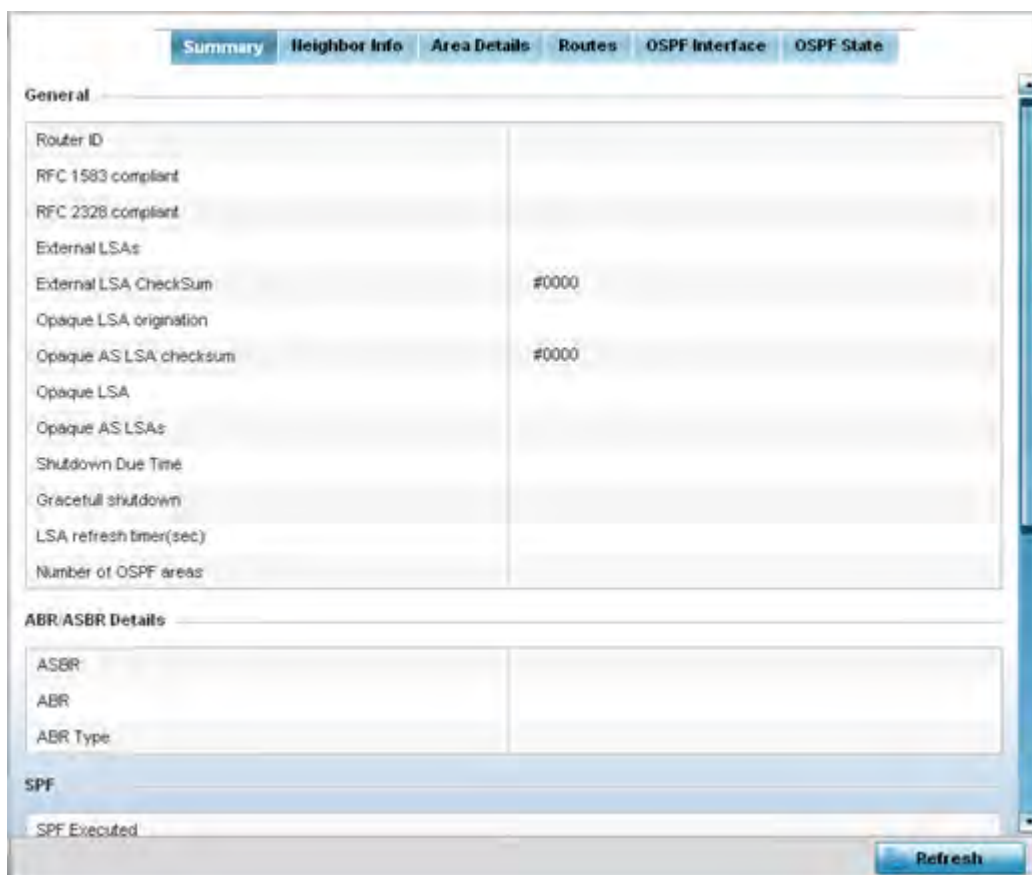


Figure 15-79 Wireless Controller - OSPF Summary tab

The **Summary** tab describes the following data fields:

General	The general field displays the router ID assigned for this OSPF connection, RFC compliance information and LSA data.
ABR/ASBR Details	Lists <i>Autonomous System Boundary Router</i> (ASBR) data relevant to OSPF routing, including the ASBR, ABR and ABR type. An <i>Area Border Router</i> (ABR) is a router that connects one or more areas to the main backbone network. It is considered a member of all areas it is connected to. An ABR keeps multiple copies of the link-state database in memory, one for each area to which that router is connected. An ASBR is a router connected to more than one Routing protocol and exchanges routing information with routers in other protocols. ASBRs typically also run an exterior routing protocol (for example, BGP), or use static routes, or both. An ASBR is used to distribute routes received from other, external ASs throughout its own autonomous system. Routers in other areas use ABR as next hop to access external addresses. Then the ABR forwards packets to the ASBR announcing the external addresses.
SPF	Refer to the SPF field to assess the status of the <i>shortest path forwarding</i> (SFF) execution, <i>last SPF execution</i> , <i>SPF delay</i> , <i>SPF due in</i> , <i>SPF hold multiplier</i> , <i>SPF hold time</i> , <i>SPF maximum hold time</i> and <i>SPF timer due flag</i> .

Stub Router	The summary screen displays information relating to stub router advertisements and shutdown and startup times. An OSPF stub router advertisement allows a new router into a network without immediately routing traffic through the new router and allows a graceful shut down or reload a router without dropping packets that are destined for other networks. This feature introduces three configuration options that allow you to configure a router that is running the OSPF protocol to advertise a maximum or infinite metric to all neighbors.

- 4 Select the **Refresh** button to update the statistics counters to their latest values.

15.3.21.2 OSPF Neighbors

► OSPF

OSPF establishes neighbor relationships to exchange routing updates with other routers. A controller or service platform supporting OSPF sends hello packets to discover neighbors and elect a designated router. The hello packet includes link state information and list of neighbors. OSPF is savvy with layer 2 topologies. If on a point-to-point link, OSPF knows it is sufficient, and the link stays up. If on a broadcast link, the router waits for election before determining if the link is functional.

To view OSPF neighbor statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.
- 4 Select the **Neighbor Info** tab.

Summary Neighbor Info Area Details Routes OSPF Interface OSPF State									
Router ID ⊖	Neighbour Priority	IF Name	Neighbour Address	Request Count	Retransmit Count	Dead Time	Self Neighbour State	Source Address	Summary Count

Type to search in tables
Row Count: 0

Refresh

Figure 15-80 *Wireless Controller - OSPF Neighbor Info tab*

The **Neighbor Info** tab describes the following:

Router ID	Displays the router ID assigned for this OSPF connection. The router is a level three Internet Protocol packet switch. This ID must be established in every OSPF instance. If not explicitly configured, the highest logical IP address is duplicated as the router identifier. However, since the router identifier is not an IP address, it does not have to be a part of any routable subnet in the network.
Neighbor Priority	Displays each listed neighbor's priority in respect to becoming the designated router managing the OSPF connection. The designated router is the router interface elected among all routers on a particular multi-access network segment.
IF Name	Lists the name assigned to the router interface used to support connections amongst OSPF enabled neighbors.
Neighbor Address	Lists the IP address of the neighbor sharing the router interface with each listed router ID.
Request Count	Lists the connection request count (hello packets) to connect to the router interface, discover neighbors and elect a designated router.
Retransmit Count	Lists the connection retransmission count attempted in order to connect to the router interface, discover neighbors and elect a designated router. A <i>designated router</i> (DR) is the router interface elected among all routers on a particular multi-access network segment, generally assumed to be broadcast.
Dead Time	Lists the dead time between neighbors in the network topology that are currently utilizing the listed router ID.
Self Neighbor State	Displays the self-neighbor status assessment used to discover neighbors and elect a designated router.
Source Address	Displays the single source address used by all neighbor routers to obtain topology and connection status. This form of multicasting significantly reduces network load.
Summary Count	Routes that originate from other areas are called summary routes. Summary routes are not flooded in a totally stubby or NSSA totally stubby area.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.3.21.3 OSPF Area Details

► OSPF

An OSPF network is subdivided into routing areas (with 32 bit area identifiers) to simplify administration and optimize traffic utilization. Areas are logical groupings of hosts and networks, including routers having interfaces connected to an included network. Each area maintains a separate link state database whose information may be summarized towards the rest of the network. An OSPF Area contains a set of routers exchanging *Link State Advertisements* (LSAs) with others in the same area. Areas limit LSAs and encourage aggregate routes. Areas are identified by 32-bit IDs, expressed either in decimal, or octet-based dot-decimal notation.

To view OSPF area statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.

4 Select the **Area Details** tab.

Summary		Neighbor Info		Area Details		Routes	OSPF Interface		OSPF State		
OSPF Area ID	OSPF RIF	Fully adj numbers	Auth Type	Total LSA	Router LSA	Network LSA	Summary LSA	ASBR Summary LSA	ISSA LSA	Opaque Area LSA CSUM	Opaque link CSUM

Type to search in tables

Row Count: 0

Refresh

Figure 15-81 *Wireless Controller - OSPF Area Details tab*

The **Area Details** tab describes the following:

OSPF Area ID	Lists the connection request count (hello packets) to connect to the router interface, discover neighbors and elect a designated router.
OSPF INF	Lists the interface ID (virtual interface for dynamic OSPF routes) supporting each listed OSPF area ID.
Fully adj numbers	Fully adjusted numbers strip away the effects of other non OSPF and LSA factors and events, leaving only relevant OSPF area network route events counted.
Auth Type	Lists the authentication schemes used to validate the credentials of dynamic route connections and their areas.
Total LSA	Lists the <i>Link State Advertisements</i> (LSAs) of all entities using the dynamic route (in any direction) in the listed area ID.
Router LSA	Lists the Link State Advertisements of the router supporting each listed area ID. The router LSA reports active router interfaces, IP addresses, and neighbors.
Network LSA	Displays which routers are joined together by the designated router on a broadcast segment (e.g. Ethernet). Type 2 LSAs are flooded across their own area only. The link state ID of the type 2 LSA is the IP interface address of the designated route.
Summary LSA	The summary LSA is generated by ABR to leak area summary address info into another areas. ABR generates more than one summary LSA for an area if the area addresses cannot be properly aggregated by only one prefix.
ASBR Summary LSA	Originated by ABRs when an ASBR is present to let other areas know where the ASBR is. These are supported just like summary LSAs.

NSSA LSA	Routers in a <i>Not-so-stubby-area</i> (NSSA) do not receive external LSAs from Area Border Routers, but are allowed to send external routing information for redistribution. They use type 7 LSAs to tell the ABRs about these external routes, which the Area Border Router then translates to type 5 external LSAs and floods as normal to the rest of the OSPF network. Redistribution into an NSSA area creates a special type of LSA known as TYPE 7, which can exist only in an NSSA area. An NSSA ASBR generates this LSA, and an NSSA ABR router translates it into type 5 LSA which gets propagated into the OSPF domain.
Opaque Area LSA CSUM	Displays the Type-10 opaque link area checksum with the complete contents of the LSA.
Opaque link CSUM	Displays the Type-10 opaque link checksum with the complete contents of the LSA.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.3.21.4 OSPF Route Statistics

► OSPF

Refer to the *Routes* tab to assess the status of OSPF *Border Routes*, *External Routes*, *Network Routes* and *Router Routes*.

To view OSPF route statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.
- 4 Select the **Routes** tab. **Border Routes** display by default.

An *area border router* (ABR) connects (links) more than one area. Usually an ABR is used to connect non-backbone areas to the backbone. If OSPF virtual links are used an ABR will also be used to connect the area using the virtual link to another non-backbone area. Border routes use internal OSPF routing table entries to an ABR or *Autonomous System Boundary Router* (ASBR). Border routers maintain an LSDB for each area supported. They also participate in the backbone.

- 5 Refer to **External Routes** tab.

[illegible]

Figure 15-82 *Wireless Controller - OSPF External Routes tab*

External routes are external to area, originate from other routing protocols (or different OSPF processes) and are inserted into OSPF using redistribution. A *stub* area is configured not to carry external routes. Each external route can be tagged by the advertising router, enabling the passing of additional information between routers. Each external route can also be tagged by the advertising router, enabling the passing of additional information between routers on the boundary of the autonomous system.

The External route tab displays a list of external routes, the area impacted, cost, path type, tag and type 2 cost. Cost factors may be the distance of a router (round-trip time), network throughput of a link, or link availability and reliability, expressed as simple unit-less numbers. This provides a dynamic process of traffic load balancing between routes of equal cost.

- 6 Refer to the **Network Routes** tab.

[illegible]

Figure 15-83 *Wireless Controller - OSPF Network Routes tab*

Network routes support more than two routers, with the capability of addressing a single physical message to all attached routers (broadcast). Neighboring routers are discovered dynamically using OSPF hello messages. This use of the hello protocol takes advantage of broadcast capability. An OSPF network route makes further use of multicast capabilities, if they exist. Each pair of routers on the network is assumed to communicate directly.

The network tab displays the network name, impacted OSPF area, cost, destination and path type.

- 7 Select the **Router Routes** tab.

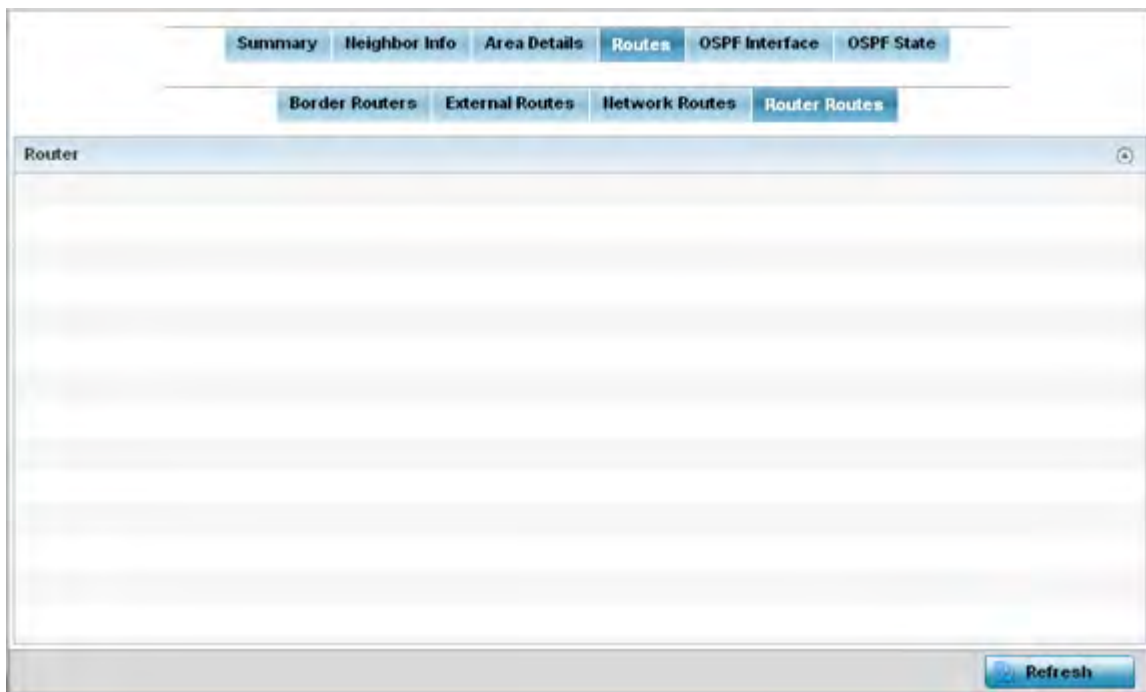


Figure 15-84 *Wireless Controller - OSPF Router Routes tab*

An internal (or *router*) route connects to one single OSPF area. All of its interfaces connect to the area in which it is located and does not connect to any other area.

- 8 Select the **Refresh** button (within any of the four OSPF Routes tabs) to update the statistics counters to their latest values

15.3.21.5 OSPF Interface

► OSPF

An OSPF interface is the connection between a router and one of its attached networks. An interface has state information associated with it, which is obtained from the underlying lower level protocols and the routing protocol itself. A network interface has associated a single IP address and mask (unless the network is an unnumbered point-to-point network). An interface is sometimes also referred to as a link.

To view OSPF interface statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.
- 4 Select the **OSPF Interface** tab.

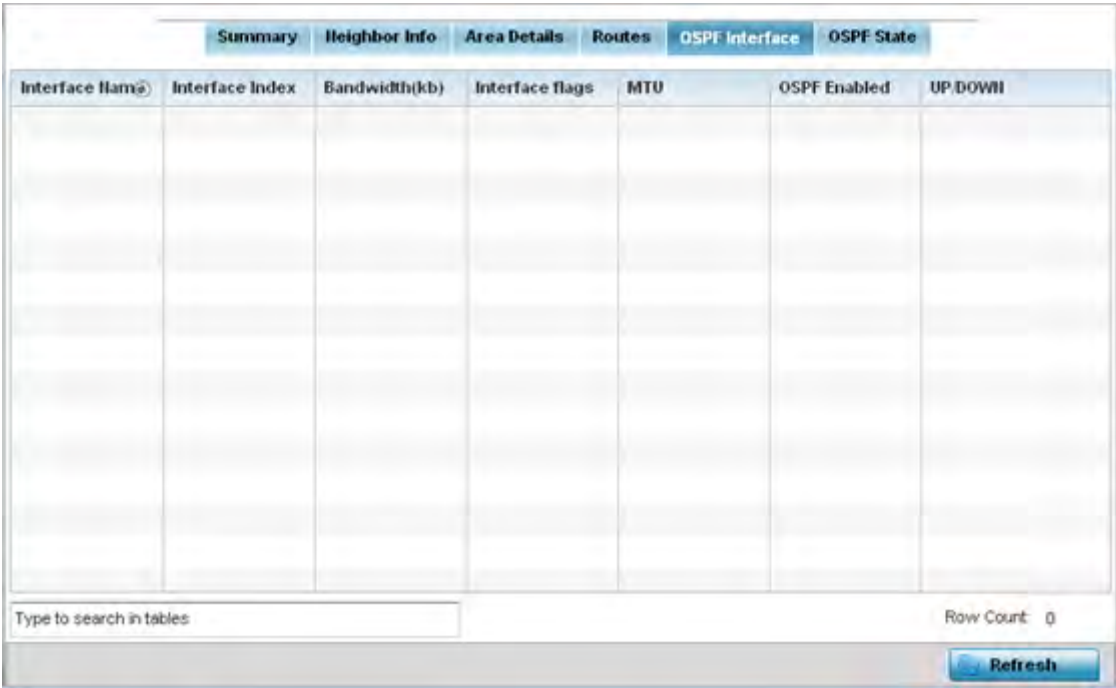


Figure 15-85 *Wireless Controller - OSPF Interface tab*

The **OSPF Interface** tab describes the following:

Interface Name	Displays the IP addresses and mask defined as the virtual interface for dynamic OSPF routes. Zero config and DHCP can be used to generate route addresses, or a primary and secondary address can be manually provided.
Interface Index	Lists the numerical index used for the OSPF interface. This interface ID is in the hello packets establishing the OSPF network connection.
Bandwidth(kb)	Lists the OSPF interface bandwidth (in Kbps) from 1 - 10,000,000.
Interface flags	Displays the flag used to determine the interface status and how to proceed.
MTU	Lists the OSPF interface <i>maximum transmission unit</i> (MTU) size. The MTU is the largest physical packet size (in bytes) a network can transmit. Any packets larger than the MTU are divided into smaller packets before being sent.
OSPF Enabled	Lists whether OSPF has been enabled for each listed interface. OSPF is disabled by default.
UP/DOWN	Displays whether the OSPF interface (the dynamic route) is currently up or down for each listed interface. An OSPF interface is the connection between a router and one of its attached networks.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.3.21.6 OSPF State

► OSPF

An OSPF enabled controller or service platform sends hello packets to discover neighbors and elect a designated router for dynamic links. The hello packet includes link *state* data periodically updated on all OSPF members. The controller or service platform tracks link state information to help assess the health of the OSPF dynamic route.

To view OSPF state statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **OSPF** from the left-hand side of the UI.
- 4 Select the **OSPF State** tab.

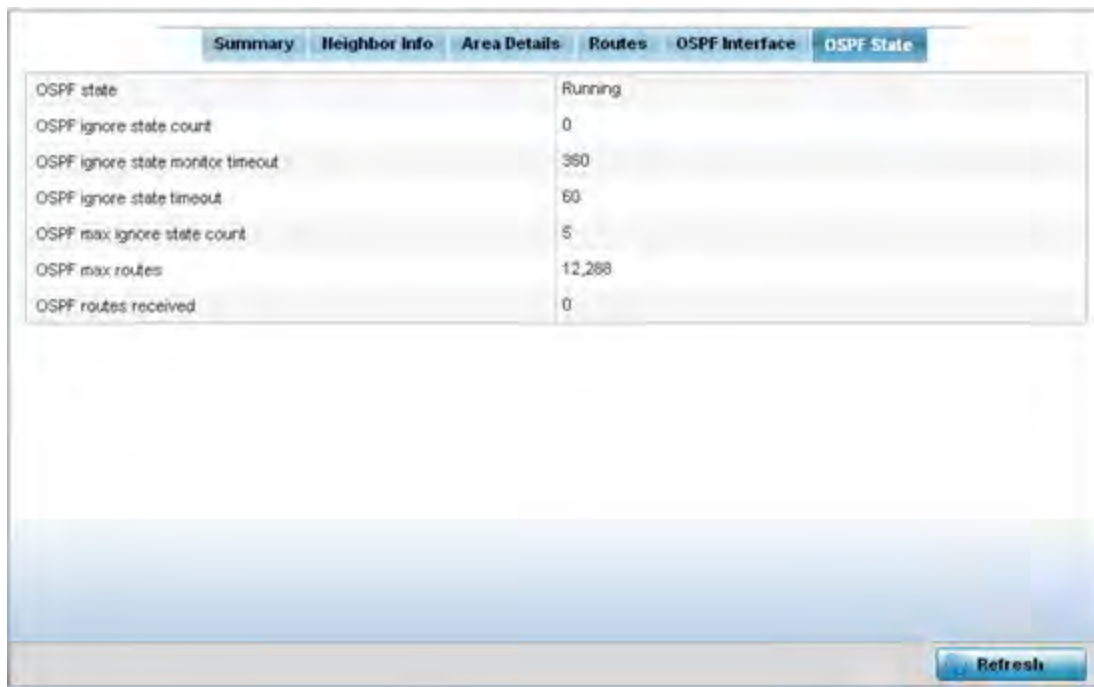


Figure 15-86 Wireless Controller - OSPF State tab

The **OSPF State** tab describes the following:

OSPF state	Displays the OSPF link state amongst neighbors within the OSPF topology. Link state information is maintained in a <i>link-state database</i> (LSDB) which is a tree image of the entire network topology. Identical copies of the LSDB are periodically updated through flooding on all OSPF supported nodes. Flooding is the part of the OSPF protocol that distributes and synchronizes the link-state database between OSPF routers.
OSPF ignore state count	Lists the number of times state requests have been ignored between the controller or service platform and its peers within this OSPF supported broadcast domain.
OSPF ignore state monitor timeout	Displays the timeout that, when exceeded, prohibits the controller or service platform from detecting changes to the OSPF link state.
OSPF ignore state timeout	Displays the timeout that, when exceeded, returns the controller or service platform back to state assessment amongst neighbors in the OSPF topology.
OSPF max ignore state count	Displays whether an OSPF state timeout is being ignored and not utilized in the transmission of state update requests amongst neighbors within the OSPF topology.
OSPF max routes	States the maximum number of routes negotiated amongst neighbors within the OSPF topology.

OSPF routes received	Lists the routes received and negotiated amongst neighbors within the OSPF topology.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.3.22 L2TPv3

► Controller Statistics

Use L2TP V3 to create tunnels for transporting layer 2 frames. L2TP V3 enables a controller or service platform to create tunnels for transporting Ethernet frames to and from bridge VLANs and physical ports. L2TP V3 tunnels can be defined between WING devices and other devices supporting the L2TP V3 protocol.

To review a selected controller or service platform's L2TPv3 statistics:

- 6 Select the **Statistics** menu from the Web UI.
- 7 Select a **Wireless Controller** node from the left navigation pane.
- 8 Select **L2TPv3 Tunnels**.

	Tunnel Name	Local Address	Peer Address	Peer	Tunnel State	Tunnel Mode	Peer Host Name	Peer Control Connection ID	Control Connection ID	Up Time	Encapsulation Protocol	Critical Resource	VRRP Group	Establishment Criteria
	l2tp-199-0-ap7632-9AFFF9-0.0.0.0	2.2.2.1	2.2.2.19	1	Established	Active	ap7632-	4,292,368	1,811,440	5 days	ip		0	Always
	l2tp-199-1-ap7612-17DE2F-0.0.0.0	2.2.2.1	2.2.2.19	1	Established	Active	ap7612-	1,891,408	3,991,360	5 days	ip		0	Always
	l2tp-199-3-ap7602-D1B28B-0.0.0.0	2.2.2.1	2.2.2.19	1	Established	Active	ap7602-	2,665,664	3,796,320	5 days	ip		0	Always
	l2tp-199-5-ap7622-D1A917-0.0.0.0	2.2.2.1	2.2.2.19	1	Established	Active	ap7622-	3,490,400	658,534	4 days	ip		0	Always

Type to search in tables

Row Count: 4

Down

Down All

Up

Up All

Refresh

Figure 15-87 *Wireless Controller - L2TPv3 screen*

The **L2TPv3** screen displays the following:

Tunnel Name	Displays the name of each listed L2TPv3 tunnel assigned upon creation. Each listed tunnel name can be selected as a link to display session data specific to that tunnel. The Sessions screen displays cookie size information as well as pseudowire information specific to the selected tunnel. Data is also available to define whether the tunnel is a trunk session and whether tagged VLANs are used. The number of transmitted, received and dropped packets also display to provide a throughput assessment of the tunnel connection. Each listed session name can also be selected as a link to display VLAN information specific to that session. The VLAN Details screen lists those VLANs used an interface in L2TP tunnel establishment.
Local Address	Lists the IP address assigned as the local tunnel end point address, not the tunnel interface's IP address. This IP is used as the tunnel source IP address. If a local address is not specified, the source IP address is chosen automatically based on the tunnel peer IP address.
Peer Address	Lists the IP address of the L2TP tunnel peer establishing the tunnel connection.
Tunnel State	States whether the tunnel is Idle (not utilized by peers) or is currently active.
Peer Host Name	Lists the assigned peer hostname used as matching criteria in the tunnel establishment process.
Peer Control Connection ID	Displays the numeric identifier for the tunnel session. This is the peer pseudowire ID for the session. This source and destination IDs are exchanged in session establishment messages with the L2TP peer.
Control Connection ID	Displays the router ID(s) sent in tunnel establishment messages with a potential peer device.
Up Time	Lists the amount of time the L2TP connection has remained established amongst peers sharing the L2TPv3 tunnel connection. The Up Time is displayed in a <i>Days: Hours: Minutes: Seconds:</i> format. If D:0 H:0 M:0 S:0 is displayed, the tunnel connection is not currently established.
Encapsulation Protocol	Displays either <i>IP</i> or <i>UDP</i> as the peer encapsulation protocol. The default setting is IP. UDP uses a simple transmission model without implicit handshakes. Tunneling is also called encapsulation. Tunneling works by encapsulating a network protocol within packets carried by the second network.
Critical Resource	Displays monitored critical resources. Critical resources are device IP addresses or interface destinations interpreted as critical to the health of the network. Critical resources allow for the continuous monitoring of these defined addresses. A critical resource, if not available, can result in the network suffering performance degradation. A critical resource can be a gateway, AAA server, WAN interface or any hardware or service on which the stability of the network depends.
VRRP Group	Lists a VRRP group ID (if utilized). A VRRP group is only enabled when the establishment criteria is set to vrrp-master. A VRRP master responds to ARP requests, forwards packets with a destination link MAC layer address equal to the virtual router MAC layer address, rejects packets addressed to the IP associated with the virtual router and accepts packets addressed to the IP associated with the virtual router.

Establishment Criteria	Displays the tunnel establishment criteria for this tunnel. Tunnel establishment involves exchanging 3 message types (SCCRQ, SCCRQ and SCCN) with the peer. Tunnel IDs and capabilities are exchanged during the tunnel establishment with the host.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

- 9 To view per-session statistics for a specific L2TPv3 tunnel, click the Tunnel Name link. The sessions for the selected L2TPv3 tunnel are displayed.
- 10 Click the VLAN ID of the desired session to display session statistics.

15.3.23 VRRP

► Controller Statistics

The *VRRP* statistics screen displays *Virtual Router Redundancy Protocol* (VRRP) configuration statistics supporting router redundancy in a wireless network requiring high availability.

To review a selected controller or service platform's VRRP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **VRRP**.

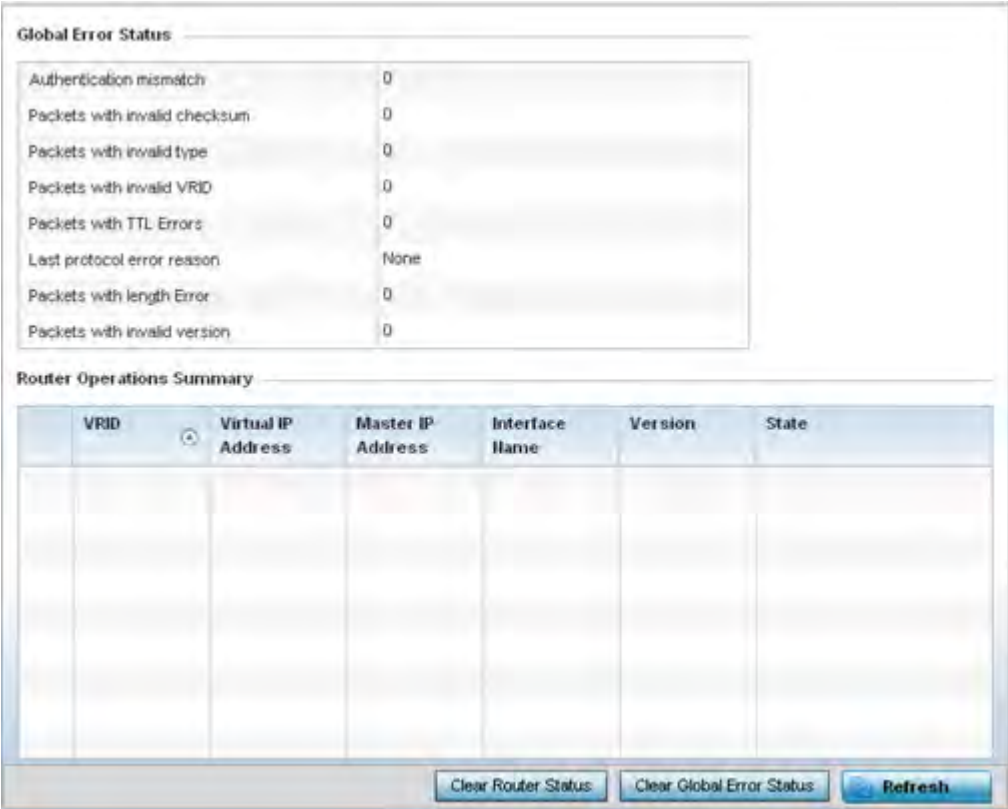


Figure 15-88 *Wireless Controller - VRRP screen*

- 4 Refer to the **Global Error Status** field to review the various sources of packet errors logged during the implementation of the virtual route.

Errors include the mismatch of authentication credentials, invalid packet checksums, invalid packet types, invalid virtual route IDs, TTL errors, packet length errors and invalid (non matching) VRRP versions.

- 5 Refer to the **Router Operations Summary** for the following status:

VRID	Lists a numerical index (1 - 254) used to differentiate VRRP configurations. The index is assigned when a VRRP configuration is initially defined. This ID identifies the virtual router a packet is reporting status for. The ID displays as a link that can optionally selected to list the ID's VRRP information in greater detail.
Virtual IP Address	Lists the virtual interface IP address used as the redundant gateway address for the virtual route.
Master IP Address	Displays the IP address of the elected VRRP master. A VRRP master (once elected) responds to ARP requests, forwards packets with a destination link layer MAC address equal to the virtual router MAC address, rejects packets addressed to the IP address associated with the virtual router and accepts packets addressed to the IP address associated with the virtual router.
Interface Name	Displays the interfaces selected to supply VRRP redundancy failover support.
Version	Display VRRP version 3 (RFC 5798) or 2 (RFC 3768) as selected to set the router redundancy. Version 3 supports sub-second (centisecond) VRRP failover and support services over virtual IP.
State	Displays the current state of each listed virtual router ID.
Clear Router Status	Select the <i>Clear Router Status</i> button to clear the Router Operations Summary table values to zero and begin new data collections.
Clear Global Error Status	Select the <i>Clear Global Error Status</i> button to clear the Global Error Status table values to zero and begin new data collections.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

- 6 Optionally select a **VRID** to list the ID's VRRP information in greater detail.

Configuration	
VRID	201
Interface Name	vlan201
Version	2
Priority	254
Delta Priority	
CRM Down Action	
No. of Virtual IP Address	1
Virtual IP Addresses	1 item
Advertisement Interval	1 sec
Sync Group	☒
Preempt	☒
Preempt Delay	3m 0s

Router Status	
Master Transitions	1
Master Reason	master no response
Advertisement Pkts Received	13
Advertisement Interval Errors	0
Advertisement Pkts Sent	591,320
Received Pkts in Init State	0
Received Pkts with Priority Zero	0
Sent Pkts with Priority Zero	0
Address List Errors	0

Operational State	
Virtual MAC Address	00-00-5E-00-01-C9
Local IP Address	192.168.201.1
Critical Resource	
CRM Status	
Sync Group Failure	
Interface Status	up and running

Name	Interface Status

Refresh Exit

Figure 15-89 Wireless Controller - VRRP VRID Detail screen

7 The **Configuration** field lists the following for the selected VRID:

VRID	Lists this selected ID's assigned ID. The index is assigned when a VRRP configuration is initially defined. This ID identifies the virtual router a packet is reporting status for.
Interface	Displays the interfaces selected to supply VRRP redundancy failover support.
Version	Displays the VRRP version scheme used with the configuration. VRRP version 3 (RFC 5798) and 2 (RFC 3768) are selectable to set the router redundancy. Version 3 supports sub-second (centisecond) VRRP failover and support services over virtual IP. For more information on the VRRP protocol specifications (available publicly) refer to http://www.ietf.org/rfc/rfc3768.txt (version 2) and http://www.ietf.org/rfc/rfc5798.txt (version 3).
Priority	Lists the ID's numerical value (from 1 - 254) used for the virtual router master election process. The higher the numerical value, the higher the priority in the election process.
Delta Priority	Displays the configured priority (by the set value) when the monitored interface is down. When critical resource monitoring, the configured value is incremented by the value defined.
CRM Down Action	Lists the critical resource down action applied to this listed VRID.
No. of Virtual IP Address	Lists the number of virtual interface IP address used as the redundant gateway address for the virtual route.
Virtual IP Addresses	Lists the virtual interface IP address set as the redundant gateway address for the virtual route.

Advertisement Interval	Lists the interval for unsolicited router assignments. The advertisement interval is the minimum interval between sending router updates. Sending too many updates creates flapping of routes leading to possible disruption.
Sync Group	Lists whether a VRRP sync group is assigned to this VRRP ID's group of virtual IP addresses. This triggers VRRP failover if an advertisement is not received from the virtual masters that are part of this VRRP sync group.
Preempt	Lists whether preempt is enabled for the selected ID. Preempt ensures a high priority backup router is available to preempt a lower priority backup router resource. The default setting is enabled. When selected, the preempt delay option becomes enabled to set the actual delay interval for pre-emption. This setting determines if a node with a higher priority can take over all the Virtual IPs from the nodes with a lower priority.
Preempt Delay	If preempt is enabled, this item lists the delay interval (in seconds) for pre-emption.

8 The **Operational State** field lists the following for the selected VRID:

Virtual MAC Address	Lists the alpha numeric virtual MAC address utilized by the selected VRID.
Local IP Address	This address represents an alternative to an interface IP address. The last byte of the address (XX) is the VRID, which is different for each virtual router in the network
Critical Resource	Displays the critical resource currently utilized by the selected VRID.
CRM Status	Lists operational network status of the critical resource used by this VRID.
Sync Group Failure	Lists any sync failures detected with the sync group of virtual IP addresses.
Interface Status	Lists the operational network status of the interfaces selected to supply VRRP redundancy failover support.

9 The **Router Status** field lists the following router performance and error data:

Master Transitions	Lists the number of transitions to master router designation that have occurred with this VRID's router.
Master Reason	Displays an event message in respect the dedicated VRRP router's availability.
Advertisement Pkts Received	Lists the number of router advertisements received by this selected VRID. Router advertisements are periodically sent to hosts or sent in response to solicitation requests. Router advertisements contain prefixes used for link determination, address configuration and maximum hop limits.
Advertisement Interval Errors	Lists this VRID's number of advertisement prefix errors for link determination, address configuration and maximum hop limits.
Advertisement Pkts Sent	Lists the number of router advertisements sent by this selected VRID. Router advertisements are periodically sent to hosts or sent in response to solicitation requests. Router advertisements contain prefixes used for link determination, address configuration and maximum hop limits.
Received Pkts in Init State	Lists the number of packets received by the selected VRID when a router receives a hello packet but the local router ID is not listed in the received neighbor field. This means bidirectional communication is not been established.

Received Pkts with Priority Zero	Lists this VRID's number of received packets with a value of zero.
Sent Pkts with Priority Zero	Lists this VRID's number of sent packets with a value of zero.
Address List Errors	Lists the number of router event errors detected where an address that could not be resolved and bidirectional communication could not be established.

10 Refer to the **Monitor Interface** field to assess the names of this VRID's interface utilization and their respective statuses.

15.3.24 Critical Resources

► Controller Statistics

The Critical Resources statistics screen displays a list of device IP addresses on the network (gateways, routers etc.). These defined IP addresses are critical to the health of the controller or service platform managed network. These device addresses are pinged regularly by the Access Point. If there is a connectivity issue, an event is generated stating a critical resource is unavailable.

To view controller or service platform Critical Resource statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Critical Resource** from the left-hand side of the UI.

Figure 15-90 Wireless Controller - Critical Resource screen

- 4 Refer to the **General** field to assess the **Monitor Interval** and **Monitor Using Flows Interval** used to poll for updates from the critical resource IP listed for **Source IP For Port-Limited Monitoring**. **Monitoring Retries before Marking Resource as DOWN** are the number of retry connection attempts permitted before this listed resource is defined as down (offline).

5 Refer to the following **List of Critical Resources**:

Critical Resource Name	Lists the name of the resource being monitored by the controller or service platform.
Via	Lists the VLAN used by the critical resource as a virtual interface. the VLAN displays as a link than can be selected to list configuration and network address information in greater detail.
Status	Defines the operational state of each listed critical resource VLAN interface (Up or Down).
Error Reason	Provides an error status as to why the critical resource is not available over its designated VLAN.
Mode	Defines the operational state of each listed critical resource (up or down).
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.3.25 LDAP Agent Status

► *Controller Statistics*

When LDAP has been specified as an external resource (as opposed to local RADIUS resources) to validate PEAP-MS-CHAP v2 authentication requests, user credentials and password information needs to be made available locally to successfully connect to the external LDAP server. Up to two LDAP Agents (primary and secondary external resources) can be defined as external resources for PEAP-MS-CHAP v2 authentication requests. For more information on setting LDAP agents as part of the RADIUS server policy, see *Configuring RADIUS Server Policies on page 11-57*.

To view controller or service platform LDAP agent statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **LDAP Agent Status** from the left-hand side of the UI.

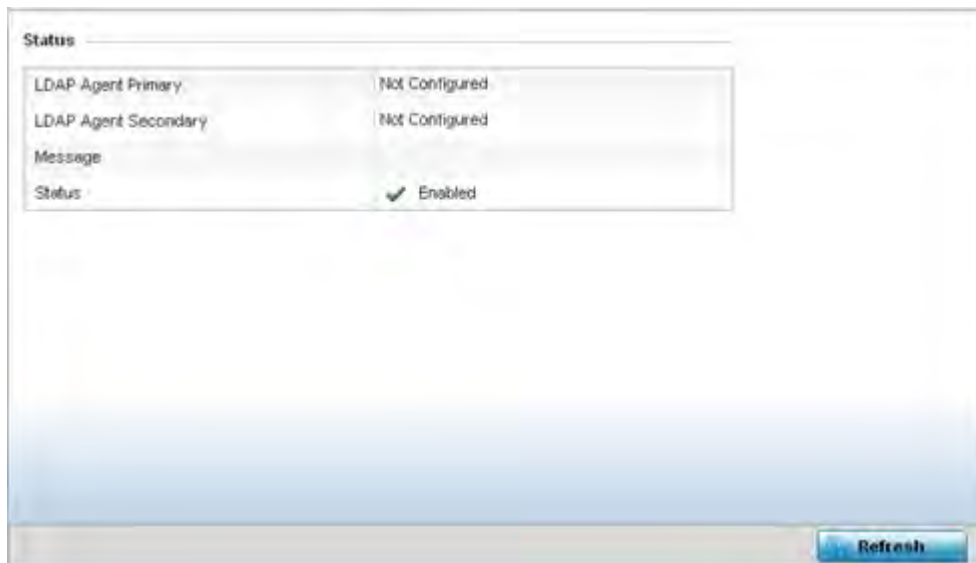


Figure 15-91 *Wireless Controller - LDAP Agent Status screen*

The **LDAP Agent Status** screen displays the following:

LDAP Agent Primary	Lists the primary IP address of a remote LDAP server resource used by the controller or service platform to validate PEAP-MS-CHAP v2 authentication requests. When a RADIUS server policy's data source is set to LDAP, this is the first resource for authentication requests.
LDAP Agent Secondary	Lists the secondary IP address of a remote LDAP server resource used by the controller or service platform to validate PEAP-MS-CHAP v2 authentication requests. When a RADIUS server policy's data source is set to LDAP, this is the second resource for authentication requests.
Message	Displays any system message generated in the controller or service platform's connection with the primary or secondary LDAP agent. If there's a problem with the username and password used to connection to the LDAP agent it would be listed here.
Status	Displays whether the controller or service platform has successfully joined the remote LDAP server domain designated to externally validate PEAP-MS-CHAP v2 authentication requests.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.3.26 Mint Links

► *Controller Statistics*

Wireless controllers and Access Points use the MiNT protocol as the primary means of device discovery and communication for Access point adoption and management. MiNT provides a mechanism to discover neighbor devices in the network, and exchange packets between devices regardless of how these devices are connected (L2 or L3).

MiNT provides the means to secure communications at the transport layer. Using MiNT, a device can be configured to only communicate with other authorized (MiNT enabled) devices of the same model. MiNT links can be established over a VLAN (Among Access Points on a VLAN) or IP (remote access point to controller).

MiNT Links are automatically created between controllers and Access Points during adoption using MLCP (*MiNT Link Creation Protocol*). They can also be manually created between a controller and Access Point (or) between Access Points. MiNT links are manually created between controllers while configuring a cluster.

Level 2 (or) remote MiNT links are controller aware links, and requires IP network for communication. This level 2 MiNT links at access points are intended for remote Adaptive AP deployment and management from NOC. With Level2 MiNT links, access points are only aware of the controllers and not about other Access points. Level 2 MiNT links also provide partitioning, between Access Points deployed at various remote sites.

To view controller or service platform Mint link statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Mint Links** from the left-hand side of the UI.

15 - 140

The [Mint Links](#) screen lists the *name* of the impacted VLAN or link in the form of a link that can be selected to display more granular information about that VLAN. A green check mark or a red X defines whether the listed VLAN is *listening* to traffic, *forced* to stay up or *unused* with the Mint link. The *level* column specifies whether the listed Mint link is traditional switching link (level 2) or a routing link (level 3). The *type* column defines whether the listed Mint link is a VLAN or an IPv4 or IPv6 type network address. The *dis* column lists how each link was discovered.

The *hello seq number* and *hello interval* define the interval between hello keep alive messages between link end points. While the *adj hold time* sets the time after the last hello packet when the connected between end points is defined as lost.

- Periodically select **Refresh** to update the screen's data counters to their latest values.
- If needed, select a Mint link from the *name* column to display more granular information for that link.

Mint Links				
name	vlan-10			
level	1			
cost	10			
hello interval	4			
adj hold time	13			

Adjacencies				
neighbor	state	up time	last hello	
08.19.E3.6E	up	546,679	2	
12.3B.65.87	up	546,679	0	
19.43.53.0D	up	546,679	3	
4D.1B.B2.10	up	546,679	0	
68.64.0A.8F	up	546,679	0	

Figure 15-93 *Wireless Controller - Mint Link Details screen*

The first table lists the Mint link's name and *level* specifying whether the Mint link is traditional switching link (level 2) or a routing link (level 3). The *cost* defines the cost for a packet to travel from its originating port to its end point destination. The *hello interval* lists the time between hello keep alive messages between link end points. The *adj hold time* sets the time after the last hello packet when the connected between end points is defined as lost.

The *Adjacencies* table lists *neighbor* devices by their hardware identifiers and operational *state* to help determine their availability as Mint link end points and peers. The *up time* lists the selected link's detection on the network and the last hello lists when the *last hello* message was exchanged.

- Periodically select *Refresh* to update the statistics counters to their latest values.

15.3.27 Guest Users

► *Controller Statistics*

A *captive portal* is an access policy for providing guests temporary and restrictive access to the wireless network. A captive portal configuration provides secure authenticated access using a standard Web browser. Captive portals provide authenticated access by capturing and re-directing a wireless user's Web browser session to a captive portal login page where the user must enter valid credentials to access to the network. Captive portals can have their access durations set by an administrator to either provide temporary access to the controller or service platform managed network or provide access without limitations.

For information on setting captive portal duration and authentication settings, refer to *Configuring Captive Portal Policies on page 11-1*.

To view the controller or service platform guest user utilization:

- Select the **Statistics** menu from the Web UI.
- Select a Wireless Controller node from the left navigation pane.
- Select **Guest Users** from the left-hand side of the UI.

15 - 142

The **Guest Users** screen describes the following:

Name	Lists the administrator assigned name of the client utilizing the controller or service platform for guest access to the wireless network.
Configured Time (days:hrs:mins:secs)	Displays the restricted permissions each listed client was initially configured for their captive portal guest user session with this managing controller or service platform.
Remaining Time (days:hrs:mins:secs)	Displays the time each listed client has remaining in their captive portal guest user session with this managing controller or service platform.
Configured Kilobytes	Lists the maximum configured bandwidth consumable by the listed guest user (in kilobytes).
Remaining Kilobytes	Lists the remaining bandwidth available to the listed guest user (in kilobytes). This is the difference between the configured (maximum) bandwidth and the users's current utilization.
Configured Downlink Rate (kbps)	Specifies the download speed configured for the listed guest user. When bandwidth is available, the user can download data at the specified rate (in kilobytes per second). If a guest user has a bandwidth based policy and exceeds the specified data limit, their speed is throttled to the defined reduced downlink rate. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Configured Uplink Rate (kbps)	Specifies the upload speed dedicated to the listed guest user. When bandwidth is available, the user is able to upload data at the specified rate (in kilobytes per second). If a guest user has a bandwidth based policy and exceeds the specified data limit, their speed is throttled to the reduced uplink rate. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Current Downlink Rate (Kbps)	Lists the listed guest user's current downlink rate in kbps. Use this information to assess whether this user's configured downlink rate is adequate for their session requirements and whether their reduced downlink rate need adjustment if the configured downlink rate is exceeded. For more information, refer to <i>Defining User Pools on page 11-53</i> .

Current Uplink Rate (Kbps)	Lists the listed guest user's current uplink rate in kbps. Use this information to assess whether this user's configured uplink rate is adequate for their session requirements and whether their reduced uplink rate need adjustment if the configured uplink rate is exceeded. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

15.3.28 GRE Tunnels

► Controller Statistics

Generic Routing Encapsulation (GRE) is one of the available tunneling mechanisms which uses IP as the transport protocol and can be used for carrying many different passenger protocols. The tunnels behave as virtual point-to-point links that have two endpoints identified by the tunnel source and tunnel destination addresses at each endpoint.

Use the GRE Tunnel screen to view information on the traffic flow in a GRE tunnel.

To view the GRE Tunnel statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **GRE Tunnels** from the left-hand side of the UI.

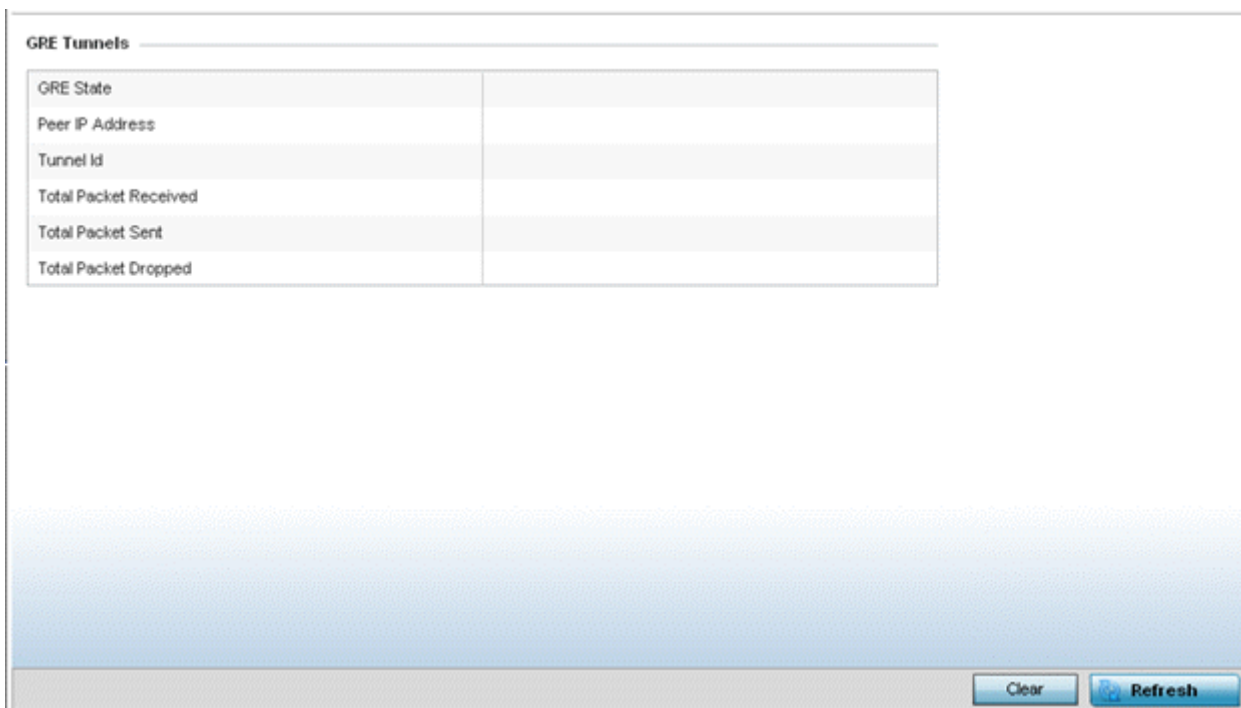


Figure 15-95 Wireless Controller – GRE Tunnel screen

The **GRE Tunnels** screen describes the following:

GRE State	Displays the current operational state of the GRE tunnel.

Peer IP Address	Displays the IP address of the peer device on the remote end of the GRE tunnel.
Tunnel Id	Displays the session ID of an established GRE tunnel. This ID is only viable while the tunnel is operational and does not carry to subsequent sessions.
Total Packets Received	Displays the total number of packets received from a peer at the remote end of the GRE tunnel.
Total Packets Sent	Displays the total number of packets sent from this controller or service platform to a peer at the remote end of the GRE tunnel.
Total Packets Dropped	Lists the number of packets dropped from tunneled exchanges between this controller or service platform and a peer at the remote end of the VPN tunnel
Clear	Select Clear to revert the screen counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

15.3.29 Dot1x

► *Controller Statistics*

Dot1x (or 802.1x) is an IEEE standard for network authentication. Devices supporting Dot1x allow the automatic provision and connection to the wireless network without launching a Web browser at login. When within range of a Dot1x network, a device automatically connects and authenticates without needing to manually login.

To view the Dot1x statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select the Wireless Controller node from the left navigation pane.
- 3 Select **Dot1x** from the left-hand side of the UI.

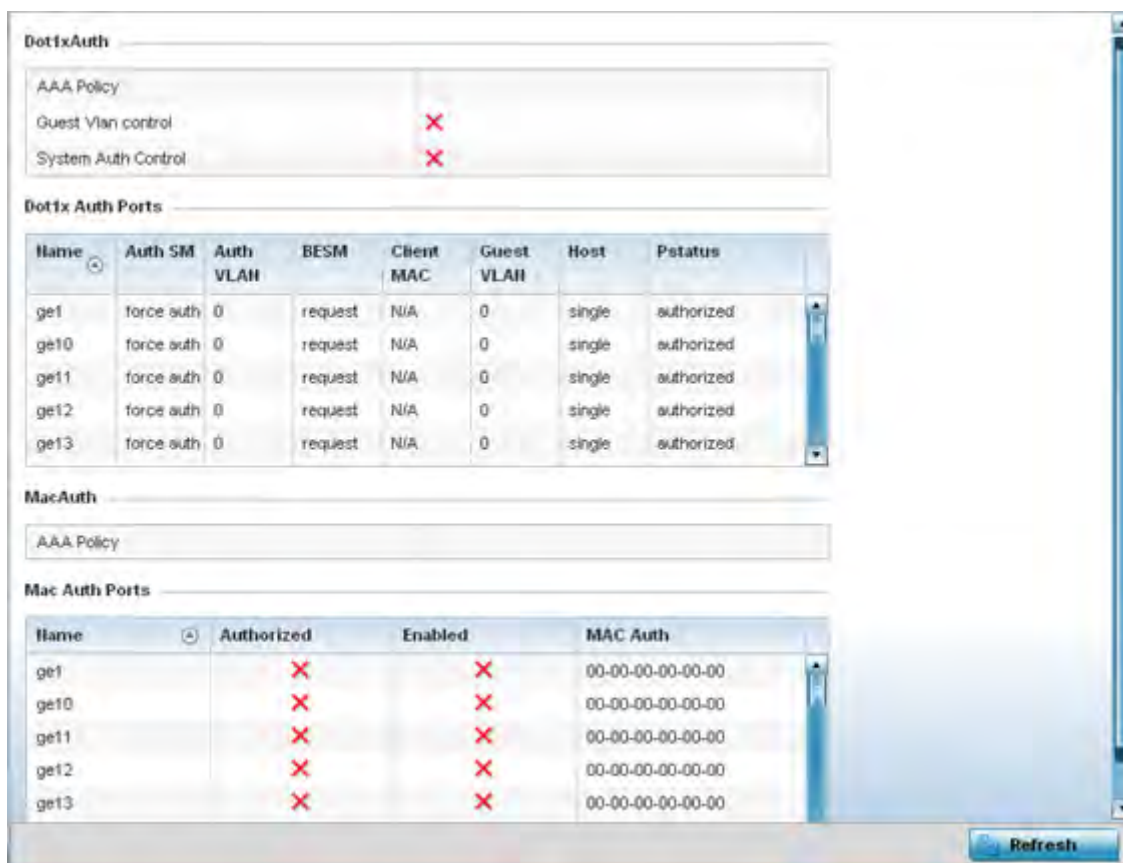


Figure 15-96 Wireless Controller – Dot1x screen

4 Refer to the following **Dot1xAuth** statistics:

AAA Policy	Lists the AAA policy currently being utilized for authenticating user requests.
Guest Vlan Control	Lists whether guest VLAN control has been allowed (or enabled). This is the VLAN traffic is bridged on if the port is unauthorized and guest VLAN globally enabled. A green checkmark designates guest VLAN control as enabled. A red X defines guest VLAN control as disabled.
System Auth Control	Lists whether Dot1x authorization is globally enabled for the controller or service platform. A green checkmark designates Dot1x authorization globally enabled. A red X defines Dot1x as globally disabled.

5 Review the following **Dot1x Auth Ports** utilization information:

Name	Lists the controller or service platform ge ports subject to automatic connection and authentication using Dot1x.
Auth SM	Lists whether Dot1x authentication is forced over the listed port.
Auth VLAN	Lists the numeric VLAN ID used as a virtual interface for authentication requests over the listed port.
BESM	Lists whether an authentication request is pending on the listed port.
Client MAC	Lists the MAC address of requesting clients seeking authentication over the listed port.

Guest VLAN	Lists the guest VLAN utilized for the listed port. This is the VLAN traffic is bridged on if the port is unauthorized and guest VLAN globally enabled.
Host	Lists whether the host is a single entity or not.
Pstatus	Lists whether the listed port has been authorized for Dot1x network authentication.

6 Refer to the **MacAuth** table to assess the AAA policy applied to MAC authorization requests.

7 Review the following **MAC Auth Ports** utilization information:

Name	Lists the controller or service platform ge ports subject to automatic connection and MAC authentication using Dot1x.
Authorized	Lists whether MAC authorization using Dot1x has been authorized (permitted) on the listed ge port. A green checkmark designates Dot1x authorization as permitted. A red X defines authorization as disabled.
Enabled	Lists whether MAC authorization using Dot1x has been enabled on the listed ge port. A green checkmark designates Dot1x authorization as allowed. A red X defines authorization as disabled.
MAC Auth	Lists the port's factory encoded MAC address.

8 Select the **Refresh** button to update the screen's statistics counters to their latest value.

15.3.30 Network

► Controller Statistics

Use the *Network* screen to view information for ARP, DHCP, Routing, MLD and Bridging. Each of these screens provides enough data to troubleshoot issues related to the following:

- *ARP Entries*
- *Route Entries*
- *Default Routes*
- *Bridge*
- *IGMP*
- *MLD*
- *LACP*
- *Traffic Shaping*
- *DHCP Options*
- *Cisco Discovery Protocol*
- *Link Layer Discovery Protocol*
- *IPv6 Neighbor Discovery*
- *MSTP*

15.3.30.1 ARP Entries

► Network

The *Address Resolution Protocol* (ARP) is a networking protocol for determining a network host's hardware address when its IP address or network layer address is known.

To view the ARP entries on the network statistics screen:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Networks** menu from the left-hand side of the UI.
- 4 Select **ARP**.

IP Address	ARP MAC Address	Type	VLAN
10.233.89.253	00-0F-35-76-F4-3C	Dynamic	vlan10
10.233.89.72	00-11-25-95-F8-F8	Dynamic	vlan10
172.168.1.107	B4-C7-99-0F-C9-DC	Dynamic	vlan5
172.168.1.200	00-14-85-A0-F5-9A	Dynamic	vlan5
172.168.7.200	00-16-C7-86-A2-43	Dynamic	vlan4

Type to search in tables

Row Count: 5

Refresh

Figure 15-97 Wireless Controller - Network ARP screen

The **ARP Entries** screen displays the following:

IP Address	Displays the IP address of the client being resolved on behalf of the controller or service platform.
ARP MAC Address	Displays the MAC address of the device where an IP address is being resolved.
Type	Defines whether the entry was added statically or created dynamically in respect to network traffic. Entries are typically static.
VLAN	Displays the name of the virtual interface where the IP address was found.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.2 Route Entries

► Network

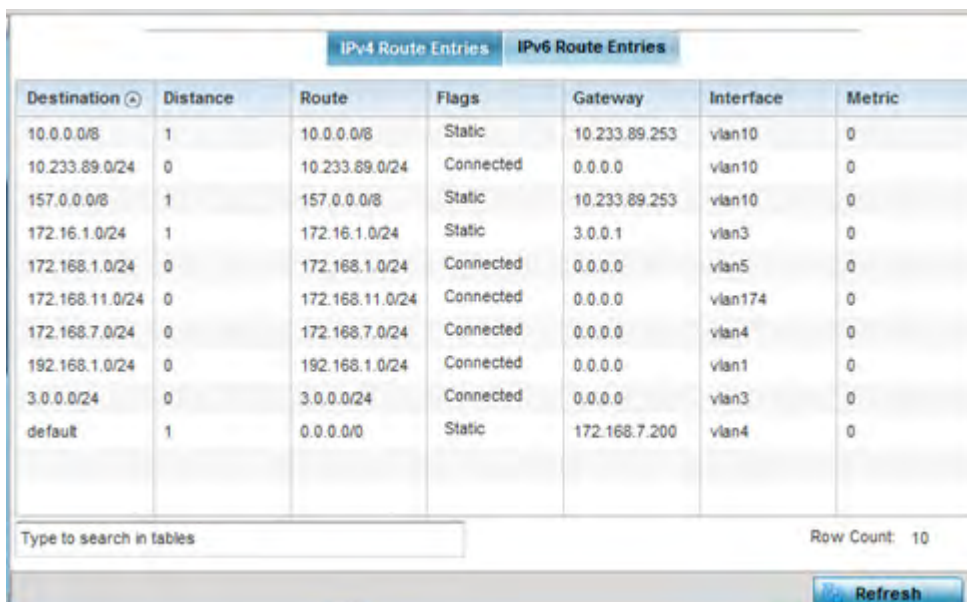
The *Route Entries* screen displays data for routing packets to a defined destination. When an existing destination subnet does not meet the needs of the network, add a new destination subnet, subnet mask and gateway as needed for either IPv4 or IPv6 formatted data packets.

IPv4 operates as a best effort delivery method, as it does not guarantee delivery, and does not ensure proper sequencing or duplicate delivery (unlike (TCP)). IPv4 hosts can use link local addressing to provide local connectivity.

IPv6 is the latest revision of the *Internet Protocol* (IP) designed to replace IPv4. IPv6 provides enhanced identification and location information for devices on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.

To view the route entries:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Route Entries**. The **IPv4 Route Entries** tab displays by default.



Destination	Distance	Route	Flags	Gateway	Interface	Metric
10.0.0.0/8	1	10.0.0.0/8	Static	10.233.89.253	vlan10	0
10.233.89.0/24	0	10.233.89.0/24	Connected	0.0.0.0	vlan10	0
157.0.0.0/8	1	157.0.0.0/8	Static	10.233.89.253	vlan10	0
172.16.1.0/24	1	172.16.1.0/24	Static	3.0.0.1	vlan3	0
172.168.1.0/24	0	172.168.1.0/24	Connected	0.0.0.0	vlan5	0
172.168.11.0/24	0	172.168.11.0/24	Connected	0.0.0.0	vlan174	0
172.168.7.0/24	0	172.168.7.0/24	Connected	0.0.0.0	vlan4	0
192.168.1.0/24	0	192.168.1.0/24	Connected	0.0.0.0	vlan1	0
3.0.0.0/24	0	3.0.0.0/24	Connected	0.0.0.0	vlan3	0
default	1	0.0.0.0/0	Static	172.168.7.200	vlan4	0

Figure 15-98 Wireless Controller - IPv4 Route Entries screen

The **IPv4 Route Entries** screen provides the following information:

Destination	Displays the IPv4 formatted address of the destination route address.
Distance	Lists the hop distance to a desired route. Devices regularly send neighbors their own assessment of the total cost to get to all known destinations. A neighboring device examines the information and compares it to their own routing data. Any improvement on what's already known is inserted in that device's own routing tables. Over time, each networked device discovers the optimal next hop for each destination.
Route	Lists the IPv4 formatted IP address used for routing packets to a defined destination.
Flags	The flag signifies the condition of the <i>direct</i> or <i>indirect</i> route.
Gateway	Displays the gateway IP address used to route packets to the destination subnet.
Interface	Displays the name of the controller interface or VLAN utilized by the destination subnet.

Metric	Lists the metric (or cost) of the route to select (or predict) the best route. The metric is computed using a routing algorithm, and covers information bandwidth, network delay, hop count, path cost, load, MTU, reliability, and communication cost.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

- 5 Select the **IPv6 Route Entries** tab to review route data for IPv6 formatted traffic.

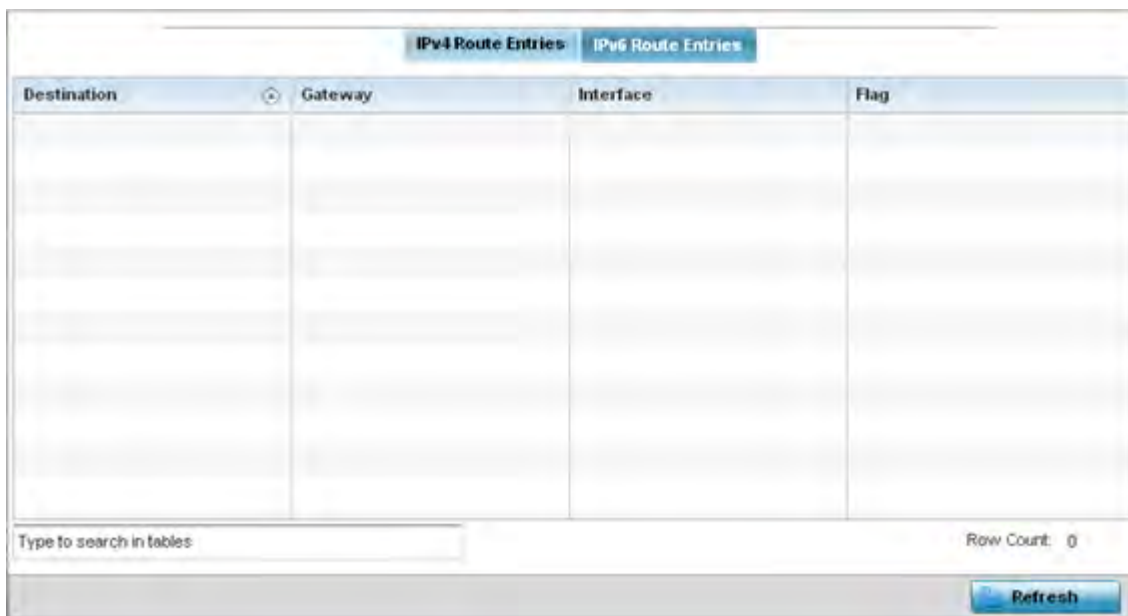


Figure 15-99 Wireless Controller - IPv6Route Entries screen

The **IPv6 Route Entries** screen provides the following information:

Destination	Displays the IPv6 formatted address of the destination route address. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
Gateway	Displays the gateway IP address used to route packets to the destination subnet.
Interface	Displays the name of the controller interface or VLAN utilized by the destination subnet.
Flag	The flag signifies the condition of the <i>direct</i> or <i>indirect</i> route.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

15.3.30.3 Default Routes

► Network

In an IPv6 supported environment unicast routing is always enabled. A controller or service platform routes IPv6 formatted traffic between interfaces as long as the interfaces are enabled for IPv6 and ACLs allow IPv6 formatted traffic. However, an administrator can add a default routes as needed.

Static routes are manually configured. They work fine in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.

To view controller or service platform default routes:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Default Routes**. The **IPv4 Default Routes** tab displays by default.

IPv4 Default Routes		IPv6 Default Routes				
DNS Server	Gateway Address	Installed	Metric	Monitor Mode	Source	Monitoring Status
	157.235.95.2	✓	100	gateway-monitoring	Static-Route	reachable

Type to search in tables: Row Count: 1

Refresh

Figure 15-100 Wireless Controller - IPv4 Default Routes screen

The **IPv4 Default Routes** screen provides the following information:

DNS Server	Lists the address of the DNS server providing IPv4 formatted address assignments on behalf of the controller or service platform.
Gateway Address	Lists the IP address of the gateway resource used with the listed route.
Installed	A green checkmark defines the listed route as currently installed on the controller or service platform. A red X defines the route as not currently installed and utilized.
Metric	The metric (or cost) could be the distance of a router (round-trip time), link throughput or link availability.
Monitor Mode	Displays where in the network the route is monitored for utilization status.
Source	Lists whether the route is <i>static</i> or an administrator defined <i>default</i> route. Static routes are manually configured. Static routes work adequately in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.
Monitoring Status	Lists whether the defined IPv4 route is currently reachable on the controller or service platform managed network. If not, perhaps a topology change has occurred to a static route requiring a default route be utilized.
Refresh	Select <i>Refresh</i> to update the display to the latest values.



The **IPv6 Default Routes** screen provides the following information:

Gateway Address	Lists the IP address of the gateway resource used with the listed route.
Installed	A green checkmark defines the listed IPv6 default route as currently installed on the controller or service platform. A red X defines the route as not currently installed and utilized.
Interface Name	Displays the interface on which the IPv6 default route is being utilized.
Lifetime	Lists the lifetime representing the valid usability of the default IPv6 route.
Preference	Displays the administrator defined IPv6 preferred route for IPv6 traffic.
Source	Lists whether the route is <i>static</i> or an administrator defined <i>default</i> route. Static routes are manually configured. Static routes work adequately in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.
Status	Lists whether the defined IPv6 route is currently reachable on the controller or service platform managed network. If not, perhaps a topology change has occurred to a static route requiring a default route be utilized.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

15.3.30.4 Bridge

► Network

Bridging is a forwarding technique making no assumption about where a particular network address is located. It depends on flooding and the examination of source addresses in received packet headers to locate unknown devices. Once a device is located, its location is stored in a table to avoid broadcasting to that device again.

1. Select the **Statistics** menu from the

Bridge Name	MAC Address	Interface	VLAN

Bridge Name	MAC Address	Interface	VLAN	Forwarding
1	00-0F-8F-19-BA-4C	ge1	1	forward
1	00-15-70-38-06-49	ge1	1	forward
1	00-15-70-81-74-2D	ge1	1	forward
1	00-23-68-88-0D-A7	ge1	1	forward
1	5C-0E-8B-18-10-91	ge1	1	forward
1	3C-CE-73-F4-47-83	ge1	1	forward
1	00-23-68-99-BB-7C	ge1	1	forward
1	00-A0-F8-68-D5-5D	ge1	1	forward
1	00-15-70-37-FD-F2	ge1	1	forward
1	00-23-68-13-9B-34	ge1	1	forward
1	00-23-68-0F-43-D8	ge1	1	forward
1	00-02-B3-28-D1-55	ge1	1	forward

Type to search in tables

Row Count: 12

Refresh

Figure 15-102 *Wireless Controller - Network Bridge screen*

The **Bridge** screen displays the following:

Bridge Name	Displays the numeric ID of the network bridge.
MAC Address	Displays the MAC address of each listed bridge.
Interface	Displays the controller or service platform physical port interface the bridge uses to transfer packets. Interface availability is slightly different amongst supported controller and service platform models.
VLAN	Displays the VLAN the bridge is using as a virtual interface within the controller or service platform managed network.
Forwarding	Displays whether the bridge is forwarding packets.
Refresh	Select <i>Refresh</i> to update the statistics counters to the latest values.

15.3.30.5 IGMP

► Network

Internet Group Management Protocol (IGMP) is a protocol used for managing members of IP multicast groups. The Access Point listens to IGMP network traffic and forwards the IGMP multicast packets to radios on which the

interested hosts are connected. On the wired side of the network, the Access Point floods all the wired interfaces. This feature reduces unnecessary flooding of multicast traffic in the network.

To view network IGMP configuration options:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **IGMP**.

Group			
VLAN	Group Address	Port Members	Version

Multicast Router (MRouter)					
VLAN	Learn Mode	Port Members	Mint IDs	Query Interval	Version
10	pim-dvmrp	ge2		10	3

Refresh

Figure 15-103 Wireless Controller - Network IGMP screen

The **Group** field describes the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
Group Address	Displays the Multicast Group ID supporting the statistics displayed. This group ID is the multicast address hosts are listening to.
Port Members	Displays the ports on which multicast clients have been discovered. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported controller and service platform models.
Version	Displays each listed group IGMP version compatibility as either version 1, 2 or 3.

The **Multicast Router (MRouter)** field describes the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
Learn Mode	Displays the learning mode used by the router as either <i>Static</i> or <i>PIM-DVMRP</i> .
Port Members	Displays the physical ports on which multicast clients have been discovered by the multicast router. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported controller and service platform models.

MiNT IDs	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure Access Point profile communications at the transport layer. Using MiNT, an Access Point can be configured to only communicate with other authorized (MiNT enabled) Access Points of the same model.
Query Interval	Lists the IGMP query interval implemented when the querier functionality is enabled. The default value is 60 seconds.
Version	Lists the multicast router IGMP version compatibility as either version 1, 2 or 3. The default setting is 3.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.6 MLD

► Network

Multicast Listener Discovery (MLD) snooping enables a controller, service platform or Access Point to examine MLD packets and make forwarding decisions based on content. MLD is used by IPv6 devices to discover devices wanting to receive multicast packets destined for specific multicast addresses. MLD uses multicast listener queries and multicast listener reports to identify which multicast addresses have listeners and join multicast groups.

MLD snooping caps the flooding of IPv6 multicast traffic on controller, service platform or Access Point VLANs. When enabled, MLD messages are examined between hosts and multicast routers and to discern which hosts are receiving multicast group traffic. The controller, service platform or Access Point then forwards multicast traffic only to those interfaces connected to interested receivers instead of flooding traffic to all interfaces.

To view network MLD configuration options:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **MLD**.

Multicast Listener Discovery (MLD) Group

VLAN	Group Address	Port Members	Version

IPv6 Multicast Router (MRouter)

VLAN	MiNT IDs	Learn Mode	Port Members	Query Interval	Version

Refresh

Figure 15-104 Wireless Controller - Network MLD screen

The **Multicast Listener Discovery (MLD) Group** field describes the following:

VLAN	Displays the group VLAN where the MLD groups multicast transmission is conducted.
Group Address	Displays the Multicast Group ID supporting the statistics displayed. This group ID is the multicast address hosts are listening to.
Port Members	Displays the ports on which MLD multicast clients have been discovered. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported controller and service platform models.
Version	Displays each listed group's version compatibility as either version 1, 2 or 3.

The **IPv6 Multicast Router (MRouter)** field describes the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
MiNT IDs	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure communications at the transport layer. Using MiNT, a controller or service platform can be configured to only communicate with other authorized (MiNT enabled) devices.
Learn Mode	Displays the learning mode used by the router as either <i>Static</i> or <i>PIM-DVMRP</i> .
Port Members	Displays the physical ports on which multicast clients have been discovered by the multicast router. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported controller and service platform models.
Query Interval	Lists the query interval implemented when the querier functionality is enabled. The default value is 60 seconds.
Version	Lists the multicast router version compatibility as either version 1, 2 or 3. The default setting is 3.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.7 LACP

► Network

Link Aggregation Control Protocol (LACP) is used to dynamically determine if link aggregation is possible and then to automatically configure the aggregation. LACP is a part of the IEEE 802.1ad standard and allows the switch to dynamically reconfigure the link aggregation groups (LAGs). A LAG is enabled only if the LACP determines that the remote device is also using LACP and is able to join the LAG.

To view network LACP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **LACP**. The **System and Aggregator Statistics** tab displays by default.

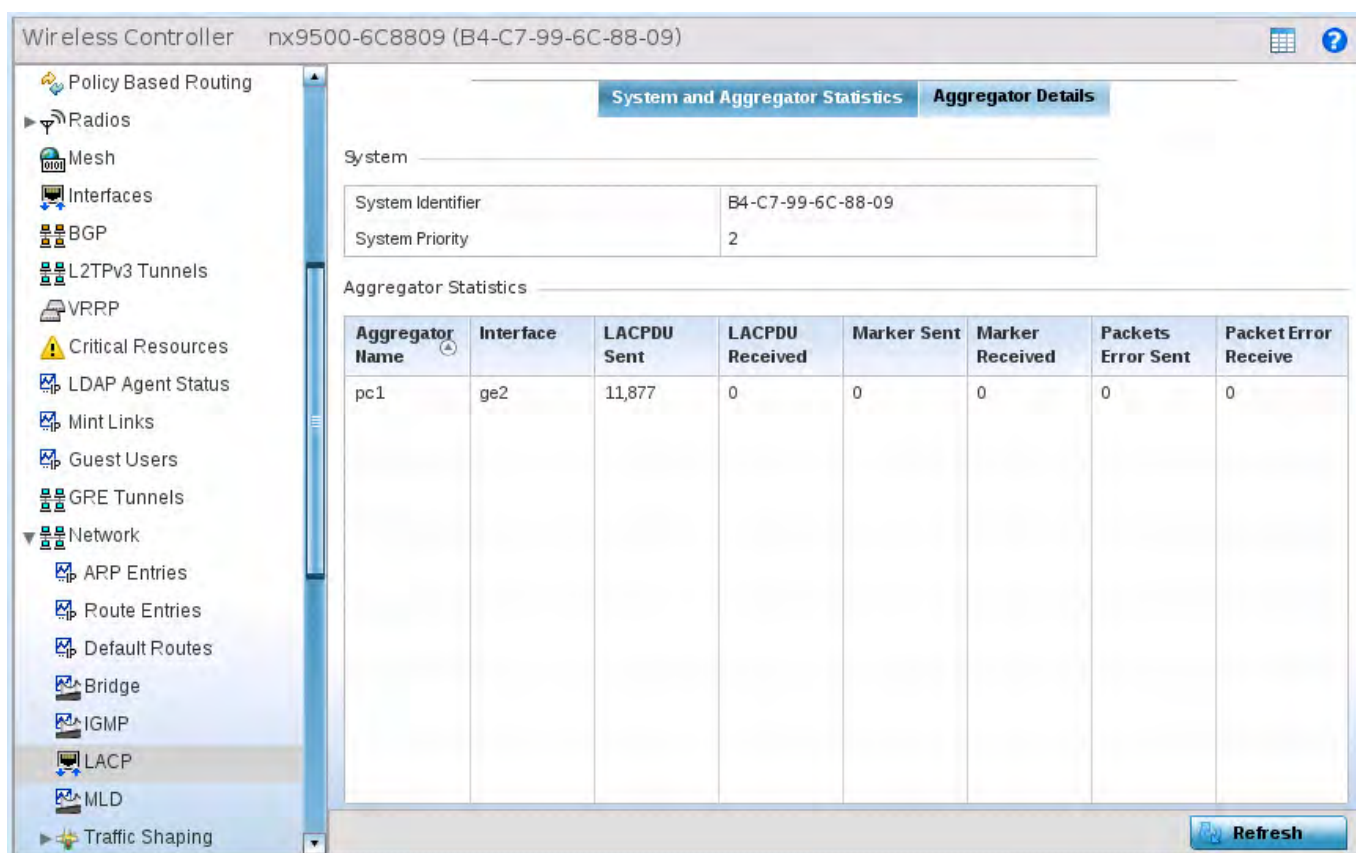


Figure 15-105 Wireless Controller - Network LACP - System And Aggregator Statistics screen

The **System** field describes the following:

System Identifier	Displays the MAC address of the device.
System Priority	Displays the system's LACP priority value.

The **Aggregator Statistics** field describes the following:

Aggregator Name	Displays the name of the port channel configured on this device.

Interface	Displays the name of the interface for which these statistics are being displayed.
LACPDU Sent	Displays the number of Link Aggregation Control Protocol Data Units (LACPDU)s sent from this device.
LACPDU Received	Displays the number of LACPDU)s received by this device.
Marker Sent	Displays the number of marker packets sent. Marker packets are sent to the remote device to ensure that all frames transmitted through the link have been received.
Marker Received	Displays the number of marker packet responses received from the remote device.
Packets Error Sent	Displays the total number packets transmitted with error
Packets Error Received	Displays the total number packets received with error

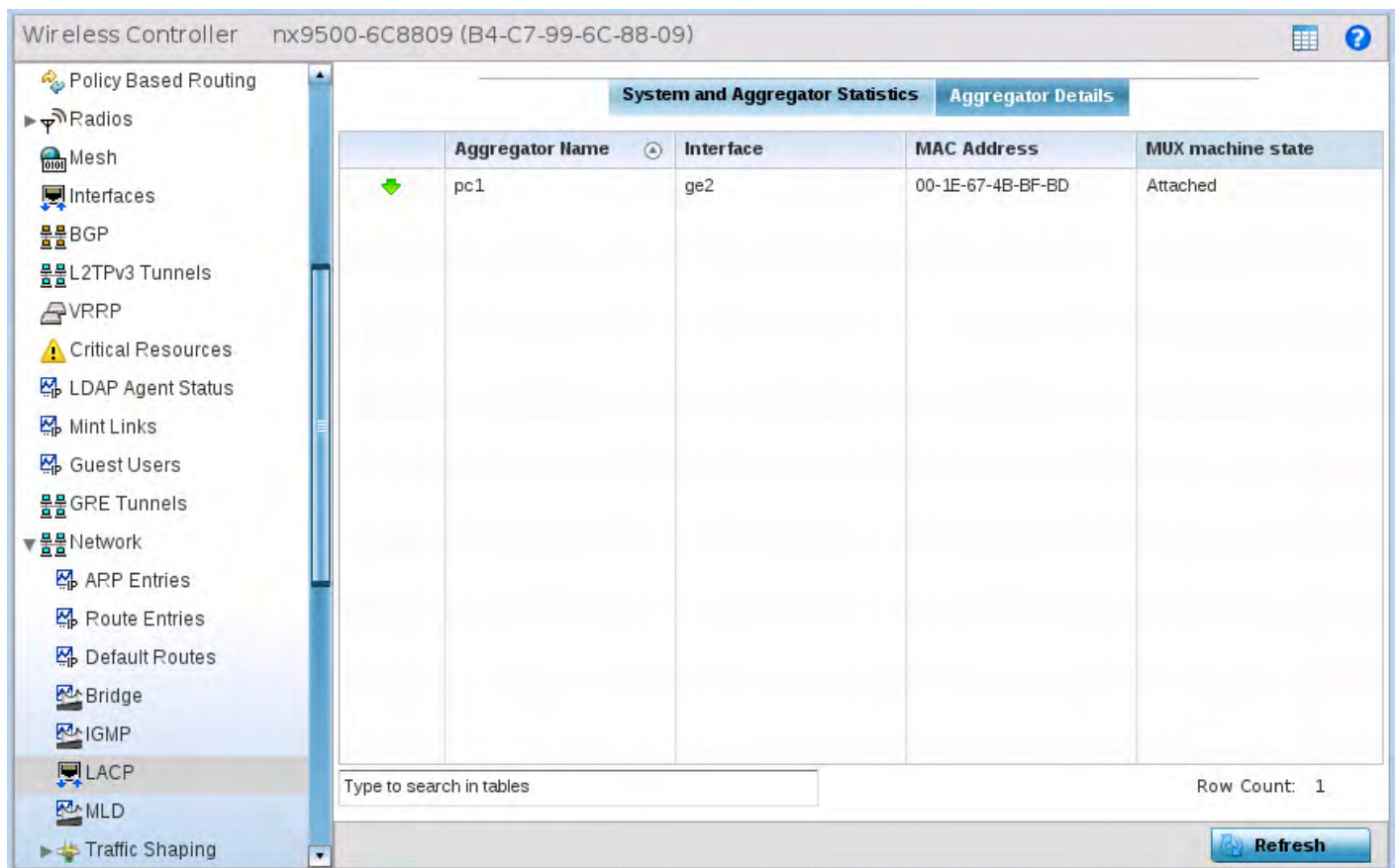


Figure 15-106 Wireless Controller - Network LACP screen - Aggregator Details tab

- 5 Select the **Aggregator Details** tab. This field describes the following:

Aggregator Name	Displays the name of the link aggregator (LAG).
Interface	Displays the name of the interface that is a member of the LAG.
MAC Address	Displays the MAC address of the physical interface.

MUX machine state	Displays the state of the multiplexer state machine for the aggregation port. The values are: • attached – Displays the state as attached, when the multiplexer state machine is initiating the process of attaching the port to the selected aggregator. • detached – Displays the state as detached, when the multiplexer state machine is initiating the process of detaching the port from the aggregator. • collecting/distributing – Displays the state as collecting/distributing. Collecting and distributing states are merged together to form a combined state (coupled control). Because independent control is not possible, the coupled control state machine does not wait for the partner to signal that collection has started before enabling both collection and distribution.

15.3.30.8 Traffic Shaping

► Network

Traffic shaping regulates network data transfers to ensure a specific performance level. Traffic shaping delays the flow of packets defined as less important than prioritized traffic streams. Traffic shaping enables traffic control out an interface to match its flow to the speed of a remote target's interface and ensure traffic conforms applied policies. Traffic can be shaped to meet downstream requirements and eliminate network congestion when data rates are in conflict.

Apply traffic shaping to specific applications to apply application categories. When application and ACL rules are conflicting, an application takes precedence over an application category, then ACLs.

To view network the controller or service platform's traffic shaping configuration:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Traffic Shaping**. The Status screen displays by default, and lists the controller or service platform's traffic shaping status.

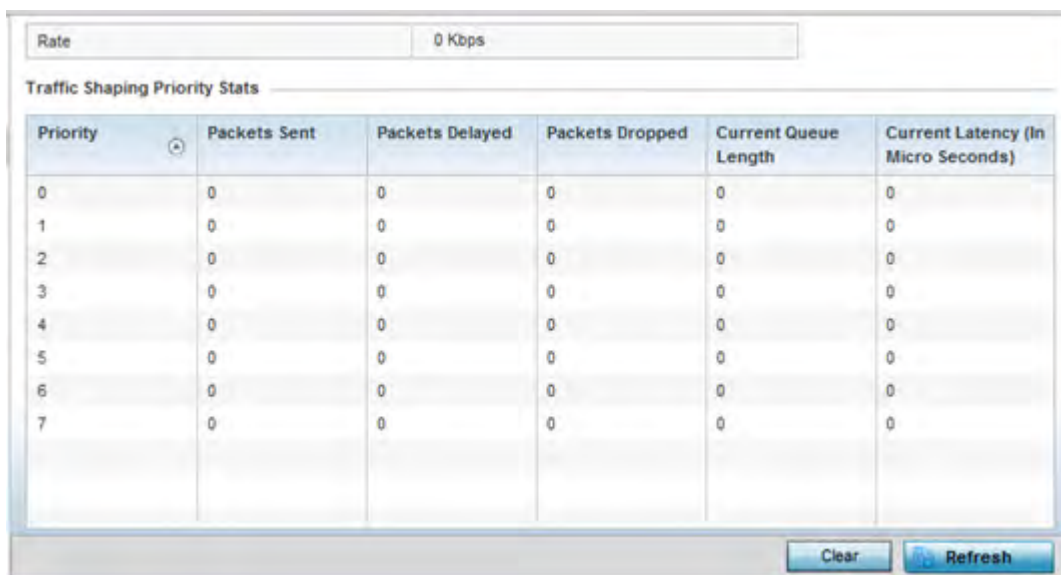


Figure 15-107 *Wireless Controller - Network Traffic Shaping screen*

- 5 Select **Statistics**.
- 6 Refer to the following **Traffic Shaping** statistics:

Rate	The rate configuration controls the maximum traffic rate sent or received on an interface. Consider this form of rate limiting on interfaces at the edge of a network to limit traffic into or out of the network. Traffic within the set limit is sent and traffic exceeding the set limit is dropped or sent with a different priority.
Priority	Lists the traffic shaper queue priority. There are 8 queues (0 - 7), and traffic is queued in each based on incoming packets 802.1p markings.
Packets Sent	Provides a baseline of the total number of packets sent to assess packet delays and drops as a result of the filter rules applied in the traffic shaping configuration.
Packets Delayed	Lists the packets defined as less important than prioritized traffic streams and delayed as a result of traffic shaping filter rules applied.
Packets Dropped	Lists the packets defined as less important than prioritized traffic streams, delayed and eventually dropped as a result of traffic shaping filter rules applied.
Current Length	Lists the packet length of the data traffic <i>shaped</i> to meet downstream requirements.
Current Latency	Traffic shaping latency is the time limit after which packets start dropping as a result of the traffic prioritization filter rules applied.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.9 DHCP Options

► Network

Controllers and service platforms contain an internal *Dynamic Host Configuration Protocol* (DHCP) server. The DHCP server can provide the dynamic assignment of IP addresses automatically from existing address pools. This

is a protocol that includes IP address allocation and delivery of host-specific configuration parameters from a DHCP server to a host. Some of these parameters include IP address, gateway and network mask.

To view network DHCP options:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **DHCP Options**.

Server Information	Image File	Configuration	Legacy Adoption	Adoption
n/a	n/a	n/a	n/a	pool1=172.168.7.197,172.168.7.10;level=2

Type to search in tables

Row Count: 1

Refresh

Figure 15-108 Wireless Controller - Network DHCP Options screen

The **DHCP Options** screen describes the following:

Server Information	Lists server information specific to each DHCP server resource available to requesting clients for the dynamic assignment of IP addresses.
Image File	Displays the image file name. BOOTP or the bootstrap protocol can be used to boot diskless clients. An image file is sent from the boot server. The file contains the operating system image. DHCP servers can be configured to support BOOTP.
Configuration	Displays the name of the configuration file on the DHCP server.
Legacy Adoption	Displays legacy (historical) device adoption information.
Adoption	Displays pending (current) adoption information.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.10 Cisco Discovery Protocol

► Network

The *Cisco Discovery Protocol* (CDP) is a proprietary Data Link Layer network protocol implemented in Cisco networking equipment and used to share information about network devices.

To view a controller or service platform's CDP Statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Cisco Discovery Protocol**.

Capabilities	Device ID	Local Port	Platform	Port ID	TTL
Router	ap6521-970CC6	ge1	AP-6521-60010-W	ge1	123
Router	ap650-312A10	ge1	AP-0650-60010-W	ge1	137
Router Switch	ap7131-8A4848	ge1	AP7131N	ge1	174
Router Switch IGM	Switch	ge2	cisco WS-C3560-2	FastEthernet0/4	128

Type to search in tables Row Count: 4

Clear Neighbors Refresh

Figure 15-109 Wireless Controller - Network CDP screen

The **Cisco Discovery Protocol** screen displays the following:

Capabilities	Displays the capabilities code for Cisco neighbors.
Device ID	Displays the configured device ID or name for each device in the table.
Local Port	Displays the local port name for each CDP capable device.
Platform	Displays the model number of the CDP capable device.
Port ID	Displays the identifier for the local port.
TTL	Displays the <i>time to live</i> (TTL) for each CDP connection.
Clear Neighbors	Click <i>Clear Neighbors</i> to remove all known CDP neighbors from the table.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.11 Link Layer Discovery Protocol

► Network

The *Link Layer Discovery Protocol* (LLDP) or IEEE 802.1AB is a vendor-neutral data link layer protocol used by network devices for advertising of (announcing) their identity, capabilities, and interconnections on a IEEE 802 LAN network. The protocol is formally referred to by the IEEE as *Station and Media Access Control Connectivity Discovery*.

To view a controller or service platform's Link Layer Discovery Protocol statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.

- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Link Layer Discovery Protocol**.

Capabilities	Device ID	Enabled Capabilities	Local Port	Platform	Port ID	TTL
bridge wlan_ap rc	ap6511-084522	bridge wlan_ap rc	up1	AP-6511-80010-L	5C-0E-8B-08-45-2	121

Type to search in tables: Row Count: 1

Figure 15-110 *Wireless Controller - Network LLDP screen*

The **Link Layer Discovery Protocol** screen displays the following:

Capabilities	Displays the Access Point capabilities code.
Device ID	Displays the configured device ID or name for each device in the table.
Enabled Capabilities	Displays which LLDP capabilities are currently utilized by the listed device.
Local Port	Displays the physical local port name for each LLDP capable device.
Platform	Displays the model number of the LLDP capable device and its firmware load.
Port ID	Displays the identifier for the local port.
TTL	Displays the <i>time to live</i> (TTL) for each LLDP connection.
Clear Neighbors	Click <i>Clear Neighbors</i> to remove all known LLDP neighbors from the table.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.12 IPv6 Neighbor Discovery

► Network

IPv6 neighbor discovery uses ICMP messages and solicited multicast addresses to find the link layer address of a neighbor on the same local network, verify the neighbor's reachability and track neighboring devices.

Upon receiving a neighbor solicitation message, the destination replies with *neighbor advertisement* (NA). The source address in the advertisement is the IPv6 address of the device sending the message. The destination address in the advertisement message is the IPv6 address of the device sending the neighbor solicitation. The data portion of the NA includes the link layer address of the node sending the neighbor advertisement.

Neighbor solicitation messages also verify the availability of a neighbor once its the link layer address is identified. When a node wants to verify the reachability of a neighbor, the destination address in a neighbor solicitation message is the unicast address of the neighbor.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **IPv6 Neighbor Discovery**.

[illegible]

The **IPv6 Neighbor** screen displays the following:

IPv6 Address	Lists an IPv6 IP address for neighbor discovery. IPv6 hosts can configure themselves automatically when connected to an IPv6 network using the neighbor discovery protocol via CMPv6 router discovery messages. When first connected to a network, a host sends a link-local router solicitation multicast request for its configuration parameters; routers respond to such a request with a router advertisement packet that contains Internet Layer configuration parameters. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
MAC Address	Lists the factory encoded hardware MAC address of the neighbor device using an IPv6 formatted IP address as its network identifier.
Type	Displays the device type for the neighbor solicitation. Neighbor solicitations request the link layer address of a target node while providing the sender's own link layer address to the target. Neighbor solicitations are multicast when the node needs to resolve an address and unicast when the node seeks to verify the reachability of a neighbor. Options include <i>Host</i> , <i>Router</i> and <i>DHCP Server</i> .
VLAN	Lists the virtual interface (from 1 - 4094) used for the required neighbor advertisements and solicitation messages used for neighbor discovery.

Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.30.13 MSTP

► Network

The *Multiple Spanning Tree Protocol* (MSTP) provides an extension to RSTP to optimize the usefulness of VLANs. MSTP allows for a separate spanning tree for each VLAN group, and blocks all but one of the possible alternate paths within each spanning tree topology.

If there's just one VLAN in the Access Point managed network, a single spanning tree works fine. However, if the network contains more than one VLAN, the network topology defined by single STP would work, but it's possible to make better use of the alternate paths available by using an alternate spanning tree for different VLANs or groups of VLANs.

MSTP includes all of its spanning tree information in a single *Bridge Protocol Data Unit* (BPDU) format. BPDUs are used to exchange information bridge IDs and root path costs. Not only does this reduce the number of BPDUs required to communicate spanning tree information for each VLAN, but it also ensures backward compatibility with RSTP. MSTP encodes additional region information after the standard RSTP BPDU as well as a number of MSTI messages. Each MSTI messages conveys spanning tree information for each instance. Each instance can be assigned a number of configured VLANs. The frames assigned to these VLANs operate in this spanning tree instance whenever they are inside the MST region. To avoid conveying their entire VLAN to spanning tree mapping in each BPDU, the Access Point encodes an MD5 digest of their VLAN to an instance table in the MSTP BPDU. This digest is used by other MSTP supported devices to determine if the neighboring device is in the same MST region as itself.

To view a controller or service platform's MSTP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **MSTP**.

MST Config

CFG Name	My Name
Digest	0xac36177f50283cd4b83821d8ab26de62
Format ID	0
Name	1
Revision	0

MST Bridge

	BPDU Filter	BPDU Guard	Bridge Admin Cisco	Bridge Enabled	Bridge Oper Cisco	CIST Bridge ID	CIST Bridge Priority	CIST Reg Root ID
	✖	✖	✖	✖	✖	1: CIST Brik	32,768	1: CIST Reg Root id E

MST Bridge Port Detail

Name	Role	Send MSTP	State	Type	Admin BPDU Filter	Admin BPDU Guard	Admin Edge	Admin P2P MAC	Admin Root Guard
ge1	4	MSTP	Forward	0	2	2	✖	✖	✖
ge10	4	STP	Forward	0	2	2	✖	✖	✖
ge2	4	MSTP	Forward	0	2	2	✖	✖	✖
ge3	4	MSTP	Forward	0	2	2	✖	✖	✖

Refresh

Figure 15-112 Wireless Controller - Network MSTP screen

The **MST Config** field displays the name assigned to the MSTP configuration, its digest, format ID, name and revision.

The **MST Bridge** field lists the filters and guards that have been enabled and whether Cisco interoperability is enabled.

The **MST Bridge Port Detail** field lists specific controller or service platform port status and their current state.

15.3.31 DHCPv6 Relay & Client

► Controller Statistics

DHCPv6 is a networking protocol for configuring IPv6 hosts with IP addresses, IP prefixes or other configuration attributes required on an IPv6 network. DHCPv6 relay agents receive messages from clients and forward them a DHCPv6 server. The server sends responses back to the relay agent and the relay agent sends the responses to the client on the local link.

To assess the DHCPv6 relay configuration:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **DHCP Relay & Client** from the left-hand side of the UI.

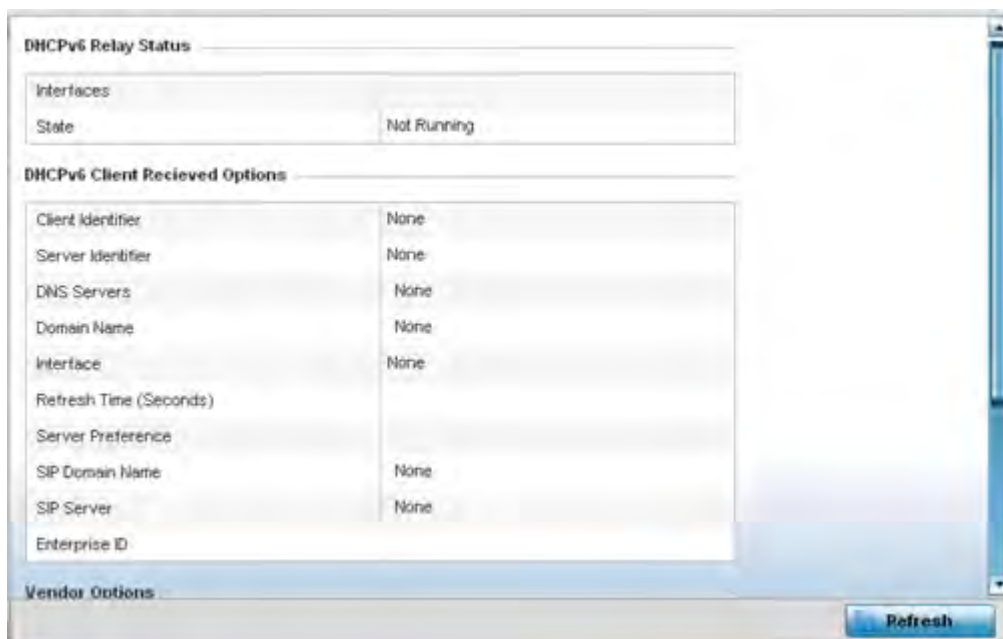


Figure 15-113 Wireless Controller - DHCPv6 Relay and Client screen

- 4 The **DHCPv6 Relay Status** tables defines the following:

Interfaces	Displays the controller or service platform interface used for DHCPv6 relay.
State	Displays the current operational state of the DHCPv6 server to assess its availability as a viable IPv6 provisioning resource.

- 5 The **DHCPv6 Client Received Options** tables defines the following:

Client Identifier	Lists whether the reporting client is using a <i>hardware address</i> or <i>client identifier</i> as its identifier type within requests to the DHCPv6 server.
Server Identifier	Displays the server identifier supporting client DHCPv6 relay message reception.
DNS Servers	Lists the DNS server resources supporting relay messages received from clients.
Domain Name	Lists the domain to which the remote server resource belongs.
Interface	Displays the interfaces dedicated to client DHCPv6 relay message reception.
Refresh Time (Seconds)	Lists the time (in seconds) since the data populating the DHCPv6 client received options table has been refreshed.
Server Preference	Lists the preferred DHCPv6 server resource supporting relay messages received from clients.
SIP Domain Name	Lists the SIP domain name supporting DHCPv6 client telephone extensions or voice over IP systems.
SIP Server	Displays the SIP server name supporting DHCPv6 telephone extensions or voice over IP systems.
Enterprise ID	Lists the enterprise ID associated with DHCPv6 received client options.

6 Refer to the **Vendor Options** table for the following:

Code	Lists the relevant numeric DHCP vendor code.
Data	Lists the supporting data relevant to the listed DHCP vendor code.

7 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.3.32 DHCP Server

► Controller Statistics

Controllers and service platforms contain an internal *Dynamic Host Configuration Protocol* (DHCP) server. DHCP can provide IP addresses automatically. DHCP is a protocol that includes mechanisms for IP address allocation and delivery of host-specific configuration parameters (IP address, network mask gateway etc.) from a DHCP server to a host.

To review DHCP server statistics, refer to the following:

- [Viewing General DHCP Information](#)
- [Viewing DHCP Binding Information](#)
- [Viewing DHCP Server Networks Information](#)

15.3.32.1 Viewing General DHCP Information

► DHCP Server

To view *General* DHCP status and binding information for both DHCPv4 and DHCPv6:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller from the left navigation pane.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **General**.

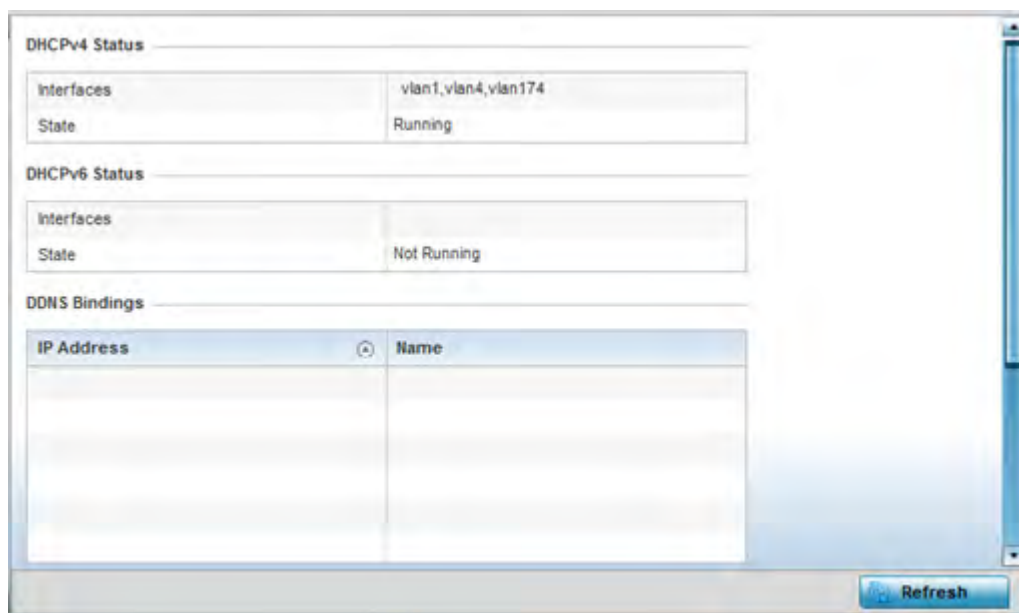


Figure 15-114 Wireless Controller - DHCP Server General screen

- 5 The **DHCPv4 Status** and **DHCPv6 Status** tables defines the following:

Interfaces	Displays the controller or service platform interface used with the DHCPv4 or DHCPv6 resource for IP address provisioning.
State	Displays the current operational state of the DHCPv4 or DHCPv6 server to assess its availability as a viable IP provisioning resource.

- 6 The **DDNS Bindings** table displays the following:

IP Address	Displays the IP address assigned to the requesting client.
Name	Displays the domain name mapping corresponding to the listed IP address.

- 7 The **DHCP Manual Bindings** table displays the following:

IP Address	Displays the IP address for clients requesting DHCP provisioning resources.
Client Id	Displays the client's ID used to differentiate requesting clients.

- 8 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.3.32.2 Viewing DHCP Binding Information

► *DHCP Server*

The *DHCP Binding* screen displays DHCP binding information such as expiry time, client IP addresses and their MAC address.

Controllers and service platforms build and maintain a DHCP snooping table (DHCP binding database). A controller or service platform uses the snooping table to identify and filter untrusted messages. The DHCP binding database keeps track of DHCP addresses assigned to ports, as well as filtering DHCP messages from untrusted ports. Incoming packets received on untrusted ports, are dropped if the source MAC address does not match the MAC in the binding table.

To view the DHCP binding information:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **Bindings**.

[illegible]

Figure 15-115 *Wireless Controller - DHCP Server Bindings screen*

The **Bindings** screen displays the following:

Expiry Time	Displays the expiration of the lease used by the client for controller or service platform DHCP resources.
IP Address	Displays the IP address of each listed client requesting DHCP services.
DHCP MAC Address	Displays the MAC address of each listed client requesting DHCP services.
Clear	Select a table entry and select <i>Clear</i> to remove the client from the list of devices requesting DHCP services from the controller or service platform.
Clear All	Select <i>Clear All</i> to remove all listed clients from the list of requesting clients.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.32.3 Viewing DHCP Server Networks Information

► DHCP Server

The DHCP server maintains a pool of IP addresses and client configuration parameters (default gateway, domain name, name servers etc). On receiving a valid client request, the server assigns the requestor an IP address, a lease (the validity of time), and other IP configuration parameters.

The *Networks* screen provides network pool information such as the subnet for the addresses you want to use from the pool, the pool name, the used addresses and the total number of addresses.

To view the **DHCP Server Networks** information:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **Networks**.

Name	Subnet Address	Used Addresses	Total Addresses
vlan1	192.168.1.0/24	0	19

Figure 15-116 *Wireless Controller - DHCP Server Networks screen*

The **Networks** screen displays the following:

Name	Displays the name of the virtual network (VLAN) from which IP addresses can be issued to DHCP client requests on the listed controller or service platform interface.
Subnet Address	Displays the subnet for the IP addresses used from the network pool.
Used Addresses	Displays the number of host IP addresses allocated by the DHCP server.
Total Addresses	Displays the total number of IP addresses available in the network pool for requesting clients.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.33 Firewall

► *Controller Statistics*

A firewall is designed to block unauthorized access while permitting authorized communications. It's a device or a set of devices configured to permit or deny computer applications based on a set of rules. For more information, refer to the following:

- *Viewing Packet Flow Statistics*
- *Viewing Denial of Service Statistics*
- *IP Firewall Rules*
- *IPv6 Firewall Rules*
- *MAC Firewall Rules*
- *NAT Translations*
- *Viewing DHCP Snooping Statistics*
- *IPv6 Neighbor Snooping*

15.3.33.1 Viewing Packet Flow Statistics

► Firewall

The *Packet Flows* screen displays data traffic packet flow utilization. The chart lists the different protocol flows supported, and displays a proportional view of the flows in respect to their percentage of data traffic utilized. The *Total Active Flows* field displays the total number of flows supported by the controller or service platform.

To view the packet flow statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **Packets Flows**.

Select **Clear All** to revert the statistics counters to zero and begin a new data collection, or select **Refresh** to update the display to the latest values.

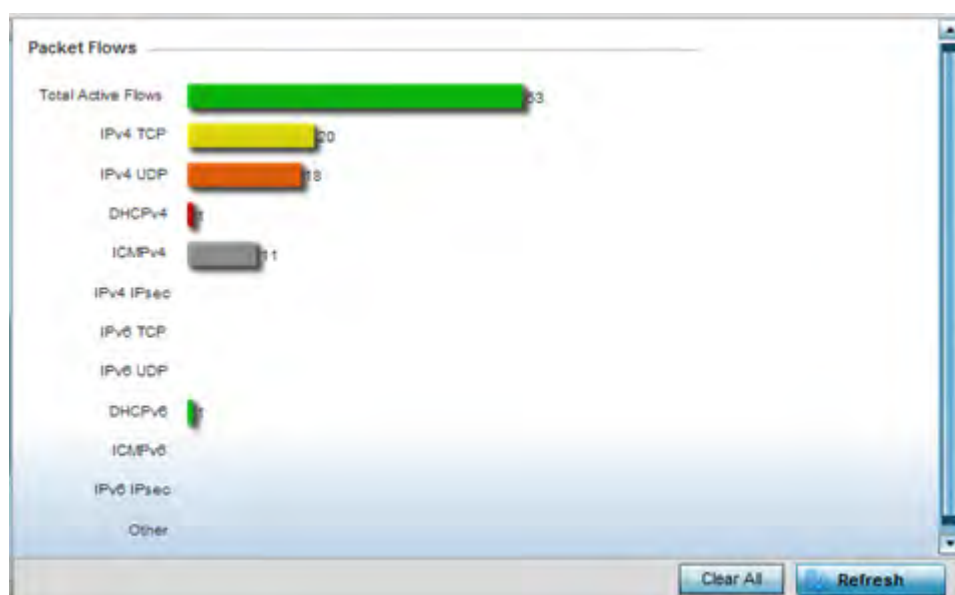


Figure 15-117 Firewall Packet Flows

15.3.33.2 Viewing Denial of Service Statistics

► Firewall

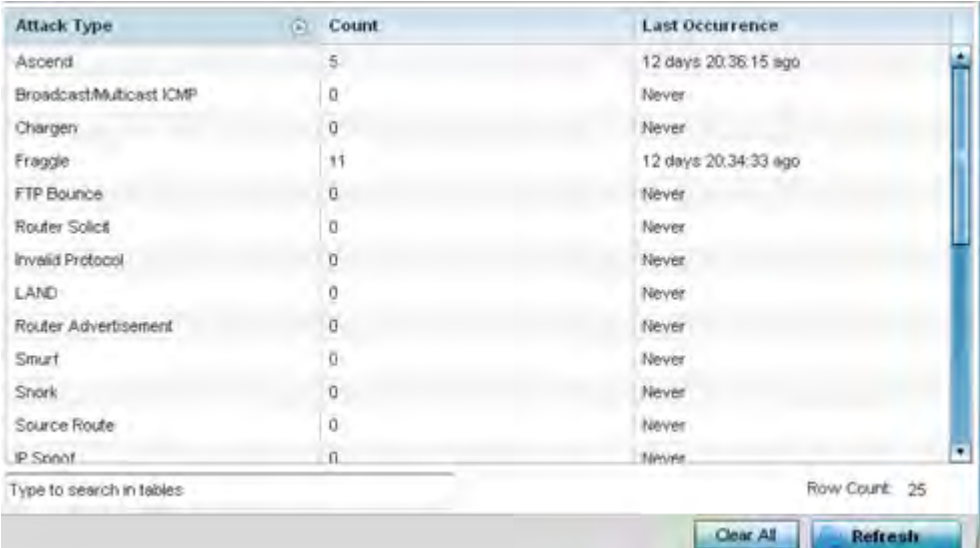
A *denial-of-service attack* (DoS attack), or distributed denial-of-service attack, is an attempt to make a computer resource unavailable to its intended users. Although the means to carry out a DoS attack may vary, it generally consists of a concerted effort to prevent an Internet site or service from functioning efficiently.

One common attack involves saturating the target's (victim's) machine with external communications requests, such that it cannot respond to legitimate traffic, or responds so slowly as to be rendered effectively unavailable. DoS attacks are implemented by either forcing the targeted computer(s) to reset, or consuming its resources so that it can no longer provide its intended service.

The *Denial of Service* screen displays attack type, number of occurrences, and time of last occurrence.

To view the denial of service statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **Denial of Service**.



Attack Type	Count	Last Occurrence
Ascend	5	12 days 20:36:15 ago
BroadcastMulticast ICMP	0	Never
Chargen	0	Never
Fraggle	11	12 days 20:34:33 ago
FTP Bounce	0	Never
Router Solicit	0	Never
Invalid Protocol	0	Never
LAND	0	Never
Router Advertisement	0	Never
Smurf	0	Never
Snork	0	Never
Source Route	0	Never
IP Spoof	0	Never

Type to search in tables: Row Count: 25

Figure 15-118 Wireless Controller - Firewall DoS screen

The **Denial of Service** screen displays the following:

Attack Type	Displays the DoS attack type. The controller or service platform supports enabling or disabling 24 different DoS attack filters.
Count	Displays the number of times each DoS attack was observed by the controller or service platform's firewall.
Last Occurrence	Displays the amount of time since the DoS attack has been observed by the controller or service platform's firewall.
Clear All	Select <i>Clear All</i> to revert the statistics counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.33.3 IP Firewall Rules

► Firewall

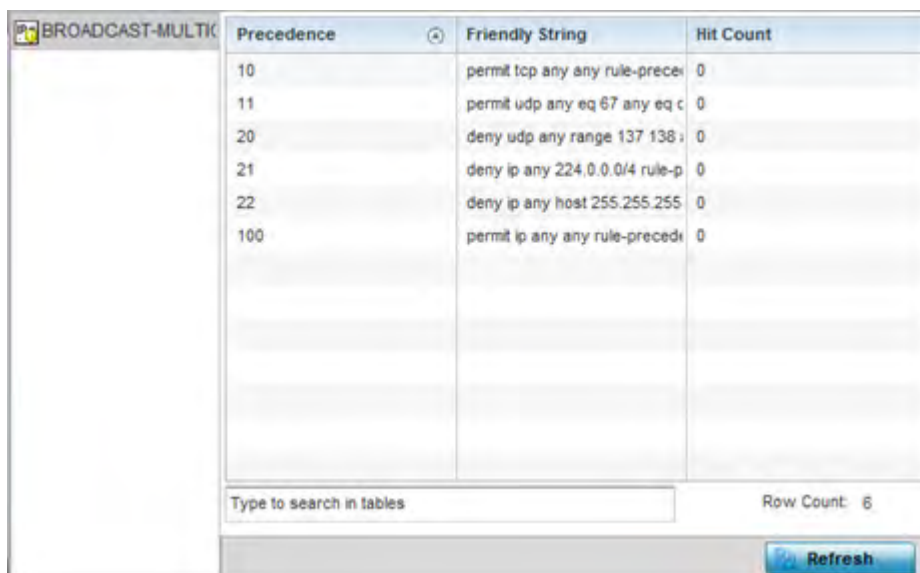
Create firewall rules to let any computer send IPv4 traffic to, or receive traffic from, programs, system services, computers or users. Firewall rules can be created to provide one of the three actions listed below that match the rule's criteria:

- *Allow a connection*
- *Allow a connection only if it is secured through the use of Internet Protocol security*
- *Block a connection*

Rules can be created for either inbound or outbound traffic.

To view existing IPv4 firewall rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **IP Firewall Rules**.



Precedence	Friendly String	Hit Count
10	permit tcp any any rule-prece	0
11	permit udp any eq 67 any eq c	0
20	deny udp any range 137 138	0
21	deny ip any 224.0.0.0/4 rule-p	0
22	deny ip any host 255.255.255	0
100	permit ip any any rule-precedi	0

Type to search in tables Row Count: 6

Refresh

Figure 15-119 Wireless Controller - Firewall IP Firewall Rules screen

The **IP Firewall Rules** screen displays the following:

Precedence	Displays the precedence (priority) applied to packets. Every rule has a unique precedence value between 1 - 5000. You cannot add two rules with the same precedence value.
Friendly String	This is a string that provides more information as to the contents of the rule. This is for information purposes only.
Hit Count	Displays the number of times each IP ACL has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.33.4 IPv6 Firewall Rules

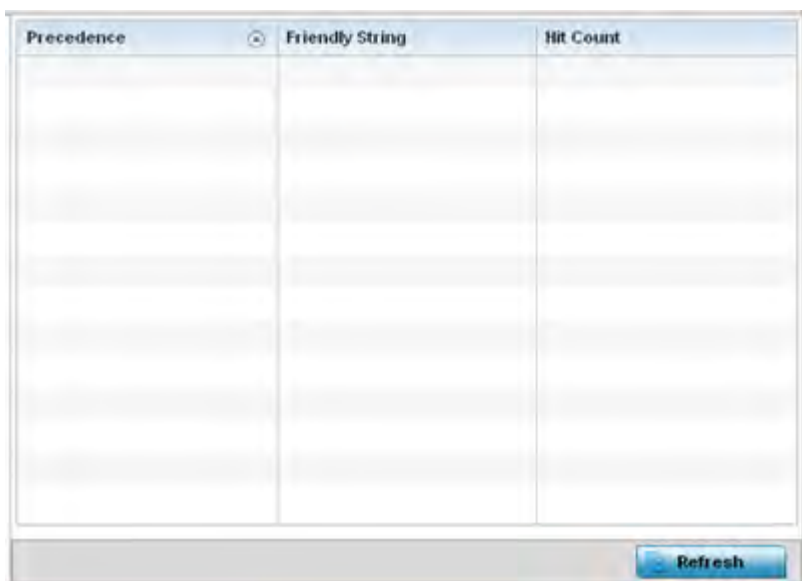
► Firewall

IPv6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. These hosts require firewall packet protection unique to IPv6 traffic, as IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. IPv6 hosts can configure themselves automatically when connected to an IPv6 network using the *neighbor discovery* (ND) protocol via ICMPv6 router discovery messages. When first connected to a network, a host sends a link-local router solicitation multicast request for its configuration parameters; routers respond to such a request with a router advertisement packet that contains Internet layer configuration parameters.

- Allow an IPv6 formatted connection
- Allow a connection only if it is secured through the use of IPv6 security
- Block a connection and exchange of IPv6 formatted packets

To view existing IPv6 firewall rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **IPv6 Firewall Rules**.



Precedence	Friendly String	Hit Count

Refresh

Figure 15-120 Wireless Controller - Firewall IPv6 Firewall Rules screen

The **IPv6 Firewall Rules** screen displays the following:

Precedence	Displays the precedence (priority) applied to IPV6 formatted packets. Unlike IPv4, IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Every rule has a unique precedence value between 1 - 5000. You cannot add two rules with the same precedence value.
Friendly String	This is a string that provides more information as to the contents of the IPv6 specific IP rule. This is for information purposes only.
Hit Count	Displays the number of times each IPv6 ACL has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.33.5 MAC Firewall Rules

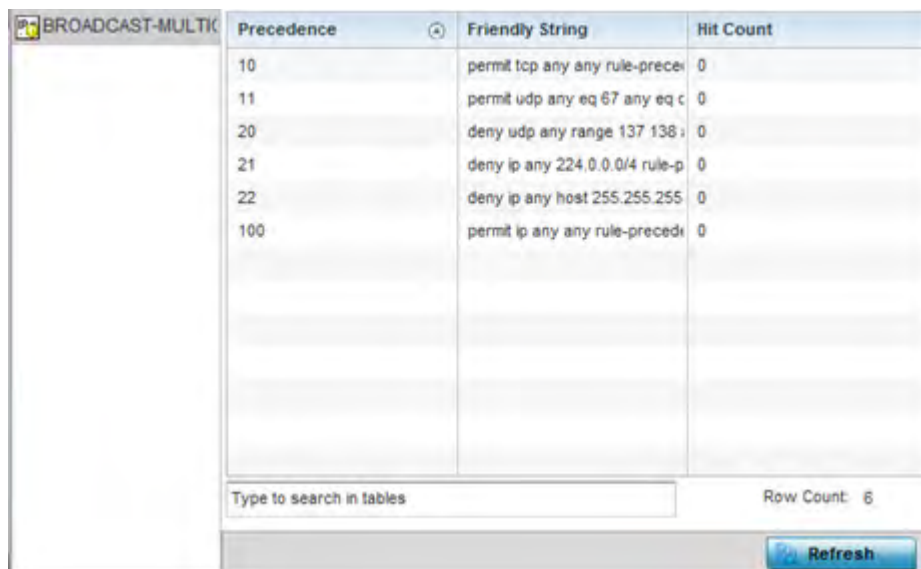
► Firewall

The ability to allow or deny client access by MAC address ensures malicious or unwanted users are unable to bypass security filters. Firewall rules can use one of the three following actions based on a rule criteria:

- *Allow a connection*
- *Allow a connection only if it is secured through the MAC firewall security*
- *Block a connection*

To view MAC firewall rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **MAC Firewall Rules**.



Precedence	Friendly String	Hit Count
10	permit tcp any any rule-prece	0
11	permit udp any eq 67 any eq c	0
20	deny udp any range 137 138 :	0
21	deny ip any 224.0.0.0/4 rule-p	0
22	deny ip any host 255.255.255	0
100	permit ip any any rule-preced	0

Type to search in tables

Row Count: 6

Refresh

Figure 15-121 Wireless Controller - Firewall MAC Firewall Rules screen

The **MAC Firewall Rules** screen displays the following:

Precedence	Displays the precedence (priority) applied to packets. The rules within an <i>Access Control Entries</i> (ACL) list are based on their precedence values. Every rule has a unique precedence value between 1 and 5000. You cannot add two rules with the same precedence value.
Friendly String	This string provides more information as to the contents of the rule. This is for information purposes only.
Hit Count	Displays the number of times each WLAN ACL has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.33.6 NAT Translations

► Firewall

Network Address Translation (NAT) is a technique to modify network address information within IP packet headers in transit. This enables mapping one IP address to another to protect wireless controller managed network address credentials. With typical deployments, NAT is used as an IP masquerading technique to hide private IP addresses behind a single, public facing, IP address.

NAT can provide a profile outbound Internet access to wired and wireless hosts connected to either an Access Point or a wireless controller. Many-to-one NAT is the most common NAT technique for outbound Internet access. Many-to-one NAT allows an Access Point or wireless controller to translate one or more internal private IP addresses to a single, public facing, IP address assigned to a 10/100/1000 Ethernet port or 3G card.

To assess the controller or service platform's NAT configuration and statistics.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select an Access Point node from the left navigation pane.
Expand the **Firewall** menu from the left-hand side of the UI.
- 3 Select **NAT Translations**.

	Protocol	Forward Source IP	Forward Source Port	Forward Dest IP	Forward Dest Port	Reverse Source IP	Reverse Source Port	Reverse Dest IP	Reverse Dest Port
+	tcp	172.26.14.21	55,536	74.125.200.1	443	74.125.200.1	443	10.233.89.179	41,019
+	tcp	172.26.15.2	51,719	107.181.174.	80	107.181.174.	80	10.233.89.179	48,521
+	tcp	157.235.207.	51,476	10.233.89.17	445	172.26.23.5	445	157.235.207.38	51,476
+	tcp	172.26.15.2	9,579	107.181.174.	80	107.181.174.	80	10.233.89.179	41,813
+	tcp	172.26.15.2	10,146	193.124.186.	443	193.124.186.	443	10.233.89.179	44,784
+	tcp	157.235.208.	49,222	10.233.89.17	445	172.26.23.5	445	157.235.208.189	49,222
+	tcp	157.235.207.	60,475	10.233.89.17	445	172.26.23.5	445	157.235.207.156	60,475
+	tcp	172.26.16.99	54,969	74.125.200.1	443	74.125.200.1	443	10.233.89.179	47,636
+	tcp	172.26.15.2	23,855	107.181.174.	80	107.181.174.	80	10.233.89.179	57,892
+	tcp	172.26.14.21	55,535	74.125.200.1	443	74.125.200.1	443	10.233.89.179	34,909
+	tcp	172.26.15.2	31,262	107.181.174.	80	107.181.174.	80	10.233.89.179	57,115
+	udp	172.26.10.14	61,493	192.36.148.1	53	192.36.148.1	53	10.233.89.179	35,360
+	udp	172.26.10.14	60,840	192.228.79.2	53	192.228.79.2	53	10.233.89.179	36,717
+	udp	172.26.10.14	52,689	192.33.4.12	53	192.33.4.12	53	10.233.89.179	52,573
+	udp	172.26.10.14	60,815	128.63.2.53	53	128.63.2.53	53	10.233.89.179	35,750
+	udp	172.26.10.14	52,689	192.203.230.	53	192.203.230.	53	10.233.89.179	53,077
+	udp	172.26.14.22	61,506	157.235.187.	53	157.235.187.	53	10.233.89.179	43,804

Type to search in tables

Row Count: 112

Refresh

Figure 15-122 Wireless Controller - Firewall NAT Translation screen

- 4 The **NAT Translations** screen displays the following:

Protocol	Displays the translation protocol as either <i>TCP</i> , <i>UDP</i> or <i>ICMP</i> .
Forward Source IP	Displays the internal network IP address for forward facing NAT translations.
Forward Source Port	Displays the internal network (virtual) port for forward facing NAT translations.
Forward Dest IP	Displays the external network destination IP address for forward facing NAT translations.
Forward Dest Port	Displays the external network destination port for forward facing NAT translations.
Reverse Source IP	Displays the internal network IP address for reverse facing NAT translations.
Reverse Source Port	Displays the internal network port for reverse facing NAT translations.
Reverse Dest IP	Displays the external network destination IP address for reverse facing NAT translations.
Reverse Dest Port	Displays the external network destination port for reverse facing NAT translations.

Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

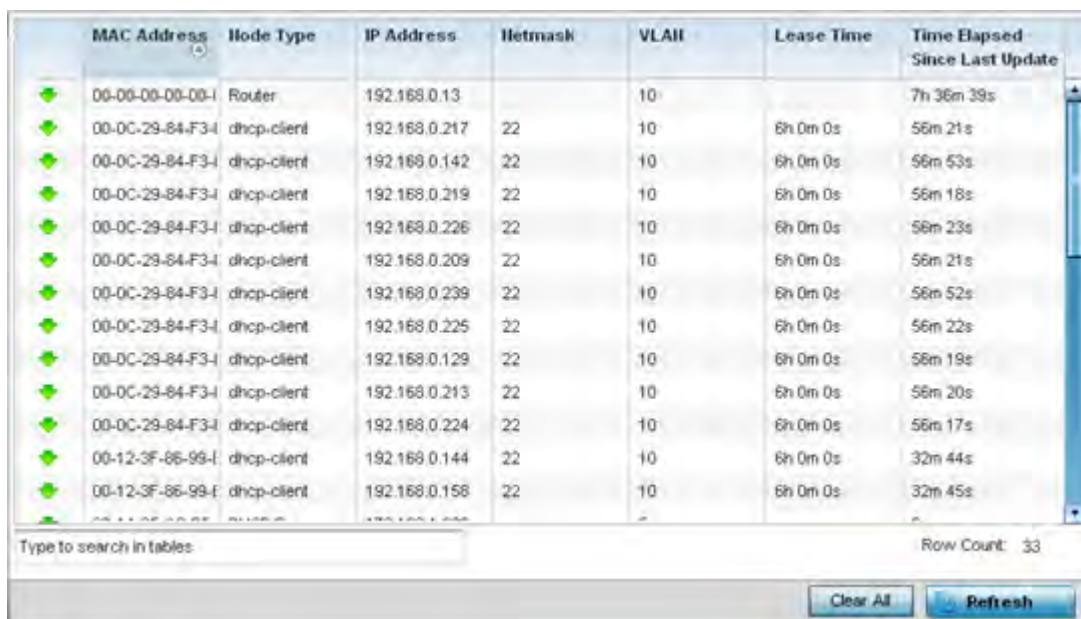
15.3.33.7 Viewing DHCP Snooping Statistics

► Firewall

When DHCP servers are allocating IP addresses to the clients, DHCP snooping can strengthen the security on the LAN allowing only clients with specific IP/MAC addresses.

To view the DHCP snooping statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **DHCP Snooping**.



	MAC Address	Node Type	IP Address	Netmask	VLAN	Lease Time	Time Elapsed Since Last Update
➤	00-00-00-00-00-00	Router	192.168.0.13		10		7h 36m 39s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.217	22	10	6h 0m 0s	56m 21s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.142	22	10	6h 0m 0s	56m 53s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.219	22	10	6h 0m 0s	56m 18s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.226	22	10	6h 0m 0s	56m 23s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.209	22	10	6h 0m 0s	56m 21s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.239	22	10	6h 0m 0s	56m 52s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.225	22	10	6h 0m 0s	56m 22s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.129	22	10	6h 0m 0s	56m 19s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.213	22	10	6h 0m 0s	56m 20s
➤	00-0C-29-84-F3-4	dhcp-client	192.168.0.224	22	10	6h 0m 0s	56m 17s
➤	00-12-3F-86-99-4	dhcp-client	192.168.0.144	22	10	6h 0m 0s	32m 44s
➤	00-12-3F-86-99-4	dhcp-client	192.168.0.158	22	10	6h 0m 0s	32m 45s

Type to search in tables: Row Count: 33

Clear All Refresh

Figure 15-123 Wireless Controller - Firewall DHCP Snooping screen

The **DHCP Snooping** screen displays the following:

MAC Address	Displays the MAC address of the client.
Node Type	Displays the NetBios node with an IP pool from which IP addresses can be issued to client requests on this interface.
IP Address	Displays the IP address used for DHCP discovery and requests between the DHCP server and DHCP clients.
Netmask	Displays the subnet mask used for DHCP discovery and requests between the DHCP server and DHCP clients.
VLAN	Displays the controller or service platform virtual interface ID used for a new DHCP configuration.

Lease Time	When a DHCP server allocates an address for a DHCP client, the client is assigned a lease (which expires after a designated interval defined by the administrator). The lease is the time an IP address is reserved for re-connection after its last use. Using short leases, DHCP can dynamically reconfigure networks in which there are more computers than available IP addresses. This is useful, for example, in education and customer environments where client users change frequently. Use longer leases if there are fewer users.
Time Elapsed Since Last Update	Displays the amount of time elapsed since the DHCP server was last updated.
Clear All	Select <i>Clear All</i> to revert the counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's counters to their latest values.

15.3.33.8 IPv6 Neighbor Snooping

► Firewall

IPv6 snooping bundles layer 2 IPv6 hop security features, such as IPv6 *neighbor discovery* (ND) inspection, IPv6 address gleaning and IPv6 device tracking. When IPv6 ND is configured on a device, packet capture instructions redirect the ND protocol and DHCP for IPv6 traffic up to the controller for inspection.

A database of connected IPv6 neighbors is created from the IPv6 neighbor snoop. The database is used by IPv6 to validate the link layer address, IPv6 address and prefix binding of the neighbors to prevent spoofing and potential redirect attacks.

To review IPv6 neighbor snooping statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **IPv6 Neighbor Snooping**.

MAC Address	Node Type	IPv6 Address	VLAN	Mint Id	Snoop Id	Time Elapsed Since Last Update
10-0B-A9-35-B3-C	ipv6	fe80::11c2:5073:6	30	4D.84.A2.70	8,896	6s
24-77-03-9D-5B-2	tentative,ipv6	fe80::9cb9:9f20:6	30		6,880	3m 59s
30-F7-C5-4F-31-2	tentative,ipv6	fe80::d5:3c9e:223	666		5,856	1m 30s
44-6D-57-08-1A-D	ipv6	fe80::d1d0:2904:2	30	4D.18.84.BC	9,984	11s
60-67-20-A5-B8-2	tentative,ipv6	fe80::4c41:8be:cc	30		1,664	2m 21s
6C-71-D9-54-92-1	ipv6	fe80::c5e9:48af:a	100	4D.84.A2.70	10,560	14s
78-FD-94-05-8C-0	tentative,ipv6	fe80::10e4:458d:8	666		4,736	3m 51s
84-3A-4B-AC-68-E	ipv6	fe80::6135:21a7:b	30		6,400	32m 28s
84-3A-4B-AC-68-E	ipv6	2601:646:8d00:b1	30		14,208	32m 28s
8C-70-5A-B5-60-D	ipv6	fe80::dd98:f6b6:a	30	4D.84.A2.70	5,857	1s
B4-B6-76-AC-EC-2	tentative,ipv6	fe80::794a:fb8f:78	30		9,312	4m 59s
C4-D9-87-38-A6-7	ipv6	fe80::6d2a:ed2f:2c	30		6,272	5m 23s
CC-3D-82-82-2B-C	ipv6	fe80::b01d:c01c:c	30		544	43m 54s
E4-1F-13-6A-5C-6	ipv6	fe80::a8f3:2769:7	6		7,968	3m 44s
F8-16-54-7B-1E-EI	tentative,ipv6	fe80::98c0:60fa:7	30		9,888	3m 10s

Type to search in tables

Row Count: 16

Clear Neighbors Refresh

Figure 15-124 Wireless Controller - Firewall IPv6 Neighbor Snooping screen

The **IPv6 Neighbor Snooping** screen displays the following:

MAC Address	Displays the hardware encoded MAC address of an IPv6 client reporting to the controller or service platform.
Node Type	Displays the NetBios node type from an IPv6 address pool from which IP addresses can be issued to requesting clients.
IPv6 Address	Displays the IPv6 address used for DHCPv6 discovery and requests between the DHCPv6 server and DHCP clients.
VLAN	Displays the controller or service platform virtual interface ID used for a new DHCPv6 configuration.
Mint Id	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure communications at the transport layer. Using MiNT, a device can be configured to only communicate with other authorized (MiNT enabled) devices of the same model.
Snoop Id	Lists a numeric snooping ID associated with each packet inspection snooping session conducted by the controller or service platform.
Time Elapsed Since Last Update	Displays the amount of time elapsed since the DHCPv6 server was last updated.
Clear Neighbors	Select <i>Clear Neighbors</i> to revert the counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's counters to their latest values.

15.3.34 VPN

► Controller Statistics

IPSec VPN provides a secure tunnel between two networked peer controllers or service platforms. Administrators can define which packets are sent within the tunnel, and how they are protected. When a tunnelled peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its remote peer destination.

Tunnels are sets of *security associations* (SA) between two peers. SAs define the protocols and algorithms applied to sensitive packets and specify the keying mechanisms used by tunnelled peers. SAs are unidirectional and exist in both the inbound and outbound direction. SAs are established per the rules and conditions of defined security protocols (AH or ESP).

Crypto maps combine the elements comprising IPSec SAs. Crypto maps also include *transform sets*. A transform set is a combination of security protocols, algorithms and other settings applied to IPSec protected traffic. One crypto map is utilized for each IPsec peer, however for remote VPN deployments one crypto map is used for all the remote IPsec peers.

Internet Key Exchange (IKE) protocol is a key management protocol standard used in conjunction with IPSec. IKE enhances IPSec by providing additional features, flexibility, and configuration simplicity for the IPSec standard. IKE automatically negotiates IPSec SAs, and enables secure communications without time consuming manual pre-configuration.

VPN statistics are partitioned into the following:

- *IKESA*
- *IPSec*

15.3.34.1 IKESA

► VPN

The *IKESA* screen allows for the review of individual peer security association statistics.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **VPN** and expand the menu to reveal its sub menu items.
- 4 Select **IKESA**.

15 - 181

Review the following VPN peer security association statistics:

Peer	Lists IDs for peers sharing <i>security associations</i> (SA) for tunnel interoperability. When a peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its destination.
Version	Displays each peer's IKE version used for auto IPsec secure authentication with the IPsec gateway and other controllers or service platforms.
State	Lists the online or offline state of each listed peer's SA.
Lifetime	Displays the lifetime for the duration of each listed peer IPsec VPN security association. Once the set value is exceeded, the association is timed out.
Local IP Address	Displays each listed peer's local tunnel end point IP address. This address represents an alternative to an interface IP address.
Clear/Clear All	Select Clear to remove a selected peer. Select the <i>Clear All</i> button to clear each peer of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

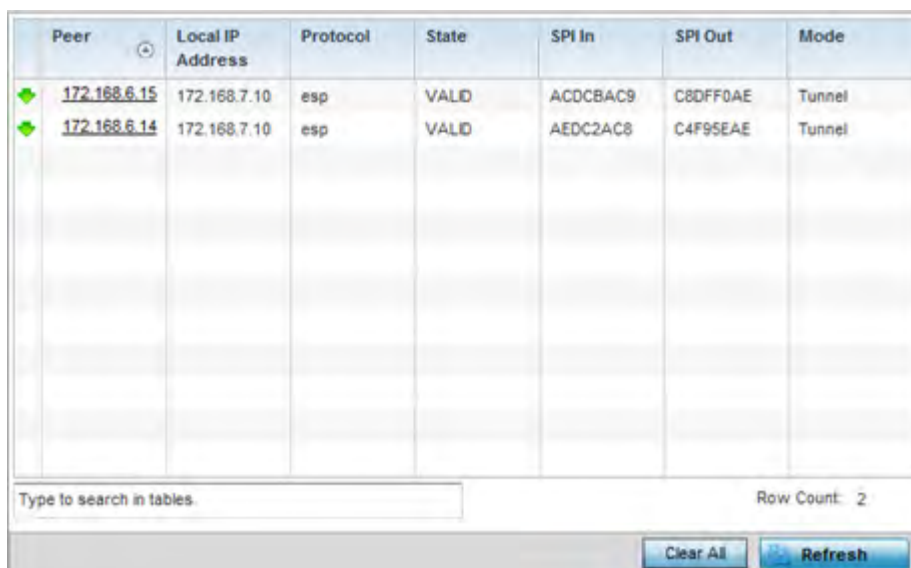
15.3.34.2 IPSec

▶ VPN

Use the *IPSec* VPN screen to assess tunnel status between networked peers.

To view IPSec VPN status for tunnelled peers:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **VPN** and expand the menu to reveal its sub menu items.
- 4 Select **IPSec**.



Peer	Local IP Address	Protocol	State	SPI In	SPI Out	Mode
172.168.6.15	172.168.7.10	esp	VALID	ACDCBAC9	C8DF0AE	Tunnel
172.168.6.14	172.168.7.10	esp	VALID	AEDC2AC8	C4F95EAE	Tunnel

Type to search in tables. Row Count: 2

Clear All Refresh

Figure 15-126 Wireless Controller - VPN IPSec screen

Review the following VPN peer security association statistics:

Peer	Lists IP addresses for peers sharing <i>security associations</i> (SA) for tunnel interoperability. When a peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its destination.
Local IP Address	Displays each listed peer's local tunnel end point IP address. This address represents an alternative to an interface IP address.
Protocol	Lists the security protocol used with the VPN IPSec tunnel connection. SAs are unidirectional, existing in each direction and established per security protocol. Options include ESP and AH.
State	Lists the state of each listed peer's security association.
SPI In	Lists <i>stateful packet inspection</i> (SPI) status for incoming IPSec tunnel packets. SPI tracks each connection traversing the IPSec VPN tunnel and ensures they are valid.
SPI Out	Lists SPI status for outgoing IPSec tunnel packets. SPI tracks each connection traversing the IPSec VPN tunnel and ensures they are valid.
Mode	Displays the IKE mode. IPSEC has two modes in IKEv1 for key exchanges. Aggressive mode requires 3 messages be exchanged between the IPSEC peers to setup the SA, Main requires 6 messages

Clear All	Select the <i>Clear All</i> button to clear each peer of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.35 Viewing Certificate Statistics

► *Controller Statistics*

The *Secure Socket Layer* (SSL) protocol is used to ensure secure transactions between Web servers and browsers. This protocol uses a third-party, a certificate authority, to identify one end or both ends of the transactions. A browser checks the certificate issued by the server before establishing a connection.

For more information, see:

- *Viewing Trustpoints Statistics*
- *Viewing the RSA Key Details*

15.3.35.1 Viewing Trustpoints Statistics

► *Viewing Certificate Statistics*

Each certificate is digitally signed by a trustpoint. The trustpoint signing the certificate can be a certificate authority, corporate or individual. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters and an association with an enrolled identity certificate.

To view controller or service platform trustpoint statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Certificate** and expand the menu to reveal its sub menu items.
- 4 Select **Trustpoint**.

Certificate Details

Subject Name	CN=NX9000-B4-C7-99-0C-98-48
Alternate Subject Name	
Issuer Name	CN=NX9000-B4-C7-99-0C-98-48
Serial Number	5d
RSA Key Used	default_rsa_key
IS CA	☒ No
Is Self Signed	☒ Yes
Server Certificate Present	☒ Yes
CRL Present	☒ No

Validity

Valid From	02:02:2013 18:31:49 UTC
Valid Until	01:31:2023 18:31:49 UTC

Certificate Authority (CA) Details

Subject Name	
Alternate Subject Name	
Issuer Name	
Serial Number	

Refresh

Figure 15-127 *Wireless Controller - Certificates Trustpoint screen*

The **Certificate Details** field displays the following:

Subject Name	Describes the entity to which the certificate is issued.
Alternate Subject Name	Lists alternate subject information about the certificate as provided to the certificate authority.
Issuer Name	Displays the name of the organization issuing the certificate.
Serial Number	Lists the unique serial number of the certificate.
RSA Key Used	Displays the name of the key pair generated separated, or automatically when selecting a certificate.
IS CA	Indicates whether this certificate is an authority certificate (Yes/No).
Is Self Signed	Displays whether the certificate is self-signed (Yes/No).
Server Certification Present	Displays whether a server certification is present or not (Yes/No).
CRL Present	Displays whether a <i>Certificate Revocation List</i> (CRL) is present (Yes/No). A CRL contains a list of subscribers paired with digital certificate status. The list displays revoked certificates along with the reasons for revocation. The date of issuance and the entities that issued the certificate are also included.

The **Validity** field displays the following:

Valid From	Displays the certificate's issue date stating the beginning of the certificate's validity.
Valid Until	Displays the certificate's expiration date.

The **Certificate Authority (CA) Details** field displays the following:

Subject Name	Displays information about the entity to which the certificate is issued.
Alternate Subject Name	This section provides alternate information about the certificate as provided to the certificate authority. This field is used to provide more information that supports information provided in the <i>Subject Name</i> field.
Issuer Name	Displays the organization issuing the certificate.
Serial Number	Lists the unique serial number of each certificate issued.

The **Certificate Authority Validity** field displays the following:

Validity From	Displays the date when the validity of a CA begins.
Validity Until	Displays the date when the validity of a CA expires.

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.3.35.2 Viewing the RSA Key Details

► *Viewing Certificate Statistics*

Rivest, Shamir, and Adleman (RSA) is an algorithm for public key cryptography. It's the first algorithm known to be suitable for signing as well as encryption.

The RSA Keys screen displays a list of RSA keys installed in the selected Access Point. RSA Keys are generally used for establishing a SSH session, and are a part of the certificate set used by RADIUS, VPN and HTTPS.

To view the RSA Key details:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Certificate** and expand the menu to reveal its sub menu items.
- 4 Select **RSA Keys**.

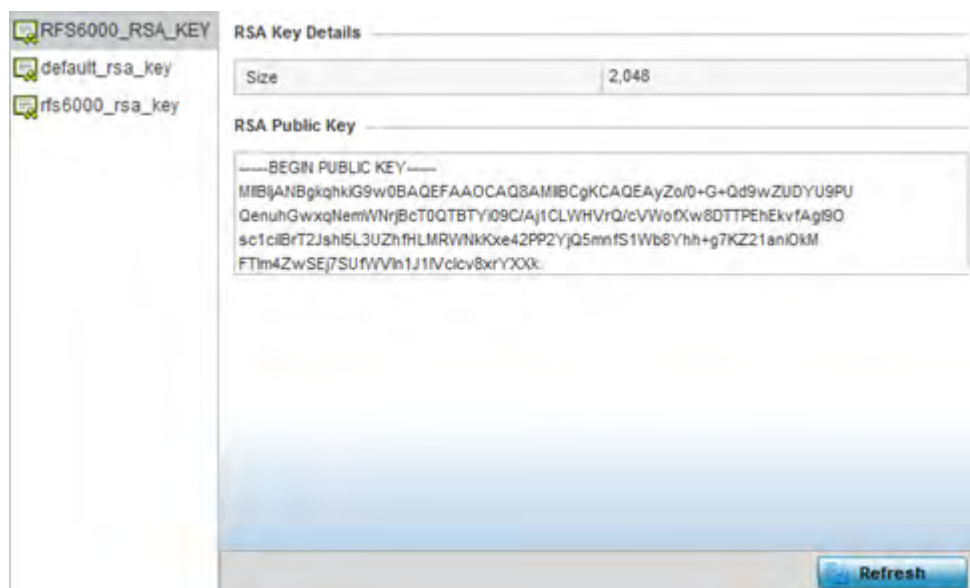


Figure 15-128 *Wireless Controller - Certificates RSA Keys screen*

The **RSA Key Details** field describes the size (in bits) of the desired key. If not specified, a default key size of 1024 is used.

The **RSA Public Key** field describes the public key's character set used for encrypting messages. This key is known to everyone.

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.3.36 WIPS Statistics

► *Controller Statistics*

Wireless Intrusion Protection System (WIPS) detects the presence of unauthorized Access Points. Unauthorized attempts to access the WLAN is generally accompanied by intruding clients finding network vulnerabilities. Basic forms of this behavior can be monitored and reported without a dedicated WIPS deployment. When the parameters exceed a configurable threshold, the controller or service platform generates a SNMP trap and reports the result via the management interfaces. Basic WIPS functionality does not require monitoring APs and does not perform off-channel scanning.

For more information, see:

- *Viewing the Client Blacklist*
- *Viewing WIPS Event Statistics*

15.3.36.1 Viewing the Client Blacklist

► *WIPS Statistics*

This *Client Blacklist* displays blacklisted clients detected using WIPS. Blacklisted clients are not allowed to associate to connected devices within the controller or service platform managed network.

To view the client blacklist screen:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.

- 3 Select **WIPS** and expand the menu to reveal its sub menu items.
- 4 Select **Client Blacklist**.

Event Name	Blacklisted Client	Time Blacklisted	Total Time	Time Left
dos-eapol-start-storm	44-55-44-55-44-55	Thu Jun 10 2012 12:26:26	2h 0m 0s	1h 0m 0s
null-probe-response	44-55-44-55-44-55	Thu Jun 10 2012 12:26:26	40m 0s	20m 0s

Type to search in tables: Row Count: 2

Refresh

Figure 15-129 *Wireless Controller - WIPS Client Blacklist screen*

The **Client Blacklist** screen displays the following:

Event Name	Displays the name of the detected wireless intrusion resulting in a blacklisting of the client from controller or service platform resources.
Blacklisted Client	Displays the MAC address of the intruding client device pending exclusion from the controller or service platform managed network.
Time Blacklisted	Displays the time this client was blacklisted.
Total Time	Displays the duration the unauthorized device remained in the WLAN.
Time Left	Displays the duration after which the blacklisted client is removed from the blacklist.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.36.2 Viewing WIPS Event Statistics

The *WIPS Events* screen displays event information for rogue Access Point intrusions within the controller or service platform managed network.

To view WIPS event statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **WIPS** and expand the menu to reveal its sub menu items.

4 Select **WIPS Events**

Event Name	Reporting AP	Originating Device	Detector Radio	Time Reported
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 08:08:39 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 10:16:36 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 04:24:30 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 03:14:12 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:03:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:01:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 10:47:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 10:53:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 03:07:07 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 08:10:27 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 10:59:44 AM
ad-hoc-violation	ap7502-BC1340	60-03-08-A7-93-E0	1	Fri May 15 2015 01:22:14 AM

Type to search in tables

Row Count: 97

Clear All Refresh

Figure 15-130 *Wireless Controller - WIPS Events screen*

The **WIPS Events** screen displays the following:

Event Name	Displays the name of the detected intrusion event.
Reporting AP	Displays the hostname of the AP reporting each intrusion. The Access Point displays as a link that can be selected to provide configuration and network address information in greater detail.
Originating Device	Displays the MAC address of the intruder AP.
Detector Radio	Displays which AP radio is making the intrusion detection.
Time Reported	Displays the time when the intruding AP was detected.
Clear All	Select <i>Clear All</i> to reset the statistics counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.37 Sensor Server

► *Controller Statistics*

Sensor servers allow the monitor and download of data from multiple sensors and remote locations using Ethernet, TCP/IP or serial communication. Repeaters are available to extend the transmission range and combine sensors with various frequencies on the same receiver.

To view the Sensor Server statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Sensor Servers** from the left-hand side of the controller or service platform UI.

IP Address/Hostname	Port	Status
	0	no server defined
	0	no server defined
157.235.95.128	443	online

Type to search in tables

Row Count: 3

Refresh

Figure 15-131 *Wireless Controller - Sensor Server screen*

The **Sensor Servers** screen displays the following:

IP Address/Hostname	Displays a list of sensor server IP addresses. These are sensor resources available to the controller or service platform.
Port	Displays the port on which this server is listening.
Status	Displays whether the server is <i>connected</i> or <i>not connected</i> .
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.38 Bonjour Services

► *Controller Statistics*

Bonjour is Apple's zero-configuration networking (Zeroconf) implementation. Zeroconf is a group of technologies including service discovery, address assignment and hostname resolution. Bonjour locates the devices (printers, computers etc.) and services these computers provide over a local network.

Bonjour provides a method to discover services on a LAN. Bonjour allows users to set up a network without any configuration. Services such as printers, scanners and file-sharing servers can be found using Bonjour. Bonjour only works within a single broadcast domain. However, with a special DNS configuration, it can be extended to find services across broadcast domains.

To view the Bonjour service statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Bonjour Services** from the left-hand side of the controller or service platform UI.

Type to search in tables.

Row Count: 7

Refresh

Figure 15-132 *Wireless Controller - Bonjour Services screen*

Refer to the following Bonjour service utilization stats:

Service Name	Lists the services discoverable by the Bonjour gateway. Services can either be <i>pre-defined</i> Apple services (scanner, printer etc.) or an <i>alias</i> not available on the predefined list.
Instance Name	Lists the name of each Bonjour service instance (session) utilized by the controller or service platform.
IP Address	Lists the network IP address utilized by the listed Bonjour service providing resources to the controller or service platform.
Port	Displays the port used to secure a connection with the listed Bonjour service.
Vlan	Lists the VLAN(s) on which a listed Bonjour service is routable.
Vlan Type	Lists the VLAN type as either a <i>local</i> bridging mode or a shared <i>tunnel</i> .
Expiry	Lists the expiration date of the listed Bonjour service, and its availability to discover resources on the LAN.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.39 Captive Portal Statistics

▶ Controller Statistics

A captive portal redirects an HTTP client to a Web page (usually for authentication purposes) before authenticating for Internet access. A captive portal turns a Web browser into an authenticator. This is done by

intercepting packets (regardless of the address or port) until the user opens a browser and attempts to access the Internet. At that time, the browser is redirected to a Web page requiring authentication.

To view the controller or service platform captive portal statistics:

- 1 Select the **Statistics** tab from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Captive Portal** from the left-hand side of the controller or service platform UI.

[illegible]

Figure 15-133 *Wireless Controller - Captive Portal screen*

The **Captive Portal** screen displays the following:

Client MAC	Displays the requesting client's MAC address. The MAC displays as a link that can be selected to display client configuration and network address information in greater detail.
Client IP	Displays the requesting client's IPv4 formatted IP address.
Client IPv6	Displays the requesting client's IPv6 formatted IP address.
Captive Portal	Displays the captive portal name that each listed client is utilizing for guest access to controller resources.
Port Name	Lists the controller or service platform port name supporting the captive portal connection with the listed client MAC address.
Authentication	Displays the authentication status of the requesting client.
WLAN	Displays the name of the WLAN the client belongs to.
VLAN	Displays the name of the requesting client's VLAN interface.
Remaining Time	Displays the time after which the client is disconnected from the captive portal managed Internet.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

Frequency	An SNTP server clock's skew (difference) for the controller or service platform and the dedicated NTP resource.
Leap	Indicates if a second is added or subtracted to SNTP packet transmissions, or if transmissions are synchronized.
Precision	Displays the precision of the controller's time clock (in Hz). The values that normally appear in this field range from -6 for mains-frequency clocks to -20 for microsecond clocks.
Reference Time	Displays the time stamp the local clock was last set or corrected.
Reference	Displays the address of the time source the controller or service platform is synchronized to.
Root Delay	The total round-trip delay in seconds. This variable can take on both positive and negative values, depending on relative time and frequency offsets. The values that normally appear in this field range from negative values (a few milliseconds) to positive values (several hundred milliseconds).
Root Dispersion	The difference between the time on the root NTP server and its reference clock. The reference clock is the clock used by the NTP server to set its own clock.
Stratum	Displays how many hops the controller or service platform is from its current NTP resource.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.3.40.2 Viewing NTP Associations

► Network Time

The interaction between the controller or service platform and an SNTP server constitutes an association. SNTP associations can be either peer associations (the controller or service platform synchronizes to another system or allows another system to synchronize to it), or a server associations (only the controller or service platform synchronizes to the SNTP resource, not the other way around).

To view the NTP associations:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select a Wireless Controller node from the left navigation pane.
- 3 Select **Network Time**.
- 4 Select **NTP Associations**.

Figure 15-135 *Wireless Controller - NTP Association screen*

Delay Time	Displays the round-trip delay (in seconds) for SNTP broadcasts between the SNTP server and the controller or service platform.
Display	Displays the time difference between the peer NTP server and the onboard wireless controller clock.
Offset	Displays the calculated offset between the controller or service platform and the SNTP server. The controller or service platform adjusts its clock to match the server's time. The offset gravitates towards zero overtime, but never completely reduces its offset to zero.
Poll	Displays the maximum interval between successive messages (in seconds) to the nearest power of two.
Reach	Displays the status of the last eight SNTP messages. If an SNTP packet is lost, the lost packet is tracked over the next eight SNTP messages.
Reference IP Address	Displays the address of the time source the controller or service platform is synchronized to.
Server IP Address	Displays the numerical IP address of the SNTP resource (server) providing SNTP updates to the controller.
State	Displays the NTP association status code.
Status	Displays the NTP peer's current status.
Time	Displays the timestamp of the last NTP packet received from the NTP peer.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4 Access Point Statistics

► *Statistics*

The Access Point statistics screens displays controller or service platform connected Access Point *performance, health, version, client support, radio, mesh, interface, DHCP, firewall, WIPS, sensor, captive portal, NTP* and *load* information. Access point statistics consists of the following:

- *Health*
- *Device*
- *Web-Filtering*
- *Application Visibility (AVC)*
- *Device Upgrade*
- *Adoption*
- *AP Detection*
- *Guest User*
- *Wireless LANs*
- *Policy Based Routing*
- *Radios*
- *Mesh*
- *Interfaces*
- *RTLS*
- *PPPoE*
- *Bluetooth*
- *OSPF*
- *L2TPv3 Tunnels*
- *VRRP*
- *Critical Resources*
- *LDAP Agent Status*
- *Mint Links*
- *Guest Users*
- *GRE Tunnels*
- *Dot1x*
- *Network*
- *DHCPv6 Relay & Client*
- *DHCP Server*
- *Firewall*
- *VPN*
- *Certificates*
- *WIPS*
- *Sensor Servers*
- *Bonjour Services*
- *Captive Portal*
- *Network Time*
- *Load Balancing*
- *Environmental Sensors (AP8132 Models Only)*

15.4.1 Health

► Access Point Statistics

The *Health* screen displays a selected Access Point's hardware version and software version. Use this information to fine tune the performance of an Access Point. This screen should also be the starting point for troubleshooting an Access Point since it's designed to present a high level display of Access Point performance efficiency.

To view the Access Point health:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Health**.

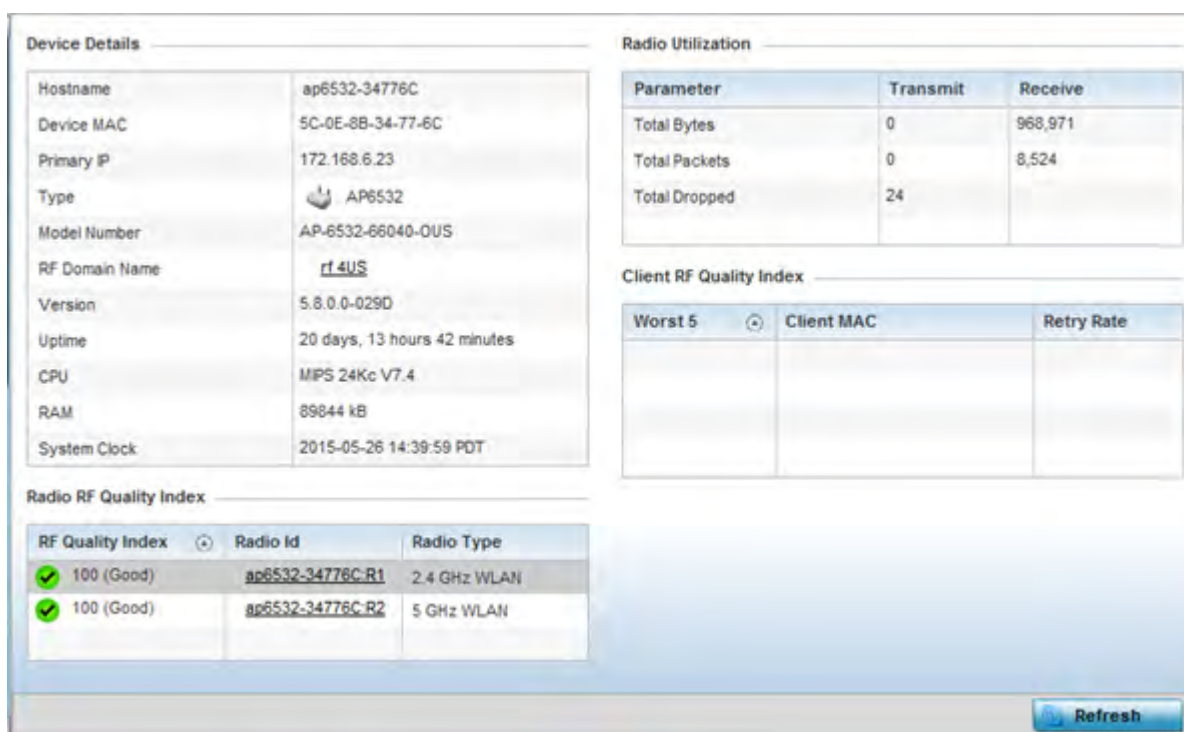


Figure 15-136 Access Point - Health screen

The **Device Details** field displays the following information:

Hostname	Displays the AP's unique name as assigned within the controller or service platform managed network. A hostname is assigned to a device connected to a computer network.
Device MAC	Displays the MAC address of the AP. This is factory assigned and cannot be changed.
Primary AP	Displays the IP address of assigned to this device either through DHCP or through static IP assignment.
Type	Displays the Access Point's model type.
Model Number	Displays the Access Point's model number to help further differentiate the Access Point from others of the same model series and defined country of operation.

RF Domain Name	Displays the Access Point's RF Domain membership. Unlike a controller or service platform, an Access Point can only belong to one RF Domain based on its model. The domain name appears as a link that can be selected to show RF Domain utilization in greater detail.
Version	Displays the Access Point's current firmware version. Use this information to assess whether an upgrade is required for better compatibility.
Uptime	Displays the cumulative time since the Access Point was last rebooted or lost power.
CPU	Displays the processor core.
RAM	Displays the free memory available with the RAM.
System Clock	Displays the system clock information.

The **Radio RF Quality Index** field displays the following:

RF Quality Index	Displays Access Point radios and their quality indices. RF quality index indicates the overall RF performance. The RF quality indices are: 0 – 50 (poor) 50 – 75 (medium) 75 – 100 (good)
Radio Id	Displays a radio's hardware encoded MAC address. The ID appears as a link that can be selected to show radio utilization in greater detail.
Radio Type	Identifies whether the radio is a 2.4 or 5 GHz.

The **Radio Utilization Index** field displays the following:

Total Bytes	Displays the total bytes of data transmitted and received by the Access Point since the screen was last refreshed.
Total Packets	Lists the total number of data packets transmitted and received by the Access Point since the screen was last refreshed.
Total Dropped	List the number of dropped data packets by an Access Point radio since the screen was last refreshed.

The **Client RF Quality Index** field displays the following:

Worst 5	Displays clients having lowest RF quality within the network.
Client MAC	Displays the MAC addresses of the clients with the lowest RF indices.
Retry Rate	Displays the average number of retries per packet. A high number indicates possible network or hardware problems.

- 4 Select the **Refresh** button as needed to update the screen's statistics counters to their latest values.

15.4.2 Device

► Access Point Statistics

The *Device* screen displays basic information about the selected Access Point. Use this screen to gather version information, such as the installed firmware image version, the boot image and upgrade status.

To view the device statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Device**.

The screenshot displays the 'Access Point - Device' screen with the following sections:

- System**

Model Number	AP-6532-66040-0US
Serial Number	10260522200743
Version	5.6.0.0-056R
Boot Partition	secondary
Fallback Enabled	✓ Enabled
Fallback Image Triggered	✗ No
Next Boot	secondary
- Firmware Images**

Primary Build Date	11/25/2014 00:36:22
Primary Install Date	12/04/2014 10:40:16
Primary Version	5.8.0.0-004D
Secondary Build Date	04/17/2014 18:58:06
Secondary Install Date	12/04/2014 10:49:33
Secondary Version	5.6.0.0-056R
FPGA Version	Unknown
PoE Firmware Version	Unknown
- System Resources**

Available Memory (KB)	40,152
Total Memory (KB)	90,092
Currently Free RAM	44.5%
Recommended Free RAM	10.0%
Current File Descriptors	700
Maximum File Descriptors	25,500
CPU Load 1 Minute	4.2%
CPU Load 5 Minutes	4.2%
CPU Load 15 Minutes	4.1%
Smart Cache	
- IPv6 Name Servers**

Name Server	Type
- Sensor Lock**

Sensor Lock State	✗ No
- Upgrade Status**

Upgrade Status	Successful
- IPv6 Hop Limit**

Hop Limit	64

A 'Refresh' button is located at the bottom right of the screen.

Figure 15-137 Access Point - Device screen

The **System** field displays the following:

Model Number	Displays the model of the selected Access Point to help distinguish its exact SKU and country of operation.
Serial Number	Displays the numeric serial number set for the Access Point.
Version	Displays the software (firmware) version on the Access Point.
Boot Partition	Displays the boot partition type.
Fallback Enabled	Displays whether this option is enabled. This method enables a user to store a known legacy version and a new version in device memory. The user can test the new software, and use an automatic fallback, which loads the old version on the Access Point if the new version fails.
Fallback Image Triggered	Displays whether the fallback image was triggered. The fallback image is an old version of a known and operational software stored in device memory. This allows a user to test a new version of software. If the new version fails, the user can use the old version of the software.

Next Boot	Designates this version as the version used the next time the AP is booted.

The **System Resources** field displays the following:

Available Memory (MB)	Displays the available memory (in MB) available on the Access Point.
Total Memory (MB)	Displays the Access Point's total memory.
Currently Free RAM	Displays the Access Point's free RAM space. If its very low, free up some space by closing some processes.
Recommended Free RAM	Displays the recommended RAM required for routine operation.
Current File Descriptors	Displays the Access Point's current file description.
Maximum File Descriptors	Displays the Access Point's maximum file description.
CPU Load 1 Minute	Lists this Access Point's CPU utilization over a 1 minute span.
CPU Load 5 Minutes	Lists this Access Point's CPU utilization over a 5 minute span.
CPU Load 15 Minutes	Lists this Access Point's CPU utilization over a 15 minute span.

The **Upgrade Status** field displays the following:

Upgrade Status	Displays the status of the last firmware upgrade performed by this controller or service platform.
Upgrade Status Time	Lists a time stamp defining the occurrence of the most recent upgrade operation.

The **Fan Speed** field displays the following:

Number	Displays the number of fans supported on the this Access Point.
Speed (Hz)	Displays the fan speed in Hz.

The **Temperature** field displays the following:

Number	Displays the number of temperature elements used by the Access Point.
Temperature	Displays the current temperature (in Celsius) to assess a potential Access Point overheat condition.

The **Kernal Buffers** field displays the following:

Buffer Size	Lists the sequential buffer size.
Current Buffers	Displays the current buffers available to the selected Access Point.
Maximum Buffers	Lists the maximum buffers available to the selected Access Point.

The **IP Domain** field displays the following:

Number	Displays the number of fans supported on the this Access Point.

Speed (Hz)	Displays the fan speed in Hz.

The **IP Name Servers** field displays the following:

Name Server	Displays the names of the servers designated to provide DNS resources to this Access Point.
Type	Displays the type of server for each server listed.

The **Firmware Images** field displays the following:

Primary Build Date	Displays the build date when this Access Point firmware version was created.
Primary Install Date	Displays the date this version was installed.
Primary Version	Displays the primary version string.
Secondary Build Date	Displays the build date when this version was created.
Secondary Install Date	Displays the date this secondary version was installed.
Secondary Version	Displays the secondary version string.
FPGA Version	Displays whether a FPGA supported firmware load is being utilized.
PoE Firmware Version	Displays whether a PoE supported firmware load is being utilized.

The **IPv6 Name Servers** field displays the following:

Name Server	List the IPv6 name server hosting a network service for providing responses to queries against a directory. The IPv6 name server maps a human recognizable identifier to a system's internal identifier. This service is performed by the server in response to a network service protocol request.
Type	Lists the type of IPv6 name server mapping a human readable identifier to system identifier.

The **Sensor Lock** field displays the following:

Sensor Lock	Displays whether a lock has been applied to Access Point sensor capabilities.

The **Power Management** field displays the following:

Power Management Mode	Displays the power mode currently invoked by the selected Access Point.
Power Management Status	Lists the power status of the Access Point.
Ethernet Power Status	Displays the Access Point's Ethernet power status.
Radio Power Status	Displays the power status of the Access Point's radios.

The **IPv6v Hop Limit** table displays the following:

Hop Limit	Lists the maximum number of times IPv6 traffic can hop. The IPv6 header contains a hop limit field that controls the number of hops a datagram can be sent before being discarded (similar to the TTL field in an IPv4 header).

The **IPv6 Delegated Prefixes** table displays the following:

IPv6 Delegated Prefix	In IPv6, prefix delegation is used to assign a network address prefix, configuring the controller or service platform with the prefix.
Prefix Name	Lists the name assigned to the IPv6 delegated prefix.
DHCPv6 Client State	Displays the current DHCPv6 client state as impacted by the IPv6 delegated prefix.
Interface Name	Lists the interface over which IPv6 prefix delegation occurs.
T1 timer (seconds)	Lists the amount of time in seconds before the DHCP T1 (delay before renew) timer expires.
T2 timer (seconds)	Lists the amount of time in seconds before the DHCP T2 (delay before rebind) timer expires.
Last Refreshed (seconds)	Lists the time, in seconds, since IPv6 prefix delegation has been updated.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the IPv6 formatted addresses remains in a preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime.
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the IPv6 formatted address remains in a valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

- 4 Select **Refresh** to update the statistics counters to their latest values.

15.4.3 Web-Filtering

► Access Point Statistics

The *Web-Filtering* screen displays information on Web requests for content and whether the requests were blocked or approved based on URL filter settings defined for the selected Access Point. A URL filter is comprised of several filter rules. A whitelist bans all sites except the categories and URL lists defined in the whitelist. The blacklist allows all sites except the categories and URL lists defined in the blacklist.

To view this Access Point's Web filter statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Web-Filtering**.

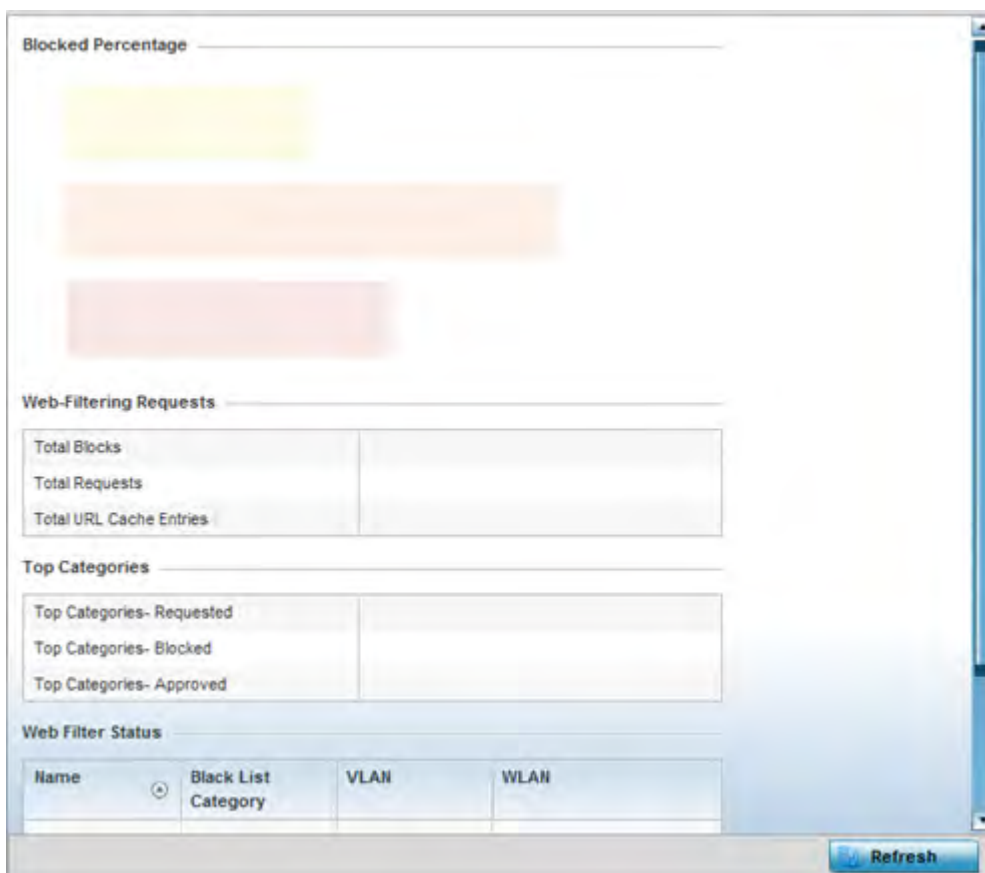


Figure 15-138 Access Point - Web Filtering screen

The **Web-Filtering Requests** field displays the following information:

Total Blocks	Lists the number of Web request hits against content blocked in the URL blacklist.
Total Requests	Lists the total number of requests for URL content cached locally on this Access Point.
Total URL Cache Entries	Displays the number of chached URL data entries made on this Access Point on the request of requesting clients requiring URL data managed by the Access Point and their respective whitelist or blacklist.

The **Top Categories** field helps administrators assess the content most requested, blocked or approved based on the defined whitelist and blacklist permissions:

Top Categories - Requested	Lists those Web content categories most requested by clients managed by this Access Point. Use this information to assess whether the permissions defined in the blacklist and whitelist optimally support these client requests for cached Web content.

Top Categories - Blocked	Lists those Web content categories blocked most often for requesting clients managed by this Access Point. Use this information to periodically assess whether the permissions defined in the blacklist and whitelist still restrict the desired cached Web content from requesting clients. Remember, a whitelist bans all sites except the categories and URL lists defined in the whitelist. The blacklist allows all sites except the categories and URL lists defined in the blacklist.
Top Categories - Approved	Lists those Web content categories approved most often on behalf of requesting clients managed by this Access Point. Periodically review this information to assess whether this cached and available Web content still adhere's to your organization's standards for client access.

The **Web Filter Status** field displays the following information:

Name	Displays the name of the filter whose URL rule set has been invoked.
Blacklist Category	Lists the blacklist category whose URL filter rule set has caused data to be filtered to a requesting client. Periodically assess whether these rules are still relevant to the data requirements of requesting clients.
VLAN	Lists the impacted Access Point VLAN whose Web data traffic has been filtered based on the restrictions in the listed blacklist category.
WLAN	Lists the impacted Access Point WLAN whose Web data traffic has been filtered based on the restrictions in the listed blacklist category. Periodically assess whether clients are segregated to the correct WLAN based on their cached Web data requirements and impending filter rules.

- Periodically select **Refresh** to update this screen to its latest values.

15.4.4 Application Visibility (AVC)

► Access Point Statistics

Access Points can inspect every byte of each application header packet allowed to pass to their connected clients. When an application is recognized and classified by the WiNG application recognition engine, administrator defined actions can be applied to that specific application. For information on categorizing, filtering and logging the application data allowed to proliferate the WiNG network, refer to *Application Policy on page 7-54* and *Application on page 7-58*.

To view Access Point application utilization statistics:

- Select the **Statistics** menu from the Web UI.
- Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- Select **Application Visibility (AVC)**.

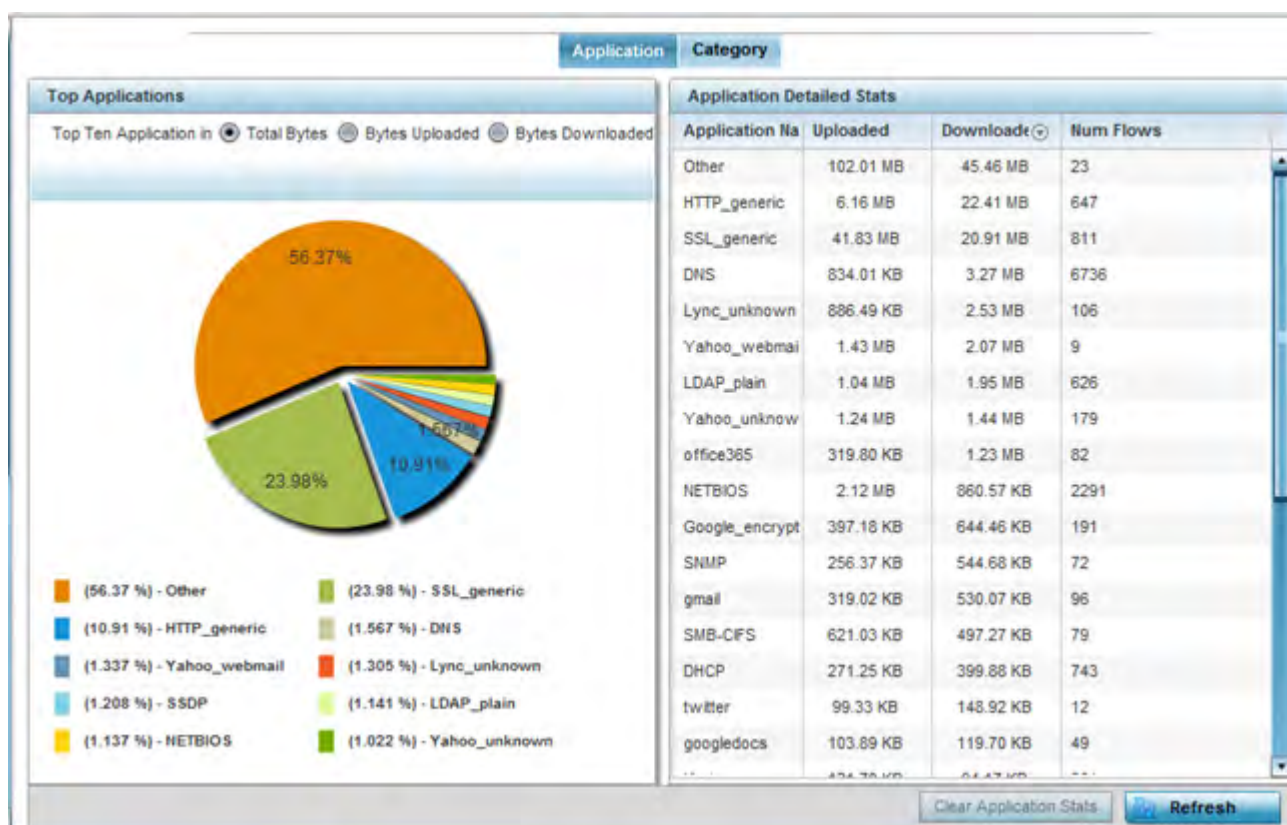


Figure 15-139 Access Point - Application Visibility

- 4 Refer to the **Top Applications** graph to assess the most prolific, and allowed, application data passing through the Access Point.

Total Bytes	Displays the top ten utilized applications in respect to total data bytes passing through the Access Point. These are only the administrator <i>allowed</i> applications approved for proliferation within the Access Point managed network.
Bytes Uploaded	Displays the top ten applications in respect to total data bytes uploaded through the Access Point managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten applications in respect to total data bytes downloaded from the Access Point managed network. If this application data is not aligned with application utilization expectations, consider allowing or denying additional applications and categories or adjusting their precedence (priority).

- 5 Refer to the **Application Detailed Stats** table to assess specific application data utilization:

Application Name	Lists the allowed application name whose data (bytes) are passing through the Access Point managed network.
Uploaded	Displays the number of uploaded application data (in bytes) passing through the Access Point managed network.

Downloaded	Displays the number of downloaded application data (in bytes) passing through the Access Point managed network.
Num Flows	Lists the total number of application data flows passing through the Access Point for each listed application. An application flow can consist of packets in a specific connection or media stream. Application packets with the same source address/port and destination address/port are considered one flow.
Clear Application Stats	Select this option to clear the application assessment data counters and begin a new assessment.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

6 Select the **Category** tab.

Categories are existing WiNG or user defined application groups (video, streaming, mobile, audio etc.) that assist administrators in filtering (allowing or denying) application data. For information on categorizing application data, refer to *Application Policy on page 7-54* and *Application on page 7-58*.

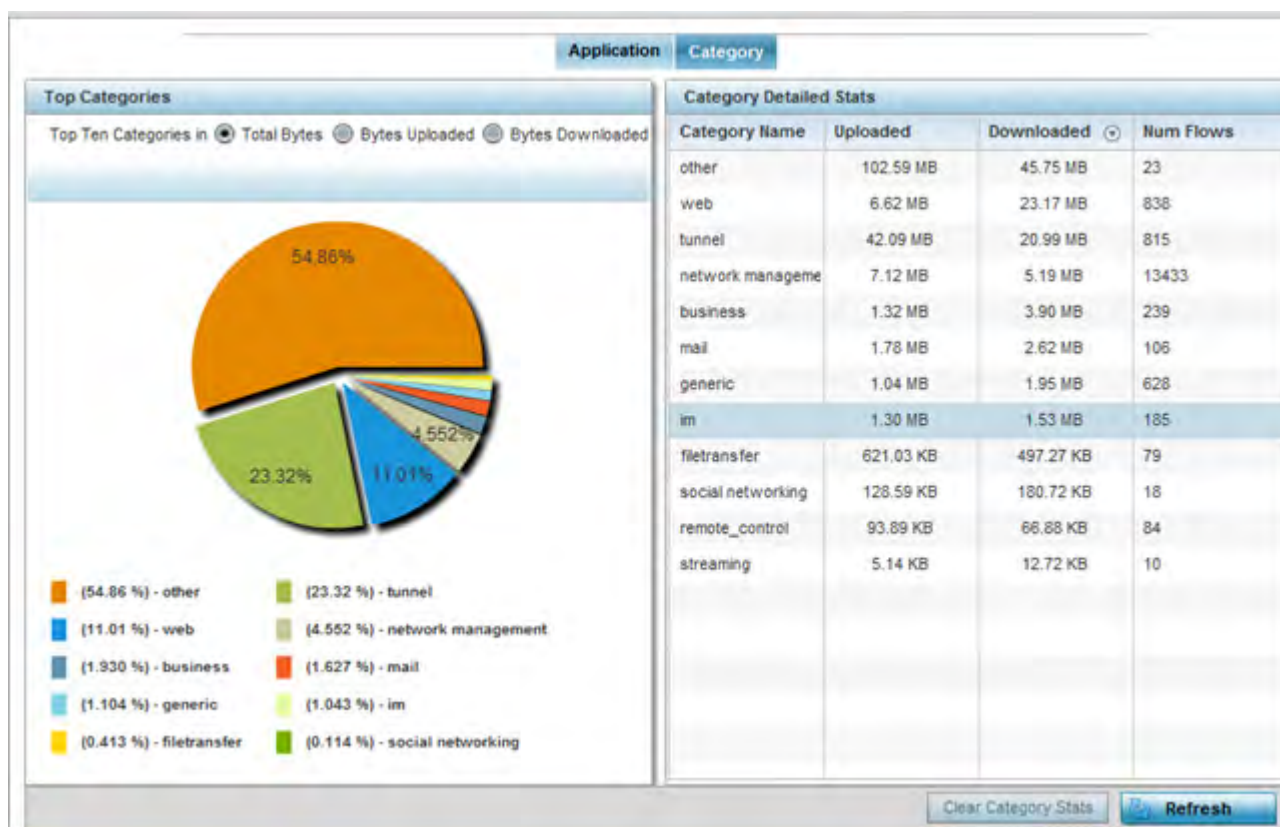


Figure 15-140 Access Point - Application Category Visibility

7 Refer to the **Top Categories** graph to assess the most prolific, and allowed, application data categories utilized by the Access Point.

Total Bytes	Displays the top ten application categories in respect to total data bytes passing through the Access Point managed network. These are only the administrator <i>allowed</i> application categories approved for proliferation within the Access Point managed network.

Bytes Uploaded	Displays the top ten application categories in respect to total data bytes uploaded through the controller or service platform managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories or adjusting their precedence (priority).
Bytes Downloaded	Displays the top ten application categories in respect to total data bytes downloaded from the Access Point managed network. If this category data is not aligned with application utilization expectations, consider allowing or denying additional categories and categories or adjusting their precedence (priority).

8 Refer to the **Category Detailed Stats** table to assess specific application category data utilization:

Category Name	Lists the allowed category whose application data (in bytes) is passing through the Access Point managed network.
Uploaded	Displays the number of uploaded application category data (in bytes) passing the through the Access Point managed network.
Downloaded	Displays the number of downloaded application category data (in bytes) passing the through the Access Point managed network.
Num Flows	Lists the total number of application category data flows passing through Access Point connected clients. A category flow can consist of packets in a specific connection or media stream. Packets with the same source address/port and destination address/port are considered one flow.
Clear Application Stats	Select this option to clear the application category assessment data counters and begin a new assessment.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.4.5 Device Upgrade

► Access Point Statistics

The *Device Upgrade* screen displays information about devices receiving updates and the devices used to provision them. Use this screen to gather version data, install firmware images, boot an image and upgrade status.

To view the device upgrade statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Device Upgrade**.

Device Hostname	Type	State	Time Last Upgraded	Retries Count	Upgraded By	Last Update Status
ap6532-A65738	ap6532	failed	Mon Apr 13 2015 01:16:40 AM	3	NX95-Pri	download timed out
ap621-E9F899	ap621	failed	Mon Apr 13 2015 01:16:39 AM	3	NX95-Pri	download timed out
ap6532-34776C	ap6532	done	Tue Apr 14 2015 02:20:39 AM	2	NX95-Pri	download timed out
ap8232-7F0DE4	ap82xx	done	Tue Apr 28 2015 06:19:33 AM	1	NX95-Pri	download timed out
ap6532-347800	ap6532	failed	Mon Apr 13 2015 01:16:39 AM	3	NX95-Pri	download timed out
ap6532-A65724	ap6532	failed	Mon Apr 13 2015 01:16:40 AM	3	NX95-Pri	download timed out
ap6532-3475E4	ap6532	failed	Mon Apr 13 2015 01:16:39 AM	3	NX95-Pri	download timed out
ap8132-738E2C	ap81xx	failed	Mon Apr 13 2015 01:16:40 AM	3	NX95-Pri	download timed out
ap6511-8A4B11	ap6511	failed	Mon Apr 13 2015 01:16:40 AM	3	NX95-Pri	download timed out
ap6532-A65721	ap6532	done	Wed May 6 2015 12:59:30 AM	1	NX95-Pri	Update error: Unable to get
ap6532-347800	ap6532	done	Wed May 6 2015 12:59:30 AM	1	NX95-Pri	Update error: Unable to get
ap650-2433AC	ap650	done	Wed May 6 2015 12:59:24 AM	1	NX95-Pri	Update error: Unable to get

Type to search in tables

Row Count: 2047

Clear History Refresh

Figure 15-141 Access Point - Device Upgrade screen

The **Upgrade** screen displays the following information:

Device Hostname	Displays the administrator assigned hostname of the Access Point receiving the update.
Type	Displays the Access Point model type of the device receiving a firmware update from the provisioning Access Point.
State	Displays the current state of the Access Point upgrade (<i>done</i> , <i>failed</i> etc.).
Time Last Upgraded	Displays the date and time of the last successful Access Point firmware upgrade operation.
Retries Count	Displays the number of retries made in an Access Point firmware update operation.
Upgraded By	Displays the MAC address of the Access Point that performed the upgrade operation.
Last Update Status	Displays the status of the last upgrade operation (<i>Start Upgrade</i> , <i>Update Error</i> etc.).
Clear History	Select the <i>Clear History</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.6 Adoption

► Access Point Statistics

Access point adoption stats are available for both currently adopted and Access Points pending adoption. Historical data can be also be fetched for adopted Access Points.

For more information, refer to the following:

- *Adopted APs*
- *AP Adoption History*
- *AP Self Adoption History*
- *Pending Adoptions*

15.4.6.1 Adopted APs

► Adoption

The *Adopted APs* screen lists Access Points adopted by the selected Access Point, their RF Domain memberships and network service information.

To view adopted Access Point statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Adoption** menu item.
- 4 Select **Adopted APs**.

[illegible]

Figure 15-142 *Access Point - Adopted APs screen*

The **Adopted APs** screen displays the following:

Access Point	Displays the name assigned to the adopted Access Point as part of its device configuration.
Type	Lists the each listed Access Point type adopted by this Access Point.

RF Domain Name	Displays each Access Point's RF Domain membership. An Access Point can only share RF Domain membership with other Access Points of the same model.
Model Number	Displays each listed Access Point's numeric model (AP6532, AP6562, etc.).
Status	Displays each listed Access Point's configuration status to help determine its service role.
Errors	Lists any configuration errors that may be hindering a clean adoption.
Adopted By	Lists the adopting Access Point.
Adoption time	Displays each listed Access Point's time of adoption.
Startup Time	Displays each listed Access Point's in service time since last offline.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

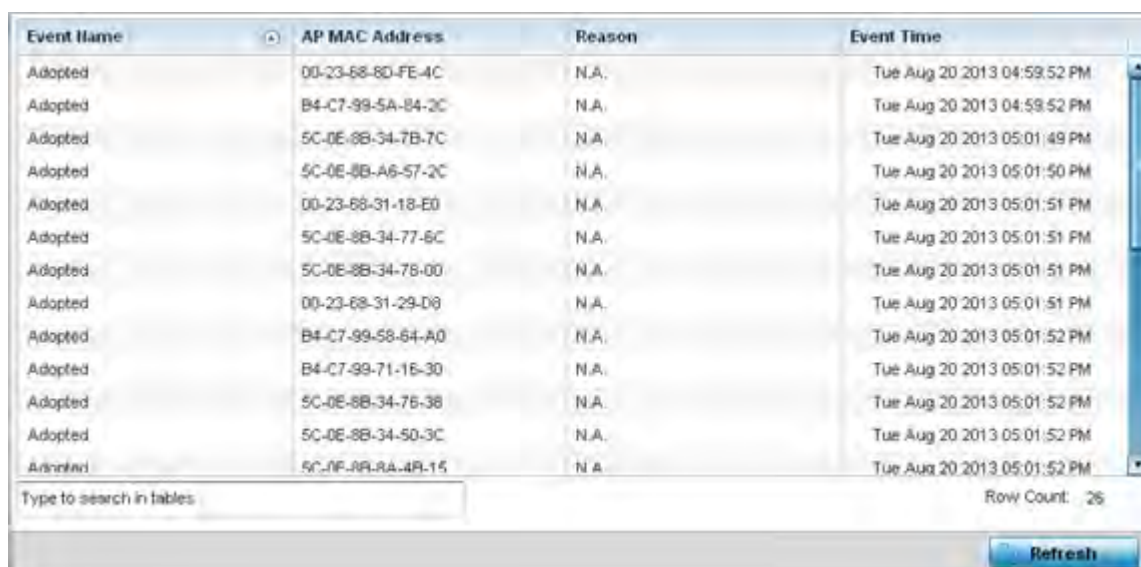
15.4.6.2 AP Adoption History

► Adoption

The *AP Adoption History* screen displays a list of peer Access Points and their adoption event status.

To review a selected Access Point's adoption history:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand the a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Adoption** menu item.
- 4 Select **AP Adoption History**.



Event Name	AP MAC Address	Reason	Event Time
Adopted	00-23-68-8D-FE-4C	N.A.	Tue Aug 20 2013 04:59:52 PM
Adopted	B4-C7-99-5A-B4-2C	N.A.	Tue Aug 20 2013 04:59:52 PM
Adopted	5C-0E-8B-34-7B-7C	N.A.	Tue Aug 20 2013 05:01:49 PM
Adopted	5C-0E-8B-A6-57-2C	N.A.	Tue Aug 20 2013 05:01:50 PM
Adopted	00-23-68-31-18-E0	N.A.	Tue Aug 20 2013 05:01:51 PM
Adopted	5C-0E-8B-34-77-6C	N.A.	Tue Aug 20 2013 05:01:51 PM
Adopted	5C-0E-8B-34-78-00	N.A.	Tue Aug 20 2013 05:01:51 PM
Adopted	00-23-68-31-29-D8	N.A.	Tue Aug 20 2013 05:01:51 PM
Adopted	B4-C7-99-58-64-A0	N.A.	Tue Aug 20 2013 05:01:52 PM
Adopted	B4-C7-99-71-16-30	N.A.	Tue Aug 20 2013 05:01:52 PM
Adopted	5C-0E-8B-34-75-38	N.A.	Tue Aug 20 2013 05:01:52 PM
Adopted	5C-0E-8B-34-50-3C	N.A.	Tue Aug 20 2013 05:01:52 PM
Adopted	5C-0E-8B-34-4A-15	N.A.	Tue Aug 20 2013 05:01:52 PM

Type to search in tables: Row Count: 26

Refresh

Figure 15-143 Access Point - AP Adoption History screen

The **Adopted Devices** screen describes the following historical data for adopted Access Points:

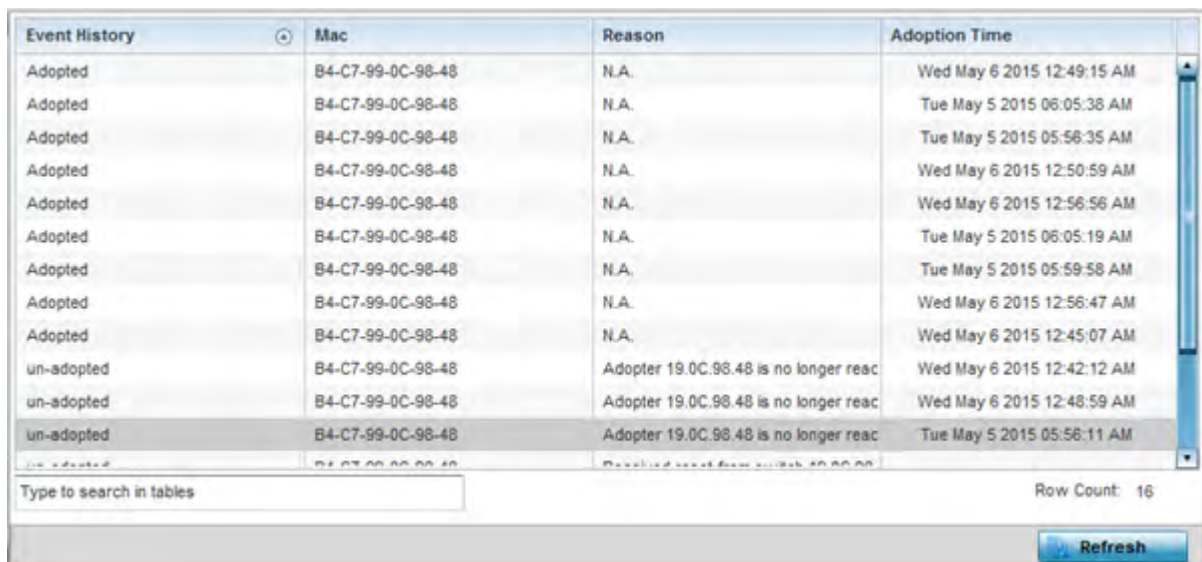
Event Name	Displays the adoption status of each listed Access Point as either <i>adopted</i> or <i>un-adopted</i> .
AP MAC Address	Displays the MAC address of each Access Point this Access Point has attempted to adopt.
Reason	Displays the reason code for each event listed.
Event Time	Displays day, date and time for each Access Point adoption attempt.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.6.3 AP Self Adoption History

► Adoption

The *AP Self Adoption History* displays an event history of peer Access Points that have adopted to the selected Access Point.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand the a RF Domain, select a controller, and select one of its connected Access Points.
- 3 Expand the **Adoption** menu item.
- 4 Select **AP Self Adoption History**.



Event History	Mac	Reason	Adoption Time
Adopted	B4-C7-99-0C-98-48	N.A.	Wed May 6 2015 12:49:15 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Tue May 5 2015 06:05:38 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Tue May 5 2015 05:56:35 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Wed May 6 2015 12:50:59 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Wed May 6 2015 12:56:56 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Tue May 5 2015 06:05:19 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Tue May 5 2015 05:59:58 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Wed May 6 2015 12:56:47 AM
Adopted	B4-C7-99-0C-98-48	N.A.	Wed May 6 2015 12:45:07 AM
un-adopted	B4-C7-99-0C-98-48	Adopter 19.0C.98.48 is no longer reac	Wed May 6 2015 12:42:12 AM
un-adopted	B4-C7-99-0C-98-48	Adopter 19.0C.98.48 is no longer reac	Wed May 6 2015 12:48:59 AM
un-adopted	B4-C7-99-0C-98-48	Adopter 19.0C.98.48 is no longer reac	Tue May 5 2015 05:56:11 AM

Type to search in tables Row Count: 16 Refresh

Figure 15-144 Access Point - AP Self Adoption History screen

The **AP Self Adoption History** screen describes the following historical data for adopted Access Points:

Event History	Displays the self adoption status of each AP as either <i>Adopted</i> or <i>un-adopted</i> .
MAC	Displays the hardware encoded <i>Media Access Control</i> (MAC) of the auto adopted Access Point.
Reason	Displays the adoption reason code for an Access Point's auto adoption.

Adoption Time	Displays a timestamp for the Access Point's auto-adoption by the controller or service platform.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.6.4 Pending Adoptions

► Adoption

The *Pending Adoptions* screen displays a list of devices yet to be adopted to this peer Access Point, or Access Points in the process of adoption.

To view pending Access Point statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand the a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Adoption** menu item.
- 4 Select **Pending Adoptions**.

	MAC Address	Type	IP Address	VLAN	Reason	Discovery Option	Last Seen
🟢	84-24-8D-18-	ap7532	10.0.1.120	0	Auto-Provisioning-Poli	fqdn: IL-01-188480.ping	3/1/2016 09:13:19 AM ▶
🟢	84-24-8D-89-	ap7532	10.80.216.20	0	Auto-Provisioning-Poli	fqdn: IL-02-89FD68.Zentei	3/1/2016 09:13:10 AM ▶

Type to search in tables

Row Count: 2

Add to Devices Refresh

Figure 15-145 Access Point - Pending Adoptions screen

The **Pending Adoptions** screen provides the following:

MAC Address	Displays the MAC address of the device pending adoption.
Type	Displays the Access Point's model type.
IP Address	Displays the current network IP Address of the device pending adoption.
VLAN	Displays the current VLAN used as a virtual interface by device pending adoption.
Reason	Displays the status as to why the device is still pending adoption and has not yet successfully connected to this Access Point.
Discovery Option	Displays the discovery option code for each AP listed pending adoption.

Last Seen	Displays the date and time stamp of the last time the device was seen. Click the arrow next to the date and time to toggle between standard time and UTC.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.7 AP Detection

► Access Point Statistics

The *AP Detection* screen displays potentially hostile Access Points, their SSIDs, reporting AP, and so on. Continuously revalidating the credentials of detected devices reduces the possibility of an Access Point hacking into the network.

To view the AP detection statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **AP Detection**.

Unsanctioned AP	Reporting AP	SSID	AP Mode	Radio Type	Channel	RSSI	Last Seen
00-11-3F-DD-B7-20		wlan1			6	-68 dBm	2s
00-11-3F-DE-AE-E0		checksum			11	-66 dBm	33s
00-11-3F-DE-B9-90		traffic_shaping			6	-70 dBm	4s
00-11-3F-E3-4B-90		remotevpn			6	-79 dBm	2s
00-13-60-D4-A0-20		nanoDemo_1			6	-64 dBm	5s
00-14-C2-AA-FF-10		aaa			7	-66 dBm	3s
00-15-70-AE-32-38		M-Wireless			6	-74 dBm	18s
00-15-70-AE-33-E8		M-Guest			6	-68 dBm	6s
00-15-70-AE-33-F8		M-Guest			6	-65 dBm	2s
00-15-70-AE-37-A0		M-Wireless			1	-55 dBm	40s
00-15-70-AE-38-60		M-Wireless			11	-69 dBm	33s
00-15-70-C8-4F-60		test_pppoe_wlan			6	-75 dBm	17s

Type to search in tables

Row Count: 190

Clear All Refresh

Figure 15-146 Access Point - AP Detection

The **AP Detection** screen displays the following:

Unsanctioned AP	Displays the MAC address of a detected Access Point that is yet to be authorized for interoperability within the Access Point managed network.
Reporting AP	Displays the hardware encoded MAC address of the radio used by the detecting Access Point. Select an Access Point to display configuration and network address information in greater detail.
SSID	Displays the WLAN SSID the unsanctioned Access Point was detected on.
AP Mode	Displays the operating mode of the unsanctioned Access Point.
Radio Type	Displays the type of the radio on the unsanctioned Access Point. The radio can be 802.11b, 802.11bg, 802.11bgn, 802.11a or 802.11an.

Channel	Displays the channel the unsanctioned Access Point is currently transmitting on.
RSSI	Lists a <i>relative signal strength indication</i> (RSSI) for a detected (and perhaps unsanctioned) Access Point.
Last Seen	Displays the time (in seconds) the unsanctioned Access Point was last seen on the network.
Clear All	Select the <i>Clear All</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

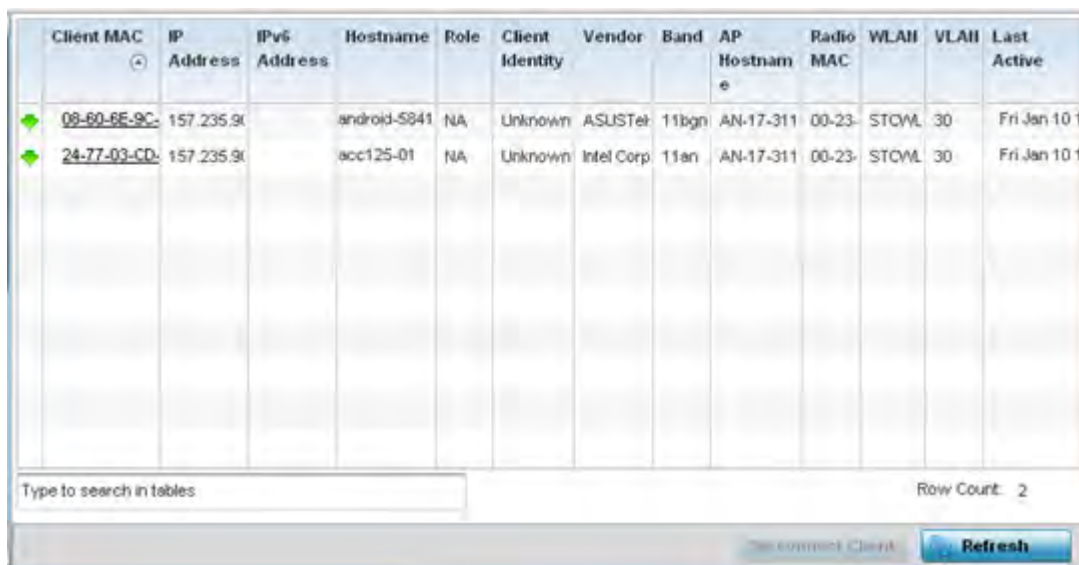
15.4.8 Guest User

► Access Point Statistics

The *Guest User* screen displays credential information for wireless clients associated with an Access Point. Use this information to assess if configuration changes are required to improve network performance.

To view guest user statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Guest User**.



Client MAC	IP Address	IPv6 Address	Hostname	Role	Client Identity	Vendor	Band	AP Hostname	Radio MAC	WLAN	VLAN	Last Active
08-60-BE-9C	157.235.91		android-5841	NA	Unknown	ASUSTek	11bgn	AN-17-311	00-23-STCMA	30		Fri Jan 10 1
24-77-03-CD	157.235.91		acc125-01	NA	Unknown	Intel Corp	11an	AN-17-311	00-23-STCMA	30		Fri Jan 10 1

Type to search in tables

Row Count: 2

Refresh

Figure 15-147 Access Point - Guest User screen

The **Guest User** screen displays the following client information:

Client MAC	Displays the hardcoded MAC address assigned to the guest client at the factory. The address displays as a link that can be selected to display configuration and network address information in greater detail.

IP Address	Displays the unique IP address of the guest client. Use this address as necessary throughout the applet for filtering and device intrusion recognition and approval.
IPv6 Address	Displays the current IPv6 formatted IP address a listed guest client is using as a network identifier. IPv6 is the latest revision of the <i>Internet Protocol</i> (IP) designed to replace IPv4. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
Hostname	Displays the hostname (MAC addresses) of connected guest clients. The hostname displays as a link that can be selected to display configuration and network address information in greater detail.
Role	Lists the guest client's defined role within the Access Point managed network.
Client Identity	Displays the unique identity of the listed guest client as it appears to its adopting Access Point.
Vendor	Displays the name of the client vendor (manufacturer).
Band	Displays the 802.11 radio band on which the listed guest client operates.
AP Hostname	Displays the administrator assigned hostname of the Access Point to which this Access Point is adopted.
Radio MAC	Displays the MAC address of the radio which the wireless client is using.
WLAN	Displays the name of the WLAN the Access Point's using with each listed guest client. Use this information to determine if the client's WLAN assignment best suits its intended deployment in respect to the WLAN's QoS objective.
VLAN	Displays the VLAN ID each listed guest client is currently mapped to as a virtual interface for Access Point interoperability.
Last Active	Displays the time when this guest client was last seen (or detected) by a device within the Access Point managed network.
Disconnect Client	Select a specific client MAC address and select the <i>Disconnect Client</i> button to terminate this client's connection to its Access Point.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.9 Wireless LANs

► Access Point Statistics

The *Wireless LANs* screen displays an overview of Access Point WLAN utilization. This screen displays Access Point WLAN assignment, SSIDs, traffic utilization, number of radios the Access Point is utilizing on the WLAN and transmit and receive statistics.

To review a selected Access Point's WLAN statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Wireless LANs**.

15 - 215

The **Wireless LANs** screen displays the following:

Secondary Next Hop IP	If the primary hop is unavailable, a second resource is used. This column lists the address set for the alternate route in the election process.
Secondary Next Hop State	Displays whether the secondary hop is applied to incoming routed packets (UP/UNREACHABLE).
Default Next Hop IP	If a packet subjected to PBR does not have an explicit route to the destination, the configured default next hop is used. This is either the IP address of the next hop or the outgoing interface. Only one default next hop is available. The difference between the next hop and the default next-hop is in case of former, PBR occurs first, then destination based routing. In case of the latter, the order is reverse.
Default Next Hop State	Displays whether the default hop is being applied to incoming routed packets.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.11 Radios

► *Access Point Statistics*

The *Radio* statistics screens display information on Access Point radios. The actual number of radios depend on the Access Point model and type. This screen displays information on a per radio basis. Use this information to refine and optimize the performance of each radio and therefore improve network performance.

The Access Point's radio statistics screens provide details about associated radios. It provides radio ID, radio type, RF quality index etc. Use this information to assess the overall health of radio transmissions and Access Point placement.

Each of these screens provide enough statistics to troubleshoot issues related to the following three areas:

- *Status*
- *RF Statistics*
- *Traffic Statistics*

Individual Access Point radios display as selectable links within each of the three Access Point radio screens. To review a radio's configuration in greater detail, select the link within the Radio column of either the *Status*, *RF Statistics* or *Traffic Statistics* screens.

Additionally, navigate the *Traffic*, *WMM TSPEC*, *Wireless LANs* and *Graph* options available on the upper, left-hand side, of the screen to review radio traffic utilization, WMM QoS settings, WLAN advertisement and radio graph information in greater detail. This information can help determine whether the radio is properly configured in respect to its intended deployment objective.

To view Access Point radio statistics:

- [illegible]

The radio **Status** screen provides the following information:

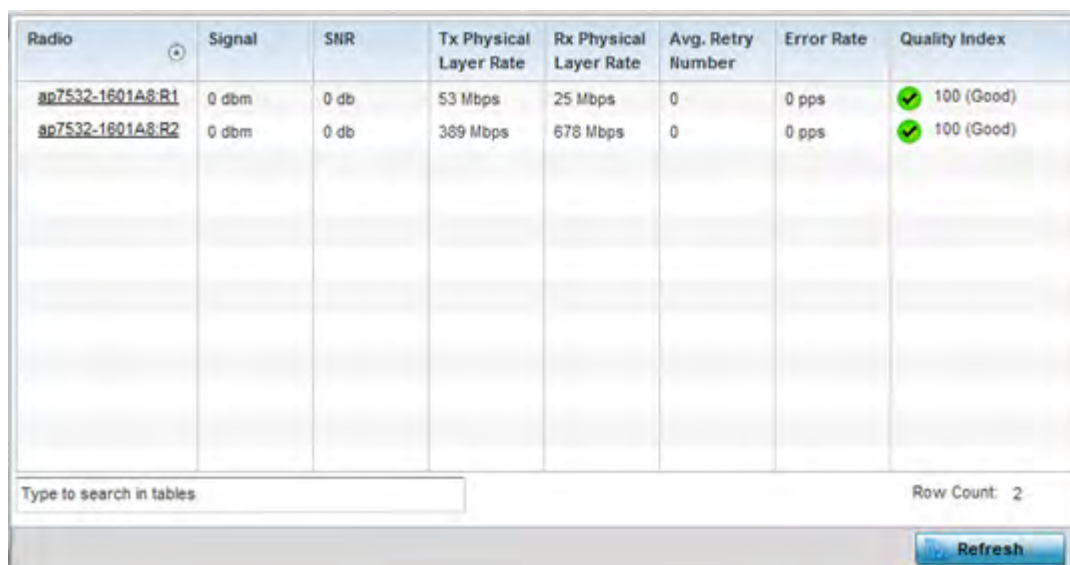
Wireless Controller and Service Platform System Reference Guide

15.4.11.2 RF Statistics

Use the *RF Statistics* screen to review Access Point radio transmit and receive statistics, error rate and RF quality.

To view Access Point radio RF statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Radios** menu item.
- 4 Select **RF Statistics**.



Radio	Signal	SNR	Tx Physical Layer Rate	Rx Physical Layer Rate	Avg. Retry Number	Error Rate	Quality Index
ap7532-1601A8-R1	0 dbm	0 db	53 Mbps	25 Mbps	0	0 pps	✓ 100 (Good)
ap7532-1601A8-R2	0 dbm	0 db	389 Mbps	678 Mbps	0	0 pps	✓ 100 (Good)

Type to search in tables

Row Count: 2

Refresh

Figure 15-151 Access Point - Radio RF Statistics screen

The **RF Statistics** screen lists the following:

Radio	Displays the name assigned to the radio as its unique identifier. The name displays in the form of a link that can be selected to launch a detailed screen containing radio throughout data.
Signal	Displays the radio's current power level in - dBm.
SNR	Displays the signal to noise ratio of the radio's associated wireless clients.
Tx Physical Layer Rate	Displays the data transmit rate for the radio's physical layer. The rate is displayed in Mbps.
Rx Physical Layer Rate	Displays the data receive rate for the radio's physical layer. The rate is displayed in Mbps.
Avg Retry Number	Displays the average number of retries per packet. A high number indicates possible network or hardware problems. Assess the error rate in respect to potentially high signal and SNR values to determine whether the error rate coincides with a noisy signal.
Error Rate	Displays the total number of received packets which contained errors for the listed radio.

Quality Index	Displays the traffic utilization index of the radio. This is expressed as an integer value. 0 – 20 indicates very low utilization, and 60 and above indicate high utilization.
Quality Index	Displays an integer that indicates overall RF performance. The RF quality indices are: 0 – 50 (poor) 50 – 75 (medium) 75 – 100 (good)
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.11.3 Traffic Statistics

Refer to the *Traffic Statistics* screen to review Access Point radio transmit and receive statistics, data rate, and packets dropped during both transmit and receive operations.

To view the Access Point radio traffic statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand **Radios**.
- 4 Select **Traffic Statistics**.

[illegible]

Figure 15-152 *Access Point - Radio Traffic Statistics screen*

The **Traffic Statistics** screen displays the following:

Radio	Displays the name assigned to the radio as its unique identifier. The name displays in the form of a link that can be selected to launch a detailed screen containing radio throughout data.

Tx Bytes	Displays the total number of bytes transmitted by each listed radio. This includes all user data as well as any management overhead data.
Rx Bytes	Displays the total number of bytes received by each listed radio. This includes all user data as well as any management overhead data.
Tx Packets	Displays the total number of packets transmitted by each listed radio. This includes all user data as well as any management overhead packets.
Rx Packets	Displays the total number of packets received by each listed radio. This includes all user data as well as any management overhead packets.
Tx User Data Rate	Displays the rate (in kbps) user data is transmitted by each listed radio. This rate only applies to user data and does not include management overhead.
Rx User Data Rate	Displays the rate (in kbps) user data is received by the radio. This rate only applies to user data and does not include management overhead.
Tx Dropped	Displays the total number of transmitted packets dropped by each listed radio. This includes all user data as well as management overhead packets that were dropped.
Traffic Index	This area displays the traffic index, which measures how efficiently the traffic medium is utilized. It's defined as the percentage of current throughput relative to the maximum possible throughput. The indices include: 0 – 20 (Very low utilization) 20 – 40 (Low utilization) 40 – 60 (Moderate utilization) 60 and above (High utilization)
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.12 Mesh

► Access Point Statistics

The *Mesh* screen provides detailed statistics on each Mesh capable client available within the selected Access Point's radio coverage area.

To view the Mesh statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Mesh**.

[illegible]

Figure 15-153 *Access Point - Mesh screen*

The **Mesh** screen describes the following:

Client	Displays the system assigned name of each member of the mesh network.
Client Radio MAC	Displays the MAC address of each client radio in the mesh network.
Portal	Mesh points connected to an external network and forward traffic in and out are Mesh Portals. Mesh points must find paths to a Portal to access the Internet. When multiple Portals exist, the Mesh point must select one.
Portal Radio MAC	Lists the MAC addresses of those Access Points serving as mesh portals.
Connect Time	Displays the elapsed connection time for each listed client in the mesh network.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.13 Interfaces

► *Access Point Statistics*

The *Interface* screen provides detailed statistics on each of the interfaces available on the selected Access Point. Use this screen to review the statistics for each interface. Interfaces vary amongst supported Access Point models.

To review Access Point interface statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Interfaces**.

The **General** tab displays by default.



Figure 15-154 Access Point- General Interface screen

Interface Statistics support the following:

- *General Interface Details*
- *IPv6 Address*
- *Multicast Groups Joined*
- *Network Graph*

15.4.13.1 General Interface Details

► Interfaces

The *General* tab provides information on a selected Access Point interface such as its MAC address, type and TX/RX statistics.

The **General** table displays the following:

Name	Displays the name of the Access Point interface ge1, vlan1 etc.
Interface MAC Address	Displays the MAC address of the interface.
IP Address	IP address of the interface.
IP Address Type	Displays the IP address type, either IPv4 or IPv6.
Secondary IP	Displays a list of secondary IP resources assigned to this interface.
Hardware Type	Displays the networking technology.
Index	Displays the unique numerical identifier for the interface.
Access VLAN	Displays the tag assigned to the native VLAN.
Access Setting	Displays the VLAN mode as either <i>Access</i> or <i>Trunk</i> .
Administrative Status	Displays whether the interface is currently UP or DOWN.
Operational Status	Lists whether the selected interface is currently UP (operational) or DOWN.

The **IPv6 Mode and MTU** table displays the following:

IPv6 Mode	Lists the current IPv6 mode utilized.
IPv6 MTU	Lists the IPv6 formatted largest packet size that can be sent over the interface.

The **Specification** table displays the following information:

Media Type	Displays the physical connection type of the interface. Medium types include: <i>Copper</i> - Used on RJ-45 Ethernet ports <i>Optical</i> - Used on fibre optic gigabit Ethernet ports
Protocol	Displays the routing protocol used by the interface.
MTU	Displays the <i>maximum transmission unit</i> (MTU) setting configured on the interface. The MTU value represents the largest packet size that can be sent over a link. 10/100 Ethernet ports have a maximum setting of 1500.
Mode	Lists whether traffic on the listed port is Layer 2 or Layer 3.
Metric	Displays the metric associated with the interface's route.
Maximum Speed	Displays the maximum speed the interface uses to transmit or receive data.
Admin Speed	Displays the speed the port can transmit or receive. This value can be either <i>10</i> , <i>100</i> , <i>1000</i> or <i>Auto</i> . This value is the maximum port speed in Mbps. Auto indicates the speed is negotiated between connected devices.
Operator Speed	Displays the current speed of data transmitted and received over the interface.
Admin Duplex Setting	Displays the administrator's duplex setting.
Current Duplex Setting	Displays the interface as either <i>half duplex</i> , <i>full duplex</i> or <i>unknown</i> .

The **Traffic** table displays the following:

Good Octets Sent	Displays the number of octets (bytes) with no errors sent by the interface.
Good Octets Received	Displays the number of octets (bytes) with no errors received by the interface.
Good Packets Sent	Displays the number of good packets transmitted.
Good Packets Received	Displays the number of good packets received.
Mcast Pkts Sent	Displays the number of multicast packets sent through the interface.
Mcast Pkts Received	Displays the number of multicast packets received through the interface.
Ucast Pkts Sent	Displays the number of unicast packets sent through the interface.
Ucast Pkts Received	Displays the number of unicast packets received through the interface.
Bcast Pkts Sent	Displays the number of broadcast packets sent through the interface.
Bcast Pkts Received	Displays the number of broadcast packets received through the interface.

Packet Fragments	Displays the number of packet fragments transmitted or received through the interface.
Jabber Pkts	Displays the number of packets transmitted through the interface larger than the MTU.

The **Errors** table displays the following:

Bad Pkts Received	Displays the number of bad packets received through the interface.
Collisions	Displays the number of collisions over the selected interface.
Late Collisions	A late collision is any collision that occurs after the first 64 octets of data have been sent. Late collisions are not normal, and usually the result of out of specification cabling or a malfunctioning device.
Excessive Collisions	Displays the number of excessive collisions. Excessive collisions occur when the traffic load increases to the point a single Ethernet network cannot handle it efficiently.
Drop Events	Displays the number of dropped packets transmitted or received through the interface.
Tx Undersize Pkts	Displays the number of undersized packets transmitted through the interface.
Oversize Pkts	Displays the number of oversized packets transmitted through the interface.
MAC Transmit Error	Displays the number of failed transmits due to an internal MAC sublayer error (that's not a late collision), due to excessive collisions or a carrier sense error.
MAC Receive Error	Displays the number of received packets that failed due to an internal MAC sublayer (that's not a late collision), an excessive number of collisions or a carrier sense error.
Bad CRC	Displays the CRC error. The CRC is the 4 byte field at the end of every frame. The receiving station uses it to interpret if the frame is valid. If the CRC value computed by the interface does not match the value at the end of frame, it is considered as a bad CRC.

The **Receive Errors** table displays the following:

Rx Frame Errors	Displays the number of frame errors received at the interface. A frame error occurs when data is received, but not in an expected format.
Rx Length Errors	Displays the number of length errors received at the interface. Length errors are generated when the received frame length was either less or over the Ethernet standard.
Rx FIFO Errors	Displays the number of FIFO errors received at the interface. First-in First-out queueing is an algorithm that involves buffering and forwarding of packets in the order of arrival. FIFO entails no priority. There is only one queue, and all packets are treated equally. An increase in FIFO errors indicates a probable hardware malfunction.
Rx Missed Errors	Displays the number of missed packets. Packets are missed when the hardware received FIFO has insufficient space to store an incoming packet.
Rx Over Errors	Displays the number of overflow errors received. Overflows occur when a packet size exceeds the allocated buffer size.

The **Transmit Errors** field displays the following:

Tx Errors	Displays the number of packets with errors transmitted on the interface.
Tx Dropped	Displays the number of transmitted packets dropped from the interface.
Tx Aborted Errors	Displays the number of packets aborted on the interface because a clear-to-send request was not detected.
Tx Carrier Errors	Displays the number of carrier errors on the interface. This generally indicates bad Ethernet hardware or bad cabling.
Tx FIFO Errors	Displays the number of FIFO errors transmitted at the interface. <i>First-in First-Out</i> queueing is an algorithm that involves the buffering and forwarding of packets in the order of arrival. FIFO uses no priority. There is only one queue, and all packets are treated equally. An increase in the number of FIFO errors indicates a probable hardware malfunction.
Tx Heartbeat Errors	Displays the number of heartbeat errors. This generally indicates a software crash, or packets stuck in an endless loop.
Tx Window Errors	Displays the number of window errors transmitted. TCP uses a sliding window flow control protocol. In each TCP segment, the receiver specifies the amount of additional received data (in bytes) the receiver is willing to buffer for the connection. The sending host can send only up to that amount. If the sending host transmits more data before receiving an acknowledgment, it constitutes a window error.

- 4 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.13.2 IPv6 Address

► Interfaces

IPv6 is the latest revision of the *Internet Protocol* (IP) designed to replace IPv4. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.

To view IPv6 address utilization:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Interfaces** menu from the left-hand side of the UI.
- 4 Select **IPv6 Address**.

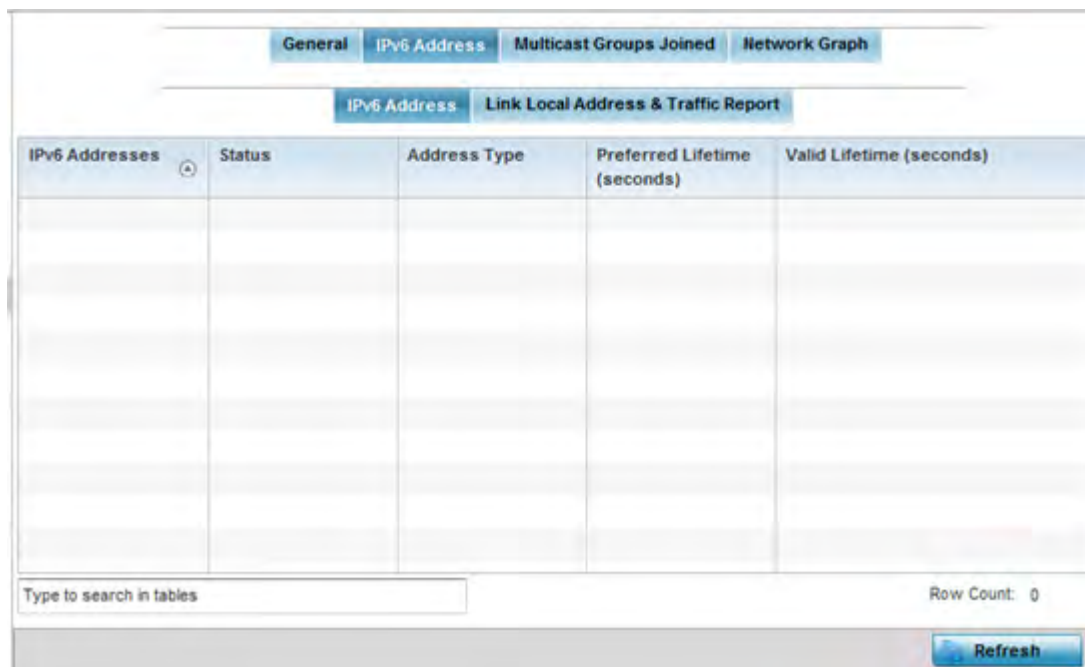


Figure 15-155 Access Point - Interface IPv6 Address screen

- 5 The **IPv6 Addresses** table displays the following:

IPv6 Addresses	Lists the IPv6 formatted addresses currently utilized by the Access Point on the selected interface.
Status	Lists the current utilization status of each IPv6 formatted address currently in use by this controller or Access Point's selected interface.
Address Type	Lists whether the address is unicast or multicast in its utilization over the selected Access Point interface.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the IPv6 formatted addresses remains in a preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the IPv6 formatted address remains in a valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

- 6 Select the **Link Local Address & Traffic Report** tab to assess data traffic and errors discovered in transmitted and received IPv6 formatted data packets.

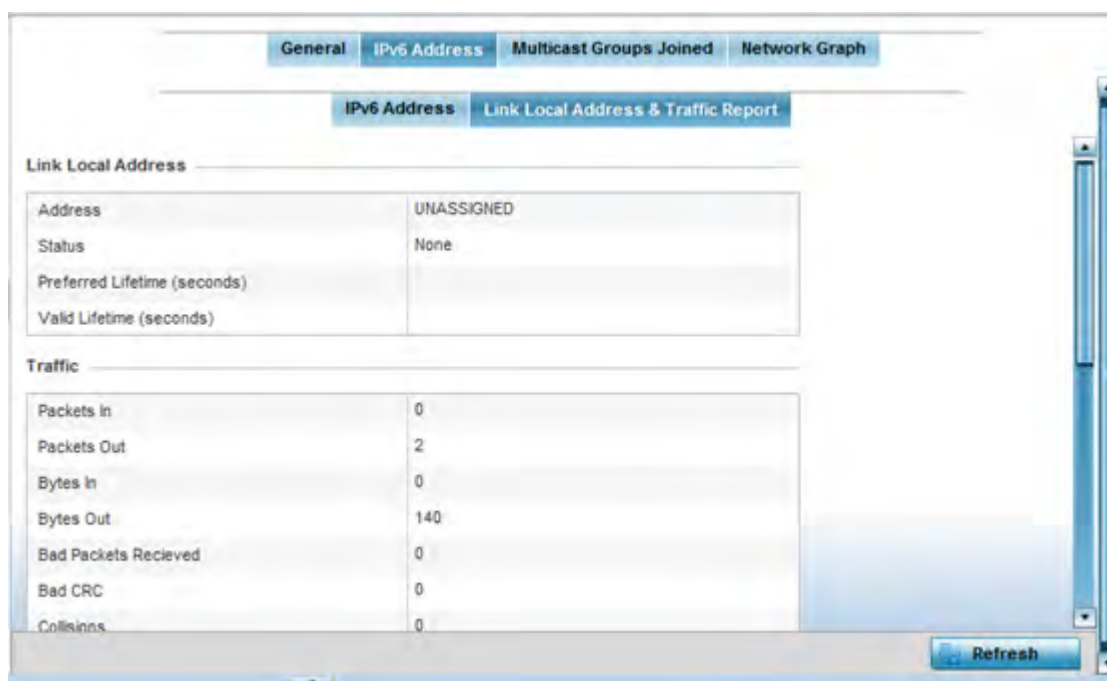


Figure 15-156 Access Point - Interface IPv6 Address screen

7 Verify the following **Local Link Address** data for the IPv6 formatted address:

Address	Lists the IPv6 local link address. IPv6 requires a link local address assigned to every interface the IPv6 protocol is enabled on, even when one or more routable addresses are assigned.
Status	Lists the IPv6 local link address utilization status and its current availability.
Preferred Lifetime (seconds)	Lists is the time in seconds (relative to when the packet is sent) the local link addresses remains in the preferred state on the selected interface. The preferred lifetime must always be less than or equal to the valid lifetime.
Valid Lifetime (seconds)	Displays the time in seconds (relative to when the packet is sent) the local link addresses remains in the valid state on the selected interface. The valid lifetime must always be greater than or equal to the preferred lifetime.

8 Verify the following IPv6 formatted **Traffic** data:

Packets In	Lists the number of IPv6 formatted data packets received on the selected Access Point interface since the screen was last refreshed.
Packets Out	Lists the number of IPv6 formatted data packets transmitted on the selected Access Point interface since the screen was last refreshed.
Refresh	Periodically select <i>Refresh</i> to update the screen's counters to their latest values.

9 Review the following **Receive Errors** for IPv6 formatted data traffic:

Receive Length Errors	Displays the number of IPv6 length errors received at the interface. Length errors are generated when the received IPv6 frame length was either less or over the Ethernet standard.

Receive Over Errors	Displays the number of IPv6 overflow errors received. Overflows occur when a packet size exceeds the allocated buffer size.
Receive Frame Errors	Displays the number of IPv6 frame errors received at the interface. A frame error occurs when data is received, but not in an expected format.
Receive FIFO Errors	Displays the number of IPv6 FIFO errors received at the interface. <i>First-in First-out</i> queueing is an algorithm that involves buffering and forwarding of packets in the order of arrival. FIFO entails no priority. There is only one queue, and all IPv6 formatted packets are treated equally. An increase in FIFO errors indicates a probable hardware malfunction.
Receive Missed Errors	Displays the number of missed IPv6 formatted packets. Packets are missed when the hardware received FIFO has insufficient space to store an incoming packet.

10 Review the following **Transmit Errors** for IPv6 formatted data traffic:

Transmit Errors	Displays the number of IPv6 formatted data packets with errors transmitted on the interface.
Transmit Aborted Errors	Displays the number of IPv6 formatted packets aborted on the interface because a clear-to-send request was not detected.
Transmit Carrier Errors	Displays the number of IPv6 formatted carrier errors on the interface. This generally indicates bad Ethernet hardware or bad cabling.
Transmit FIFO Errors	Displays the number of IPv6 formatted FIFO errors transmitted at the interface. <i>First-in First-Out</i> queueing is an algorithm that involves the buffering and forwarding of packets in the order of arrival. FIFO uses no priority. There is only one queue, and all packets are treated equally. An increase in the number of FIFO errors indicates a probable hardware malfunction.
Transmit Heartbeat Errors	Displays the number of IPv6 formatted heartbeat errors. This generally indicates a software crash, or packets stuck in an endless loop.
Transmit Window Errors	Displays the number of IPv6 formatted window errors transmitted. TCP uses a sliding window flow control protocol. In each TCP segment, the receiver specifies the amount of additional received data (in bytes) the receiver is willing to buffer for the connection. The sending host can send only up to that amount. If the sending host transmits more data before receiving an acknowledgment, it constitutes a window error.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest value.

15.4.13.3 Multicast Groups Joined

► Interfaces

Multicast groups scale to a larger set of destinations by *not* requiring prior knowledge of who or how many destinations there are. Multicast devices use their infrastructure efficiently by requiring the source to send a packet only once, even if delivered to a large number of devices. Devices replicate a packet to reach multiple receivers only when necessary.

Access Points are free to join or leave a multicast group at any time. There are no restrictions on the location or members in a multicast group. A host may be a member of more than one multicast group at any given time and does not have to belong to a group to send messages to members of a group.

To view the Access Point's multicast group memberships on the selected interface:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Interfaces**.
- 4 Select **Multicast Groups Joined**.

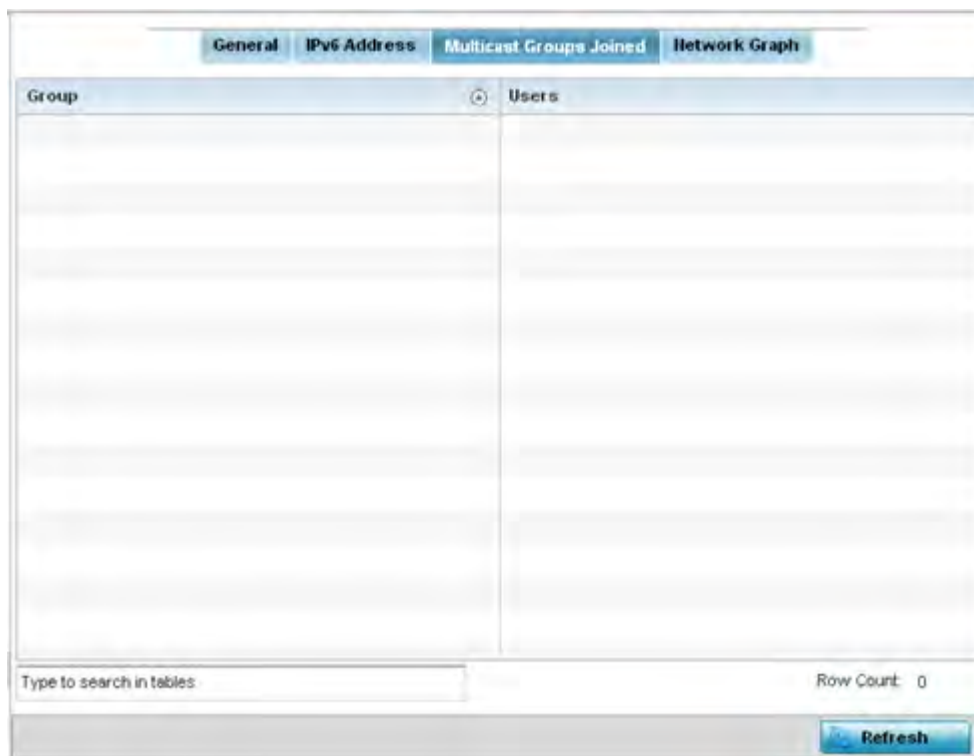


Figure 15-157 Access Point - Interface Multicast Groups Joined screen

- 5 The screen displays the following:

Group	Lists the name of existing multicast groups whose current members share multicast packets with one another on this selected interface as a means of collective interoperation.
Users	Lists the number of devices currently interoperating on this interface in each listed multicast group. Any single device can be a member of more than one group at a time.

- 6 Periodically select **Refresh** to update the screen's counters to their latest values.

15.4.13.4 Network Graph

► Interfaces

The *Network Graph* displays statistics the Access Point continuously collects for its interfaces. Even when the interface statistics graph is closed, data is still collected. Display the interface statistics graph periodically for assessing the latest interface information. Up to three different stats can be selected and displayed within the graph.

To view a detailed graph for an interface, select an interface and drop it on to the graph. The graph displays Port Statistics as the Y-axis and the Polling Interval as the X-axis. Use the **Polling Interval** from the drop-down menu to define the intervals data is displayed on the graph.

To view the Interface Statistics graph:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Interfaces**.
- 4 Select **Network Graph**. Use the **Parameters** drop-down menu to specify interface values to trend.



Figure 15-158 Access Point- Interface Network Graph screen

15.4.14 RTLS

► Access Point Statistics

The *real time locationing system* (RTLS) enables accurate location determination and presence detection capabilities for Wi-Fi-based devices, Wi-Fi-based active RFID tags and passive RFID tags. While the operating system does not support locationing locally, it does report the locationing statistics of both Aeroscout and Ekahau tags.

To review a selected Access Point's RTLS statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **RTLS**.

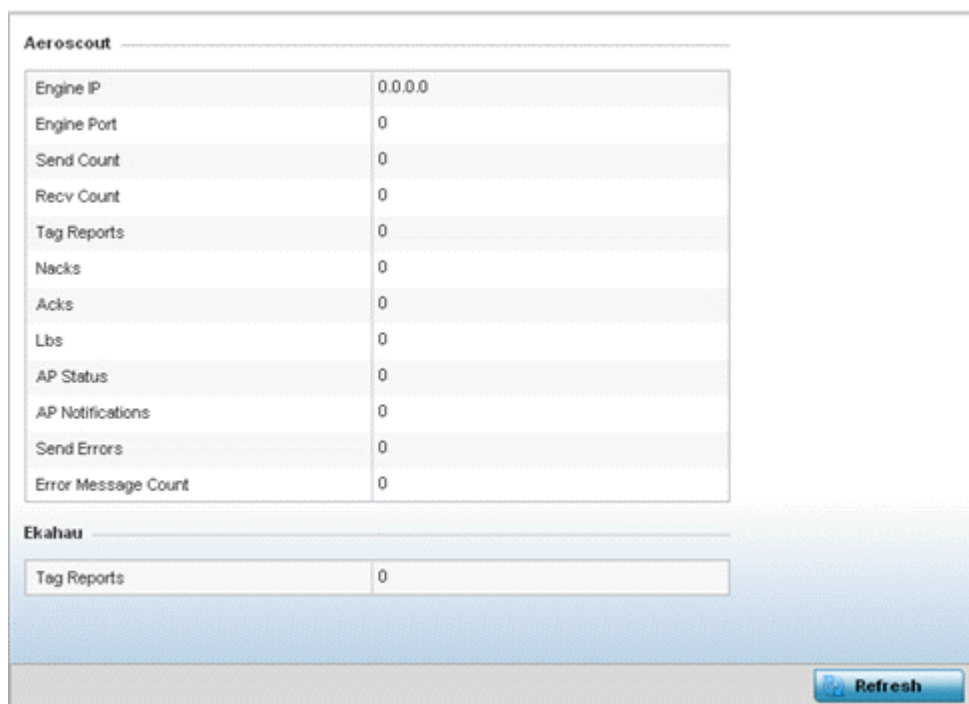


Figure 15-159 Access Point - RTLS screen

The Access Point **RTLS** screen displays the following for Aeroscout tags:

Engine IP	Lists the IP address of the Aeroscout locationing engine.
Engine Port	Displays the port number of the Aeroscout engine.
Send Count	Lists the number location determination packets sent by the locationing engine.
Recv Count	Lists the number location determination packets received by the locationing engine.
Tag Reports	Displays the number of tag reports received from locationing equipped radio devices supporting RTLS.
Nacks	Displays the number of <i>Nack</i> (no acknowledgement) frames received from RTLS supported radio devices providing locationing services.

Acks	Displays the number of <i>Ack</i> (acknowledgment) frames received from RTLS supported radio devices providing locationing services.
Lbs	Displays the number of <i>location based service</i> (LBS) frames received from RTLS supported radio devices providing locationing services.
AP Status	Provides the status of peer APs providing locationing assistance.
AP Notifications	Displays a count of the number of notifications sent to Access Points that may be available to provide RTLS support.
Send Errors	Lists the number of send errors received by the RTLS initiating Access Point.
Error Message Count	Displays a cumulative count of error messages received from RTLS enabled Access Point radios.

The Access Point **RTLS** screen displays the following for Ekahau tags:

Tag Reports	Displays the number of tag reports received from locationing equipped radio devices supporting RTLS.

- 4 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.15 PPPoE

► Access Point Statistics

The *PPPoE* statistics screen displays stats derived from the AP's access to high-speed data and broadband networks. PPPoE uses standard encryption, authentication, and compression methods as specified by the PPPoE protocol. PPPoE enables Access Points to establish a point-to-point connection to an ISP over existing Ethernet interface.

To review a selected Access Point's PPPoE statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **PPPoE**.

Configuration Information

Shutdown	✓
Service	
DSL Modem Network (VLAN)	vlan1
Authentication Type	pap
Username	
Password	
Client Idle Timeout	600
Keep Alive	✗
Maximum Transmission Unit (MTU)	1,492

Connection Status

Peer MAC Address	SID	Service	Maximum Transmission Unit (MTU)	Status
	0x0		0	Disabled

Refresh

Figure 15-160 Access Point - PPPoE screen

The **Configuration Information** field screen displays the following:

Shutdown	Displays whether a high speed client mode point-to-point connection has been enabled using the PPPoE protocol.
Service	Lists the 128 character maximum PPPoE client service name provided by the service provider.
DSL Modem Network (VLAN)	Displays the PPPoE VLAN (client local network) connected to the DSL modem. This is the local network connected to DSL modem.
Authentication Type	Lists authentication type used by the PPPoE client whose credentials must be shared by its peer Access Point. Supported authentication options include <i>None</i> , <i>PAP</i> , <i>CHAP</i> , <i>MSCHAP</i> , and <i>MSCHAP-v2</i> .
Username	Displays the 64 character maximum username used for authentication support by the PPPoE client.
Password	Displays the 64 character maximum password used for authentication by the PPPoE client.
Client Idle Timeout	The Access Point uses the listed timeout so it does not sit idle waiting for input from the PPPoE client and the server, that may never come.
Keep Alive	If a keep alive is utilized, the point-to-point connect to the PPPoE client is continuously maintained and not timed out.
Maximum Transmission Unit (MTU)	Displays the PPPoE client <i>maximum transmission unit</i> (MTU) from 500 - 1,492. The MTU is the largest physical packet size in bytes a network can transmit. Any messages larger than the MTU are divided into smaller packets before being sent. A PPPoE client should be able to maintain its point-to-point connection for this defined MTU size.

4 Refer to the **Connection Status** field.

The Connection Status table lists the MAC address, SID, Service information, MTU and status of each route destination peer. To provide this point-to-point connection, each PPPoE session learns the Ethernet address of

a remote PPPoE client, and establishes a session. PPPoE uses both a discover and session phase to identify a client and establish a point-to-point connection. By using such a connection, a Wireless WAN failover is available to maintain seamless network access if the Access Point's Wired WAN were to fail.

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.16 Bluetooth

► Access Point Statistics

AP-8432 and AP-8533 model Access Points utilize a built in Bluetooth chip for specific Bluetooth functional behaviors in a WiNG managed network. AP-8432 and AP-8533 models support both Bluetooth *classic* and Bluetooth *low energy* technology. These platforms can use their Bluetooth classic enabled radio to sense other Bluetooth enabled devices and report device data (MAC address, RSSI and device calls) to an ADSP server for intrusion detection. If the device presence varies in an unexpected manner, ADSP can raise an alarm.

AP-8432 and AP-8533 model Access Points support Bluetooth beaconing to emit either iBeacon or Eddystone-URL beacons. The Access Point's Bluetooth radio sends non-connectable, undirected *low-energy* (LE) advertisement packets on a periodic basis. These advertisement packets are short, and sent on Bluetooth advertising channels that conform to already-established iBeacon and Eddystone-URL standards.

To view Bluetooth radio statistics for an Access Point:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Point
- 3 Select **Bluetooth**.

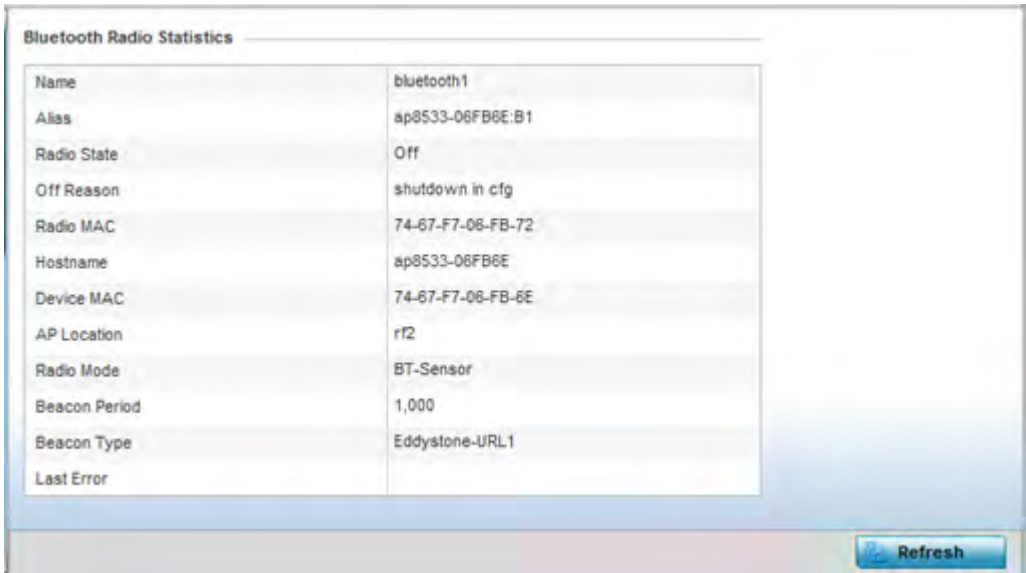


Figure 15-161 Access Point - Bluetooth screen

The Access Point's **Bluetooth** screen displays the following:

Name	Lists the name of the Access Point's Bluetooth radio.

Alias	If an alias has been defined for the Access Point its listed here. The alias value is expressed in the form of <hostname>: B<Bluetooth_radio_number>. If the administrator has defined a hostname for the Access Point, it's used in place of the Access Point's default hostname.
Radio State	Displays the current operational state (On/Off) of the Bluetooth radio.
Off Reason	If the Bluetooth radio is offline, this field states the reason.
Radio MAC	Lists the Bluetooth radio's factory encoded MAC address serving as this device's hardware identifier on the network.
Hostname	Lists the hostname set for the Access Point as its network identifier.
Device MAC	Lists the Access Point's factory encoded MAC address serving as this device's hardware identifier on the network.
AP Location	Lists the Access Point's administrator assigned deployment location.
Radio Mode	Lists an Access Point's Bluetooth radio functional mode as either <i>bt-sensor</i> or <i>le-beacon</i> .
Beacon Period	Lists the Bluetooth radio's beacon transmission period from 100 -10,000 milliseconds.
Beacon Type	Lists the type of beacon currently configured.
Last Error	Lists descriptive text on any error that's preventing the Bluetooth radio from operating.
Refresh	Select <i>Refresh</i> to update the screen's statistics counters to their latest values.

15.4.17 OSPF

► Access Point Statistics

Open Shortest Path First (OSPF) is a *link-state interior gateway protocol* (IGP). OSPF routes IP packets within a single routing domain (autonomous system), like an enterprise LAN. OSPF gathers link state information from neighbor routers and constructs a network topology. The topology determines the routing table presented to the Internet Layer which makes routing decisions based solely on the destination IP address found in IP packets.

Refer to the following for detailed descriptions of the tabs available within the OSPF statistics screen:

- *OSPF Summary*
- *OSPF Neighbors*
- *OSPF Area Details*
- *OSPF Route Statistics*
- *OSPF Route Statistics*
- *OSPF State*

15.4.17.1 OSPF Summary

► OSPF

To view OSPF summary statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**. The *Summary* tab displays by default.

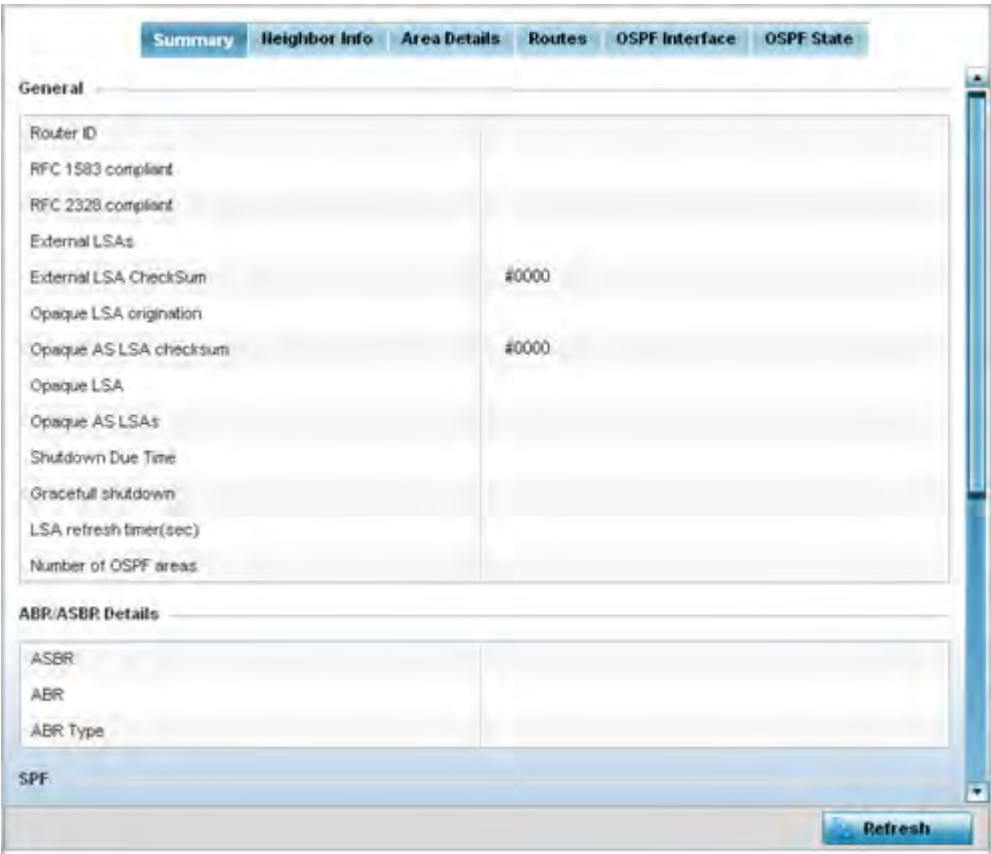


Figure 15-162 Access Point - OSPF Summary tab

The **Summary** tab describes the following information fields:

General	The general field displays the router ID assigned for this OSPF connection, RFC compliance information and LSA data.

ABR/ASBR Details	Lists <i>Autonomous System Boundary Router</i> (ASBR) data relevant to OSPF routing, including the ASBR, ABR and ABR type. An <i>Area Border Router</i> (ABR) is a router that connects one or more areas to the main backbone network. It is considered a member of all areas it is connected to. An ABR keeps multiple copies of the link-state database in memory, one for each area to which that router is connected. An ASBR is a router connected to more than one Routing protocol and exchanges routing information with routers in other protocols. ASBRs typically also run an exterior routing protocol (for example, BGP), or use static routes, or both. An ASBR is used to distribute routes received from other, external ASs throughout its own autonomous system. Routers in other areas use ABR as next hop to access external addresses. Then the ABR forwards packets to the ASBR announcing the external addresses.
SPF	Refer to the SPF field to assess the status of the <i>shortest path forwarding</i> (SFF) <i>execution</i> , <i>last SPF execution</i> , <i>SPF delay</i> , <i>SPF due in</i> , <i>SPF hold multiplier</i> , <i>SPF hold time</i> , <i>SPF maximum hold time</i> and <i>SPF timer due flag</i> .
Stub Router	The summary screen displays information relating to stub router advertisements and shutdown and startup times. An OSPF stub router advertisement allows a new router into a network without immediately routing traffic through the new router and allows a graceful shut down or reload a router without dropping packets that are destined for other networks. This feature introduces three configuration options that allow you to configure a router that is running the OSPF protocol to advertise a maximum or infinite metric to all neighbors.

- 4 Select the **Refresh** button to update the statistics counters to their latest values.

15.4.17.2 OSPF Neighbors

► OSPF

OSPF establishes neighbor relationships to exchange routing updates with other routers. An Access Point supporting OSPF sends hello packets to discover neighbors and elect a designated router. The hello packet includes link state information and list of neighbors. OSPF is savvy with layer 2 topologies. If on a point-to-point link, OSPF knows it is sufficient, and the link stays up. If on a broadcast link, the router waits for election before determining if the link is functional.

To view OSPF neighbor statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**.
- 4 Select the **Neighbor Info** tab.

15 - 239

The **Neighbor Info** tab describes the following:

Router ID	Displays the router ID assigned for this OSPF connection. The router is a level three Internet Protocol packet switch. This ID must be established in every OSPF instance. If not explicitly configured, the highest logical IP address is duplicated as the router identifier. However, since the router identifier is not an IP address, it does not have to be a part of any routable subnet in the network.
Neighbor Priority	Displays each listed neighbor's priority in respect to becoming the designated router managing the OSPF connection. The designated router is the router interface elected among all routers on a particular multi-access network segment.
IF Name	Lists the name assigned to the router interface used to support connections amongst OSPF enabled neighbors.
Neighbor Address	Lists the IP address of the neighbor sharing the router interface with each listed router ID.
Request Count	Lists the connection request count (hello packets) to connect to the router interface, discover neighbors and elect a designated router.
Retransmit Count	Lists the connection retransmission count attempted in order to connect to the router interface, discover neighbors and elect a designated router. A <i>designated router</i> (DR) is the router interface elected among all routers on a particular multi-access network segment, generally assumed to be broadcast.
Dead Time	Lists the dead time between neighbors in the network topology that are currently utilizing the listed router ID.
Self Neighbor State	Displays the self-neighbor status assessment used to discover neighbors and elect a designated router.
Source Address	Displays the single source address used by all neighbor routers to obtain topology and connection status. This form of multicasting significantly reduces network load.

Summary Count	Routes that originate from other areas are called summary routes. Summary routes are not flooded in a totally stubby or NSSA totally stubby area.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.4.17.3 OSPF Area Details

► OSPF

An OSPF network is subdivided into routing areas (with 32 bit area identifiers) to simplify administration and optimize traffic utilization. Areas are logical groupings of hosts and networks, including routers having interfaces connected to an included network. Each area maintains a separate link state database whose information may be summarized towards the rest of the network. An OSPF Area contains a set of routers exchanging *Link State Advertisements* (LSAs) with others in the same area. Areas limit LSAs and encourage aggregate routes. Areas are identified by 32-bit IDs, expressed either in decimal, or octet-based dot-decimal notation.

To view OSPF area statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**.
- 4 Select the **Area Details** tab.

OSPF Summary											
Summary		Neighbor Info		Area Details		Routes		OSPF Interface		OSPF State	
OSPF Area ID	OSPF IIIF	Fully adj numbers	Auth Type	Total LSA	Router LSA	Network LSA	Summary LSA	ASBR Summary LSA	HSSA LSA	Opaque Area LSA CSUM	Opaque link CSUM

Type to search in tables
Row Count: 0

Refresh

Figure 15-164 *Access Point - OSPF Area Details tab*

The **Area Details** tab describes the following:

OSPF Area ID	Displays either the integer (numeric ID) or IP address assigned to the OSPF area as a unique identifier.
OSPF INF	Lists the interface ID (virtual interface for dynamic OSPF routes) supporting each listed OSPF area ID.

Fully adj numbers	Fully adjusted numbers strip away the effects of other non OSPF and LSA factors and events, leaving only relevant OSPF area network route events counted.
Auth Type	Lists the authentication schemes used to validate the credentials of dynamic route connections and their areas.
Total LSA	Lists the <i>Link State Advertisements</i> (LSAs) of all entities using the dynamic route (in any direction) in the listed area ID.
Router LSA	Lists the Link State Advertisements of the router supporting each listed area ID. The router LSA reports active router interfaces, IP addresses, and neighbors.
Network LSA	Displays which routers are joined together by the designated router on a broadcast segment (e.g. Ethernet). Type 2 LSAs are flooded across their own area only. The link state ID of the type 2 LSA is the IP interface address of the designated route.
Summary LSA	The summary LSA is generated by ABR to leak area summary address info into another areas. ABR generates more than one summary LSA for an area if the area addresses cannot be properly aggregated by only one prefix.
ASBR Summary LSA	Originated by ABRs when an ASBR is present to let other areas know where the ASBR is. These are supported just like summary LSAs.
NSSA LSA	Routers in a <i>Not-so-stubby-area</i> (NSSA) do not receive external LSAs from Area Border Routers, but are allowed to send external routing information for redistribution. They use type 7 LSAs to tell the ABRs about these external routes, which the Area Border Router then translates to type 5 external LSAs and floods as normal to the rest of the OSPF network. Redistribution into an NSSA area creates a special type of LSA known as TYPE 7, which can exist only in an NSSA area. An NSSA ASBR generates this LSA, and an NSSA ABR router translates it into type 5 LSA which gets propagated into the OSPF domain.
Opaque Area LSA CSUM	Displays the Type-10 opaque link area checksum with the complete contents of the LSA. Type-10 Opaque LSAs are not flooded beyond the borders of their associated area.
Opaque link CSUM	Displays the Type-10 opaque link checksum with the complete contents of the LSA.

5 Select the **Refresh** button to update the statistics counters to their latest values.

15.4.17.4 OSPF Route Statistics

► OSPF

Refer to the *Routes* tab to assess the status of OSPF *Border Routes*, *External Routes*, *Network Routes* and *Router Routes*.

To view OSPF route statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**.

5 Refer to **External Routes** tab.

Figure 15-165 *Access Point - OSPF External Routes tab*

The External route tab displays a list of external routes, the area impacted, cost, path type, tag and type 2 cost. Cost factors may be the distance of a router (round-trip time), network throughput of a link, or link availability and reliability, expressed as simple unit-less numbers. This provides a dynamic process of traffic load balancing between routes of equal cost.

6 Refer to the **Network Routes** tab.

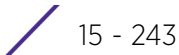


Figure 15-167 Access Point - OSPF Router Routes tab

The network tab displays the network name, impacted OSPF area, cost, destination and path type.

- Wireless Controller and Service Platform System Reference Guide

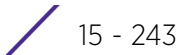


Figure 15-167 *Access Point - OSPF Router Routes tab*

An internal (or *router*) route connects to one single OSPF area. All of its interfaces connect to the area in which it is located and does not connect to any other area.

- 8 Select the **Refresh** button (within any of the four OSPF Routes tabs) to update the statistics counters to their latest values.

15.4.17.5 OSPF Interface

► OSPF

An OSPF interface is the connection between a router and one of its attached networks. An interface has state information associated with it, which is obtained from the underlying lower level protocols and the routing protocol itself. A network interface has associated a single IP address and mask (unless the network is an unnumbered point-to-point network). An interface is sometimes also referred to as a link.

To view OSPF interface statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**.
- 4 Select the **OSPF Interface** tab.

[illegible]

Figure 15-168 *Access Point - OSPF Interface tab*

The **OSPF Interface** tab describes the following:

Interface Name	Displays the IP addresses and mask defined as the virtual interface for dynamic OSPF routes. Zero config and DHCP can be used to generate route addresses, or a primary and secondary address can be manually provided.
Interface Index	Lists the numerical index used for the OSPF interface. This interface ID is in the hello packets establishing the OSPF network connection.
Bandwidth (kb)	Lists the OSPF interface bandwidth (in Kbps) in the range of 1 - 10,000,000.
Interface Flags	Displays the flag used to determine the interface status.

MTU	Lists the OSPF interface <i>maximum transmission unit</i> (MTU) size. The MTU is the largest physical packet size (in bytes) a network can transmit. Any packets larger than the MTU are divided into smaller packets before being sent.
OSPF Enabled	Lists whether OSPF has been enabled for each listed interface. OSPF is disabled by default.
UP/DOWN	Displays whether the OSPF interface (the dynamic route) is currently up or down for each listed interface. An OSPF interface is the connection between a router and one of its attached networks.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.4.17.6 OSPF State

► OSPF

An OSPF enabled Access Point sends hello packets to discover neighbors and elect a designated router for dynamic links. The hello packet includes link *state* data maintained on each Access Point and is periodically updated on all OSPF members. The Access Point tracks link state information to help assess the health of the OSPF dynamic route.

To view OSPF state statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen), expand the default node and select an Access Point for statistical observation.
- 3 Select **OSPF**.
- 4 Select the **OSPF State** tab.

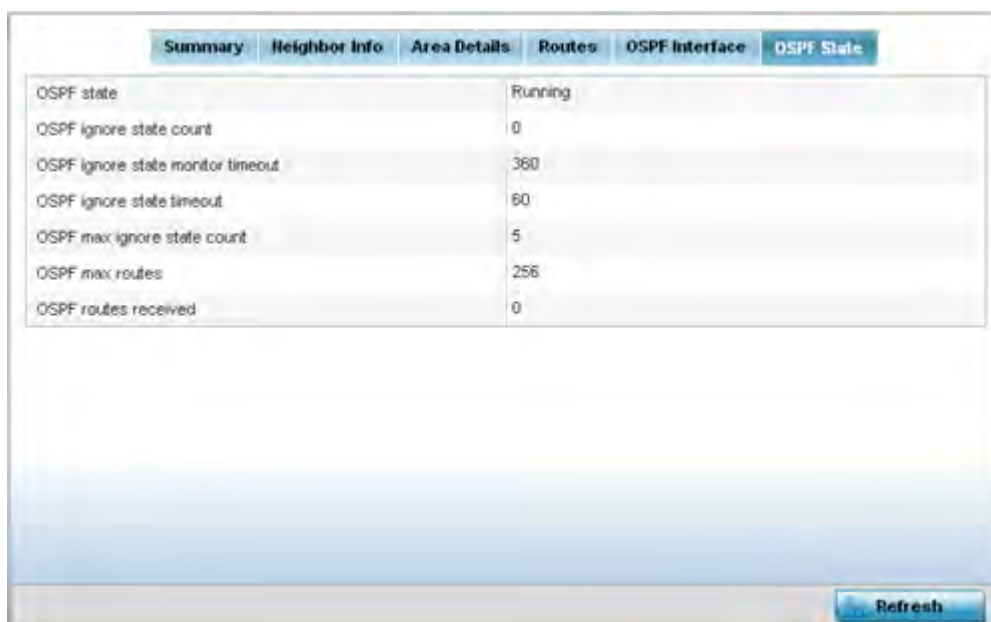


Figure 15-169 Access Point OSPF - State tab

The **OSPF State** tab describes the following:

OSPF state	Displays the OSPF link state amongst neighbors within the OSPF topology. Link state information is maintained in a <i>link-state database</i> (LSDB) which is a tree image of the entire network topology. Identical copies of the LSDB are periodically updated through flooding on all OSPF supported nodes. Flooding is the part of the OSPF protocol that distributes and synchronizes the link-state database between OSPF routers.
OSPF ignore state count	Lists the number of times state requests have been ignored between the Access Point and its peers within this OSPF supported broadcast domain.
OSPF ignore state monitor timeout	Displays the timeout that, when exceeded, prohibits the Access Point from detecting changes to the OSPF link state.
OSPF ignore state timeout	Displays the timeout that, when exceeded, returns the Access Point back to state assessment amongst neighbors in the OSPF topology.
OSPF max ignore state count	Displays whether an OSPF state timeout is being ignored and not utilized in the transmission of state update requests amongst neighbors within the OSPF topology.
OSPF max routes	States the maximum number of routes negotiated amongst neighbors within the OSPF topology.
OSPF routes received	Lists the routes received and negotiated amongst neighbors within the OSPF topology.

- 5 Select the **Refresh** button to update the statistics counters to their latest values.

15.4.18 L2TPv3 Tunnels

► Access Point Statistics

Access Points use L2TP V3 to create tunnels for transporting layer 2 frames. L2TP V3 enables an Access Point to create tunnels for transporting Ethernet frames to and from bridge VLANs and physical ports. L2TP V3 tunnels can be defined between WING devices and other devices supporting the L2TP V3 protocol.

To review a selected Access Point's L2TPv3 statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **L2TPv3**.

15 - 247

The Access Point **L2TPv3 Tunnels** screen displays the following:

Tunnel Name	Displays the name of each listed L2TPv3 tunnel assigned upon creation. Each listed tunnel name can be selected as a link to display session data specific to that tunnel. The Sessions screen displays cookie size information as well as pseudowire information specific to the selected tunnel. Data is also available to define whether the tunnel is a trunk session and whether tagged VLANs are used. The number of transmitted, received and dropped packets also display to provide a throughput assessment of the tunnel connection. Each listed session name can also be selected as a link to display VLAN information specific to that session. The VLAN Details screen lists those VLANs used an Access Point interface in L2TP tunnel establishment.
Local Address	Lists the IP address assigned as the local tunnel end point address, not the tunnel interface's IP address. This IP is used as the tunnel source IP address. If a local address is not specified, the source IP address is chosen automatically based on the tunnel peer IP address.
Peer Address	Lists the IP address of the L2TP tunnel peer establishing the tunnel connection.
Tunnel State	States whether the tunnel is Idle (not utilized by peers) or is currently active.
Peer Host Name	Lists the assigned peer hostname used as matching criteria in the tunnel establishment process.
Peer Control Connection ID	Displays the numeric identifier for the tunnel session. This is the peer pseudowire ID for the session. This source and destination IDs are exchanged in session establishment messages with the L2TP peer.
CTRL Connection ID	Displays the router ID(s) sent in tunnel establishment messages with a potential peer device.
Up Time	Lists the amount of time the L2TP connection has remained established amongst peers sharing the L2TPv3 tunnel connection. The Up Time is displayed in a <i>Days: Hours: Minutes: Seconds:</i> format. If D:0 H:0 M:0 S:0 is displayed, the tunnel connection is not currently established.

Encapsulation Protocol	Displays either <i>IP</i> or <i>UDP</i> as the peer encapsulation protocol. The default setting is IP. UDP uses a simple transmission model without implicit handshakes. Tunneling is also called encapsulation. Tunneling works by encapsulating a network protocol within packets carried by the second network.
Critical Resource	Lists critical resources for this tunnel. Critical resources are device IP addresses on the network (gateways, routers etc.). These IP addresses are critical to the health of the network. These device addresses are pinged regularly by Access Points. If there's a connectivity issue, an event is generated stating a critical resource is unavailable.
VRRP Group	Displays the VRRP group name if configured. VRRP configurations support router redundancy in a wireless network requiring high availability.
Establishment Criteria	Displays the tunnel establishment criteria for this tunnel. Tunnel establishment involves exchanging 3 message types (SCCRQ, SCCRP and SCCN) with the peer. Tunnel IDs and capabilities are exchanged during the tunnel establishment with the host.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

15.4.19 VRRP

► *Access Point Statistics*

The *VRRP* statistics screen displays *Virtual Router Redundancy Protocol* (VRRP) configuration statistics supporting router redundancy in a wireless network requiring high availability.

To review a selected Access Point's VRRP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **VRRP**.

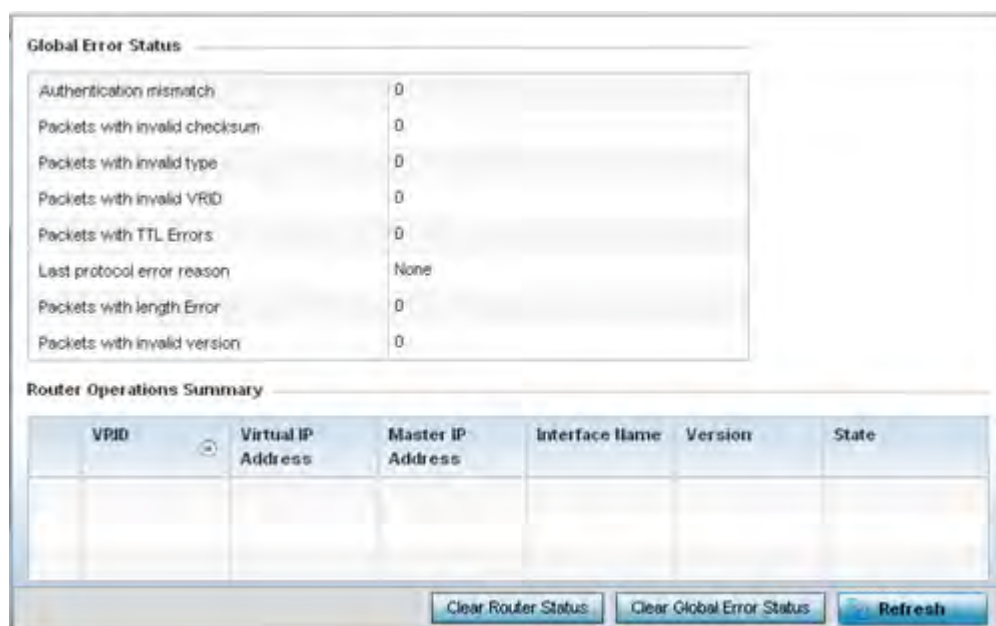


Figure 15-171 Access Point - VRRP screen

- 4 Refer to the **Global Error Status** field to review the various sources of packet errors logged during the implementation of the virtual route.

Errors include the mismatch of authentication credentials, invalid packet checksums, invalid packet types, invalid virtual route IDs, TTL errors, packet length errors and invalid (non matching) VRRP versions.

- 5 Refer to the **Router Operations Summary** for the following status:

VRID	Lists a numerical index (1 - 254) used to differentiate VRRP configurations. The index is assigned when a VRRP configuration is initially defined. This ID identifies the virtual router a packet is reporting status for.
Virtual IP Address	Lists the virtual interface IP address used as the redundant gateway address for the virtual route.
Master IP Address	Displays the IP address of the elected VRRP master. A VRRP master (once elected) responds to ARP requests, forwards packets with a destination link layer MAC address equal to the virtual router MAC address, rejects packets addressed to the IP address associated with the virtual router and accepts packets addressed to the IP address associated with the virtual router.
Interface Name	Displays the interfaces selected on the Access Point to supply VRRP redundancy failover support.
Version	Display VRRP version 3 (RFC 5798) or 2 (RFC 3768) as selected to set the router redundancy. Version 3 supports sub-second (centisecond) VRRP failover and support services over virtual IP.
State	Displays the current state of each listed virtual router ID.
Clear Router Status	Select the <i>Clear Router Status</i> button to clear the Router Operations Summary table values to zero and begin new data collections.
Clear Global Error Status	Select the <i>Clear Global Error Status</i> button to clear the Global Error Status table values to zero and begin new data collections.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.20 Critical Resources

► Access Point Statistics

The *Critical Resources* statistics screen displays a list of device IP addresses on the network (gateways, routers etc.). These IP addresses are critical to the health of the controller or service platform managed network. These device addresses are pinged regularly by managed Access Points. If there's a connectivity issue, an event is generated stating a critical resource is unavailable. Thus, each device's VLAN, ping mode and state is displayed for the administrator.

To review a selected Access Point's critical resource statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Critical Resources**.

General

Monitor Interval	30s
Monitor Using Flows Interval	30s
Source IP For Port-Limited Monitoring	0.0.0.0
Monitoring Retries before Marking Resource as	3

List of Critical Resources

Critical Resource Name	Via	Status	Mode

Refresh

Figure 15-172 Access Point - Critical Resources screen

- 4 Refer to the **General** field to assess the **Monitor Interval** and **Monitor Using Flows Interval** used to poll for updates from the critical resource IP listed for **Source IP For Port-Limited Monitoring**. **Monitoring Retries before Marking Resource as DOWN** are the number of retry connection attempts permitted before this listed resource is defined as down (offline).

The Access Point **Critical Resource** screen displays the following:

Critical Resource Name	Lists the name of the critical resource monitored by the Access Point. Critical resources are device IP addresses on the network (gateways, routers etc.). These IP addresses are critical to the health of the network. These device addresses are pinged regularly by Access Points. If there's a connectivity issue, an event is generated stating a critical resource is unavailable.
Via	Lists the VLAN used by the critical resource as a virtual interface. The critical resource displays as a link that can be selected to list configuration and network address information in greater detail.

Status	Defines the operational state of each listed critical resource VLAN interface (either <i>Up</i> or <i>Down</i>).
Error Reason	Provides an error status as to why the critical resource is not available over its designated VLAN.
Mode	Displays the operational mode of each listed critical resource.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.21 LDAP Agent Status

► Access Point Statistics

When LDAP has been specified as an external resource (as opposed to local Access Point RADIUS resources) to validate PEAP-MS-CHAP v2 authentication requests, user credentials and password information needs to be made available locally to successfully connect to the external LDAP server. Up to two LDAP Agents (primary and secondary external resources) can be defined as external resources for PEAP-MS-CHAP v2 authentication requests.

AP6521 model Access Point does not support this feature in Standalone AP or Controller AP mode. However, AP6521 model is supported when adopted and managed by a controller or service platform.

For more information on setting LDAP agents as part of the RADIUS server policy, see [Configuring RADIUS Server Policies on page 11-57](#).

To view Access Point LDAP agent statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **LDAP Agent Status**.

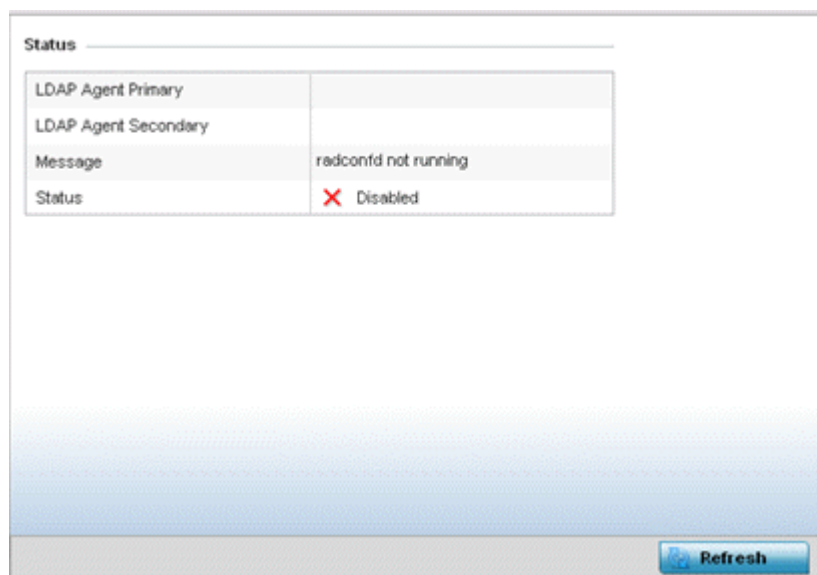


Figure 15-173 Access Point - LDAP Agent Status screen

The **LDAP Agent Status** screen displays the following:

LDAP Agent Primary	Lists the primary IP address of a remote LDAP server resource used by the Access Point to validate PEAP-MS-CHAP v2 authentication requests. When a RADIUS server policy's data source is set to LDAP, this is the first resource for authentication requests.
LDAP Agent Secondary	Lists the secondary IP address of a remote LDAP server resource used by the Access Point to validate PEAP-MS-CHAP v2 authentication requests. When a RADIUS server policy's data source is set to LDAP, this is the second resource for authentication requests.
Message	Displays any system message generated in the Access Point's connection with the primary or secondary LDAP agent. If there's a problem with the username and password used to connection to the LDAP agent, it would be listed here.
Status	Displays whether the Access Point has successfully joined the remote LDAP server domain designated to externally validate PEAP-MS-CHAP v2 authentication requests.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.4.22 Mint Links

► Access Point Statistics

Wireless controllers and Access Points use the MiNT protocol as the primary means of device discovery and communication for Access point adoption and management. MiNT provides a mechanism to discover neighbor devices in the network, and exchange packets between devices regardless of how these devices are connected (L2 or L3).

MiNT provides the means to secure communications at the transport layer. Using MiNT, a device can be configured to only communicate with other authorized (MiNT enabled) devices of the same model. MiNT links can be established over a VLAN (Among Access Points on a VLAN) or IP (remote access point to controller).

MiNT Links are automatically created between controllers and Access Points during adoption using MLCP (*MiNT Link Creation Protocol*). They can also be manually created between a controller and Access Point (or) between Access Points. MiNT links are manually created between controllers while configuring a cluster.

Level 2 (or) remote MiNT links are controller aware links, and requires IP network for communication. This level 2 MiNT links at access points are intended for remote Adaptive AP deployment and management from NOC. With Level2 MiNT links, access points are only aware of the controllers and not about other Access points. Level 2 MiNT links also provide partitioning, between Access Points deployed at various remote sites.

To view an Access Point's Mint links:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Mint Links** from the left-hand side of the UI.

Type to search in tables

Figure 15-174 *Access Point - Mint Links screen*

The [Mint Links](#) screen lists the *name* of the impacted VLAN or link in the form of a link that can be selected to display more granular information about that VLAN. A green check mark or a red X defines whether the listed VLAN is *listening* to traffic, *forced* to stay up or *unused* with the Mint link. The *level* column specifies whether the listed Mint link is traditional switching link (level 2) or a routing link (level 3). The *type* column defines whether the listed Mint link is a VLAN or an IPv4 or IPv6 type network address. The *dis* column lists how each link was discovered.

Refer to the *secure* column to assess whether the listed links are isolated between peers. The *local ip* column lists the IP address assigned as the link's end point address, not the interface's IP address. The *natted* column lists whether the link is NAT enabled or disabled for modifying network address information in IP packet headers in transit. The *cost* defines the cost for a packet to travel from its originating port to its end point destination.

The *hello seq number* and *hello interval* define the interval between hello keep alive messages between link end points. While the *adj hold time* sets the time after the last hello packet when the connected between end points is defined as lost.

The *static* and *dynamic* link columns state whether each listed link is static route using a manually configured route entry, or a dynamic route characterized by its destination. The *rim* column defines whether the listed link is managed remotely. The *control vlan* column states whether the listed link has enabled as a control VLAN. Lastly, the *clustering* column states whether listed link members discover and establish connections to other peers and provide self-healing in the event of cluster member failure.

- Periodically select **Refresh** to update the screen's data counters to their latest values.
- If needed, select a Mint link from the *name* column to display more granular information for that link.

Mint Links				
name	vlan-10			
level	1			
cost	10			
hello interval	4			
adj hold time	13			

Adjacencies				
neighbor	state	up time	last hello	
08.19.E3.6E	up	546,679	2	
12.3B.65.87	up	546,679	0	
19.43.53.0D	up	546,679	3	
4D.1B.B2.10	up	546,679	0	
68.64.0A.8F	up	546,679	0	

Refresh Exit

Figure 15-175 Access Point - Mint Link Details screen

The first table lists the Mint link's name and *level* specifying whether the Mint link is traditional switching link (level 2) or a routing link (level 3). The *cost* defines the cost for a packet to travel from its originating port to its end point destination. The *hello interval* lists the time between hello keep alive messages between link end points. The *adj hold time* sets the time after the last hello packet when the connected between end points is defined as lost.

The *Adjacencies* table lists *neighbor* devices by their hardware identifiers and operational *state* to help determine their availability as Mint link end points and peers. The *up time* lists the selected link's detection on the network and the last hello lists when the *last hello* message was exchanged.

- Periodically select *Refresh* to update the statistics counters to their latest values.

15.4.23 Guest Users

► Access Point Statistics

A *captive portal* is an access policy for providing guests temporary and restrictive access to the wireless network. A captive portal configuration provides secure authenticated access using a standard Web browser. Captive portals provide authenticated access by capturing and re-directing a wireless user's Web browser session to a captive portal login page where the user must enter valid credentials to access to the network. Captive portals can have their access durations set by an administrator to either provide temporary access to the Access Point managed network or provide access without limitations.

For information on setting captive portal duration and authentication settings, refer to *Configuring Captive Portal Policies on page 11-1*.

To view current Access Point guest user utilization:

- Select the **Statistics** menu from the Web UI.
- Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.

3 Select **Guest Users**.


Name	Configured Time (days:hrs:m ins:secs)	Remaining Time (days:hrs:m ins:secs)	Configured KiloBytes	Remaining KiloBytes	Configured Downlink Rate (kbps)	Configured Uplink Rate (kbps)	Current Downlink Rate (kbps)	Current Uplink Rate (kbps)

Type to search in tables

Row Count: 0

Refresh

Figure 15-176 Access Point – Guest Users screen

The **Guest Users** screen describes the following:

Name	Lists the administrator assigned name of the client utilizing the Access Point for guest access to the WiNG managed wireless network.
Configured Time (days:hrs:mins:secs)	Displays the restricted permissions each listed client was initially configured for their captive portal guest user session with this managing Access Point.
Remaining Time (days:hrs:mins:secs)	Displays the time each listed client has remaining in their captive portal guest user session with this Access Point.
Configured KiloBytes	Lists the maximum configured bandwidth consumable by the listed guest user (in kilobytes).
Remaining KiloBytes	Lists the remaining bandwidth available to the listed guest user (in kilobytes). This is the difference between the configured (maximum) bandwidth and the users's current utilization.
Configured Downlink Rate (kbps)	Specifies the download speed configured for the listed guest user. When bandwidth is available, the user can download data at the specified rate (in kilobytes per second). If a guest user has a bandwidth based policy and exceeds the specified data limit, their speed is throttled to the defined reduced downlink rate. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Configured Uplink Rate (kbps)	Specifies the upload speed dedicated to the listed guest user. When bandwidth is available, the user is able to upload data at the specified rate (in kilobytes per second). If a guest user has a bandwidth based policy and exceeds the specified data limit, their speed is throttled to the reduced uplink rate. For more information, refer to <i>Defining User Pools on page 11-53</i> .

Current Downlink Rate (Kbps)	Lists the listed guest user's current downlink rate in kbps. Use this information to assess whether this user's configured downlink rate is adequate for their session requirements and whether their reduced downlink rate need adjustment if the configured downlink rate is exceeded. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Current Uplink Rate (Kbps)	Lists the listed guest user's current uplink rate in kbps. Use this information to assess whether this user's configured uplink rate is adequate for their session requirements and whether their reduced uplink rate need adjustment if the configured uplink rate is exceeded. For more information, refer to <i>Defining User Pools on page 11-53</i> .
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

15.4.24 GRE Tunnels

► Access Point Statistics

Generic Routing Encapsulation (GRE) is one of the available tunneling mechanisms which uses IP as the transport protocol and can be used for carrying many different passenger protocols. The tunnels behave as virtual point-to-point links that have two endpoints identified by the tunnel source and tunnel destination addresses at each endpoint.

To review a selected Access Point's GRE statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **GRE Tunnels**.

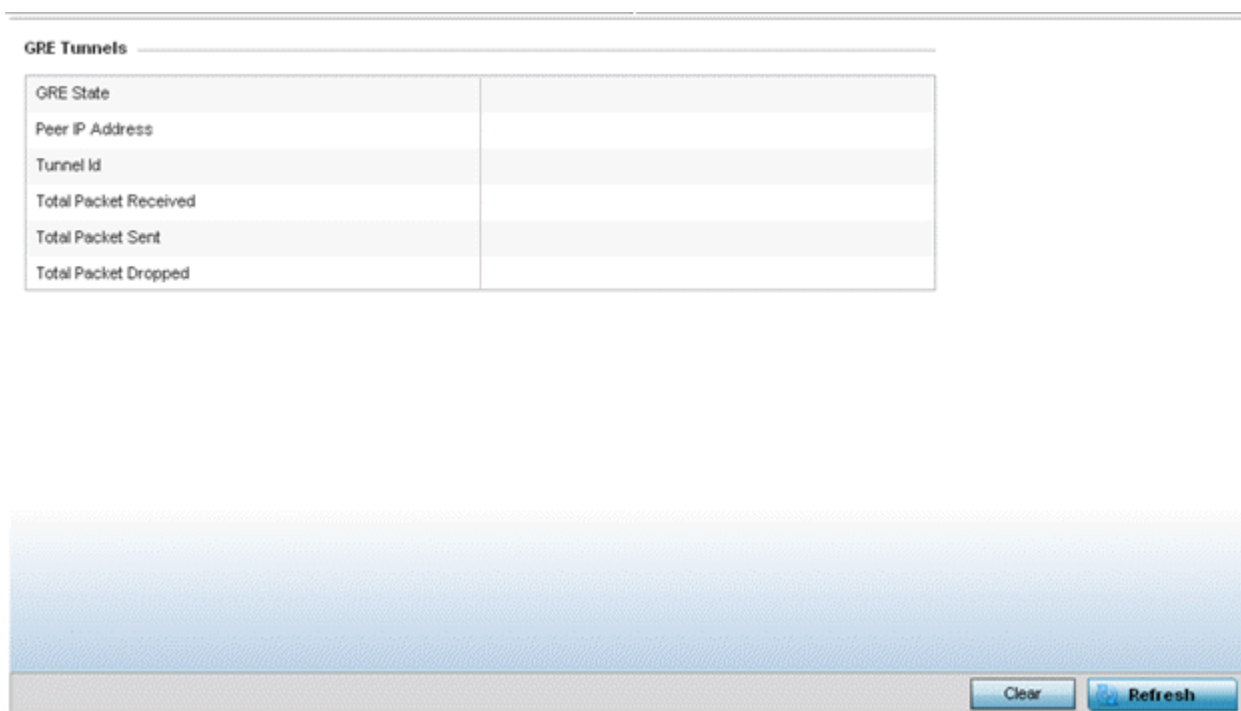


Figure 15-177 Access Point - GRE Tunnels screen

The Access Point **GRE Tunnels** screen displays the following:

GRE State	Displays the current operational state of the GRE tunnel.
Peer IP Address	Displays the IP address of the peer device on the remote end of the GRE tunnel.
Tunnel Id	Displays the session ID of an established GRE tunnel. This ID is only viable while the tunnel is operational.
Total Packets Received	Displays the total number of packets received from a peer at the remote end of the GRE tunnel.
Total Packets Sent	Displays the total number of packets sent from this Access Point to a peer at the remote end of the GRE tunnel.
Total Packets Dropped	Lists the number of packets dropped from tunneled exchanges between this Access Point and a peer at the remote end of the VPN tunnel
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest value.

15.4.25 Dot1x

► Access Point Statistics

Dot1x (or 802.1x) is an IEEE standard for network authentication. Devices supporting Dot1x allow the automatic provision and connection to the wireless network without launching a Web browser at login. When within range of a Dot1x network, a device automatically connects and authenticates without needing to manually login.

To view the Dot1x statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Dot1x** from the left-hand side of the UI.

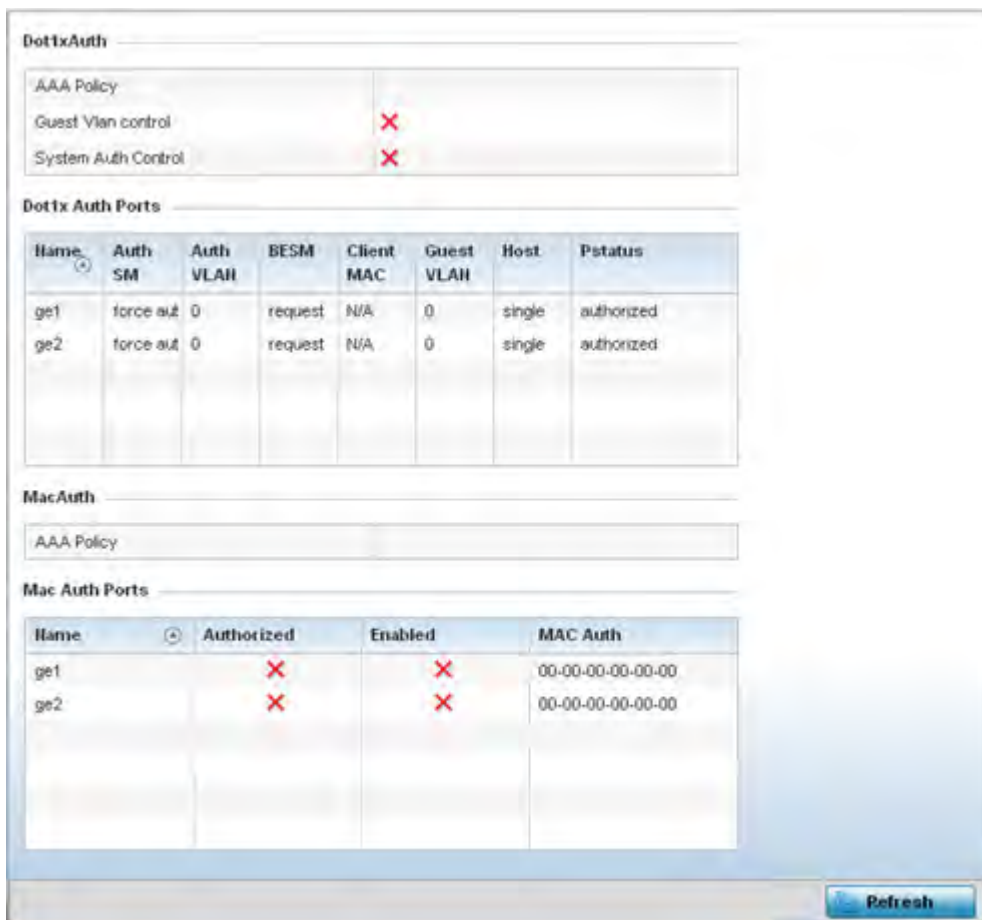


Figure 15-178 Access Point - Dot1x screen

- 4 Refer to the following **Dot1xAuth** statistics:

AAA Policy	Lists the AAA policy currently being utilized for authenticating user requests.
Guest Vlan Control	Lists whether guest VLAN control has been allowed (or enabled). This is the VLAN traffic is bridged on if the port is unauthorized and guest VLAN globally enabled. A green checkmark designates guest VLAN control as enabled. A red X defines guest VLAN control as disabled.
System Auth Control	Lists whether Dot1x authorization is globally enabled for the Access Point. A green checkmark designates Dot1x authorization globally enabled. A red X defines Dot1x as globally disabled.

- 5 Review the following **Dot1x Auth Ports** utilization information:

Name	Lists the Access Point ge ports subject to automatic connection and authentication using Dot1x.

Auth SM	Lists the current authentication state of the listed port.
Auth VLAN	Lists the virtual interface utilized post authentication.
BESM	Lists whether an authentication request is pending on the listed port.
Client MAC	Lists the MAC address of requesting clients seeking authentication over the listed port.
Guest VLAN	Lists the guest VLAN utilized for the listed port. This is the VLAN traffic is bridged on if the port is unauthorized and guest VLAN globally enabled.
Host	Lists whether the host is a single entity or not.
Pstatus	Lists whether the listed port has been authorized for Dot1x network authentication.

6 Refer to the **MacAuth** table to assess the AAA policy applied to MAC authorization requests.

7 Review the following **MAC Auth Ports** utilization information:

Name	Lists the Access Point ge ports subject to automatic connection and MAC authentication using Dot1x.
Authorized	Lists whether MAC authorization using Dot1x has been authorized (permitted) on the listed ge port. A green checkmark designates Dot1x authorization as authorized. A red X defines authorization as disabled.
Enabled	Lists whether MAC authorization using Dot1x has been enabled on the listed ge port. A green checkmark designates Dot1x authorization as allowed. A red X defines authorization as disabled.
MAC Auth	Lists the MAC address corresponding to the listed Access Point port interface on which authentication requests are made.

8 Select the **Refresh** button to update the screen's statistics counters to their latest value.

15.4.26 Network

► Access Point Statistics

Use the *Network* screen to view information for performance statistics for ARP, DHCP, Routing and Bridging. For more information, refer to the following:

- *ARP Entries*
- *Route Entries*
- *Default Routes*
- *Bridge*
- *IGMP*
- *MLD*
- *Traffic Shaping*
- *DHCP Options*
- *Cisco Discovery Protocol*
- *Link Layer Discovery Protocol*
- *IPv6 Neighbor Discovery*
- *MSTP*

15.4.26.1 ARP Entries

► Network

Address Resolution Protocol (ARP) is a protocol for mapping an IP address to a device address recognized in the local network. An address is 32 bits long. In an Ethernet local area network, however, addresses for attached devices are 48 bits long. (The physical machine address is also known as a MAC address.) A table, usually called the ARP cache, is used to maintain a correlation between each MAC address and its corresponding IP address. ARP provides the protocol rules for making this correlation and providing address conversion in both directions.

To view an Access Point's ARP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its submenu items.
- 4 Select **ARP Entries**.

IP Address	ARP MAC Address	Type	VLAN
172.168.6.10	00-15-C7-86-A2-40	Dynamic	Vlan1

Type to search in tables: Row Count: 1

Refresh

Figure 15-179 Access Point - Network ARP screen

The **ARP Entries** screen describes the following:

IP Address	Displays the IP address of the client resolved on behalf of the Access Point.
ARP MAC Address	Displays the MAC address corresponding to the IP address being resolved.
Type	Lists the type of ARP entry.
VLAN	Displays the system assigned VLAN ID where an IP address was found.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.26.2 Route Entries

► Network

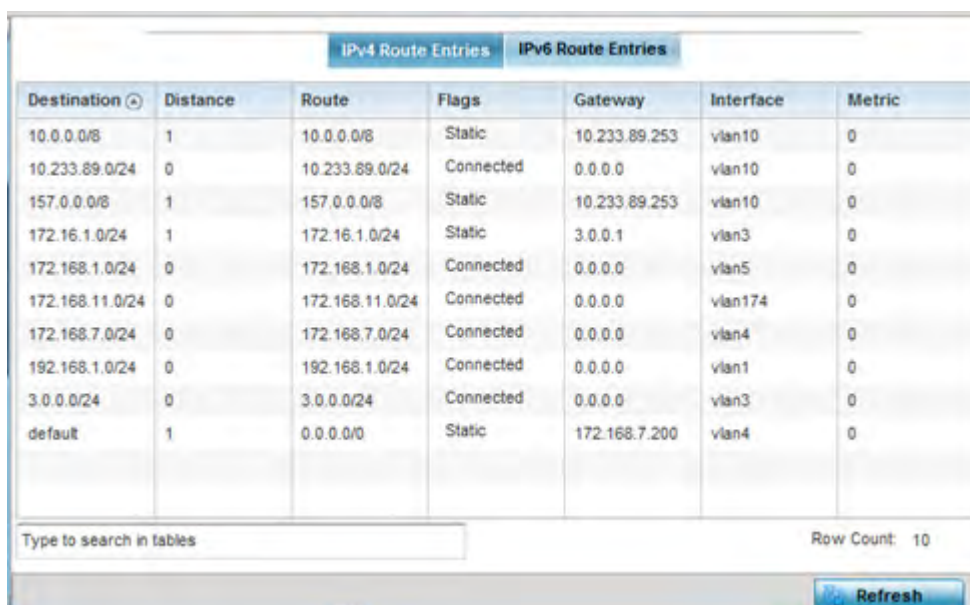
The *Route Entries* screen displays data for routing packets to a defined destination. When an existing destination subnet does not meet the needs of the network, add a new destination subnet, subnet mask and gateway as needed for either IPv4 or IPv6 formatted data packets.

IPv4 operates as a best effort delivery method, as it does not guarantee delivery, and does not ensure proper sequencing or duplicate delivery (unlike (TCP)). IPv4 hosts can use link local addressing to provide local connectivity.

IPv6 is the latest revision of the *Internet Protocol* (IP) designed to replace IPv4. IPv6 provides enhanced identification and location information for devices on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.

To view IPv4 and IPv6 route entries:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **Route Entries**. The **IPv4 Route Entries** tab displays by default.



IPv4 Route Entries		IPv6 Route Entries				
Destination	Distance	Route	Flags	Gateway	Interface	Metric
10.0.0.0/8	1	10.0.0.0/8	Static	10.233.89.253	vlan10	0
10.233.89.0/24	0	10.233.89.0/24	Connected	0.0.0.0	vlan10	0
157.0.0.0/8	1	157.0.0.0/8	Static	10.233.89.253	vlan10	0
172.16.1.0/24	1	172.16.1.0/24	Static	3.0.0.1	vlan3	0
172.168.1.0/24	0	172.168.1.0/24	Connected	0.0.0.0	vlan5	0
172.168.11.0/24	0	172.168.11.0/24	Connected	0.0.0.0	vlan174	0
172.168.7.0/24	0	172.168.7.0/24	Connected	0.0.0.0	vlan4	0
192.168.1.0/24	0	192.168.1.0/24	Connected	0.0.0.0	vlan1	0
3.0.0.0/24	0	3.0.0.0/24	Connected	0.0.0.0	vlan3	0
default	1	0.0.0.0/0	Static	172.168.7.200	vlan4	0

Type to search in tables Row Count: 10 Refresh

Figure 15-180 Access Point - Network IPv4 Route Entries screen

The **IPv4 Route Entries** screen lists the following:

Destination	Displays the IPv4 formatted address of the destination route address.

Distance	Lists the hop distance to a desired route. Devices regularly send neighbors their own assessment of the total cost to get to all known destinations. A neighboring device examines the information and compares it to their own routing data. Any improvement on what's already known is inserted in that device's own routing tables. Over time, each networked device discovers the optimal next hop for each destination.
Route	Lists the IPv4 formatted IP address used for routing packets to a defined destination.
Flags	The flag signifies the condition of the <i>direct</i> or <i>indirect</i> route.
Gateway	Displays the gateway IP address used to route packets to the destination subnet.
Interface	Displays the name of the controller interface or VLAN utilized by the destination subnet.
Metric	Lists the metric (or cost) of the route to select (or predict) the best route. The metric is computed using a routing algorithm, and covers information bandwidth, network delay, hop count, path cost, load, MTU, reliability, and communication cost.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

- 5 Select the **IPv6 Route Entries** tab to review route data for IPv6 formatted traffic.

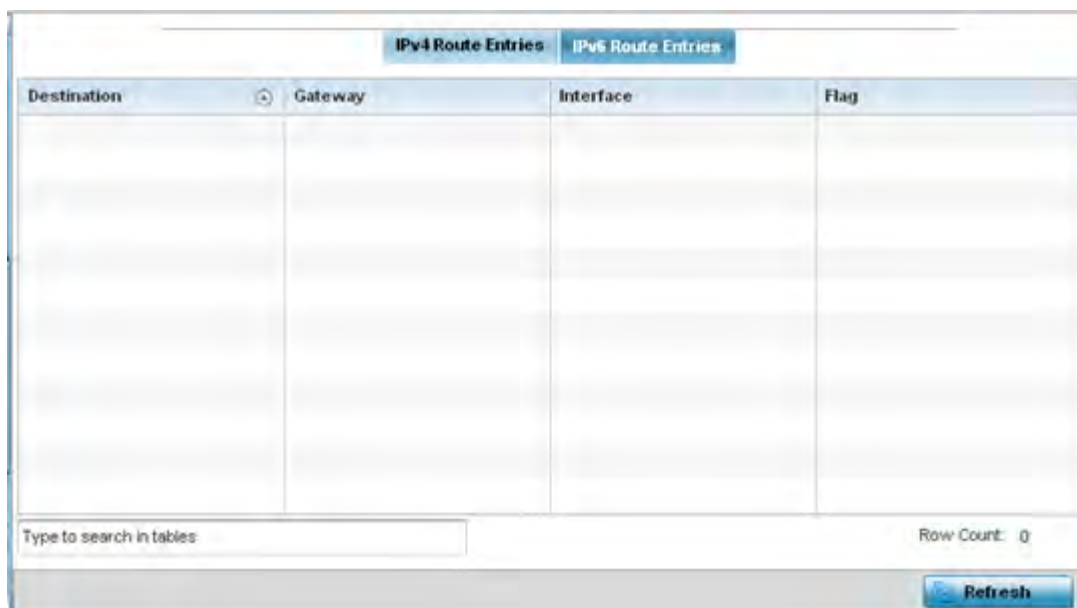


Figure 15-181 Wireless Controller - IPv6 Route Entries screen

The **IPv6 Route Entries** screen lists the following:

Destination	Displays the IPv6 formatted address of the destination route address.
Gateway	Displays the gateway IP address used to route packets to the destination subnet.
Interface	Displays the name of the controller interface or VLAN utilized by the destination subnet.
Flag	The flag signifies the condition of the <i>direct</i> or <i>indirect</i> route.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

15.4.26.3 Default Routes

► Network

In an IPv6 supported environment unicast routing is always enabled. A controller or service platform routes IPv6 formatted traffic between interfaces as long as the interfaces are enabled for IPv6 and ACLs allow IPv6 formatted traffic. However, an administrator can add a default routes as needed.

Static routes are manually configured. They work fine in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.

To view Access Point default routes:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **Default Routes**. The **IPv4 Default Routes** tab displays by default.

DNS Server	Gateway Address	Installed	Metric	Monitor Mode	Source	Monitoring Status
157.235.99.3,10.66	172.20.30.2	✓	1,000	gateway-monitorin	DHCP-Client	reachable

Figure 15-182 Access Point - IPv4 Default Routes screen

The **IPv4 Default Routes** screen provides the following information:

DNS Server	Lists the address of the DNS server providing IPv4 formatted address assignments on behalf of the Access Point.
Gateway Address	Lists the IP address of the gateway resource used with the listed route.
Installed	A green checkmark defines the listed route as currently installed on the Access Point. A red X defines the route as not currently installed and utilized.
Metric	The metric (or cost) could be the distance of a router (round-trip time), link throughput or link availability.

Monitor Mode	Displays where in the network the route is monitored for utilization status.
Source	Lists whether the route is <i>static</i> , a <i>DHCP-Client</i> or an administrator defined <i>default</i> route. Static routes are manually configured. Static routes work adequately in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.
Monitoring Status	Lists whether the defined IPv4 route is currently reachable on the Access Point managed network. If not, perhaps a topology change has occurred to a static route requiring a default route be utilized.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

- 5 Select the **IPv6 Default Routes** tab to review default route availabilities for IPv6 formatted traffic.



Figure 15-183 *Wireless Controller - IPv6 Default Routes screen*

The **IPv6 Default Routes** screen provides the following information:

Gateway Address	Lists the IP address of the gateway resource used with the listed route.
Installed	A green checkmark defines the listed IPv6 default route as currently installed on the Access Point. A red X defines the route as not currently installed and utilized.
Interface Name	Displays the interface on which the IPv6 default route is being utilized.
Lifetime	Lists the lifetime representing the valid usability of the default IPv6 route.
Preference	Displays the administrator defined IPv6 preferred route for IPv6 traffic.

Source	Lists whether the route is <i>static</i> or an administrator defined <i>default</i> route. Static routes are manually configured. Static routes work adequately in simple networks. However, static routes with topology changes require an administrator to manually configure and modify the corresponding route revisions. Default routes are useful, as they forward packets that match no specific routes in the routing table.
Status	Lists whether the defined IPv6 route is currently reachable on the Access Point managed network. If not, perhaps a topology change has occurred to a static route requiring a default route be utilized.
Refresh	Select <i>Refresh</i> to update the display to the latest values.

15.4.26.4 Bridge

► Network

Bridging is a forwarding technique used in networks. Bridging makes no assumption about where a particular address is located. It relies on the flooding and examination of source addresses in received packet headers to locate unknown devices. Once a device is located, its location is stored in a table to avoid broadcasting to that device again. Bridging is limited by its dependency on flooding, and is used in local area networks only. A bridge and an Access Point are very much alike, as an Access Point can be viewed as a bridge with a number of ports.

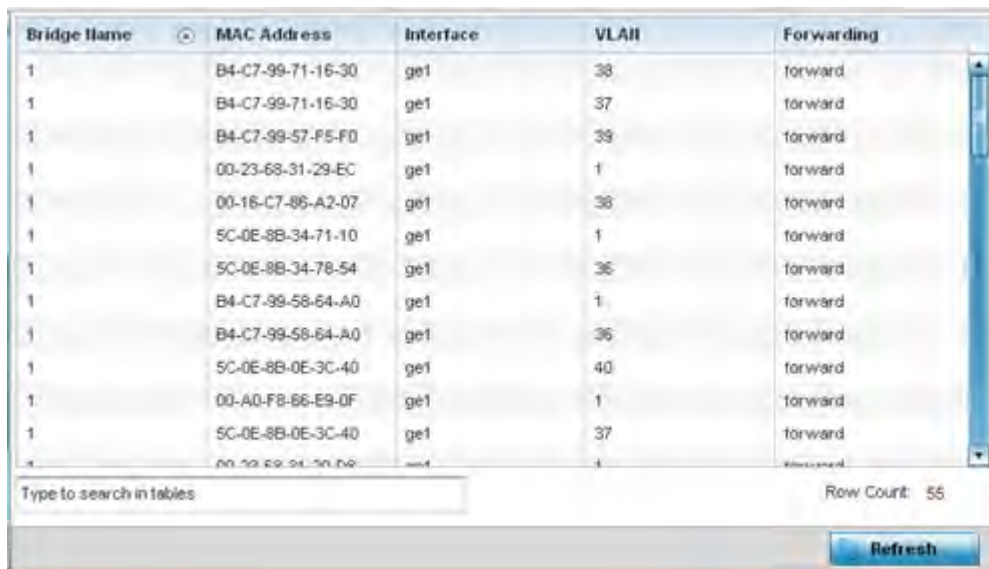
The *Bridge* screen provides details about the *Integrate Gateway Server* (IGS), which is a router connected to an Access Point. The IGS performs the following:

- Issues IP addresses
- Throttles bandwidth
- Permits access to other networks
- Times out old logins

The Bridging screen also provides information about the *Multicast Router* (MRouter), which is a router program that distinguishes between multicast and unicast packets and how they should be distributed along the Multicast Internet. Using an appropriate algorithm, a multicast router instructs a switching device what to do with the multicast packet.

To view an Access Point's Bridge statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **Bridge**.



Bridge Name	MAC Address	Interface	VLAN	Forwarding
1	B4-C7-99-71-16-30	ge1	38	forward
1	B4-C7-99-71-16-30	ge1	37	forward
1	B4-C7-99-57-F5-F0	ge1	39	forward
1	00-23-68-31-29-EC	ge1	1	forward
1	00-18-C7-85-A2-07	ge1	38	forward
1	5C-0E-8B-34-71-10	ge1	1	forward
1	5C-0E-8B-34-78-54	ge1	36	forward
1	B4-C7-99-58-64-A0	ge1	1	forward
1	B4-C7-99-58-64-A0	ge1	36	forward
1	5C-0E-8B-0E-3C-40	ge1	40	forward
1	00-A0-F8-66-E9-0F	ge1	1	forward
1	5C-0E-8B-0E-3C-40	ge1	37	forward
1	00-23-68-31-29-EC	ge1	1	forward

Type to search in tables

Row Count: 55

Refresh

Figure 15-184 Access Point - Network Bridge screen

5 Review the following bridge configuration attributes:

Bridge Name	Displays the numeric ID of the network bridge.
MAC Address	Displays the MAC address of the bridge selected.
Interface	Displays the interface (Access Point physical port name) where the bridge transferred packets. Supported Access Points models have different port configurations.
VLAN	Displays the VLAN the bridge uses a virtual interface.
Forwarding	Displays whether the bridge is forwarding packets.

6 Select **Refresh** to update the counters to their latest values.

15.4.26.5 IGMP

► Network

Internet Group Management Protocol (IGMP) is a protocol used for managing members of IP multicast groups. The Access Point listens to IGMP network traffic and forwards the IGMP multicast packets to radios on which the interested hosts are connected. On the wired side of the network, the Access Point floods all the wired interfaces. This feature reduces unnecessary flooding of multicast traffic in the network

To view a network's IGMP configuration:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **IGMP**.

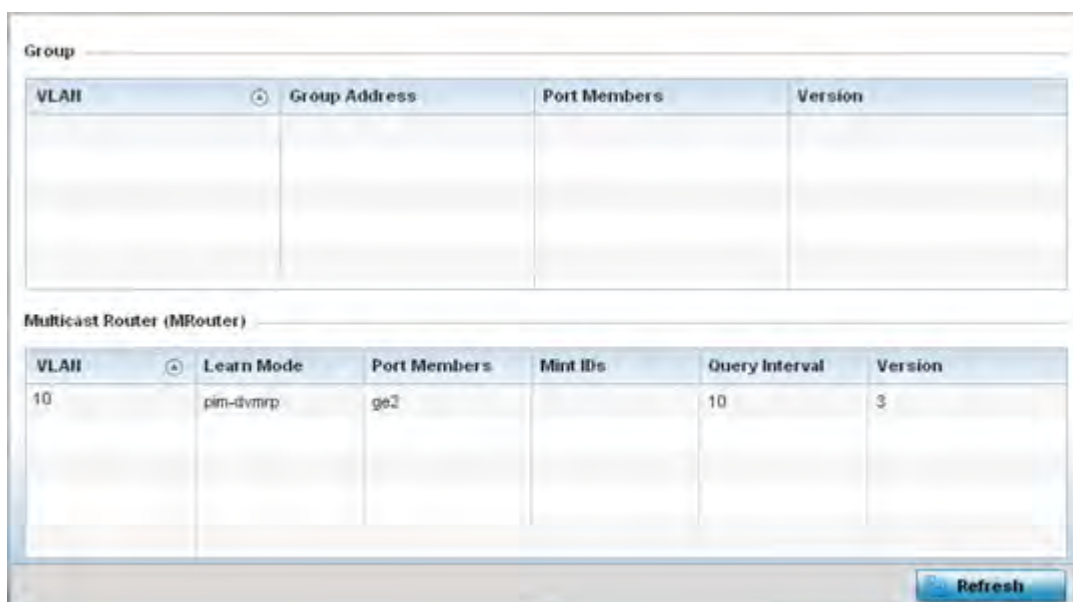


Figure 15-185 Access Point - Network IGMP screen

The **Group** field displays the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
Group Address	Displays the Multicast Group ID supporting the statistics displayed. This group ID is the multicast address that hosts are listening to.
Port Members	Displays the ports on which multicast clients have been discovered by the Access Point. For example, ge1, radio1, etc.
Version	Displays each listed group IGMP version compatibility as either version 1, 2 or 3.

The **Multicast Router (MRouter)** field displays the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
Learn Mode	Displays the learning mode used by the router as either <i>Static</i> or <i>PIM-DVMRP</i> .
Port Members	Displays the ports on which multicast clients have been discovered by the multicast router. For example, ge1, radio1, etc.
MiNT IDs	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure Access Point profile communications at the transport layer. Using MiNT, an Access Point can be configured to only communicate with other authorized (MiNT enabled) Access Points of the same model.
Query Interval	Lists the IGMP query interval implemented when the querier functionality is enabled. The default value is 60 seconds.
Version	Lists the multicast router IGMP version compatibility as either version 1, 2 or 3. The default setting is 3.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

The **Multicast Listener Discovery (MLD) Group** field describes the following:

VLAN	Displays the group VLAN where the MLD groups multicast transmission is conducted.
Group Address	Displays the Multicast Group ID supporting the statistics displayed. This group ID is the multicast address hosts are listening to.
Port Members	Displays the ports on which MLD multicast clients have been discovered. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported Access Point models.
Version	Displays each listed group's version compatibility as either version 1, 2 or 3.

The **IPv6 Multicast Router (MRouter)** field describes the following:

VLAN	Displays the group VLAN where the multicast transmission is conducted.
MiNT IDs	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure communications at the transport layer. Using MiNT, an Access Point can be configured to only communicate with other authorized (MiNT enabled) devices.
Learn Mode	Displays the learning mode used by the router as either <i>Static</i> or <i>PIM-DVMRP</i> .
Port Members	Displays the physical ports on which multicast clients have been discovered by the multicast router. For example, ge1, radio1, etc. Ports can vary somewhat amongst supported Access Point models.
Query Interval	Lists the query interval implemented when the querier functionality is enabled. The default value is 60 seconds.
Version	Lists the multicast router version compatibility as either version 1, 2 or 3. The default setting is 3.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.26.7 Traffic Shaping

► Network

Traffic shaping regulates network data transfers to ensure a specific performance level. Traffic shaping delays the flow of packets defined as less important than prioritized traffic streams. Traffic shaping enables traffic control out an interface to match its flow to the speed of a remote target's interface and ensure traffic conforms applied policies. Traffic can be shaped to meet downstream requirements and eliminate network congestion when data rates are in conflict.

Apply traffic shaping to specific applications to apply application categories. When application and ACL rules are conflicting, an application takes precedence over an application category, then ACLs.

To view network Access Point traffic shaping configuration:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **Traffic Shaping**. The Status screen displays by default, and lists the Access Point's traffic shaping status.

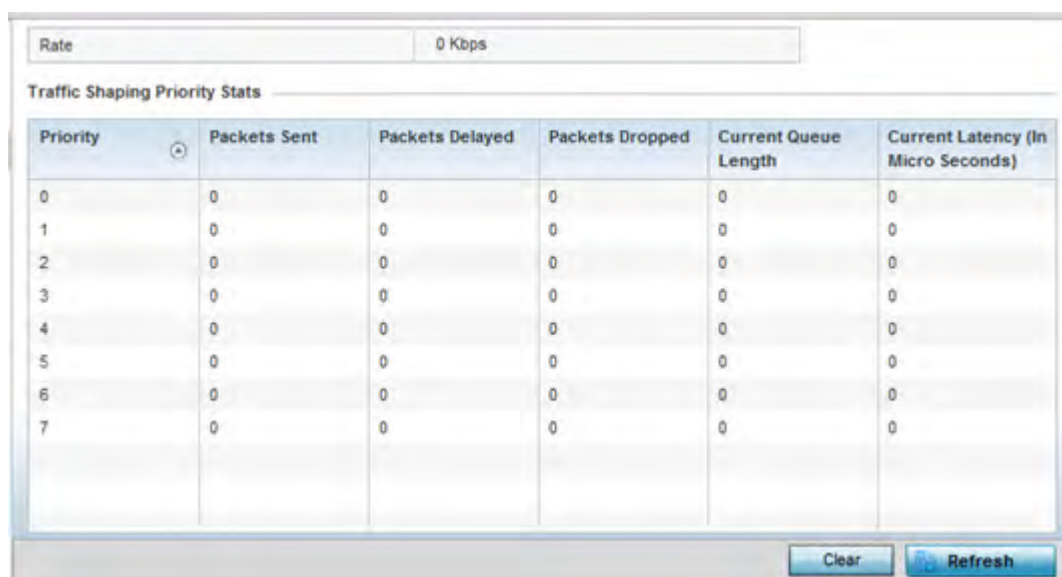


Figure 15-187 Access Point - Network Traffic Shaping Statistics screen

- 5 Select **Statistics**.
- 6 Refer to the following **Traffic Shaping** statistics:

Rate	The rate configuration controls the maximum traffic rate sent or received on an interface. Consider this form of rate limiting on interfaces at the edge of a network to limit traffic into or out of the network. Traffic within the set limit is sent and traffic exceeding the set limit is dropped or sent with a different priority.
Priority	Lists the traffic shaper queue priority. There are 8 queues (0 - 7), and traffic is queued in each based on incoming packets 802.1p markings.
Packets Sent	Provides a baseline of the total number of packets sent to assess packet delays and drops as a result of the filter rules applied in the traffic shaping configuration.
Packets Delayed	Lists the packets defined as less important than prioritized traffic streams and delayed as a result of traffic shaping filter rules applied.
Packets Dropped	Lists the packets defined as less important than prioritized traffic streams, delayed and eventually dropped as a result of traffic shaping filter rules applied.
Current Length	Lists the packet length of the data traffic <i>shaped</i> to meet downstream requirements.
Current Latency	Traffic shaping latency is the time limit after which packets start dropping as a result of the traffic prioritization filter rules applied.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.26.8 DHCP Options

► Network

Supported Access Points can use a DHCP server resource to provide the dynamic assignment of IP addresses automatically. This is a protocol that includes IP address allocation and delivery of host-specific configuration parameters from a DHCP server to a host. Some of these parameters are IP address, gateway and network mask.

The DHCP Options screen provides the DHCP server name, image file on the DHCP server, and its configuration.

To view a network's DHCP Options:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **DHCP Options**.

[illegible]

Figure 15-188 Access Point - Network DHCP Options screen

The **DHCP Options** screen displays the following:

Server Information	Displays the DHCP server hostname used on behalf of the Access Point.
Image File	Displays the image file name. BOOTP or the bootstrap protocol can be used to boot diskless clients. An image file is sent from the boot server. The image file contains the image of the operating system the client will run. DHCP servers can be configured to support BOOTP.
Configuration	Displays the name of the configuration file on the DHCP server.
Legacy Adoption	Displays historical device adoption information on behalf of the Access Point.
Adoption	Displays adoption information on behalf of the Access Point.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.26.9 Cisco Discovery Protocol

► Network

The *Cisco Discovery Protocol* (CDP) is a proprietary Data Link Layer network protocol implemented in Cisco networking equipment and used to share information about network devices.

To view an Access Point's CDP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **Cisco Discovery Protocol**.

Capabilities	Device ID	Local Port	Platform	Port ID	TTL
switch igmp_cap rc	Switch	ge1	cisco WS-C3560-2	FastEthernet0/5	121

Type to search in tables

Row Count: 1

Clear Neighbors Refresh

Figure 15-189 Access Point - Network CDP screen

The **Cisco Discovery Protocol** screen displays the following:

Capabilities	Displays the capabilities code for the device as either <i>Router</i> , <i>Trans Bridge</i> , <i>Source Route Bridge</i> , <i>Host</i> , <i>IGMP</i> or <i>Repeater</i> .
Device ID	Displays the configured device ID or name for each listed device.
Local Port	Displays the local port name (Access Point physical port) for each CDP capable device. Supported Access Point models have unique port configurations.
Platform	Displays the model number of the CDP capable device interoperating with the Access Point.
Port ID	Displays the Access Point's numeric identifier for the local port.
TTL	Displays the <i>time to live</i> (TTL) for each CDP connection.
Clear Neighbors	Select <i>Clear Neighbors</i> to remove CDP neighbors from the table and begin a new data collection.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

15.4.26.10 Link Layer Discovery Protocol

► *Network*

The *Link Layer Discovery Protocol* (LLDP) or IEEE 802.1AB is a vendor-neutral Data Link Layer protocol used by network devices for advertising of (announcing) their identity, capabilities, and interconnections on a IEEE 802 LAN network. The protocol is formally referred to by the IEEE as *Station and Media Access Control Connectivity Discovery*.

To view a network's Link Layer Discovery Protocol statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network** and expand the menu to reveal its sub menu items.
- 4 Select **Link Layer Discovery**.

[illegible]

Figure 15-190 *Access Point - Network LLDP screen*

The **Link Layer Discovery Protocol** screen displays the following:

Capabilities	Displays the capabilities code for the device.
Device ID	Displays the configured device ID or name for each device in the table.
Enabled Capabilities	Displays which device capabilities are currently enabled.
Local Port	Displays the local port name (Access Point physical port) for each LLDP capable device. Supported Access Point models have unique port configurations.
Platform	Displays the model number of the LLDP capable device interoperating with the Access Point.
Port ID	Displays the identifier for the local port.
TTL	Displays the <i>time to live</i> (TTL) for each LLDP connection.
Clear Neighbors	Select <i>Clear Neighbors</i> to remove all known LDP neighbors from the table.
Refresh	Select <i>Refresh</i> to update the statistics counters to their latest values.

► *Network*

IPv6 neighbor discovery uses ICMP messages and solicited multicast addresses to find the link layer address of a neighbor on the same local network, verify the neighbor's reachability and track neighboring devices.

Upon receiving a neighbor solicitation message, the destination replies with *neighbor advertisement* (NA). The source address in the advertisement is the IPv6 address of the device sending the message. The destination address in the advertisement message is the IPv6 address of the device sending the neighbor solicitation. The data portion of the NA includes the link layer address of the node sending the neighbor advertisement.

Neighbor solicitation messages also verify the availability of a neighbor once its the link layer address is identified. When a node wants to verify the reachability of a neighbor, the destination address in a neighbor solicitation message is the unicast address of the neighbor.

A neighbor is interpreted as reachable when an acknowledgment is returned indicating packets have been received and processed. If packets are reaching the device, they're also reaching the next hop neighbor, providing a confirmation the next hop is reachable.

To view an Access Point's IPv6 neighbor statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **IPv6 Neighbor Discovery**

[illegible]

Figure 15-191 *Access Point - Network IPv6 Neighbor screen*

The **IPv6 Neighbor** screen displays the following:

IPv6 Address	Lists an IPv6 IP address for neighbor discovery. IPv6 hosts can configure themselves automatically when connected to an IPv6 network using the neighbor discovery protocol via CMPv6 router discovery messages. When first connected to a network, a host sends a link-local router solicitation multicast request for its configuration parameters; routers respond to such a request with a router advertisement packet that contains Internet Layer configuration parameters. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
MAC Address	Lists the factory encoded hardware MAC address of the neighbor device using an IPv6 formatted IP address as its network identifier.
Type	Displays the device type for the neighbor solicitation. Neighbor solicitations request the link layer address of a target node while providing the sender's own link layer address to the target. Neighbor solicitations are multicast when the node needs to resolve an address and unicast when the node seeks to verify the reachability of a neighbor. Options include <i>Host</i> , <i>Router</i> and <i>DHCP Server</i> .
VLAN	Lists the virtual interface (from 1 - 4094) used for the required neighbor advertisements and solicitation messages used for neighbor discovery.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.26.12 MSTP

► Network

The *Multiple Spanning Tree Protocol* (MSTP) provides an extension to RSTP to optimize the usefulness of VLANs. MSTP allows for a separate spanning tree for each VLAN group, and blocks all but one of the possible alternate paths within each spanning tree topology.

If there's just one VLAN in the Access Point managed network, a single spanning tree works fine. However, if the network contains more than one VLAN, the network topology defined by single STP would work, but it's possible to make better use of the alternate paths available by using an alternate spanning tree for different VLANs or groups of VLANs.

MSTP includes all of its spanning tree information in a single *Bridge Protocol Data Unit* (BPDU) format. BPDUs are used to exchange information bridge IDs and root path costs. Not only does this reduce the number of BPDUs required to communicate spanning tree information for each VLAN, but it also ensures backward compatibility with RSTP. MSTP encodes additional region information after the standard RSTP BPDU as well as a number of MSTI messages. Each MSTI messages conveys spanning tree information for each instance. Each instance can be assigned a number of configured VLANs. The frames assigned to these VLANs operate in this spanning tree instance whenever they are inside the MST region. To avoid conveying their entire VLAN to spanning tree mapping in each BPDU, the Access Point encodes an MD5 digest of their VLAN to an instance table in the MSTP BPDU. This digest is used by other MSTP supported devices to determine if the neighboring device is in the same MST region as itself.

To view a controller or service platform's MSTP statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.

- 3 Expand the **Network** menu from the left-hand side of the UI.
- 4 Select **MSTP**.

The screenshot displays the 'Access Point- Network MSTP' configuration page. It is divided into three main sections: 'MST Config', 'MST Bridge', and 'MST Bridge Port Detail'.

MST Config

CFG Name	My Name
Digest	0xac36177f50283cd4b83821d8ab26de62
Format ID	0
Name	1
Revision	0

MST Bridge

	BPDU Filter	BPDU Guard	Bridge Admin Cisco	Bridge Enabled	Bridge Oper Cisco	CIST Bridge ID	CIST Bridge Priority	CIST Reg Root ID
	✗	✗	✗	✗	✗	1: CIST Brk	32,768	1: CIST Reg Root Id E

MST Bridge Port Detail

Name	Role	Send MSTP	State	Type	Admin BPDU Filter	Admin BPDU Guard	Admin Edge	Admin P2P MAC	Admin Root Guard
ge1	4	MSTP	Forward	0	2	2	✗	✗	✗
ge10	4	STP	Forward	0	2	2	✗	✗	✗
ge2	4	MSTP	Forward	0	2	2	✗	✗	✗
ge3	4	MSTP	Forward	0	2	2	✗	✗	✗

A 'Refresh' button is located at the bottom right of the screen.

Figure 15-192 Access Point- Network MSTP screen

The **MST Config** field displays the name assigned to the MSTP configuration, its digest, format ID, name and revision.

The **MST Bridge** field lists the filters and guards that have been enabled and whether Cisco interoperability is enabled.

The **MST Bridge Port Detail** field lists specific Access Point port status and their current state.

15.4.27 DHCPv6 Relay & Client

► Access Point Statistics

DHCPv6 is a networking protocol for configuring IPv6 hosts with IP addresses, IP prefixes or other configuration attributes required on an IPv6 network. DHCPv6 relay agents receive messages from clients and forward them a DHCPv6 server. The server sends responses back to the relay agent, and the relay agent sends the responses to the client on the local link.

To assess an Access Point's DHCPv6 relay configuration:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.

- 3 Select **DHCPv6 Relay & Client** from the left-hand side of the UI.

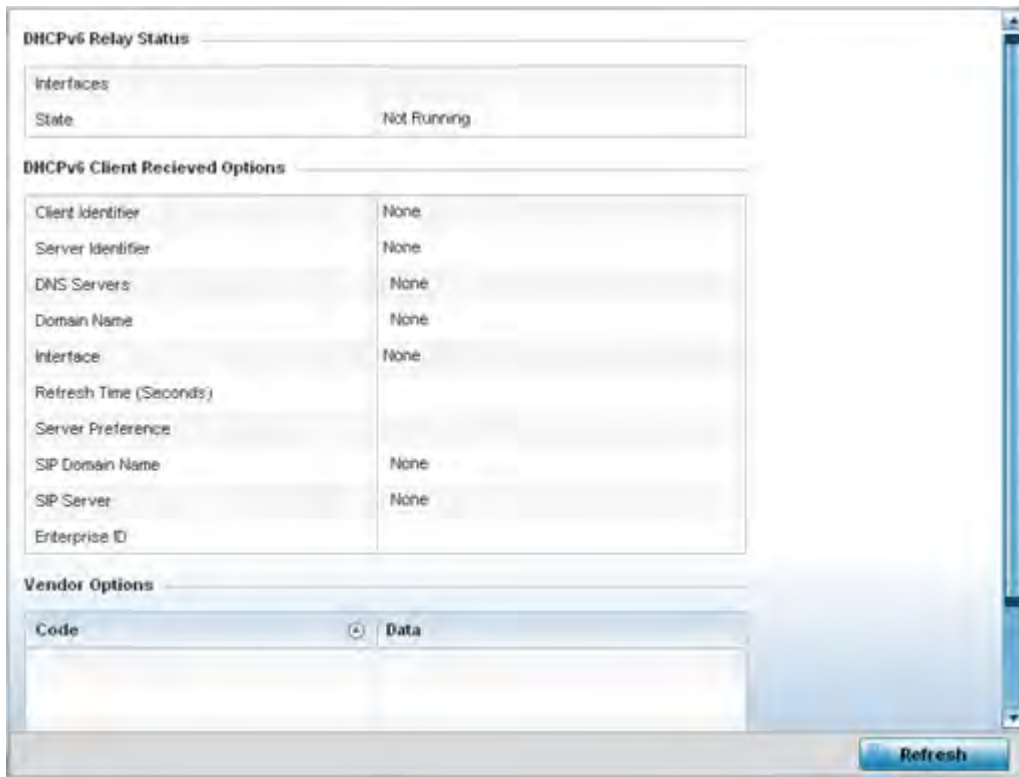


Figure 15-193 Access Point - DHCPv6 Relay and Client screen

- 4 The **DHCPv6 Status** tables defines the following:

Interfaces	Displays the Access Point interface used for DHCPv6 relay.
State	Displays the current operational state of the DHCPv6 server to assess its availability as a viable IPv6 provisioning resource.

- 5 The **DHCPv6 Status** tables defines the following:

Client Identifier	Lists whether the reporting client is using a <i>hardware address</i> or <i>client identifier</i> as its identifier type within requests to the DHCPv6 server.
Server Identifier	Displays the server identifier supporting client DHCPv6 relay message reception.
DNS Servers	Lists the DNS server resources supporting relay messages received from clients.
Domain Name	Lists the domain to which the remote server resource belongs.
Interface	Displays the interfaces dedicated to client DHCPv6 relay message reception.
Refresh Time (Seconds)	Lists the time (in seconds) since the data populating the DHCPv6 client received options table has been refreshed.
Server Preference	Lists the preferred DHCPv6 server resource supporting relay messages received from clients.
SIP Domain Name	Lists the SIP domain name supporting DHCPv6 client telephone extensions or voice over IP systems.

SIP Server	Displays the SIP server name supporting DHCPv6 telephone extensions or voice over IP systems.
Enterprise ID	Lists the enterprise ID associated with DHCPv6 received client options.

6 Refer to the **Vendor Options** table for the following:

Code	Lists the relevant numeric DHCP vendor code.
Data	Lists the supporting data relevant to the listed DHCP vendor code.

15.4.28 DHCP Server

► *Access Point Statistics*

Access Point's utilize an internal *Dynamic Host Configuration Protocol* (DHCP) server. DHCP can provide IP addresses automatically. DHCP is a protocol that includes mechanisms for IP address allocation and delivery of host-specific configuration parameters (IP address, network mask gateway etc.) from a DHCP server to a host.

To review DHCP server statistics, refer to the following:

- *Viewing General DHCP Information*
- *Viewing DHCP Binding Information*
- *Viewing DHCP Server Networks Information*

15.4.28.1 Viewing General DHCP Information

► *DHCP Server*

To view *General* DHCP status and binding information for both DHCPv4 and DHCPv6:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **General**.

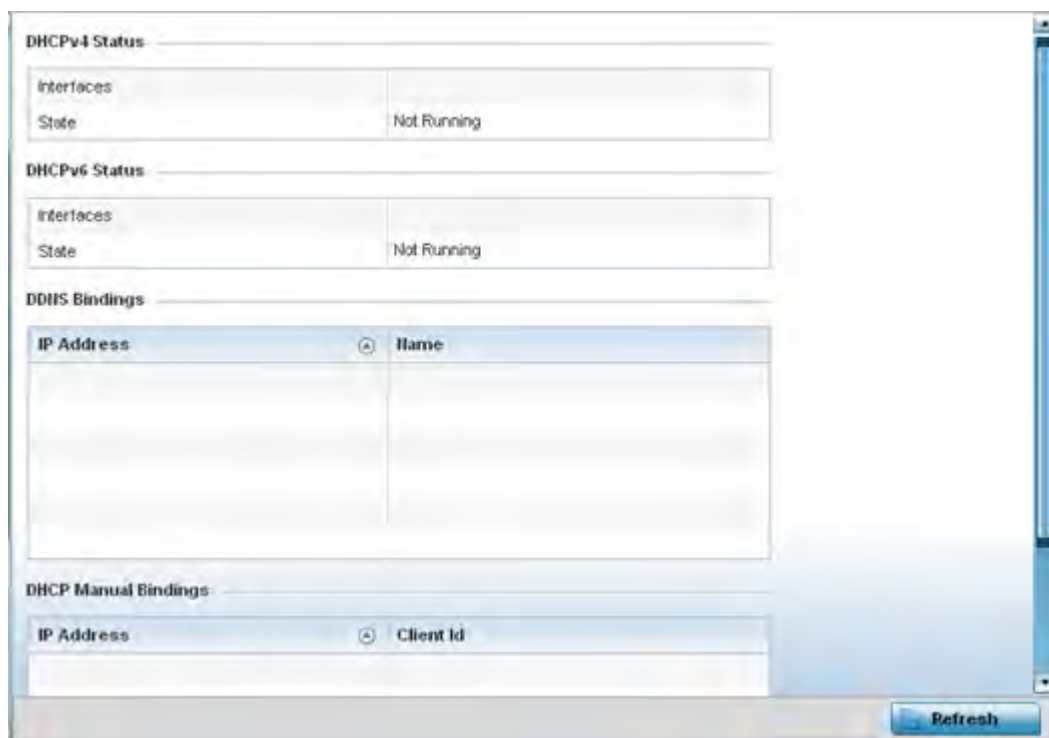


Figure 15-194 Access Point - DHCP Server General screen

- 5 The **DHCPv4 Status** and **DHCPv6 Status** tables defines the following:

Interfaces	Displays the Access Point interface used with the DHCPv4 or DHCPv6 resource for IP address provisioning.
State	Displays the current operational state of the DHCPv4 or DHCPv6 server to assess its availability as a viable IP provisioning resource.

- 6 The **DDNS Bindings** table displays the following:

IP Address	Displays the IP address assigned to the requesting client.
Name	Displays the domain name mapping corresponding to the listed IP address.

- 7 The **DHCP Manual Bindings** table displays the following:

IP Address	Displays the IP address for clients requesting DHCP provisioning resources.
Client Id	Displays the client's ID used to differentiate requesting clients.

- 8 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.28.2 Viewing DHCP Binding Information

► DHCP Server

The *DHCP Binding* screen displays DHCP binding information such as expiry time, client IP addresses and their MAC address.

Access Points build and maintain a DHCP snooping table (DHCP binding database). An Access Point uses the snooping table to identify and filter untrusted messages. The DHCP binding database keeps track of DHCP

addresses assigned to ports, as well as filtering DHCP messages from untrusted ports. Incoming packets received on untrusted ports, are dropped if the source MAC address does not match the MAC in the binding table.

To view the DHCP binding information:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **Bindings**.

Expiry Time	IP Address	DHCP MAC Address
Wed Dec 9 17:23:10 2015	172.168.7.197	00-08-F6-69-60-C2
Thu Dec 10 00:38:37 2015	172.168.7.198	B4-C7-99-6C-86-ED

Type to search in tables

Row Count: 2

Clear Clear All Refresh

Figure 15-195 Access Point - DHCP Server Bindings screen

The **Bindings** screen displays the following:

Expiry Time	Displays the expiration of the lease used by the client for Access Point DHCP resources.
IP Address	Displays the IP address of each listed client requesting DHCP services.
DHCP MAC Address	Displays the MAC address of each listed client requesting DHCP services.
Clear	Select a table entry and select <i>Clear</i> to remove the client from the list of devices requesting DHCP services from the Access Point.
Clear All	Select <i>Clear All</i> to remove all listed clients from the list of requesting clients.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.28.3 Viewing DHCP Server Networks Information

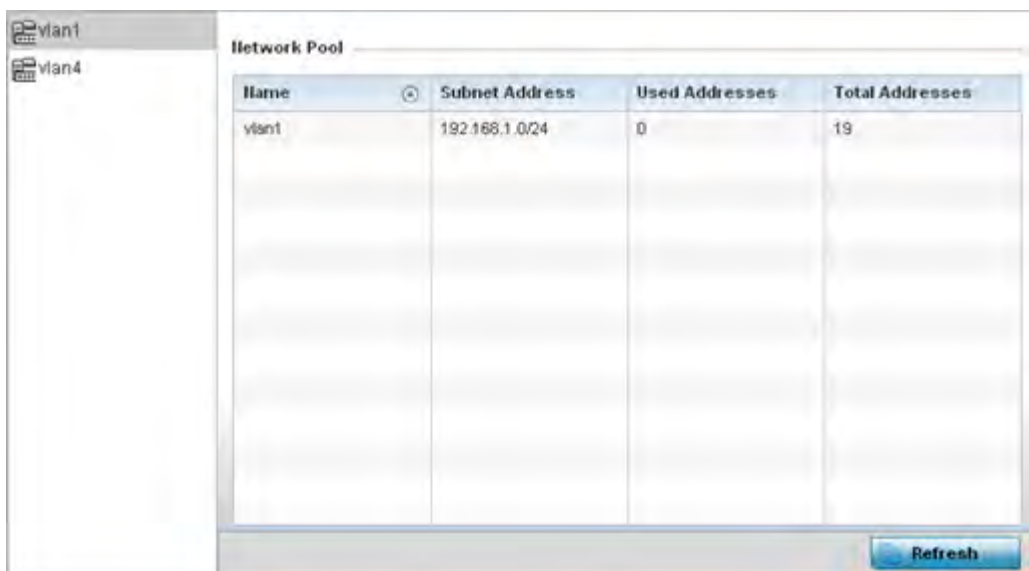
► DHCP Server

The DHCP server maintains a pool of IP addresses and client configuration parameters (default gateway, domain name, name servers etc). On receiving a valid client request, the server assigns the requestor an IP address, a lease (the validity of time), and other IP configuration parameters.

The *Networks* screen provides network pool information such as the subnet for the addresses you want to use from the pool, the pool name, the used addresses and the total number of addresses.

To view the **DHCP Server Networks** information:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **DHCP Server** menu from the left-hand side of the UI.
- 4 Select **Networks**.



Name	Subnet Address	Used Addresses	Total Addresses
vlan1	192.168.1.0/24	0	19

Figure 15-196 Access Point - DHCP Server Networks screen

The **Networks** screen displays the following:

Name	Displays the name of the virtual network (VLAN) from which IP addresses can be issued to DHCP client requests on the listed Access Point interface.
Subnet Address	Displays the subnet for the IP addresses used from the network pool.
Used Addresses	Displays the number of host IP addresses allocated by the DHCP server.
Total Addresses	Displays the total number of IP addresses available in the network pool for requesting clients.

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.29 Firewall

► Access Point Statistics

A firewall is a part of a computer system or network designed to block unauthorized access while permitting authorized communications. It's a device or set of devices configured to permit or deny access to the controller or service platform managed network based on a defined set of rules.

This screen is partitioned into the following:

- *Packet Flows*

- *Denial of Service*
- *IP Firewall Rules*
- *IPv6 Firewall Rules*
- *MAC Firewall Rules*
- *NAT Translations*
- *DHCP Snooping*
- *IPv6 Neighbor Snooping*

15.4.29.1 Packet Flows

► Firewall

The *Packet Flows* screen displays data traffic packet flow utilization. The chart represents the different protocol flows supported, and displays a proportional view of the flows in respect to their percentage of data traffic utilized.

The *Total Active Flows* graph displays the total number of flows supported. Other bar graphs display for each individual packet type.

To view Access Point packet flows statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **Packet Flows**.
- 5 Periodically select **Refresh** to update the statistics counters to their latest values. **Clear All** clears all the statistics counters and begins a new data collection.

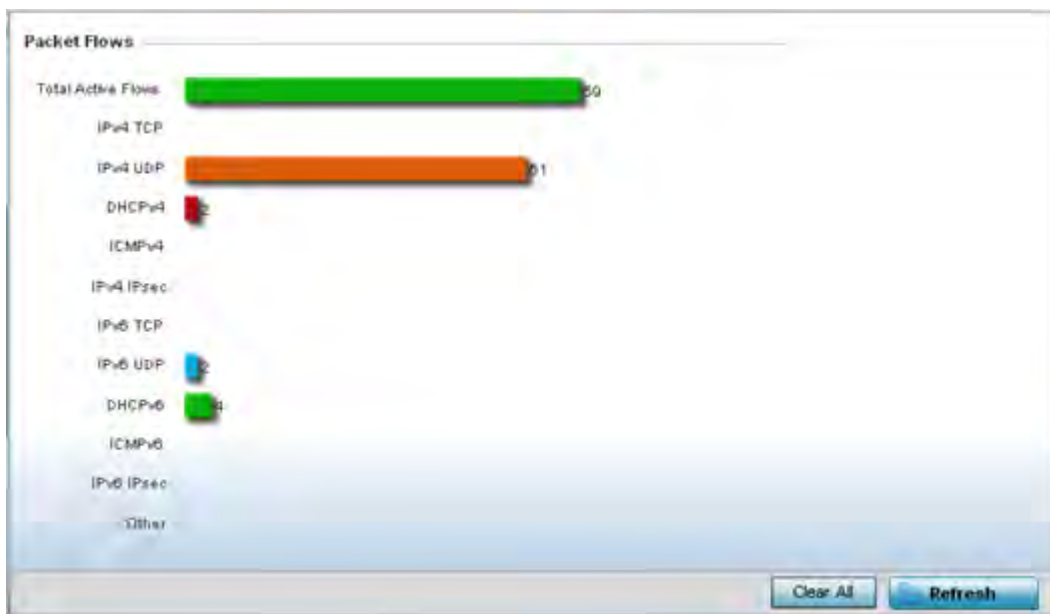


Figure 15-197 Access Point - Firewall Packet Flows screen

15.4.29.2 Denial of Service

► Firewall

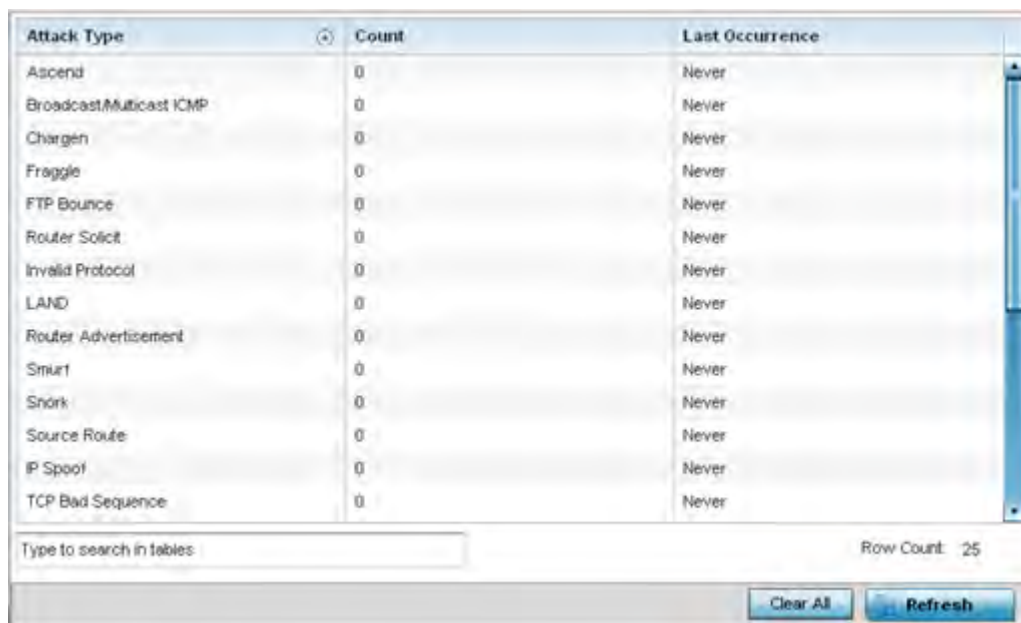
A *denial-of-service attack* (DoS attack) or distributed denial-of-service attack is an attempt to make a computer resource unavailable to its intended users. Although the means to carry out a DoS attack may vary, it generally consists of concerted efforts to prevent an Internet site or service from functioning efficiently.

One common method involves saturating the target's machine with external communications requests, so it cannot respond to legitimate traffic or responds so slowly as to be rendered effectively unavailable. DoS attacks are implemented by either forcing the targeted computer(s) to reset, or consume its resources so it can't provide its intended service.

The DoS screen displays the types of attack, number of times it occurred and the time of last occurrence.

To view Access Point DoS attack information:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **Denial of Service**.



Attack Type	Count	Last Occurrence
Ascend	0	Never
Broadcast/Multicast ICMP	0	Never
Chargen	0	Never
Fraggle	0	Never
FTP Bounce	0	Never
Router Solicit	0	Never
Invalid Protocol	0	Never
LAND	0	Never
Router Advertisement	0	Never
Smurf	0	Never
Snork	0	Never
Source Route	0	Never
IP Spoof	0	Never
TCP Bad Sequence	0	Never

Type to search in tables

Row Count: 25

Clear All Refresh

Figure 15-198 Access Point - Firewall Denial of Service screen

The **Denial of Service** screen displays the following:

Attack Type	Displays the <i>Denial of Service</i> (DoS) attack type.
Count	Displays the number of times the Access Point's firewall has detected each listed DoS attack.
Last Occurrence	Displays the when the attack event was last detected by the Access Point firewall.

Clear All	Select the <i>Clear All</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.29.3 IP Firewall Rules

► Firewall

Create firewall rules to let any computer to send IPv4 formatted traffic to, or receive traffic from, programs, system services, computers or users. Firewall rules can be created to take one of the three actions listed below that match the rule's criteria:

- *Allow an IPv4 connection*
- *Allow an IPv4 connection only if it is secured through the use of Internet Protocol security*
- *Block a connection*

Rules can be created for either inbound or outbound IPv4 formatted packet traffic. To view IPv4 firewall rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **IP Firewall Rules**.



Precedence	Friendly String	Hit Count
10	permit tcp any any rule-precedence	0
11	permit udp any eq 57 any eq dhcp	0
20	deny udp any range 137 138 any r	0
21	deny ip any 224.0.0.0/4 rule-prece	0
22	deny ip any host 255.255.255.255	0
100	permit ip any any rule-precedence	0

Type to search in tables

Row Count: 6

Refresh

Figure 15-199 Access Point - Firewall IP Firewall Rules screen

The **IP Firewall Rules** screen displays the following:

Precedence	Displays the precedence value applied to packets. The rules within an <i>Access Control Entries</i> (ACL) list are based on precedence values. Every rule has a unique precedence value between 1 and 5000. You cannot add two rules with the same precedence.

Friendly String	The friendly string provides information as to which firewall the rules apply.
Hit Count	Displays the number of times each firewall rule has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.29.4 IPv6 Firewall Rules

► Firewall

IPv6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. These hosts require firewall packet protection unique to IPv6 traffic, as IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. IPv6 hosts can configure themselves automatically when connected to an IPv6 network using the *neighbor discovery* (ND) protocol via ICMPv6 router discovery messages. When first connected to a network, a host sends a link-local router solicitation multicast request for its configuration parameters; routers respond to such a request with a router advertisement packet that contains Internet layer configuration parameters.

- Allow an IPv6 formatted connection
- Allow a connection only if it is secured through the use of IPv6 security
- Block a connection and exchange of IPv6 formatted packets

To view existing IPv6 firewall rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **IPv6 Firewall Rules**.

Figure 15-200 *Access Point- Firewall IPv6 Firewall Rules screen*

The **IPv6 Firewall Rules** screen displays the following:

Precedence	Displays the precedence (priority) applied to IPV6 formatted packets. Unlike IPv4, IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons. Every rule has a unique precedence value between 1 - 5000. You cannot add two rules with the same precedence value.
Friendly String	This is a string that provides more information as to the contents of the IPv6 specific IP rule. This is for information purposes only.
Hit Count	Displays the number of times each IPv6 ACL has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.29.5 MAC Firewall Rules

► Firewall

The ability to allow or deny Access Point connectivity by client MAC address ensures malicious or unwanted clients are unable to bypass the Access Point's security filters. Firewall rules can be created to support one of the three actions listed below that match the rule's criteria:

- *Allow a connection*
- *Allow a connection only if it's secured through the MAC firewall security*
- *Block a connection*

To view the Access Point's MAC Firewall Rules:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **MAC Firewall Rules**.

Precedence	Friendly String	Hit Count
	firewall1	10

Type to search in tables

Row Count: 1

Refresh

Figure 15-201 Access Point - Firewall MAC Firewall Rules screen

The **MAC Firewall Rules** screen displays the following information:

Precedence	Displays a precedence value, which are applied to packets. The rules within an <i>Access Control Entries</i> (ACL) list are based on their precedence. Every rule has a unique precedence between 1 and 5000. You cannot add two rules with the same precedence value.
Friendly String	This is a string that provides information as to which firewall the rules apply.
Hit Count	Displays the number of times each WLAN ACL has been triggered.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.29.6 NAT Translations

► Firewall

Network Address Translation (NAT) is a technique to modify network address information within IP packet headers in transit. This enables mapping one IP address to another to protect wireless controller managed network address credentials. With typical deployments, NAT is used as an IP masquerading technique to hide private IP addresses behind a single, public facing, IP address.

NAT can provide a profile outbound Internet access to wired and wireless hosts connected to either an Access Point or a wireless controller. Many-to-one NAT is the most common NAT technique for outbound Internet access. Many-to-one NAT allows an Access Point or wireless controller to translate one or more internal private IP addresses to a single, public facing, IP address assigned to a 10/100/1000 Ethernet port or 3G card.

To view the Firewall's NAT translations:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **NAT Translations**.

	Protocol	Forward Source IP	Forward Source Port	Forward Dest IP	Forward Dest Port	Reverse Source IP	Reverse Source Port	Reverse Dest IP	Reverse Dest Port
◆	tcp	157.235.91.9	4,441	10.233.89.68	22	172.168.1.11	22	157.235.91.9	4,441
◆	tcp	157.235.91.9	4,250	10.233.89.68	22	172.168.1.11	22	157.235.91.9	4,250
◆	tcp	10.233.89.67	2,625	10.233.89.68	22	172.168.1.11	22	10.233.89.67	2,625

Type to search in tables: Row Count: 3

Refresh

Figure 15-202 Access Point - Firewall NAT Translation screen

The **NAT Translations** screen displays the following:

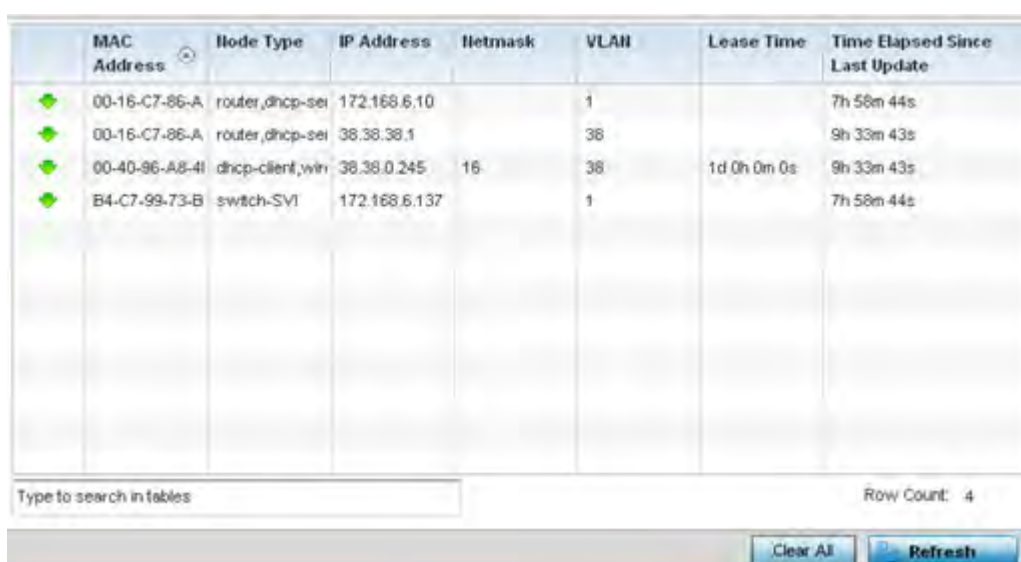
Protocol	Lists the NAT translation IP protocol as either <i>TCP</i> , <i>UDP</i> or <i>ICMP</i> .
Forward Source IP	Displays the source IP address for the forward NAT flow.
Forward Source Port	Displays the source port for the forward NAT flow (contains ICMP ID if it is an ICMP flow).
Forward Dest IP	Displays the destination IP address for the forward NAT flow.
Forward Dest Port	Destination port for the forward NAT flow (contains ICMP ID if it is an ICMP flow).
Reverse Source IP	Displays the source IP address for the reverse NAT flow.
Reverse Source Port	Displays the source port for the reverse NAT flow (contains ICMP ID if it is an ICMP flow).
Reverse Dest IP	Displays the destination IP address for the reverse NAT flow.
Reverse Dest Port	Displays the destination port for the reverse NAT flow (contains ICMP ID if it is an ICMP flow).
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.29.7 DHCP Snooping

► Firewall

When DHCP servers are allocating IP addresses to clients on the LAN, DHCP snooping can be configured to better enforce the security on the LAN to allow only clients with specific IP/MAC addresses.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Firewall** and expand the menu to reveal its sub menu items.
- 4 Select **DHCP Snooping**.



MAC Address	Node Type	IP Address	Netmask	VLAN	Lease Time	Time Elapsed Since Last Update
00-16-C7-86-A	router,dhcp-ser	172.168.6.10		1		7h 58m 44s
00-16-C7-86-A	router,dhcp-ser	38.38.38.1		38		9h 33m 43s
00-40-96-A8-4f	dhcp-client,wir	38.38.0.245	16	38	1d 0h 0m 0s	9h 33m 43s
B4-C7-99-73-B	switch-SVI	172.168.6.137		1		7h 58m 44s

Type to search in tables

Row Count: 4

Clear All Refresh

Figure 15-203 Access Point - Firewall DHCP Snooping screen

The **DHCP Snooping** screen displays the following:

MAC Address	Displays the MAC address of the client requesting DHCP resources from the controller or service platform.
Node Type	Displays the NetBios node from which IP addresses can be issued to client requests on this interface.
IP Address	Displays the IP address used for DHCP discovery, and requests between the DHCP server and DHCP clients.
Netmask	Displays the subnet mask used for DHCP discovery, and requests between the DHCP server and DHCP clients.
VLAN	Displays the VLAN used as a virtual interface for the newly created DHCP configuration.
Lease Time	When a DHCP server allocates an address for a DHCP client, the client is assigned a lease (which expires after a designated interval defined by the administrator). The lease time is the time an IP address is reserved for re-connection after its last use. Using very short leases, DHCP can dynamically reconfigure networks in which there are more computers than there are available IP addresses. This is useful, for example, in education and customer environments where client users change frequently. Use longer leases if there are fewer users.

Time Elapsed Since Last Updated	Displays the time the server was last updated.
Clear All	Select the <i>Clear All</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

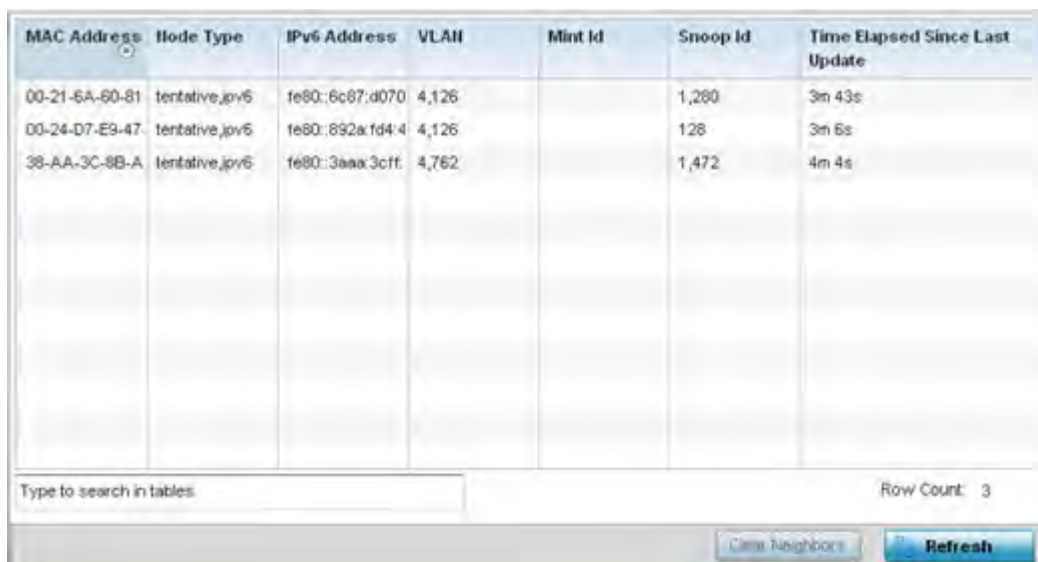
15.4.29.8 IPv6 Neighbor Snooping

► Firewall

Access Points listen to IPv6 formatted network traffic and forward IPv6 packets to radios on which the interested hosts are connected.

To review IPv6 neighbor snooping statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Expand the **Firewall** menu from the left-hand side of the UI.
- 4 Select **IPv6 Neighbor Snooping**.



MAC Address	Node Type	IPv6 Address	VLAN	Mint Id	Snoop Id	Time Elapsed Since Last Update
00-21-6A-60-81	tentative,ipv6	fe80::6c87:d070	4,126		1,260	3m 43s
00-24-D7-E9-47	tentative,ipv6	fe80::892a:fd4:4	4,126		128	3m 6s
38-AA-3C-8B-A	tentative,ipv6	fe80::3aaa:3cff	4,762		1,472	4m 4s

Type to search in tables: Row Count: 3

Figure 15-204 Access Point- Firewall IPv6 Neighbor Snooping screen

The **IPv6 Neighbor Snooping** screen displays the following:

MAC Address	Displays the MAC address of the IPv6 client.
Node Type	Displays the NetBios node with an IPv6 address pool from which IP addresses can be issued to client requests on this interface.
IPv6 Address	Displays the IPv6 address used for DHCPv6 discovery and requests between the DHCPv6 server and DHCP clients.
VLAN	Displays an Access Point virtual interface ID used for a new DHCPv6 configuration.

Mint Id	Lists MiNT IDs for each listed VLAN. MiNT provides the means to secure communications at the transport layer. Using MiNT, a device can be configured to only communicate with other authorized (MiNT enabled) devices of the same model.
Snoop Id	Lists the numeric snooping session ID generated when Access Points listen to IPv6 formatted network traffic and forward IPv6 packets to radios.
Time Elapsed Since Last Update	Displays the amount of time elapsed since the DHCPv6 server was last updated.
Clear Neighbors	Select <i>Clear Neighbors</i> to revert the counters to zero and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's counters to their latest values.

15.4.30 VPN

► Access Point Statistics

IPSec VPN provides a secure tunnel between two networked peer controllers or service platforms. Administrators can define which packets are sent within the tunnel, and how they are protected. When a tunnelled peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its remote peer destination.

Tunnels are sets of *security associations* (SA) between two peers. SAs define the protocols and algorithms applied to sensitive packets and specify the keying mechanisms used by tunnelled peers. SAs are unidirectional and exist in both the inbound and outbound direction. SAs are established per the rules and conditions of defined security protocols (AH or ESP).

Crypto maps combine the elements comprising IPSec SAs. Crypto maps also include *transform sets*. A transform set is a combination of security protocols, algorithms and other settings applied to IPSec protected traffic. One crypto map is utilized for each IPSec peer, however for remote VPN deployments one crypto map is used for all the remote IPSec peers.

Internet Key Exchange (IKE) protocol is a key management protocol standard used in conjunction with IPSec. IKE enhances IPSec by providing additional features, flexibility, and configuration simplicity for the IPSec standard. IKE automatically negotiates IPSec SAs, and enables secure communications without time consuming manual pre-configuration.

VPN statistics are partitioned into the following:

IKESA

IPSec

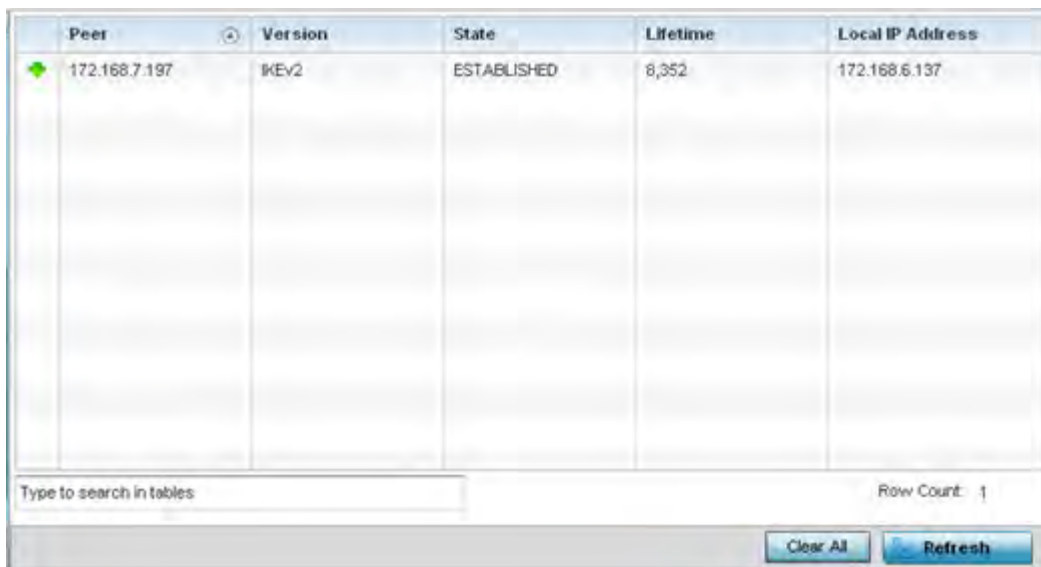
15.4.30.1 IKESA

► VPN

The *IKESA* screen allows for the review of individual peer security association statistics.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.

- 3 Select **VPN** and expand the menu to reveal its sub menu items.
- 4 Select **IKESA**.



Peer	Version	State	Lifetime	Local IP Address
172.168.7.197	IKEv2	ESTABLISHED	8,352	172.168.6.137

Type to search in tables

Row Count: 1

Clear All Refresh

Figure 15-205 Access Point - VPN IKESA screen

- 5 Review the following VPN peer security association statistics:

Peer	Lists peer IDs for peers sharing <i>security associations</i> (SA) for tunnel interoperability. When a peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its destination.
Version	Displays each peer's IKE version used for auto IPSec secure authentication with the IPSec gateway and other controllers or service platforms.
State	Lists the state of each listed peer's security association (whether established or not).
Lifetime	Displays the lifetime for the duration of each listed peer IPSec VPN security association. Once the set value is exceeded, the association is timed out.
Local IP Address	Displays each listed peer's local tunnel end point IP address. This address represents an alternative to an interface IP address.
Clear All	Select the <i>Clear All</i> button to clear each peer of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

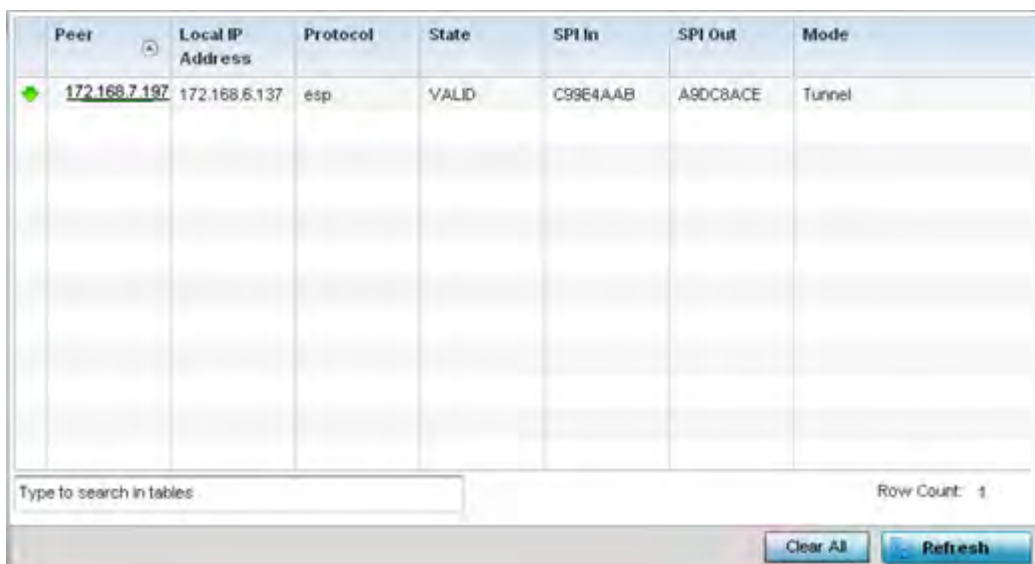
15.4.30.2 IPSec

► VPN

Use the *IPSec* VPN screen to assess tunnel status between networked peers.

To view IPSec VPN status for tunnelled peers:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points
- 3 Select **VPN** and expand the menu to reveal its sub menu items.
- 4 Select **IPSec**.



Peer	Local IP Address	Protocol	State	SPI In	SPI Out	Mode
172.168.7.197	172.168.6.137	esp	VALID	C98E4AAB	A9DC8ACE	Tunnel

Type to search in tables

Row Count: 1

Clear All Refresh

Figure 15-206 Access Point - VPN IPSec screen

- 5 Review the following VPN peer security association statistics:

Peer	Lists IP addresses for peers sharing <i>security associations</i> (SAs) for tunnel interoperability. When a peer sees a sensitive packet, it creates a secure tunnel and sends the packet through the tunnel to its destination.
Local IP Address	Displays each listed peer's local tunnel end point IP address. This address represents an alternative to an interface IP address.
Protocol	Lists the security protocol used with the VPN IPSec tunnel connection. SAs are unidirectional, existing in each direction and established per security protocol. Options include <i>ESP</i> and <i>AH</i> .
State	Lists the state of each listed peer's security association.
SPI In	Lists <i>stateful packet inspection</i> (SPI) status for incoming IPSec tunnel packets. SPI tracks each connection traversing the IPSec VPN tunnel and ensures they are valid.
SPI Out	Lists SPI status for outgoing IPSec tunnel packets. SPI tracks each connection traversing the IPSec VPN tunnel and ensures they are valid.
Mode	Displays the IKE mode. IPSEC has two modes in IKEv1 for key exchanges. Aggressive mode requires 3 messages be exchanged between the IPSEC peers to setup the SA, Main requires 6 messages.
Clear All	Select the <i>Clear All</i> button to clear each peer of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.31 Certificates

► Access Point Statistics

The *Secure Socket Layer* (SSL) protocol ensures secure transactions between Web servers and browsers. SSL uses a third-party certificate authority to identify one (or both) ends of a transaction. A browser checks the certificate issued by the server before establishing a connection.

This screen is partitioned into the following:

- *Trustpoints*
- *RSA Keys*

15.4.31.1 Trustpoints

► Certificates

Each certificate is digitally signed by a trustpoint. The trustpoint signing the certificate can be a certificate authority, corporate or individual. A trustpoint represents a CA/identity pair containing the identity of the CA, CA-specific configuration parameters and an association with an enrolled identity certificate.

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points
- 3 Select **Certificates** and expand the menu to reveal its sub menu items.
- 4 Select **Trustpoints**.

Certificate Details

Subject Name	CN=AP8132-B4-C7-99-73-BE-2C
Alternate Subject Name	
Issuer Name	CN=AP8132-B4-C7-99-73-BE-2C
Serial Number	8a
RSA Key Used	default_rsa_key
IS CA	☒ No
Is Self Signed	☒ Yes
Server Certificate Present	☒ Yes
CRL Present	☒ No

Validity

Valid From	08:23:2012 06:30:35 UTC
Valid Until	08:23:2013 06:30:35 UTC

Certificate Authority (CA) Details

Subject Name	
Alternate Subject Name	
Issuer Name	

Refresh

Figure 15-207 Access Point - Certificate Trustpoint screen

The Certificate Details field displays the following:

Subject Name	Lists details about the entity to which the certificate is issued.
Alternate Subject Name	Displays alternative details to the information specified under the Subject Name field.
Issuer Name	Displays the name of the organization issuing the certificate.
Serial Number	The unique serial number of the certificate issued.
RSA Key Used	Displays the name of the key pair generated separately, or automatically when selecting a certificate.
IS CA	Indicates whether this certificate is an authority certificate (Yes/No).
Is Self Signed	Displays whether the certificate is self-signed (Yes/No).
Server Certificate Present	Displays whether a server certification is present or not (Yes/No).
CRL Present	Displays whether a <i>Certificate Revocation List</i> (CRL) is present (Yes/No). A CRL contains a list of subscribers paired with digital certificate status. The list displays revoked certificates along with the reasons for revocation. The date of issuance and the entities that issued the certificate are also included.

- 5 Refer to the **Validity** field to assess the certificate duration beginning and end dates.
- 6 Review the *Certificate Authority (CA)* Details and Validity information to assess the subject and certificate duration periods.
- 7 Periodically select the **Refresh** button to update the screen's statistics counters to their latest values.

15.4.31.2 RSA Keys

► Certificates

Rivest, Shamir, and Adleman (RSA) is an algorithm for public key cryptography. It's the first algorithm known to be suitable for signing, as well as encryption.

The *RSA Keys* screen displays a list of RSA keys installed in the selected Access Point. RSA Keys are generally used for establishing a SSH session, and are a part of the certificate set used by RADIUS, VPN and HTTPS.

To view the RSA Key details:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points
- 3 Select **Certificates** and expand the menu to reveal its sub menu items.
- 4 Select **RSA Keys**.



Figure 15-208 Access Point - Certificate RSA Keys screen

The **RSA Key Details** field displays the size (in bits) of the desired key. If not specified, a default key size of 1024 is used.

The **RSA Public Key** field lists the public key used for encrypting messages.

- 5 Periodically select the **Refresh** button to update the screen's statistics counters to their latest values.

The WIPS **Client Blacklist** screen displays the following:

Event Name	Displays the name of the event that resulted in the blacklisting.
Blacklisted Client	Displays the MAC address of the unauthorized and blacklisted device intruding this Access Point's radio coverage area.
Time Blacklisted	Displays the time when the client was blacklisted by this Access Point.
Total Time	Displays the time the unauthorized (now blacklisted) device remained in this Access Point's WLAN.
Time Left	Displays the time the blacklisted client remains on the list.
Refresh	Select the <i>Refresh</i> button to update the statistics counters to their latest values.

15.4.32.2 WIPS Events

► WIPS

To view the WIPS events statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **WIPS** and expand the menu to reveal its sub menu items.
- 4 Select **WIPS Events**.

Event Name	Reporting AP	Originating Device	Detector Radio	Time Reported
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 08:08:39 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 10:16:36 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 04:24:30 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 27 2015 03:14:12 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:03:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 08:01:12 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 10:47:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Wed May 6 2015 10:53:57 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Tue May 26 2015 03:07:07 AM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 08:10:27 PM
ad-hoc-violation	ap7502-BC1340	00-10-18-A9-56-5D	1	Mon May 25 2015 10:59:44 AM
ad-hoc-violation	ap7502-BC1340	60-03-08-A7-93-E0	1	Fri May 15 2015 01:22:14 AM

Type to search in tables Row Count: 97

Clear All Refresh

Figure 15-210 Access Point - WIPS Events screen

The **WIPS Events** screen provides the following:

Event Name	Displays the name of the detected wireless intrusion event.
Reporting AP	Displays the MAC address of the Access Point reporting the listed intrusion.
Originating Device	Displays the MAC address of the intruding device.
Detector Radio	Displays the number of the detecting Access Point radio.

Time Reported	Displays the time when the intrusion event was detected.
Clear All	Select the <i>Clear All</i> button to clear the screen of its current status and begin a new data collection.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

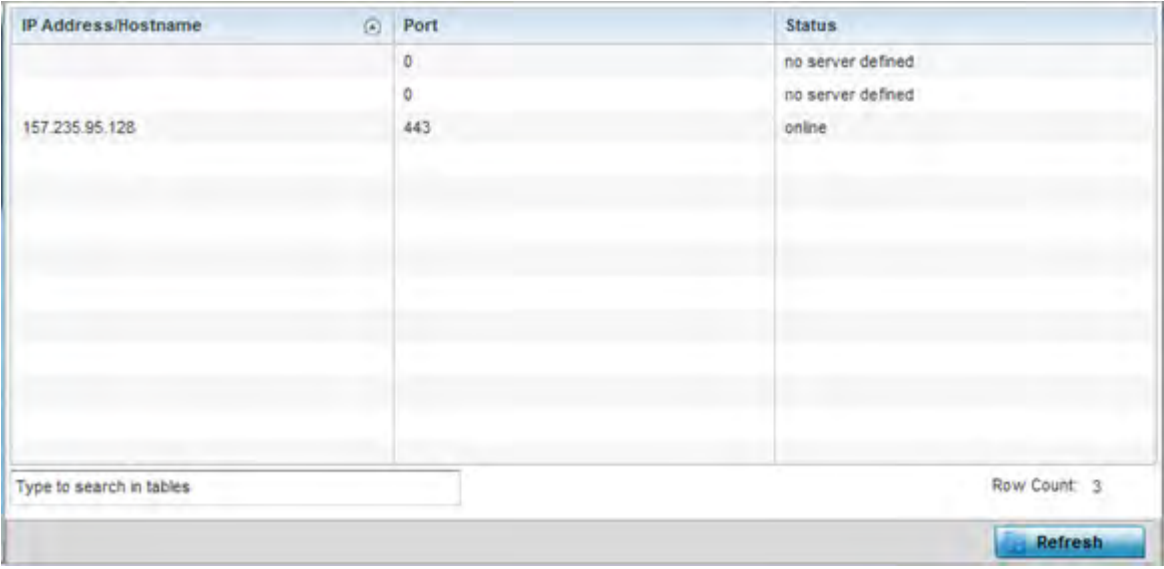
15.4.33 Sensor Servers

► Access Point Statistics

Sensor servers allow the monitor and download of data from multiple sensors and remote locations using Ethernet TCP/IP or serial communication. Repeaters are available to extend the transmission range and combine sensors with various frequencies on the same receiver.

To view the network address and status information of the sensor server resources available to the Access Point:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Sensor Servers**.



IP Address/Hostname	Port	Status
	0	no server defined
	0	no server defined
157.235.95.128	443	online

Type to search in tables

Row Count: 3

Refresh

Figure 15-211 Access Point - Sensor Servers screen

The **Sensor Servers** screen displays the following:

IP Address/Hostname	Displays a list of sensor server IP addresses or administrator assigned hostnames. These are the server resources available to the Access Point for the management of data uploaded from dedicated sensors.
Port	Displays the numerical port where the sensor server is listening. Unconnected server resources are not able to provide sensor reporting.
Status	Displays whether the server resource is connected or not.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

IP Address	Lists the network IP address utilized by the listed Bonjour service providing resources to the Access Point.
Port	Displays the port used to secure a connection with the listed Bonjour service.
Vlan	Lists the VLAN(s) on which a listed Bonjour service is routable.
Vlan Type	Lists the VLAN type as either a <i>local</i> bridging mode or a shared <i>tunnel</i> .
Expiry	Lists the expiration date of the listed Bonjour service, and its availability to discover resources on the LAN.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.35 Captive Portal

► Access Point Statistics

A captive portal forces a HTTP client to use a special Web page for authentication before using the Internet. A captive portal turns a Web browser into a client authenticator. This is done by intercepting packets regardless of the address or port, until the user opens a browser and tries to access the Internet. At that time, the browser is redirected to a Web page.

To view the captive portal statistics of an Access Point:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Captive Portal**.

Client MAC	Client IP	Client IPv6	Captive Portal	Port Name	Authentication	WLAN	VLAN	Remaining Time
54-44-08-3F-00-98	0.0.0.0		ALPHANET-GUEST-		User Redirect	GUEST-ACCESS-REGISTR	666	0s

Type to search in tables
Row Count: 1

Refresh

Figure 15-213 *Access Point - Captive Portal screen*

The **Captive Portal** screen displays the following:

Client MAC	Displays the requesting client's MAC address. The MAC displays as a link that can be selected to display client configuration and network address information in greater detail.

Client IP	Displays the requesting client's IPv4 formatted IP address.
Client IPv6	Displays the requesting client's IPv6 formatted IP address.
Captive Portal	Displays the captive portal name that each listed client is utilizing for guest access to Access Point resources.
Port Name	Lists the Access Point port name supporting the captive portal connection with the listed client MAC address.
Authentication	Displays the authentication status of the requesting client.
WLAN	Displays the name of the WLAN the client belongs to.
VLAN	Displays the name of the requesting client's VLAN interface.
Remaining Time	Displays the time after which the client is disconnected from the captive portal managed Internet.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.36 Network Time

► Access Point Statistics

Network Time Protocol (NTP) is central to networks that rely on their Access Point(s) to supply system time. Without NTP, Access Point supplied network time is unpredictable, which can result in data loss, failed processes, and compromised security. With network speed, memory, and capability increasing at an exponential rate, the accuracy, precision, and synchronization of network time is essential in an Access Point managed enterprise network. The Access Point can use a dedicated server to supply system time. The Access Point can also use several forms of NTP messaging to sync system time with authenticated network traffic.

The Network Time screen provides detailed statistics of an associated NTP Server of an Access Point. Use this screen to review the statistics for each Access Point.

The Network Time statistics screen consists of two tabs:

- *NTP Status*
- *NTP Association*

15.4.36.1 NTP Status

► Network Time

To view the Network Time statistics of an Access Point:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network Time**.

Clock Offset	Frequency	Leap	Precision	Reference Time	Reference	Root Delay	Root Dispersion	Stratum
65.322 msec	-7.2960 Hz	Clock is synchron	2^-20	a5db49b9.f16	129.188.147.1	65.322 msec	0.000 msec	3

Figure 15-214 Access Point - NTP Status screen

The **NTP Status** tab displays by default with the following information:

Clock Offset	Displays the time differential between the Access Point's time and its NTP resource's time.
Frequency	Indicates the SNTP server clock's skew (difference) for the Access Point.
Leap	Indicates if a second is added or subtracted to SNTP packet transmissions, or if transmissions are synchronized.
Precision	Displays the precision of the time clock (in Hz). The values that normally appear in this field range from -6, for mains-frequency clocks, to -20 for microsecond clocks.
Reference Time	Displays the time stamp the Access Point's clock was last synchronized or corrected.
Reference	Displays the address of the time source the Access Point is synchronized to.
Root Delay	The total round-trip delay in seconds. This variable can take on both positive and negative values, depending on relative time and frequency offsets. The values that normally appear in this field range from negative values (a few milliseconds) to positive values (several hundred milliseconds).
Root Dispersion	The difference between the time on the root NTP server and its reference clock. The reference clock is the clock used by the NTP server to set its own clock.
Stratum	Displays how many hops the Access Point is from its current NTP time resource.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.36.2 NTP Association

► Network Time

The interaction between the Access Point and an NTP server constitutes an association. NTP associations can be either peer associations (the Access Point synchronizes to another system or allows another system to synchronize to it), or a server associations (only the Access Point synchronizes to the NTP resource, not the other way around).

To view the Access Point's NTP association statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Network Time**.
- 4 Select the **NTP Association** tab.

NTP Status

NTP Association

	Delay Time ^(A)	Display	Offset	Poll	Reach	Reference IP Address	Server IP Address	State	Status	Time
	0.1	19.6	0.0	1024	255	129.188.147.1	129.188.147.2	2	Master Synced - Cor	143

Type to search in tables

Row Count: 1

Refresh

Figure 15-215 Access Point - NTP Association screen

The **NTP Association** screen displays the following:

Delay Time	Displays the round-trip delay (in seconds) for broadcasts between the NTP server and the Access Point.
Display	Displays the time difference between the peer NTP server and the Access Point's clock.
Offset	Displays the calculated offset between the Access Point and the NTP server. The Access Point adjusts its clock to match the server's time value. The offset gravitates towards zero, but never completely reduces its offset to zero.
Poll	Displays the maximum interval between successive messages (in seconds) to the nearest power of two.
Reach	Displays the status of the last eight SNTP messages. If an SNTP packet is lost, the lost packet is tracked over the next eight SNTP messages.

Reference IP Address	Displays the address of the time source the Access Point is synchronized to.
Server IP Address	Displays the numerical IP address of the SNTP resource (server) providing SNTP updates to the Access Point.
State	Displays the NTP association status code.
Status	Displays how many hops the Access Point is from its current NTP time source.
Time	Displays the time of the last statistics update.
Refresh	Select the <i>Refresh</i> button to update the screen's statistics counters to their latest values.

15.4.37 Load Balancing

► Access Point Statistics

An Access Point load can be viewed in a graph and filtered to display different load attributes. The Access Point's entire load can be displayed, as well as the separate loads on the 2.4 and 5 GHz radio bands. The channels can also be filtered for display. Each element can either be displayed *individually* or *collectively* in the graph.

To view the Access Point's load balance in a filtered graph format:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Load Balancing**.



Figure 15-216 Access Point - Load Balancing screen

The **Load Balancing** screen displays the following:

Load Balancing	Select any of the options to display any or all of the following information in the graph below: <i>AP Load</i> , <i>2.4GHz Load</i> , <i>5GHz Load</i> , and <i>Channel</i> . The graph section displays the load percentages for each of the selected variables over a period of time, which can be altered using the slider below the upper graph.
Client Requests Events	The Client Request Events displays the Time, Client, Capability, State, WLAN and Requested Channels for all client request events on the Access Point. Supported Access Points can support up to 256 clients per Access Point.

15.4.38 Environmental Sensors (AP8132 Models Only)

► Access Point Statistics

A sensor module is a USB environmental sensor extension to an AP8132 model Access Point. It provides a variety of sensing mechanisms, allowing the monitoring and reporting of the radio coverage area. The output of the sensor's detection mechanisms are viewable using either the Environmental Sensor screen.

To view an AP8132 model Access Point's environmental statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, and select one of its connected Access Points.
- 3 Select **Environment**.

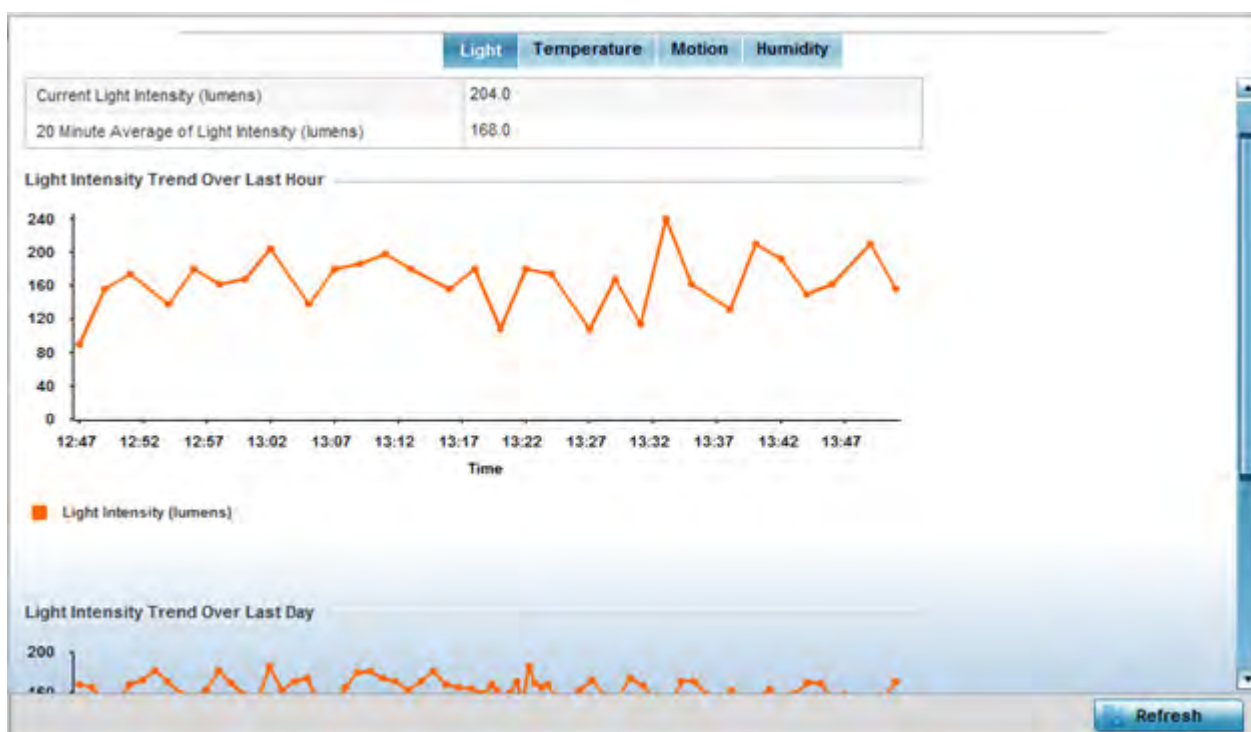


Figure 15-217 Access Point - Environmental Sensor screen (Light tab)

The **Light** tab displays by default, with additional *Temperature*, *Motion* and *Humidity* tabs available for unique sensor reporting. Each of these sensor measurements helps the administrator determine whether the immediate deployment area is occupied by changes in the Access Point's environment.

- 4 Refer to the **Light** table to assess the sensor's detected light intensity within the Access Point's immediate deployment area.

Light intensity is measured by the sensor in lumens. The table displays the **Current Light Intensity (lumens)** and a **20 Minute Average of Light Intensity (lumens)**. Compare these two items to determine whether the deployment location remains consistently lit, as an administrator can power off the Access Point's radios when no activity is detected in the immediate deployment area. For more information, see *Profile Environmental Sensor Configuration (AP8132 Only)* on page 8-222.

- 5 Refer to the **Light Intensity Trend Over Last Hour** graph to assess the fluctuation in lighting over the last hour. Use this graph to assess the deployment areas light intensity of particular hours of the day as needed to conjunction with the daily graph immediately below it.
- 6 Refer to the **Light Intensity Trend Over Last Day** graph to assess whether lighting is consistent across specific hours of the day. Use this information to help determine whether the Access Point can be upgraded or powered off during specific hours of the day.
- 7 Select the **Temperature** tab.



Figure 15-218 Access Point - Environmental Sensor screen (Temperature tab)

- 8 Refer to the **Temperature** table to assess the sensor's detected temperature within the Access Point's immediate deployment area.
Temperature is measured in centigrade. The table displays the **Current Temperature (centigrade)** and a **20 Minute Average Temperature (centigrade)**. Compare these two items to determine whether the deployment location remains consistently heated. For more information on enabling the sensor, see [Profile Environmental Sensor Configuration \(AP8132 Only\)](#) on page 8-222.
- 9 Refer to the **Temperature Trend Over Last Hour** graph to assess the fluctuation in ambient temperature over the last hour. Use this graph in combination with the Light and Motions graphs (in particular) to assess the deployment area's activity level.
- 10 Refer to the **Temperature Trend Over Last Day** graph to assess whether deployment area temperature is consistent across specific hours of the day. Use this information to help determine whether the Access Point can be upgraded or powered off during specific hours of the day.
- 11 Select the **Motion** tab.

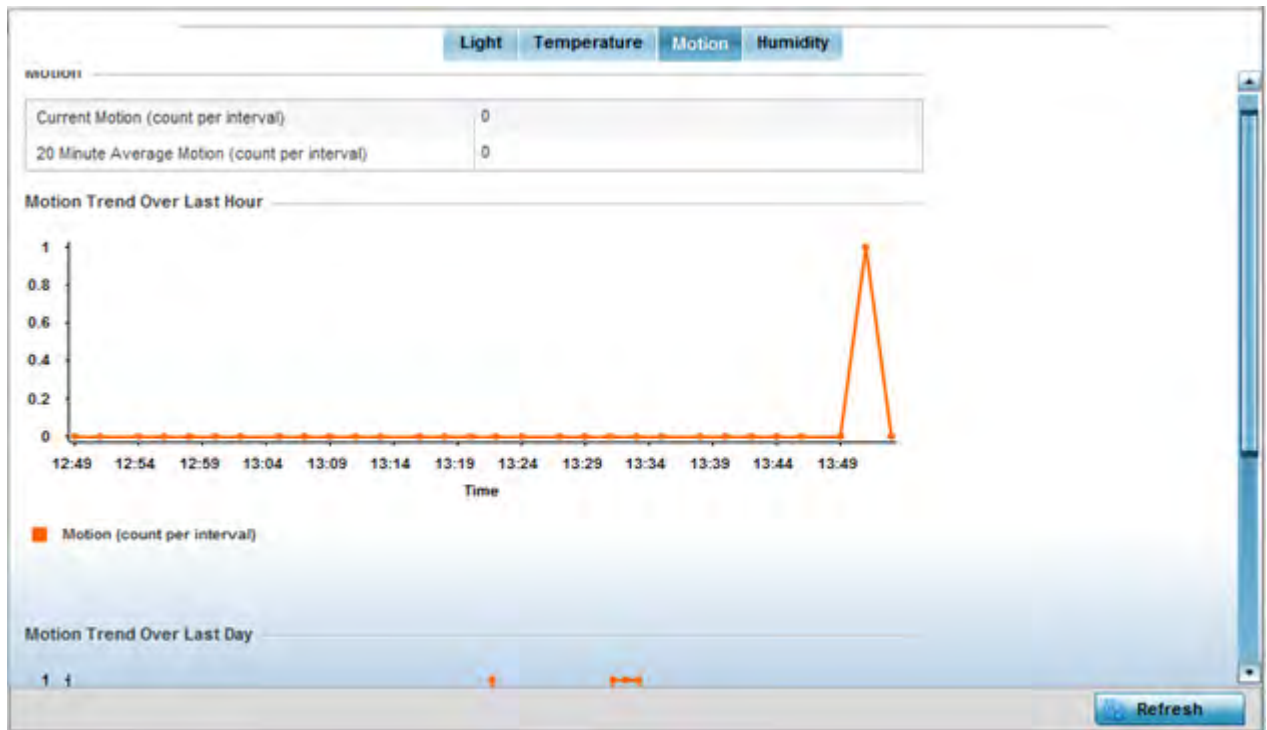


Figure 15-219 Access Point - Environmental Sensor screen (Motion tab)

- 12 Refer to the **Motion** table to assess the sensor's detected movement within the Access Point's immediate deployment area.
Motion is measured in intervals. The table displays the **Current Motion (count per interval)** and a **20 Minute Average Motion (count per interval)**. Compare these two items to determine whether the Access Point's deployment location remains consistently occupied by client users. For more information on enabling the sensor, see [Profile Environmental Sensor Configuration \(AP8132 Only\)](#) on page 8-222.
- 13 Refer to the **Motion Trend Over Last Hour** graph to assess the fluctuation in user movement over the last hour. Use this graph in combination with the Light and Temperature graphs (in particular) to assess the deployment area's activity level.
- 14 Refer to the **Motion Trend Over Last Day** graph to assess whether deployment area user movement is consistent across specific hours of the day. Use this information to help determine whether the Access Point can be upgraded or powered off during specific hours of the day.
- 15 Select the **Humidity** tab.

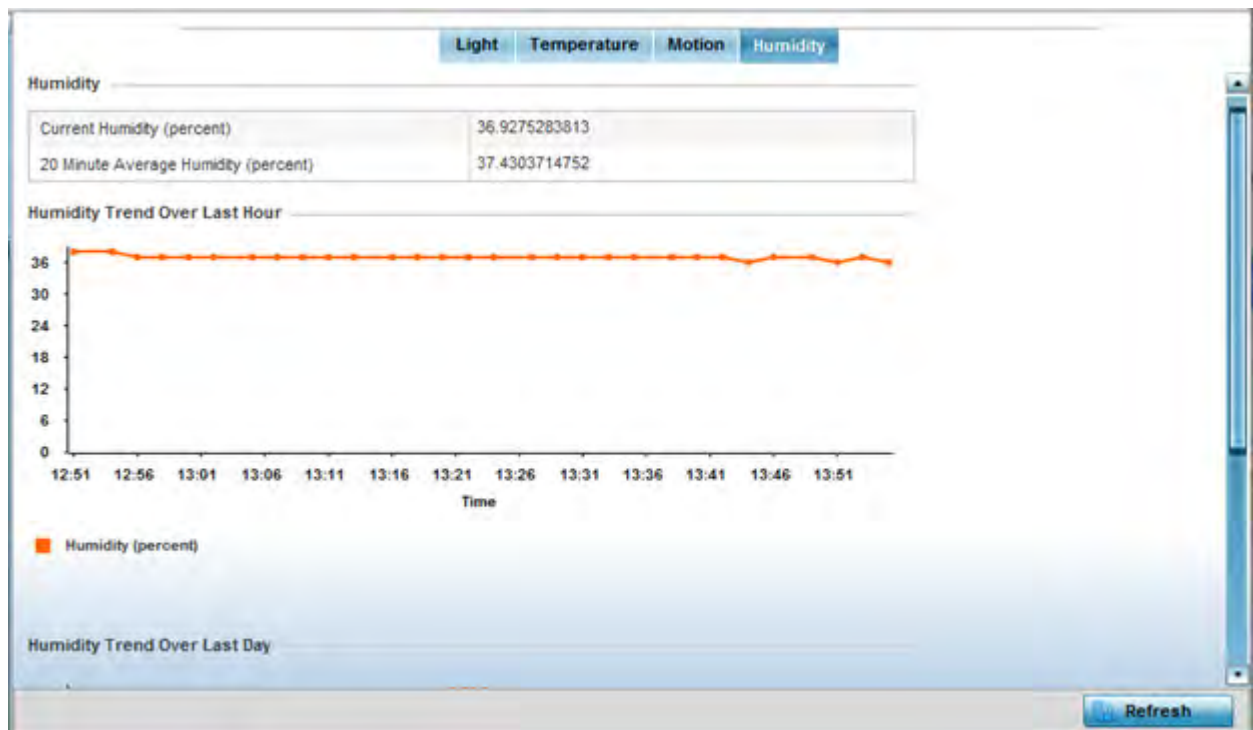


Figure 15-220 Access Point - Environmental Sensor screen (Humidity tab)

- 16 Refer to the **Humidity** table to assess the sensor's detected humidity fluctuations within the Access Point's immediate deployment area.
Humidity is measured in percentage. The table displays the **Current Humidity (percent)** and a **20 Minute Average Humidity (percent)**. Compare these two items to determine whether the deployment location remains consistently humid (often a by-product of temperature). For more information on enabling the sensor, see [Profile Environmental Sensor Configuration \(AP8132 Only\) on page 8-222](#).
- 17 Refer to the **Humidity Trend Over Last Hour** graph to assess the fluctuation in humidity over the last hour. Use this graph in combination with the Temperature and Motions graphs (in particular) to assess the deployment area's activity levels.
- 18 Refer to the **Humidity Trend Over Last Day** graph to assess whether deployment area humidity is consistent across specific hours of the day. Use this information to help determine whether the Access Point can be upgraded or powered off during specific hours of the day.

15.5 Wireless Client Statistics

► Statistics

The wireless client statistics display read-only statistics for a client selected from within its connected Access Point and controller or service platform directory. It provides an overview of the health of wireless clients in the controller or service platform managed network. Use this information to assess if configuration changes are required to improve client performance.

Wireless clients statistics can be assessed using the following criteria:

- [Health](#)

- [Details](#)
- [Traffic](#)
- [WMM TSPEC](#)
- [Association History](#)
- [Graph](#)

15.5.1 Health

► [Wireless Client Statistics](#)

The *Health* screen displays information on the overall performance of a selected wireless client.

To view the health of a wireless client:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point, then a connected client.
- 3 Select **Health**.



Figure 15-221 *Wireless Client - Health screen*

The **Wireless Client** field displays the following:

Client MAC	Displays the factory encoded MAC address of the selected wireless client.
Hostname	Lists the hostname assigned to the client when initially managed by the controller, service platform or Access Point.
Vendor	Displays the vendor name (manufacturer) of the wireless client.

State	Displays the current operational state of the wireless client. The client's state can be <i>idle</i> , <i>authenticated</i> , <i>roaming</i> , <i>associated</i> or <i>blacklisted</i> .
IP Address	Displays the IP address the selected wireless client is currently utilizing as a network identifier.
WLAN	Displays the client's connected Access Point WLAN membership. This is the WLAN whose QoS settings should account for the clients's radio traffic objective.
Radio MAC	Displays the Access Point radio MAC address the wireless client is connected to on the network.
VLAN	Displays the VLAN ID the Access Point has defined for use as a virtual interface with the client.

The **User Details** field displays the following:

Username	Displays the unique name of the administrator or operator managing the client's connected Access Point, controller or service platform.
Authentication	Lists the authentication scheme applied to the client for interoperation with the Access Point.
Encryption	Lists the encryption scheme applied to the client for interoperation with the Access Point.
Captive Portal Auth.	Displays whether captive portal authentication is enabled for the client as a guest access medium to the controller or service platform managed network.

The **RF Quality Index** field displays the following:

RF Quality Index	Displays information on the RF quality for the selected wireless client. The RF quality index is the overall effectiveness of the RF environment as a percentage of the connect rate in both directions, as well as the retry and error rate. RF quality index can be interpreted as: 0 – 20 (Very poor quality) 20 – 40 (Poor quality) 40 – 60 (Average quality) 60 – 100 (Good quality)
Average Retry Number	Displays the average number of retries per packet. A high number indicates possible network or hardware problems.
SNR	Displays the <i>signal to noise</i> (SNR) ratio of the connected wireless client.
Signal	Displays the power of the radio signals in - dBm.
Noise	Displays the disturbing influences on the signal by interference of signals in - dBm.
Error Rate	Displays the number of received bit rates altered due to noise, interference and distortion. It's a unitless performance measure.

The **Association** field displays the following:

AP Hostname	Lists the administrator assigned device name of the client's connected Access Point.

AP	Displays the MAC address of the client's connected Access Point.
Radio	Lists the target Access Point that houses the radio. Select the Access Point to view performance information in greater detail.
Radio ID	Lists the hardware encoded MAC address the radio uses as a hardware identifier that further distinguishes the radio from others within the same device.
Radio Number	Displays the Access Point's radio number (either 1, 2 or 3) to which the selected client is associated.
Radio Type	Displays the radio type. The radio can be 802.11b, 802.11bg, 802.11bgn, 802.11a or 802.11an.

- 4 The **Traffic Utilization** field displays statistics on the traffic generated and received by the selected client. This area displays the traffic index, which measures how efficiently the traffic medium is utilized. It's defined as the percentage of current throughput relative to the maximum possible throughput.

Traffic indices are:

- 0 – 20 (Very low utilization)
- 20 – 40 (Low utilization)
- 40 – 60 (Moderate utilization)
- 60 and above (High utilization)

The Traffic Utilization table displays the following:

Total Bytes	Displays the total bytes processed by the Access Point's connected wireless client.
Total Packets	Displays the total number of packets processed by the wireless client.
User Data Rate	Displays the average user data rate in both directions.
Physical Layer Rate	Displays the average packet rate at the physical layer in both directions.
Tx Dropped Packets	Displays the number of packets dropped during transmission.
Rx Errors	Displays the number of errors encountered during data transmission. The higher the error rate, the less reliable the connection or data transfer between the client and connected Access Point.

- 5 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.5.2 Details

► *Wireless Client Statistics*

The *Details* screen provides granular performance information for a selected wireless client.

To view the details screen of a connected wireless client:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point, then a connected client.
- 3 Select **Details**.

The screenshot displays the 'Wireless Client - Details' screen, which is organized into several sections:

- Wireless Client:** A table listing client attributes such as SSID (stcwl), Hostname (WICED IP), Device Type (Voice [Proto:Other, In-Call]), RF Domain (CA107-SJC), OS (Unknown), Browser (Unknown), Type (Unknown), Role, Role Policy, Client Identity (Unknown), Client Identity Precedence (0), Protected Management Frames (indicated by a red X), and Transmit Power Management (0).
- Association:** A table showing connection details including AP (FC-0A-81-BB-99-45), BSS (0E-0A-81-BB-8F-D0), Radio Number (2), Radio Type (11an), and Rate (6 9 12 18 24 36 48 54 mcs-1s).
- 802.11 Protocol:** A table detailing protocol support, such as High-Throughput (Supported with a green check), RFS (Unsupported with a red X), Negotiated Fast BSS Transition (Unsupported with a red X), Unscheduled APSD (Disabled), AID (1), Max AMSDU Size (3,839), Max AMPDU Size (8,191), Interframe Spacing (1), and Short Guard Interval (Supported with a green check).
- User Details:** A table showing authentication and encryption settings, including Username (none), Authentication (none), Encryption (ccmp), and Captive Portal Auth. (No, indicated by a red X).
- Connection:** A table displaying connection metrics like Idle Time (30m 0s), Last Active (3), Last Association (1m 0s), Session Time (100d 0h 0m 0s), and SM PowerSave Mode (static).

A 'Refresh' button is located at the bottom right of the screen.

Figure 15-222 *Wireless Client - Details screen*

The **Wireless Client** field displays the following:

SSID	Displays the client's <i>Service Set ID</i> (SSID).
Hostname	Lists the hostname assigned to the client when initially managed by the controller, service platform or Access Point managed network.
Device Type	Displays the client device type providing the details to the operating system.
RF Domain	Displays the RF Domain to which the connected client is a member via its connected Access Point, controller or service platform. The RF Domain displays as a link that can be selected to display configuration and network address information in greater detail.
OS	Lists the client's operating system (Android etc.).
Browser	Displays the browser type used by the client to facilitate its wireless connection.
Type	Lists the client manufacturer (or vendor).
Role	Lists the client's defined role in the controller, service platform or Access Point managed network.

Role Policy	Lists the user role set for the client as it became a controller, service platform or Access Point managed device.
Client Identity	Displays the unique vendor identity of the listed device as it appears to its adopting controller or service platform.
Client Identity Precedence	Lists the numeric precedence this client uses in establishing its identity amongst its peers.
Protected Management Frames	A green checkmark defines management frames as protected between this client and its associated Access Point radio. A red X states that management frames are disabled for the client and its connected radio.
Transmit Power Management	Lists the number power management frames exchanged between this client and its connected Access Point radio. Lists zero when disabled.

The **User Details** field displays the following:

Username	Displays the unique name of the administrator or operator managing the client's connected Access Point.
Authentication	Lists the authentication scheme applied to the client for interoperation with its connected Access Point radio.
Encryption	Lists the encryption scheme applied to the client for interoperation with its connected Access Point radio.
Captive Portal Auth.	Displays whether captive portal authentication is enabled. When enabled, a restrictive set of access permissions may be in effect.

The **Connection** field displays the following:

Idle Time	Displays the time for which the wireless client remained idle.
Last Active	Displays the time in seconds the wireless client was last interoperating with its connected Access Point.
Last Association	Displays the duration the wireless client was in association with its connected Access Point.
Session Time	Displays the duration for which a session can be maintained by the wireless client without it being dis-associated from the Access Point.
SM Power Save Mode	Displays whether this feature is enabled on the wireless client. The <i>spatial multiplexing</i> (SM) power save mode allows an 802.11n client to power down all but one of its radios. This power save mode has two sub modes of operation: <i>static operation</i> and <i>dynamic operation</i> .
Power Save Mode	Displays whether this feature is enabled or not. To prolong battery life, the 802.11 standard defines an optional Power Save Mode, which is available on most 802.11 clients. End users can simply turn it on or off via the card driver or configuration tool. With power save off, the 802.11 network card is generally in receive mode listening for packets and occasionally in transmit mode when sending packets. These modes require the 802.11 NIC to keep most circuits powered-up and ready for operation.
WMM Support	Displays whether WMM is enabled or not in order to provide data packet type prioritization between the Access Point and connected client.
40 MHz Capable	Displays whether the wireless client has 802.11n channels operating at 40 MHz.

Max Physical Rate	Displays the maximum data rate at the physical layer.
Max User Rate	Displays the maximum permitted user data rate.
MC2UC Streams	Lists the number of multicast to unicast data streams detected.

The **Association** field displays the following:

AP	Displays the MAC address of the client's connected Access Point.
BSS	Displays the <i>Basic Service Set</i> (BSS) the Access Point belongs to. A BSS is a set of stations that can communicate with one another.
Radio Number	Displays the Access Point radio the wireless client is connected to.
Radio Type	Displays the radio type. The radio can be 802.11b, 802.11bg, 802.11bgn, 802.11a or 802.11an.
Rate	Displays the permitted data rate for Access Point and client interoperation.

The **802.11 Protocol** field displays the following:

High-Throughput	Displays whether high throughput is supported. High throughput is a measure of the successful packet delivery over a communication channel.
RIFS	Displays whether this feature is supported. RIFS is a required 802.11n feature that improves performance by reducing the amount of dead time between OFDM transmissions.
Negotiated Fast BSS Transition	Lists whether Fast BSS transition is negotiated. This indicates support for a seamless fast and secure client handoff between two Access Points, controllers or service platforms.
Unscheduled APSD	Displays whether APSD is supported. APSD defines an unscheduled service period, which is a contiguous period of time during which the Access Point is expected to be awake.
AID	Displays the <i>Association ID</i> (AID) established by an AP. 802.11 association enables the Access Point to allocate resources and synchronize with a client. A client begins the association process by sending an association request to an Access Point. This association request is sent as a frame. This frame carries information about the client and the SSID of the network it wishes to associate. After receiving the request, the Access Point considers associating with the client, and reserves memory space for establishing an AID for the client.
Max AMSDU Size	Displays the maximum size of AMSDU. AMSDU is a set of Ethernet frames to the same destination that are wrapped in a 802.11n frame. This value is the maximum AMSDU frame size in bytes.
Max AMPDU Size	Displays the maximum size of AMPDU. AMPDU is a set of Ethernet frames to the same destination that are wrapped in an 802.11n MAC header. AMPDUs are used in a very noisy environment to provide reliable packet transmission. This value is the maximum AMPDU size in bytes.
Interframe Spacing	Displays the interval between two consecutive Ethernet frames.

Short Guard Interval	Displays the guard interval in micro seconds. Guard intervals prevent interference between data transmissions. The guard interval is the space between characters being transmitted. The guard interval eliminates <i>inter-symbol interference</i> (ISI). ISI occurs when echoes or reflections from one character interfere with another character. Adding time between transmissions allows echo's and reflections to settle before the next character is transmitted. A shorter guard interval results in shorter character times which reduces overhead and increases data rates by up to 10%.

- 4 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.5.3 Traffic

► *Wireless Client Statistics*

The traffic screen provides an overview of client traffic utilization in both the transmit and receive directions. This screen also displays a RF quality index.

To view the traffic statistics of a wireless clients:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point, then a connected client.
- 3 Select **Traffic**.

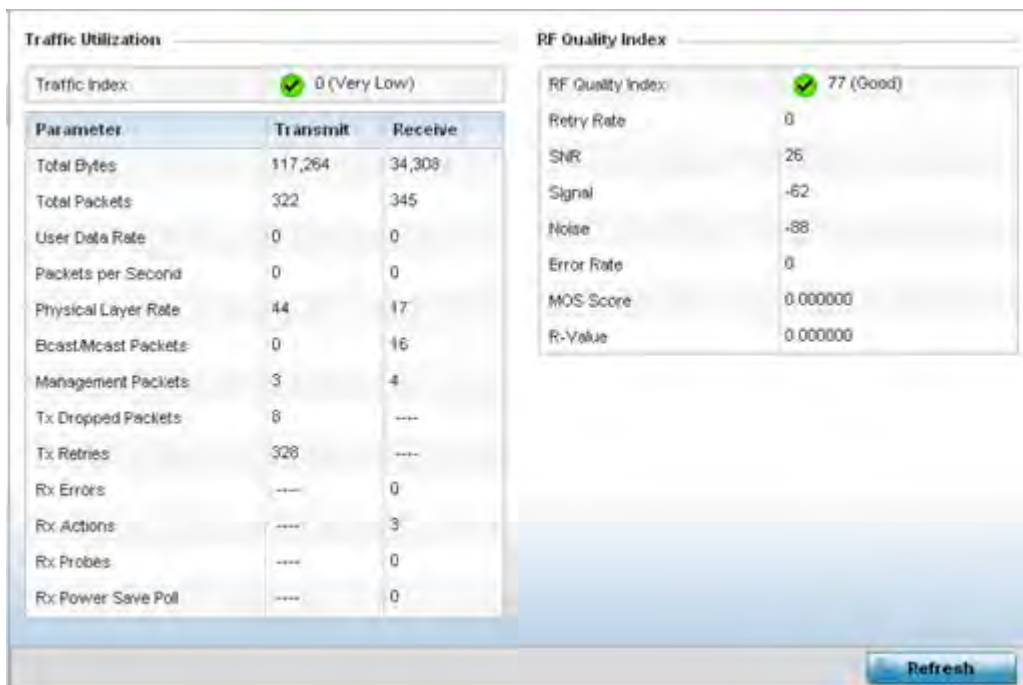


Figure 15-223 *Wireless Client - Traffic screen*

Traffic Utilization statistics employ an index, which measures how efficiently the traffic medium is used. It's defined as the percentage of current throughput relative to the maximum possible throughput.

Traffic indices are:

- 0 – 20 (Very low utilization)
- 20 – 40 (Low utilization)
- 40 – 60 (Moderate utilization)
- 60 and above (High utilization)

This screen also provides the following:

Total Bytes	Displays the total bytes processed (in both directions) by the Access Point's connected client.
Total Packets	Displays the total number of data packets processed (in both directions) by the Access Point's connected wireless client.
User Data Rate	Displays the average user data rate.
Packets per Second	Displays the packets processed per second.
Physical Layer Rate	Displays the data rate at the physical layer level.
Bcast/Mcast Packets	Displays the total number of broadcast/multicast packets processed by the client.
Management Packets	Displays the number of management (overhead) packets processed by the client.
Tx Dropped Packets	Displays the client's number of dropped packets while transmitting to its connected Access Point.
Tx Retries	Displays the total number of client transmit retries with its connected Access Point.
Rx Errors	Displays the errors encountered by the client during data transmission. The higher the error rate, the less reliable the connection or data transfer between client and connected Access Point.
Rx Actions	Displays the number of receive actions during data transmission with the client's connected Access Point.
Rx Probes	Displays the number of probes sent. A probe is a program or other device inserted at a key juncture in a for network for the purpose of monitoring or collecting data about network activity.
Rx Power Save Poll	Displays the power save using the <i>Power Save Poll</i> (PSP) mode. Power Save Poll is a protocol, which helps to reduce the amount of time a radio needs to powered. PSP allows the WiFi adapter to notify the Access Point when the radio is powered down. The Access Point holds any network packet to be sent to this radio.

The **RF Quality Index** area displays the following information:

RF Quality Index	Displays information on the RF quality of the selected wireless client. The RF quality index is the overall effectiveness of the RF environment as a percentage of the connect rate in both directions as well as the retry rate and the error rate. The RF quality index value can be interpreted as: 0 – 20 (Very low utilization) 20 – 40 (Low utilization) 40 – 60 (Moderate utilization) 60 and above (High utilization)
Retry Rate	Displays the average number of retries per packet. A high number indicates possible network or hardware problems.

SNR (dBm)	Displays the connected client's <i>signal to noise ratio</i> (SNR). A high SNR could warrant a different Access Point connection to improve performance.
Signa (dBm)	Displays the power of the radio signals in - dBm.
Noise (dBm)	Displays the disturbing influences on the signal in - dBm.
Error Rate (ppm)	Displays the number of received bit rates altered due to noise, interference and distortion. It's a unitless performance measure.
MOS Score	Displays average voice call quality using the <i>Mean Opinion Score</i> (MOS) call quality scale. The MOS scale rates call quality on a scale of 1-5, with higher scores being better. If the MOS score is lower than 3.5, it's likely users will not be satisfied with the voice quality of their call.
R-Value	R-value is a number or score used to quantitatively express the quality of speech in communications systems. This is used in digital networks that carry <i>Voice over IP</i> (VoIP) traffic. The R-value can range from 1 (worst) to 100 (best) and is based on the percentage of users who are satisfied with the quality of a test voice signal after it has passed through a network from a source (transmitter) to a destination (receiver). The R-value scoring method accurately portrays the effects of packet loss and delays in digital networks carrying voice signals.

- 4 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.5.4 WMM TSPEC

► *Wireless Client Statistics*

The 802.11e *Traffic Specification* (TSPEC) provides a set of parameters that define the characteristics of the traffic stream, (operating requirement and scheduling etc.). The sender TSPEC specifies parameters available for packet flows. Both sender and the receiver use TSPEC.

The TSPEC screen provides information about TSPEC counts and TSPEC types utilized by the selected wireless client.

To view the TSPEC statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point, then a connected client.
- 3 Select **WMM TSPEC**.

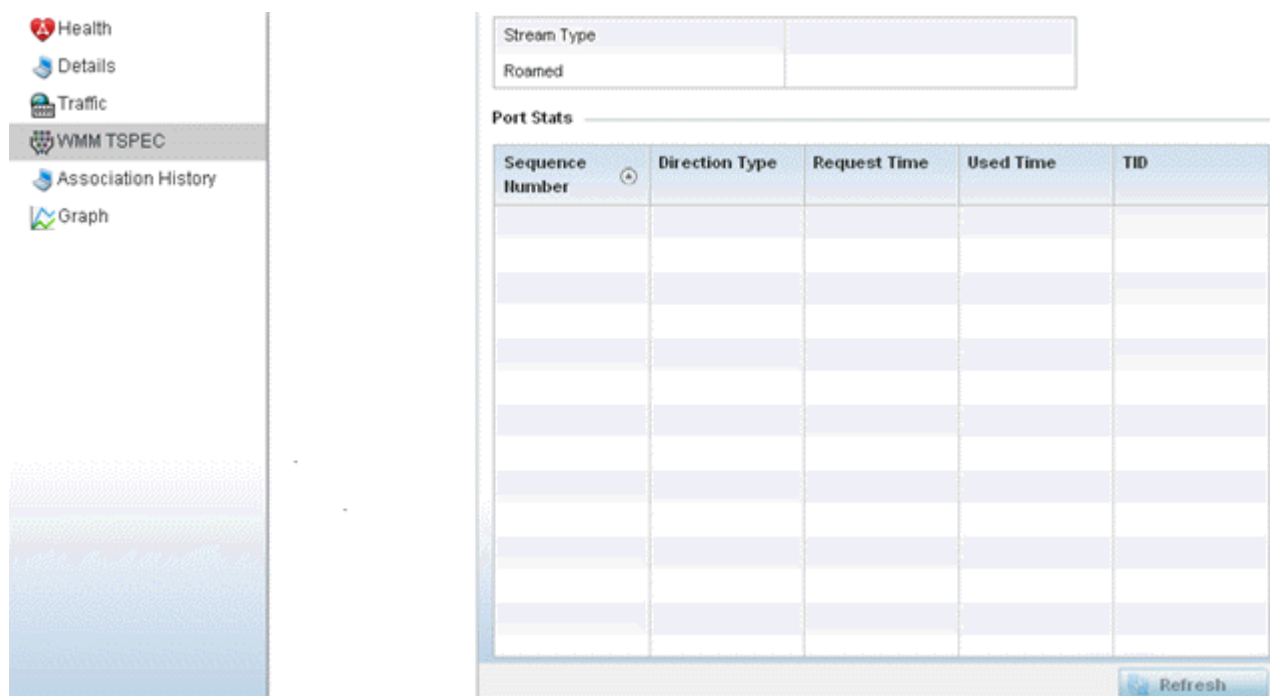


Figure 15-224 *Wireless Client - WMM TSPEC screen*

The top portion of the screen displays the TSPEC stream type and whether the client has roamed. The Ports Stats field displays the following:

Sequence Number	Lists a sequence number that's unique to this WMM TSPEC <i>uplink</i> or <i>downlink</i> data stream.
Direction Type	Displays whether the WMM TSPEC data stream is in the <i>uplink</i> or <i>downlink</i> direction.
Request Time	Lists each sequence number's request time for WMM TSPEC traffic in the specified direction. This is time allotted for a request before packets are actually sent.
Used Time	Displays the time the client used TSPEC. The client sends a <i>delete traffic stream</i> (DELTS) message when it has finished communicating.
TID	Displays the parameter for defining the traffic stream. TID identifies data packets as belonging to a unique traffic stream.

- Periodically select **Refresh** to update the screen to its latest values.

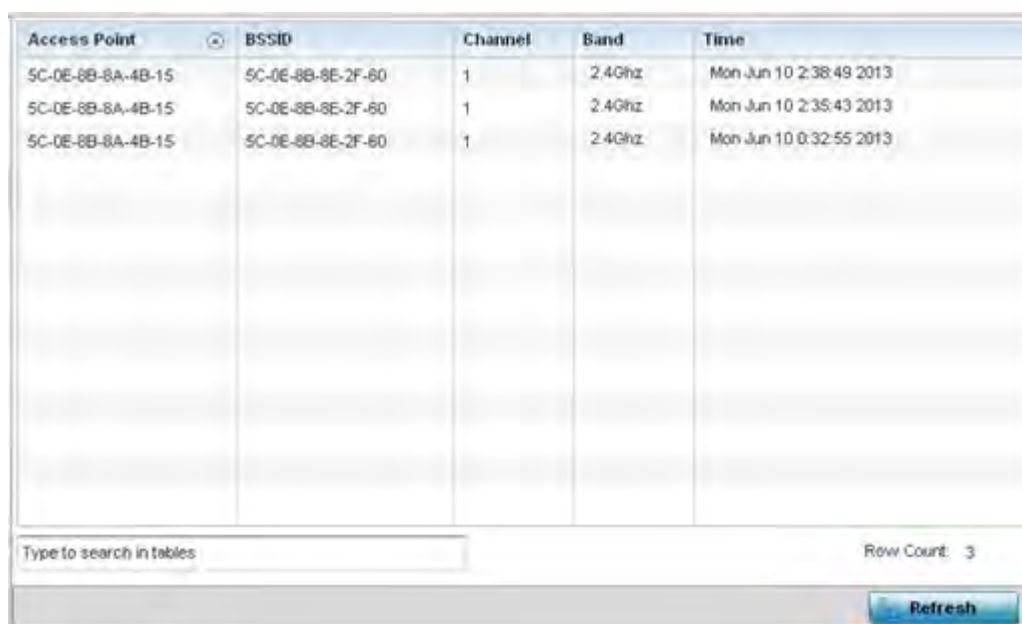
15.5.5 Association History

► *Wireless Client Statistics*

Refer to the **Association History** screen to review this client's Access Point connections. Hardware device identification, operating channel and GHz band data is listed for each Access Point. The Association History can help determine whether the client has connected to its target Access Point and maintained its connection, or has roamed and been supported by unplanned Access Points in the controller or service platform managed network.

To view a selected client's association history:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point, then a connected client.
- 3 Select **Association History**.



Access Point	BSSID	Channel	Band	Time
5C-0E-8B-8A-4B-15	5C-0E-8B-8E-2F-60	1	2.4Ghz	Mon Jun 10 2:38:49 2013
5C-0E-8B-8A-4B-15	5C-0E-8B-8E-2F-60	1	2.4Ghz	Mon Jun 10 2:35:43 2013
5C-0E-8B-8A-4B-15	5C-0E-8B-8E-2F-60	1	2.4Ghz	Mon Jun 10 0:32:55 2013

Type to search in tables

Row Count: 3

Refresh

Figure 15-225 *Wireless Client - Association History screen*

Refer to the following to discern this client's Access Point association history:

Access Point	Lists the Access Point MAC address this client has connected to, and is being managed by.
BSSID	Displays the BSSID of each previously connected Access Point.
Channel	Lists the channel shared by both the Access Point and client for interoperation, and to avoid congestion with adjacent channel traffic.
Band	Lists the 2.4 or 5GHz radio band this clients and its connect Access Point are using for transmit and receive operations.
Time	Lists the historical connection time between each listed Access Point and this client.

- 4 Select **Refresh** to update the screen to its latest values.

15.5.6 Graph

► *Wireless Client Statistics*

Use the client **Graph** to assess a connected client's radio performance and diagnose performance issues that may be negatively impact performance. Up to three selected performance variables can be charted at one time. The graph uses a Y-axis and a X-axis to associate selected parameters with their performance measure.

To view a graph of this client's statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **System** from the navigation pane (on the left-hand side of the screen). Expand a RF Domain, select a controller or service platform, an Access Point then a connected client.
- 3 Select **Graph**.
- 4 Use the **Parameters** drop down menu to define from 1- 3 variables assessing client signal noise, transmit or receive values.
- 5 Use the **Polling Interval** drop-down menu to define the interval the chart is updated. Options include *30 seconds*, *1 minute*, *5 minutes*, *20 minutes* or *1 hour*. 30 seconds is the default value.

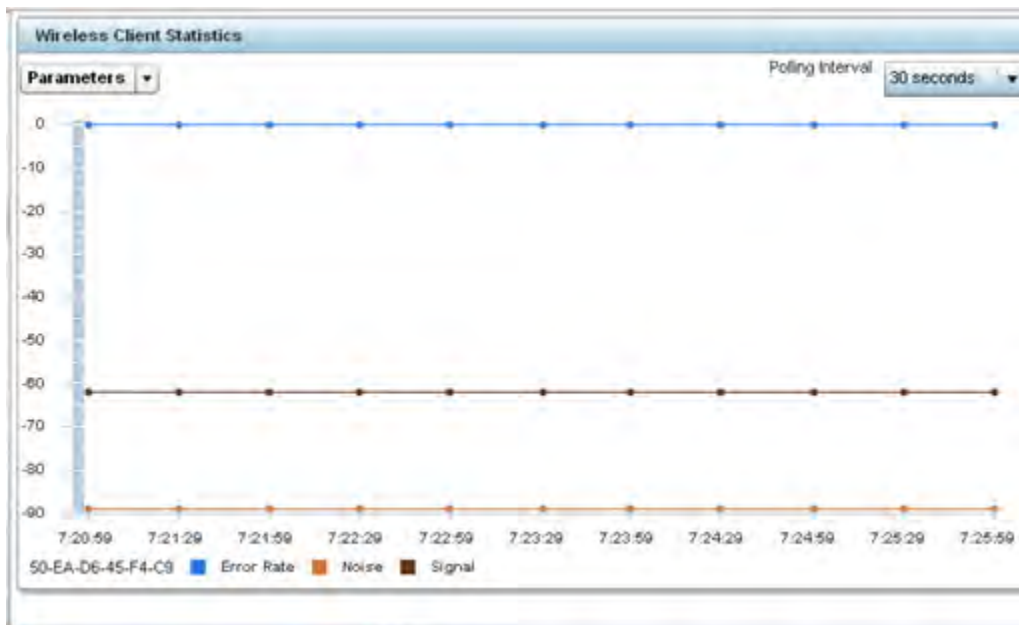


Figure 15-226 *Wireless Client - Graph*

- 6 Select an available point in the graph to list the selected performance parameter, and display that parameter's value and a time stamp of when it occurred.

15.6 Guest Access Statistics

► Statistics

Guest client statistics are uniquely available for wireless clients requesting the required pass code, authentication and access into the WiNG managed guest client network

Guest Access statistics can be assessed for the following:

- *Guest Access Cumulative Statistics*
- *Social Media Statistics*
- *Reports*
- *Notifications*
- *Guest Access Database*

15.6.1 Guest Access Cumulative Statistics

► Guest Access Statistics

The *Statistics* screen displays information on the WiNG managed guest client network. Its includes browser utilization, new versus returning user trends, client user age, client operating system, device type proliferation and gender trending.

To view a cumulative set of client guest access statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **Guest Access** above the navigation pane (on the upper left-hand side of the screen, directly to the right of System).
- 3 Select **Statistics**.

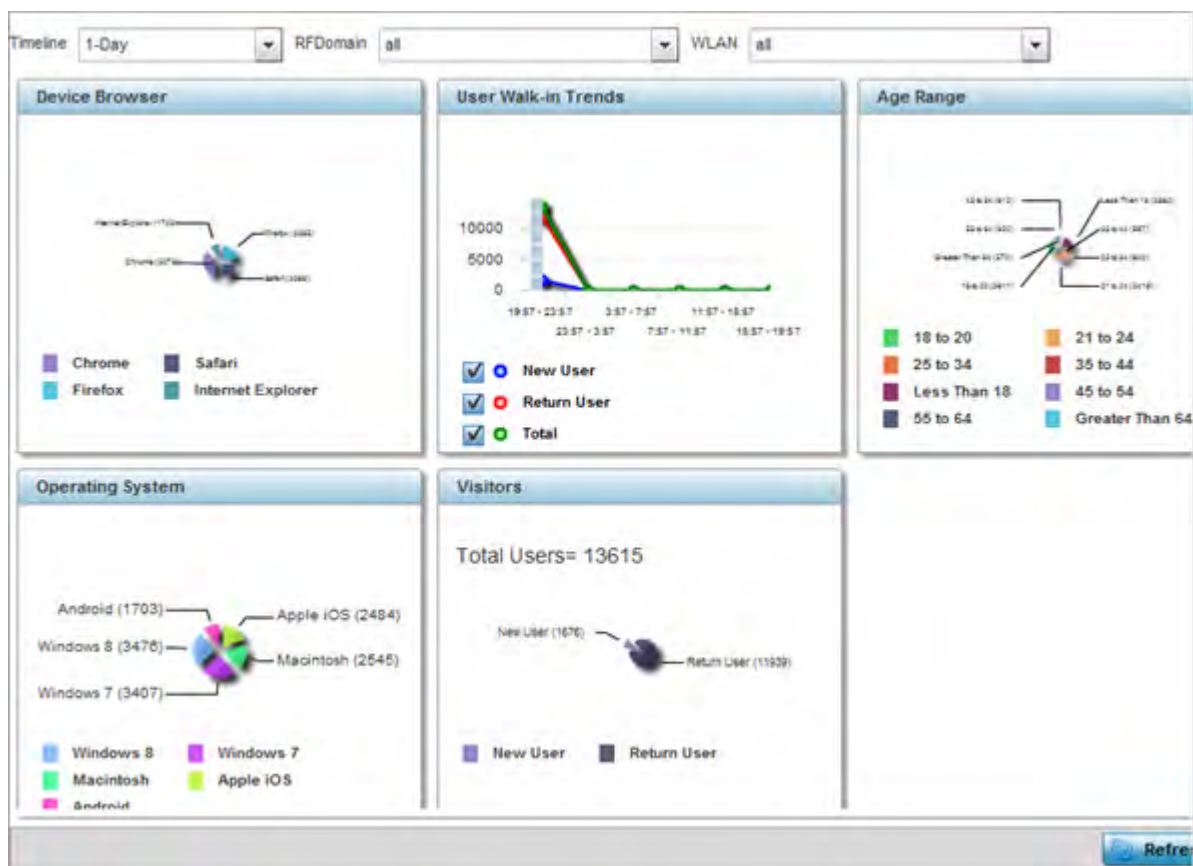


Figure 15-227 Guest Access - Statistics screen

- 4 Refer to the top of the screen to configure how the following trending periods and user filters are set for guest access statistics trending and reporting:

Timeline	Use the drop-down menu to specify whether statistics are gathered for <i>1-Day</i> , <i>1-Month</i> , <i>1-Week</i> , <i>2-Hours</i> , <i>30-Mins</i> or <i>5-Hours</i> . Timelines support the latest time period from present. For example, specifying <i>30-Mins</i> displays statistics for the most recent 30 minutes trended.
RF Domain	Use the drop-down menu to select a single RF Domain from which to filter guest access statistics. Optionally select <i>All</i> to include data from each RF Domain supported.

WLAN	Use the drop down menu to filter guest access statistics to a specific WLAN. A single WLAN can belong to more than one RF Domain.

- 5 Refer to the following to assess guest client browser, operating system, age, gender and new versus returning status to assess whether guest client utilization is in line with WiNG guest access deployment objectives:

Device Browser	Displays guest user browser utilization in pie-chart format. Each client browser type (<i>Chrome, Firefox, Safari and Internet Explorer</i>) detected within the defined trending period displays uniquely in its own color for easy differentiation. The number of guest clients utilizing each browser also displays numerically.
User Walk-in Trends	Walk-in trending enables an administrator to filter new guest access clients versus return guest clients out of the total reported for the trending period and selected RF Domain and WLAN. New guest users (blue), return guests (red) or total guests can either be collectively displayed or individually displayed by selecting one, two or all three of the options.
Age Range	Displays guest user age differentiation in pie-chart format. Age ranges are uniquely color coded as <i>Less Than 18, 18 to 20, 21 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64 and Greater Than 64</i> . Each age group detected within the trending period displays uniquely in its own color for easy differentiation. Each age range also displays numerically. Periodically assess whether the age ranges meet expectations for guest client access within the WiNG managed guest network.
Operating System	Displays guest client operating system utilization in pie-chart format. Each client operating system type (<i>Android, Windows 7, Windows 8, Apple iOS and Macintosh</i>) displays uniquely in its own color for easy differentiation. The number of guest clients utilizing each operating system also displays numerically.
Visitors	Displays return guest clients versus new guest clients in pie-chart format. Both new and returning clients display uniquely in their own color for easy differentiation. Periodically assess whether the number of returning guest clients is line with the guest network's deployment objectives in respect to the RF Domain(s) and WLAN(s) selected for trending.
Customer Loyalty App	Graphically displays the number of guest clients with loyalty application presence enabled. Loyalty application detection occurs on the Access Point to which the client is associated, allowing a retail administrator to assess whether a captive portal client is using specific retail (loyalty) applications in their captive portal. This setting is enabled by default.
Devices	Displays guest client device type utilization in pie-chart format. Each client device type (<i>Windows PC, Macintosh, Apple iPad, Android Mobile and Motorola Droid</i>) displays uniquely in its own color for easy differentiation. The number of each device type detected also displays numerically to help assess their proliferation with WiNG managed guest network.
Gender	Displays guest client gender in pie-chart format. Detected male and female guest users display uniquely in their own color for easy differentiation. Guest clients whose gender is unspecified also displays to help assess the undetermined gender client count out of total. The number of male, female and unspecified guest clients also displays numerically.

- 6 Select the **Refresh** button to update the screen's statistics counters to their latest values.

15.6.2 Social Media Statistics

► Guest Access Statistics

Device registration using social media login credentials requires user validation through the guest user's social media account. The guest user authenticates with an administrator configured social media server like Facebook or Google. Upon successful authentication, the guest user's social media profile data (collected from the social media server) is registered on the device.

To view guest access social media utilization for guest clients:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **Guest Access** above the navigation pane (on the upper left-hand side of the screen, directly to the right of System).
- 3 Select **Social**.

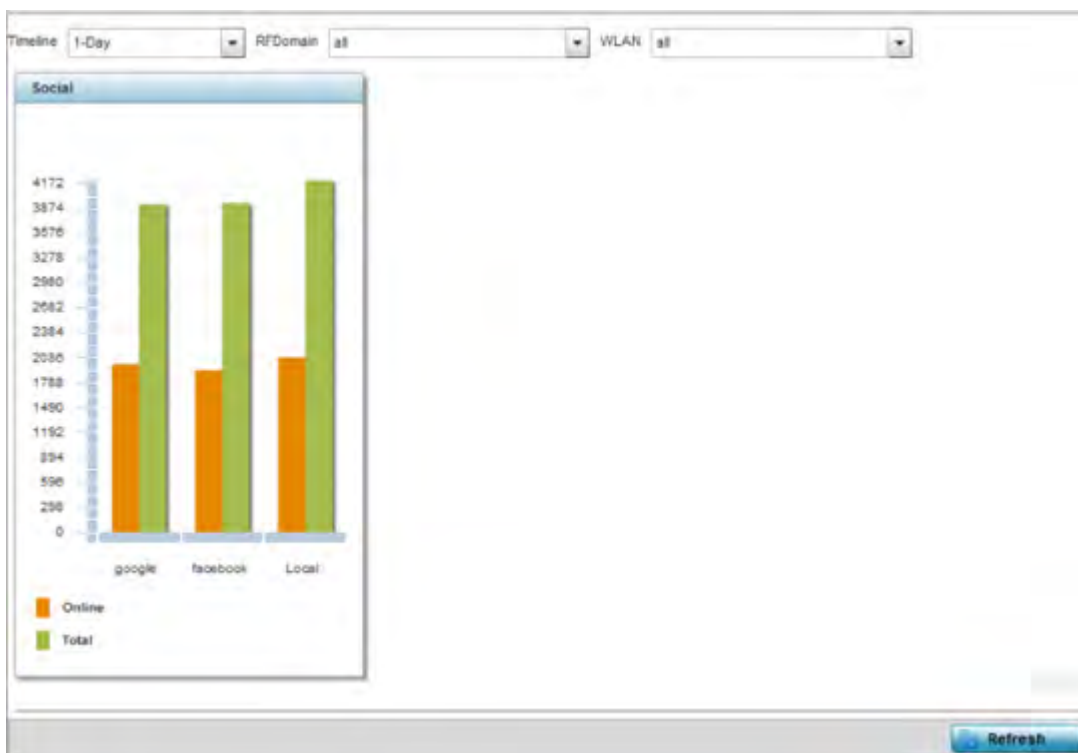


Figure 15-228 Guest Access - Social screen

- 4 Refer to the top of the screen to configure how the following trending periods and user filters are set for guest access social media trending:

Timeline	Use the drop-down menu to specify whether social media statistics are gathered for <i>1-Day</i> , <i>1-Month</i> , <i>1-Week</i> , <i>2-Hours</i> , <i>30-Mins</i> or <i>5-Hours</i> . Timelines support the latest time period from present. For example, specifying <i>30-Mins</i> displays statistics for the most recent 30 minutes trended.

RF Domain	Use the drop-down menu to select a single RF Domain from which to filter social media guest access statistics. Optionally select <i>All</i> to include data from each RF Domain supported.
WLAN	Use the drop down menu to filter guest access social media statistics to a specific WLAN. A single WLAN can belong to more than one RF Domain.

The data displays in bar graph format, with the total number of social media authenticating clients listed in green, and those currently online displayed in orange for both Google and Facebook authenticating clients. Refer to the **Local** graph to assess those clients requiring captive portal authentication as a fallback mechanism for guest registration through social media authentication.

- Periodically select **Refresh** to update the statistics counters to their latest values.

15.6.3 Reports

► Guest Access Statistics

Report queries can be filtered and run to obtain information on targeted guest clients within the WiNG guest network.

To generate customized guest client reports:

- Select the **Statistics** menu from the Web UI.
- Select **Guest Access** above the navigation pane (on the upper left-hand side of the screen, directly to the right of System).
- Select **Reports**.

Figure 15-229 Guest Access - Reports screen

- Select the drop-down menu at the top, left-hand, side of the screen to define whether the guest client's report data is fetched based on its *MAC*, *Name*, *Mobile*, *Email*, *Member* or *Time*. Once provided, enter an appropriate search string to generate a report for the target guest client. When completed with the report's search strings, select **Get Data**.

5 Refer to the **User Data** table to review the following report output:

MAC	Displays the factory encoded hardware MAC address assigned to this guest client at the factory by the manufacturer. This is the guest client's hardware identifier added to the guest user database. If the guest client requests access later, this MAC address is validated against the guest user database, and the client is allowed access to the WiNG managed guest network.
Name	Lists the name used for guest access authentication and pass code generation.
Email	Lists the E-Mail address used for guest access authentication and the receipt of the required passcode.
Mobile	Lists the guest client's registered mobile number used for guest access authentication requests and the receipt of the required passcode.
Source	Lists the source (Facebook, Google) whose username and password were used as the clients's social media authenticator.

15.6.4 Notifications

► Guest Access Statistics

For each registered guest user, a passcode is sent by E-mail, SMS or both. A guest management policy defines E-mail host and SMS gateway commands, along with credentials required for sending a passcode to guest client via E-mail and SMS. Users can configure up to 32 different guest management policies. Each policy enables the user to configure the SMS gateway, SMS message body, E-mail SMTP server, E-mail subject contents and E-mail message body. There can be only one guest management policy active per device at any one time.

The *short message service* (SMS) is the text messaging service component of phone, E-Mail and mobile systems. SMS uses standardized communications protocols to allow fixed or mobile phone devices to exchange text messages.

To review guest client notification statistics:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **Guest Access** above the navigation pane (on the upper left-hand side of the screen, directly to the right of System).
- 3 Select **Notification**.

The screenshot displays a web interface for monitoring gateway statistics. It is divided into three main sections: Clickatell Gateway, SMS to SMTP Gateway, and E-Mail Gateway. Each section contains a list of status fields and their corresponding values or indicators.

Clickatell Gateway	
Status	:
Available Credit	: 0
Session ID	:
Message ID	:
Last SMS Time	:
Last SMS Number	:
Last SMS Sent Status	:
Last SMS Authentication Status	:

SMS to SMTP Gateway	
Last E-Mail Time	:
Last E-Mail To	:
Last E-Mail Status	:

E-Mail Gateway	
Last E-Mail Time	:
Last E-Mail To	:
Last E-Mail Status	:

Figure 15-230 *Guest Access - Notification screen*

- 4 Review the following **Clickatell Gateway** information. By default, clickatell is the host SMS gateway server resource for guest access.

Status	Displays an icon as a visual indicator of the gateway status. Green defines the gateway as available. Red indicates the gateway is down and unavailable.
Session ID	Lists an event ID for the clickatell gateway session credential and passcode exchange.
Message ID	Lists the unique SMS message ID created for the successful message exchange with the clickatell host SMS gateway server.
Last SMS Time	Lists the timestamp appended to the sent time of the clickatell SMS gateway message.
Last SMS Number	Lists the numeric status code returned in response to a SMS gateway server guest access request.
Last SMS Sent Status	Lists the associated status strings returned in response to a SMS gateway server guest access request.

Last SMS Authentication Status	Lists the SMS authentication credential and validation message exchange status for the listed cleckatell gateway session ID.

5 Review the following **SMS to SMTP Gateway** information.

Last E-Mail Time	Displays the most recent E-Mailed passcode to a guest via SMS. SMS enables guest users to register with their E-Mail or mobile device ID as the primary key for authentication.
Last E-Mail To	Lists the recipient of the most recent SMS to SMTP server credential E-mail exchange containing the required passcode for the registered guest.
Last E-Mail Status	Lists the completion status of the most recent server SMS to SMTP gateway credential exchange containing the required passcode for the authenticating guest client.

6 Review the following **Email Gateway** information.

Last E-Mail Time	Displays the time of the most recent E-Mailed passcode to a guest access requesting client. Guest users can register with their E-mail credentials as the primary means of authentication.
Last E-Mail To	Lists the recipient of this session's server E-Mail credential exchange containing the required passcode for the authenticating guest client.
Last E-Mail Status	Lists the completion status of the most recent server E-Mail credential exchange containing the required passcode for the authenticating guest client.

15.6.5 Guest Access Database

► Guest Access Statistics

Refer to the **Database** screen to periodically *import* or *export* guest access information to and from a WiNG managed device. The import or export of the guest access database is supported in JSON format only. Archiving guest access utilization data is a good way to assess periods of high and low utilization and better plan for client guest access consumption of controller or Access Point network resources.

To administrate the guest access database:

- 1 Select the **Statistics** menu from the Web UI.
- 2 Select **Guest Access** above the navigation pane (on the upper left-hand side of the screen, directly to the right of *System*).
- 3 Select **Database**.

Figure 15-231 Guest Access - Database Import/Export screen

- 4 Select **Export** to archive guest access data (in JSON or CSV format) to a designated remote location, or **Import** to upload guest access utilization data back to the WiNG managed controller, service platform or Access Point.
- 5 If conducting an **Export** operation, provide the following to refine the data exported:

Format	Define whether the guest access data is exported in <i>JSON</i> or <i>CSV</i> format. <i>JavaScript Object Notation</i> (JSON) is an open standard format using text to export data objects consisting of attribute value pairs. A <i>comma-separated values</i> (CSV) file stores tabular data in plain text. Plain text means that the file is interpreted a sequence of characters, so that it is human-readable with a standard text editor. Each line of the file is a data record. Each record consists of one or more fields, separated by commas.
Timeline	Use the drop-down menu to specify whether guest access statistics are exported for the previous 1-Day, 1-Month, 1-Week, 2-Hours, 30-Mins or 5-Hours. Timelines support the latest time period from present. For example, specifying 30-Mins exports statistics trended over the most recent 30 minutes.
RF Domain	Use the drop-down menu to select a single RF Domain from which to filter social media guest access statistics. Optionally select <i>All</i> to include data from each RF Domain supported.
WLAN	Use the drop down menu to filter guest access social media statistics to a specific WLAN. A single WLAN can belong to more then one RF Domain.

- 6 When exporting or importing guest access data (regardless of format), provide the following **URL** data to accurately configure the remote host.

Format	Select the data transfer protocol used for exporting or importing guest access data. Available options include: <i>tftp</i> <i>ftp</i> <i>sftp</i>
Port	Use the spinner control to set the virtual port for the for the export or import operation.
Host	Provide a textual <i>hostname</i> or numeric IP address of the server used for guest access data transfer operations. Hostnames cannot include an underscore character. Select <i>IPv4 Address</i> to use an IPv4 formatted address as the host. Select <i>IPv6 Address</i> to use an IPv6 formatted address as the host. IPV6 provides enhanced identification and location information for computers on networks routing traffic across the Internet. IPv6 addresses are composed of eight groups of four hexadecimal digits separated by colons.
User Name	If using FTP or SFTP and the data transfer protocol, enter the <i>username</i> required by the remote FTP or SFTP server resource.
Password	If using FTP or SFTP and the data transfer protocol, enter the password required by the remote FTP or SFTP server resource.
Path/File	Specify the path to the server resource where guest access data is either exported or imported. Enter the complete relative path to the file on the server. If electing to use SFTP as the file transfer protocol, its recommended the path/file be set using the <i>command line interface</i> (CLI).

- 7 When the URL data is accurately entered, select the **Export** or **Import** button respectively to initiate the operation.
- 8 Optionally select the **Delete** tab to purge either all or part of the guest user database.



Figure 15-232 Guest Access - Database Deletion screen

- 9 Select **All** to remove the contents of the entire database. Select **Any** to invoke a drop-down menu where *Mac, Name, Mobile, Email* or a *WLAN* can be selected to refine the database removal to just a selected entity. Enter the name of the MAC address, user, mobile number or WLAN you wish to remove from the database, then select **Delete**.

15.7 Analytics Developer Interface

► Statistics

The analytics developer interface is an additional tool available to administrators to review specific APIs in granular detail. The developer interface is available to elected NOC controllers or service platforms capable of provisioning all of its peer controllers, service platforms and adopted devices. NOC controllers include NX9000, NX9500, NX9510, NX7500, and RFS6000 models.

To access the developer interface:

- 1 Connect to controller using its existing IP address, but append **/stats** to the end of the IP address as follows:
http://<CONTROLLER_IP_ADDRESS>/stats or https://<CONTROLLER_IP_ADDRESS>/stats

The following login screen displays for the developer interface:



Figure 15-233 *Developer Interface - Login screen*

- 2 Provide the same **Username** and **Password** credentials you're currently utilizing for a typical controller login. Once the login credentials are successfully entered, the following screen displays:

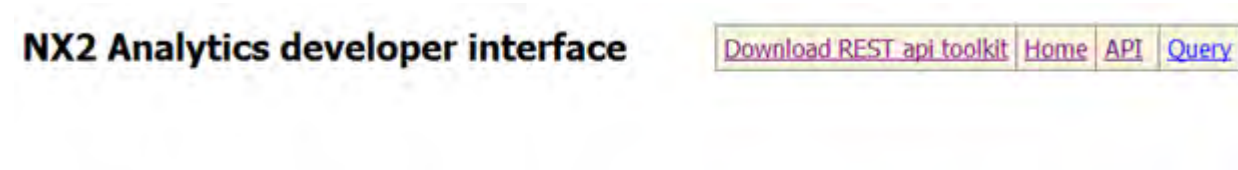


Figure 15-234 *Developer Interface - Main screen*

Refer to the following for more detailed descriptions of the functionality available to administrators using the analytics developer interface:

- [Download REST API Toolkit](#)
- [API Assessment](#)

15.7.1 Download REST API Toolkit

► Analytics Developer Interface

Sample *Representational State Transfer* (REST) code can be downloaded from the toolkit. REST is a software design schema for Web application development.

To download sample REST API code:

- 1 Select **Download REST api toolkit** from the Web UI.

A **File Download** screen displays prompting for the desired location of the download or whether the files should be opened directly.

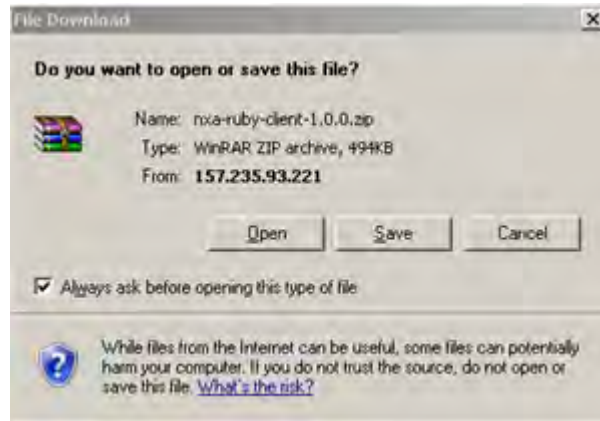


Figure 15-235 Developer Interface -File Download screen

- 2 Open the zip archive and review the **Readme** file to assess the contents and how they can be leveraged for API creation and modification.

Sample Ruby Client

A sample ruby client is provided as part of this package. The Ruby client can be used as a sample to pull statistics data from NXAnalytics. The response from NXAnalytics is in JSON format.

Contents

Readme.txt file.

Ruby script files:

NXStatsClient.rb

NXARESTClient.rb

NXResultsJSONParser.rb

NXLogin.rb

NXAException.rb

NXAConstants.rb

NXAConnectionParams.rb

Requirements To Run Sample Ruby Client

Ruby 2.0 or above. The sample has been tested with Ruby 2.0. To download Ruby use the following:

<https://www.ruby-lang.org/en/downloads/or> <http://rubyinstaller.org/>

Additional Ruby Gems needed to run the sample client are the following.

- ipaddress
- json
- rest-client

Please install the gems before running the sample client.

How To Run the Program From Command Line

```
ruby NXStatsClient <IPAddress Of Controller>  
    <Protocol[http|https]> <Port [8080|443]>  
    <Stats_Type>[wlan | rfdomain | radio | client | captive-portal | client-assoc-disassoc]  
    <lookback_duration_in_seconds [ 1 - 2592000]>  
    <username> <password>  
    <number_of_results_to_return [ 1 - 100]>
```

Sample:

```
ruby NXStatsClient 172.20.33.45 https 443 rfdomain 600 admin admin 30
```

How To Run the Program From IDE

If you are using Eclipse or APTANA or any other IDE please do the following.

- Choose appropriate network proxy settings
- Configure IDE to choose appropriate Ruby interpreter
- Create a Ruby project
- Copy the Ruby files as part of package to the new Ruby project
- Define the arguments required for the main Ruby program
- Run the main Ruby program

15.7.2 API Assessment

► *Analytics Developer Interface*

Refer to the toolkit's API functionality to review a collection of APIs for specific feature groups, including captive portals, client associations and disassociations, client stats, RF Domains.

To review the toolkit's built-in set of APIs:

- 1 Select **API** from the Web UI.

NX2 Features Interface

Current Feature is catalog_features

The screenshot displays the 'NX2 Features Interface'. At the top, it states 'Current Feature is catalog_features'. Below this, there is a section titled 'Available Features In catalog' which contains a list of features with expandable icons (circles with a dot) and links to 'query' and 'catalog' pages. The features listed are: CaptivePortalClientStats, ClientAssociationDisassociation, ClientStats, RFDomain, RadioStats, and WlanStats. To the right of this list is a 'List' section with a yellow background. It contains a text input field labeled 'Enter Params (n1=v1,n2=v2):' with the value 'id=' entered. Below the input field is a 'Go' button.

Figure 15-236 *Developer Interface - API*

- 2 Select an available feature from the catalog of features.

An administrator can either launch a **query** for a selected feature or select **catalog** to expose the schema for a selected feature.

- 3 Select **query** to display the **NX2 Raw Query Interface**.

NX2 Raw Query Interface



The screenshot shows a window titled "NX2 Raw Query Interface" with a text area containing the following query configuration:

```
from:
  location: (nx_state,s,d)
  id: f.*
  backWindow: 600
```

At the bottom right of the window is a "GO" button.

Figure 15-237 *Developer Interface - API Raw Query Interface*

- 4 Select **Go** to initiate the query for the selected item.

```

- <data>
  - <RFDomainStats>
    <snr>92</snr>
    <txPps>0</txPps>
    <rxBps>0</rxBps>
    <signal>0</signal>
    <numANRAdios>1</numANRAdios>
    <numSensors>1</numSensors>
    <txIndex>0</txIndex>
    <numAClients>0</numAClients>
    <numRadios>3</numRadios>
    <rfDomain>default</rfDomain>
    <threatLevel>0</threatLevel>
    <totalPps>0</totalPps>
    <txErrors>0</txErrors>
    <totalMgmtPkts>0</totalMgmtPkts>
    <txPps>0</txPps>
    <totalBps>0</totalBps>
    <txPkts>41</txPkts>
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    <numANClients>0</numANClients>
    <txBytes>13170</txBytes>
    <txBCMCPkts>0</txBCMCPkts>
    <numBGNRRadios>1</numBGNRRadios>
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    <rxBytes>6042</rxBytes>
    <noise>-.92</noise>
    <numBGClients>0</numBGClients>
    <txDropped>0</txDropped>
    <rxPkts>46</rxPkts>
    <numBClients>0</numBClients>
    <maxUserRate>0</maxUserRate>
    <txMgmtPkts>0</txMgmtPkts>
    <qIndex>100</qIndex>
    <txBCMCPkts>0</txBCMCPkts>
    <txBps>0</txBps>
    <totalBytes>19212</totalBytes>

```

Figure 15-238 *Developer Interface - API Raw Query Results*

The results of the query display the values currently set for the selected feature. This information cannot be manipulated as a configurable API attribute, though this information can be utilized as criteria for API attribute creation.

- 5 From the NX2 Features Interface, select a feature from those available and select **catalog**.

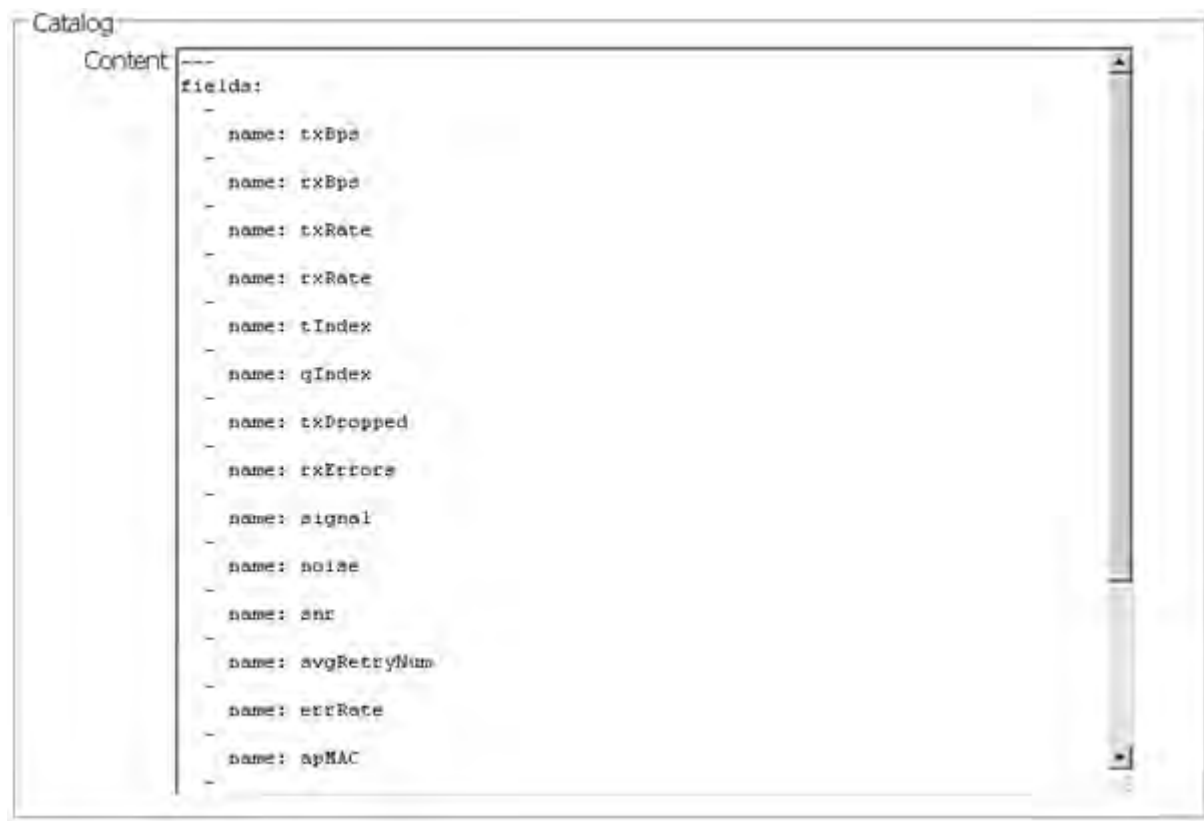


Figure 15-239 *Developer Interface - API Catalog*

The catalog item selection displays the values currently set for the selected feature. As with queries, this information cannot be manipulated as a configurable API attribute, though this information can be utilized as criteria for API attribute creation.

16 Analytics

A NX9500 and NX9510 model service platforms can provide granular and robust analytic reporting for a RFS4000 and RFS6000 controller managed network. Using analytics, data is collected and reported at varying intervals. Analytic data is culled from WLANs at either the system, RF Domain, controller/service platform or Access Point level.

Analytics can parse and process events within the NOC managed network as events are received.

The analytics display resembles the *Health* and *Inventory* pages available to controllers and Access Points, though Analytics provides performance information at a far more granular level.

The analytics user interface populates information within a *data store*, with multiple displays partitioned by performance function. The data store is a customizable display managed with just the content the administrator wants viewed. The data store is purged after 90 days if no administration is conducted sooner.

A separate analytics license is enforced at the NOC. The license restricts the number of Access Point streams processed at the NOC or forwarded to partner systems for further processing. The analytics feature can be turned on at select APs by enabling them in configuration. This way the customer can enable analytics on a select set of APs and not the entire system as long as the number of APs on which it is enabled is less than or equal to the total number of AP analytics licenses available at the NOC controller.

For more information, see:

- [System Analytics](#)
- [RF Domain Analytics](#)
- [Wireless Controller Analytics](#)
- [Access Point Analytics](#)
- [Analytic Event Monitoring](#)

16.1 System Analytics

Analytics can be administrated at the system level to include all RF Domains, their controller or service platform memberships, adopted Access Points and their connected clients. For information on monitoring analytic events, refer to [Analytic Event Monitoring](#).

To administrate analytics system-wide:

- 1 Select **Statistics** from the Web UI.
- 2 Select the **Analytics** menu item directly to the right of the System menu item within Statistics.

The analytics screen displays with **Captive Portal** data displayed by default.

Refer to the arrow icon located in the top, right-hand, side of each panel to define whether the display is in Chart format, a Table or whether you would like the output for that parameter saved as a PDF report at a user specified location.



Figure 16-1 System Analytics - Captive Portal screen

- 3 Refer to the upper, right-hand, portion of the analytics interface and define the trending period for the data displayed. Options include *Last 1 Day*, *Last 3 Days*, *Last 1 Week*, *Last 2 Weeks*, *Last 3 Weeks*, *Last 1 Month*, *Last 2 Months* or *Last 3 Months*. Today is the default setting for trending analytics data.
- 4 Refer to the following **Captive Portal** analytic data trended and reported in real-time on the selected interval:

Device Types	Displays a pie chart (by default) of the captive portal clients (smart phones, tablets, laptops etc.). Select the table icon from the top, right-hand, side of the field to display the data in table format. Both the pie chart and table display the device type and the percentage of those devices only within the captive portal.
Device OS	Displays a pie chart (by default) of connected devices (using captive portal authentication), differentiated by their operating system (<i>Windows</i> , <i>Linux</i> , <i>Android</i> etc.). Select the table icon from the top, right-hand, side of the field to display the data in table format. Both the pie chart and table display the OS type and the percentage of that device OS type only within the captive portal.
Browser Types	Displays a pie chart (by default) of the browser types utilized by captive portal authenticated devices. Select the table icon from the top, right-hand, side of the field to display the data in table format. Both the pie chart and table display the OS type by percentage of utilization only within the captive portal.

Top X URLs	Reports the top visited URLs by connected clients using captive portal authentication. Use the spinner control to refine the number of URLs reported, then select <i>Reload</i> to update the display. Set whether the content is displayed as a chart or as a table.
Search Terms	Lists the number of unique clients who searched for using a search term. Each display option lists the search term and the number of times each term was searched by a connected captive portal client. For example, if there's two clients (clients <i>A</i> and <i>B</i>), and client <i>A</i> searched for "extremenetworks" 5 times and <i>B</i> searched for "extremenetworks" 2 times. The count would be 2 and not 7. As with URLs, search terms are normalized (aggregated daily).
Normalized URLs	Reports URLs visited most often, <i>normalized</i> (aggregated daily), by devices using captive portal authentication. Select the arrow to the left of each listed URL timestamp to populate the URL and Count columns with the specific URLs visited and the number of times they've been visited.
Unique vs Repeat Users	Displays a breakdown of repeat versus new users to the captive portal. Both a chart and a table display are available, each with a timestamp of when the data was collected.
Device Count Per AP	Displays the number of top performing Access Points reporting connected client counts using captive portal authentication.
Clients in WLAN	Displays the number of managed WLANs reporting connected client counts. Client analytics are trended every 75 minutes.

- 5 Select **Client Analytics** to display analytic level data for connected wireless clients.



NOTE: Be sure to select the **Search** button adjacent to the **Search for Wireless Client** parameter to ensure the tables are populated and refreshed with detected wireless clients. Client analytics are trended every 75 minutes.

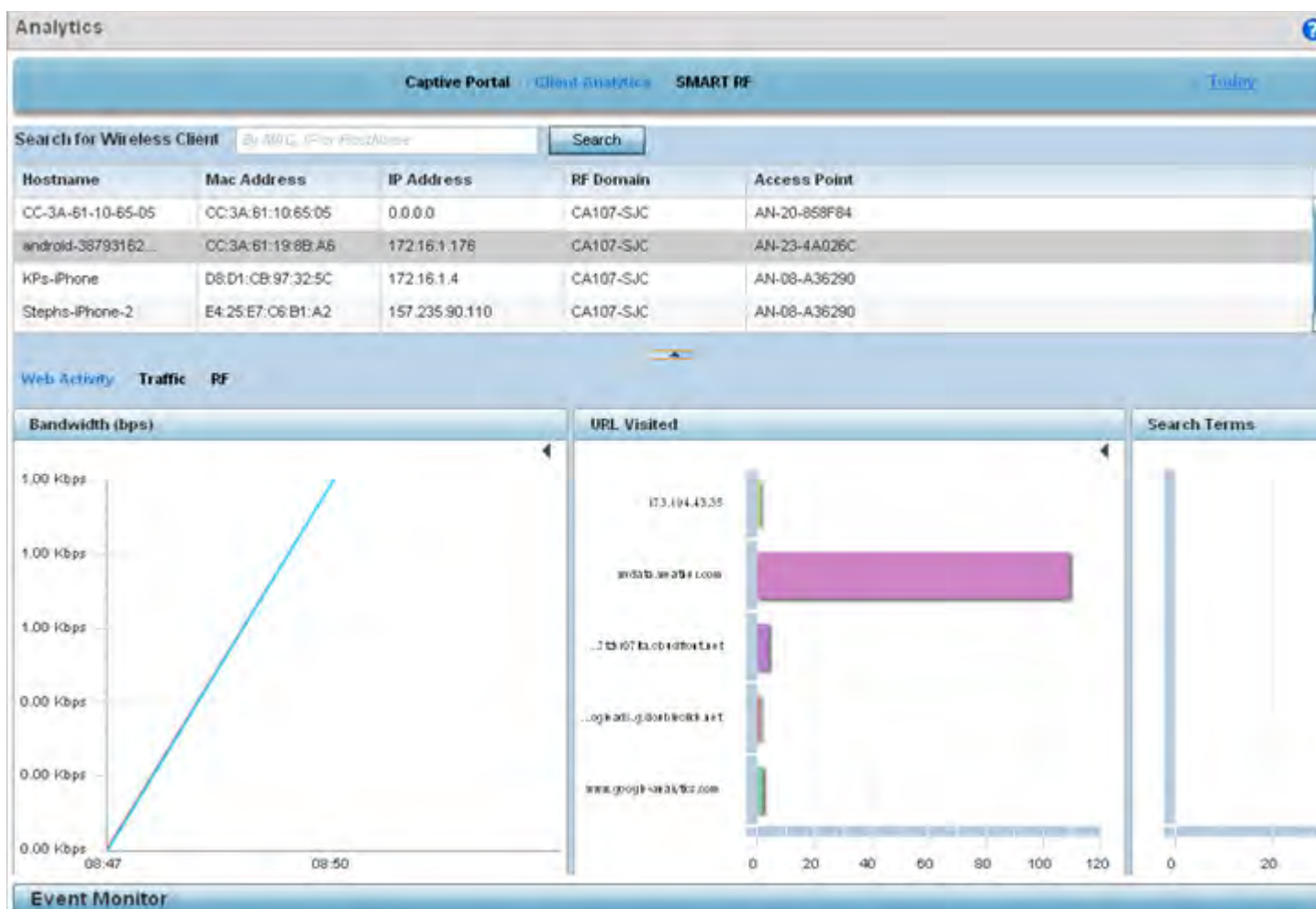


Figure 16-2 System Analytics - Client Analytics screen

6 Refer to the following **Client Analytics** trended at the selected interval:

Hostname	Lists the administrator assigned hostname set for each listed client when connected to the controller, service platform or Access Point managed network.
Mac Address	Displays the factory encoded MAC address for the listed client as a hardware manufacturing ID.
IP Address	Lists the IP addresses the client is using as a wireless network identifier within the controller, service platform or Access Point managed network.
RF Domain	Lists the client's current RF Domain membership. RF Domains allow administrators to assign regional, regulatory and RF configuration to devices deployed in a common coverage area such as on a building floor, or site. Each RF Domain contains regional, regulatory and sensor server configuration parameters and may also be assigned policies that determine access, Smart RF and WIPS configuration.
Access Point	Displays an administrator assigned hostname for each listed Access Point whose radio is providing a network connection for the wireless network.

The Client Analytics screen contains **Web Activity**, **Traffic** and **RF** displays within the lower half of the screen. Each of these analytics display an administrator's choice of graphical or tabled data for the client's Web activity, SNR, network interference, signal quality and packet retries.

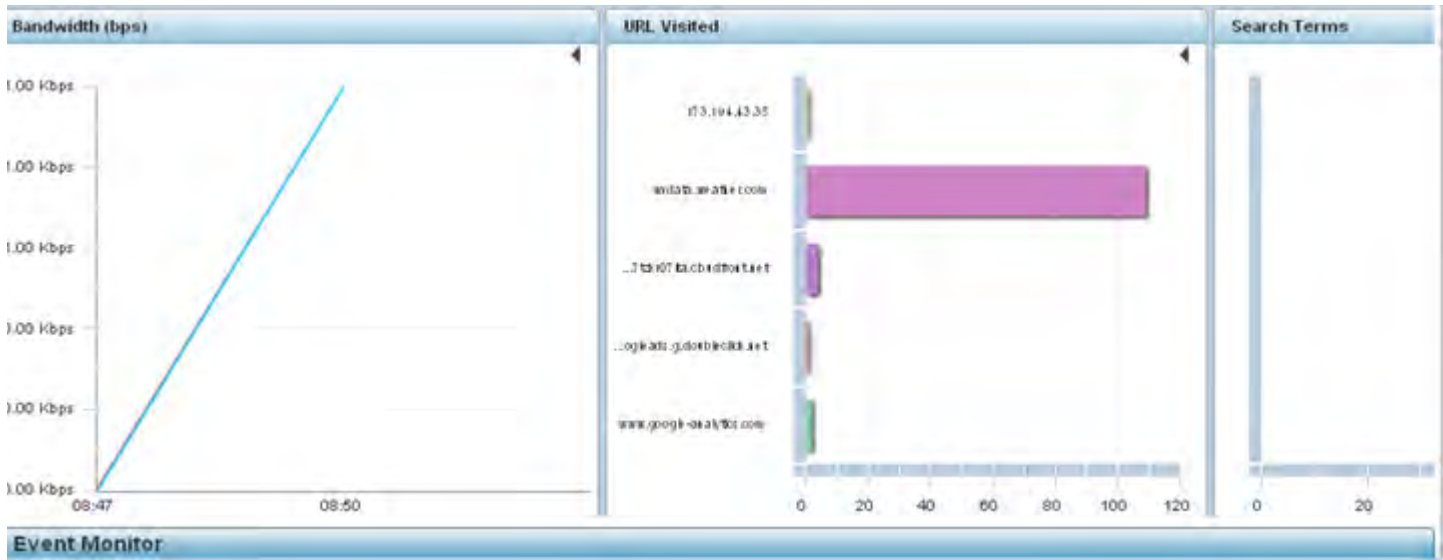


Figure 16-3 System Analytics - Client Web Activity screen

7 The **Web Activity** field displays by default with the following content trended in the selected interval:

Bandwidth	Displays the client's Web activity bandwidth utilization in <i>Bits per second</i> (Bps) in either chart or table format.
URL Visited	Displays URLs visited by a selected client in either chart or table format. Either display contains the Web destination URL and the number of times the URL was accessed by the client.
Search Terms	Displays terms used as search Web search criteria by connected clients in either chart or table format. Either display contains the search item and the number of times the term was searched by the client.

8 Select **Traffic**.

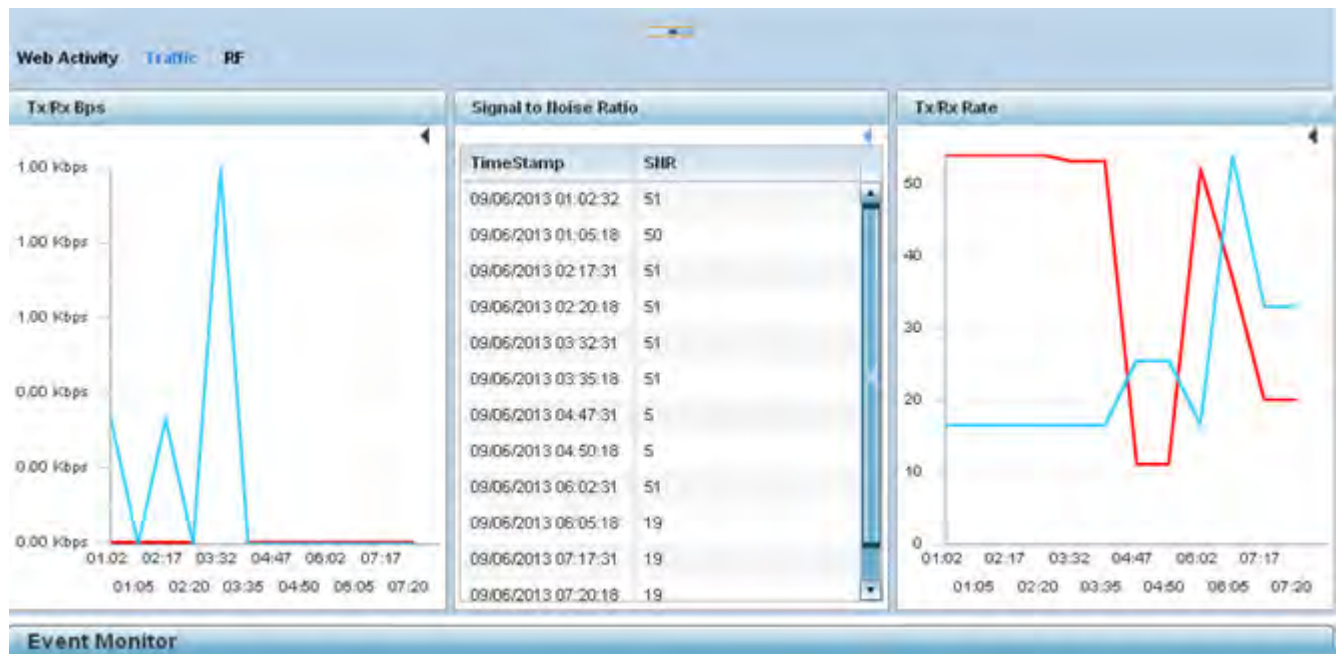


Figure 16-4 System Analytics - Client Traffic screen

9 Refer to the following client **Traffic** analytics trended at the selected interval:

Tx/Rx Bps	Displays the <i>Bits per second</i> (Bps) speed of data both transmitted from and received at the listed client, in either chart or table format.
Signal to Noise Ratio	Displays the connected client's <i>signal to noise ratio</i> (SNR) and a time stamp of its reporting. A high SNR could warrant a different Access Point connection to improve performance.
Tx/Rx Rate	Displays the connected client's transmit and receive data rate in either chart or table format.

10 Select **RF**.

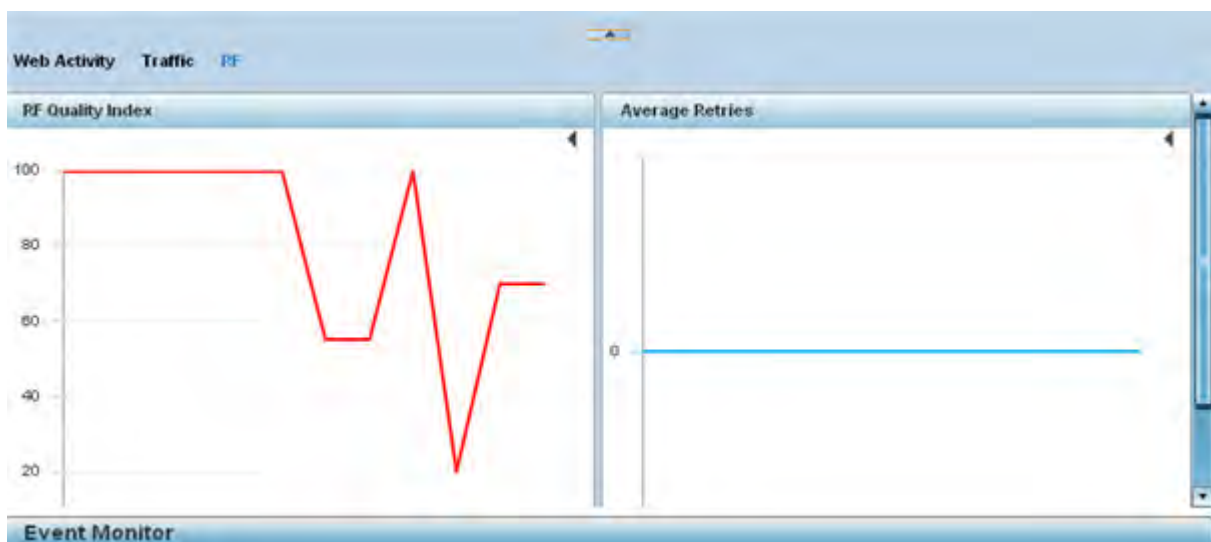


Figure 16-5 System Analytics - Client RF screen

- 11 Refer to the following client **RF** analytics trended in the selected interval:

RF Quality Index	Displays the overall effectiveness of the system-wide RF environment as a percentage of the connect rate in both directions. The RF quality index value can be interpreted as: 0 – 20 (<i>Very low utilization</i>) 20 – 40 (<i>Low utilization</i>) 40 – 60 (<i>Moderate utilization</i>) 60 and above (<i>High utilization</i>)
Average Retries	Displays the rate of client connection retry attempts and a timestamp of their occurrence in either chart or table format. A high number indicates potential network or hardware issues.

- 12 Select **Smart RF** to display system-level power and channel compensation analytics:

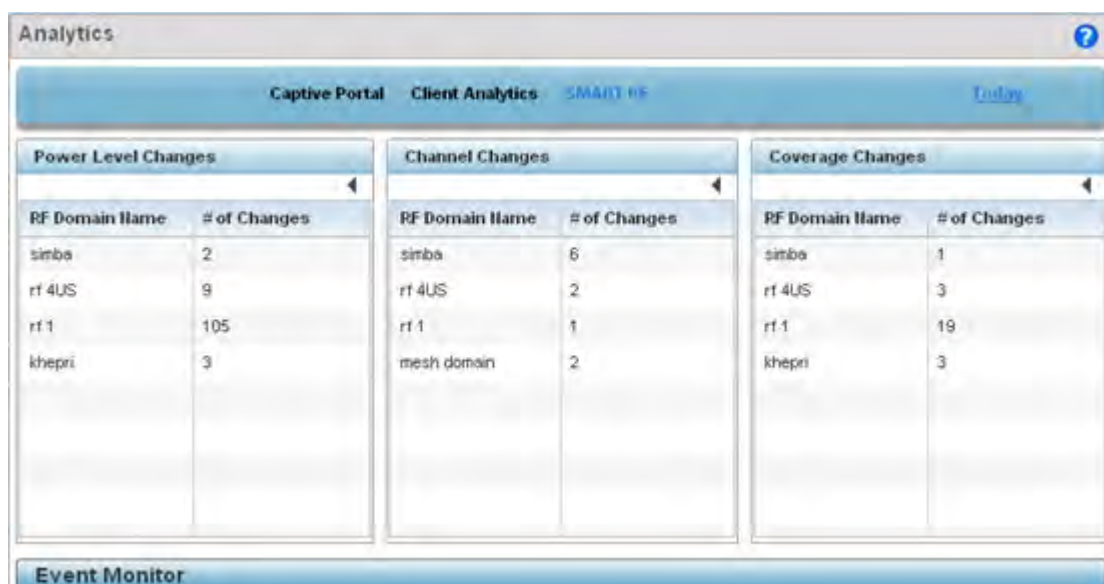


Figure 16-6 System Analytics - Smart RF screen

- 13 Refer to the following system-wide power level, channel and coverage **Smart RF** analytics trended in real-time at the administrator defined interval:

Power Level Changes	Displays the number of Smart RF power level compensations made for the system's RF Domains during the defined analytic reporting interval. This helps an administrator assess the device power changes needed to accommodate a potentially failed or poorly performing device and provides an overall insight into the overall duty cycle requirements of a particular RF Domain.
Channel Changes	Displays the number of Smart RF channel change compensations made for the system's RF Domains during the defined analytic reporting interval.
Coverage Changes	Displays the number of Smart RF coverage change compensations made for the system's RF Domains during the defined analytic reporting interval.

16.2 RF Domain Analytics

Additional analytics are available at the RF Domain level of the user interface for trending data for specific groups of RF Domain member devices. RF Domain analytics are trended every 60 minutes. For information on monitoring analytic events, refer to [Analytic Event Monitoring](#).

To administrate RF Domain level analytics:

- 1 Select **Statistics** from the Web UI.
- 2 Select the **Analytics** menu item directly to the right of the System menu item within Statistics.
- 3 Expand the System hierarchy on the left-hand side of the user interface and select a RF Domain.
The Analytics screen displays with the **Captive Portal** tab displayed by default. This is the same data presented at the system level of the user interface. For more information on captive portal analytics, see [System Analytics on page 16-1](#).
- 4 Select **Traffic** to assess throughput and bandwidth utilization information reported collectively for selected RF Domain member devices. Use the **WLAN** drop-down menu to refine whether traffic statistics are reported for a particular RD Domain WLAN or reported collectively for all WLANs.
Refer to the arrow icon located in the top, right-hand, side of each panel to define whether the display is in Chart format, a Table or whether you would like the output for that parameter saved as a PDF report at a user specified location.

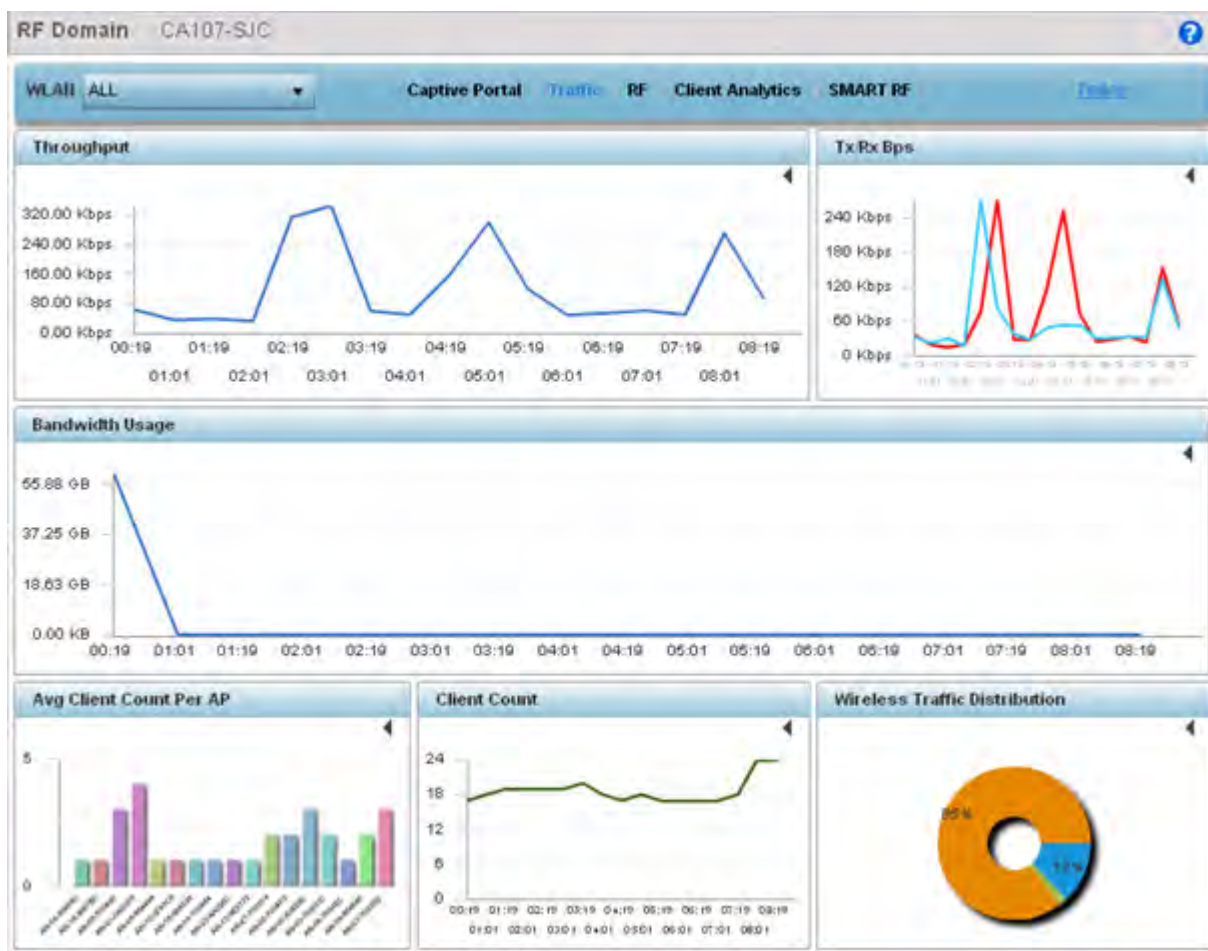


Figure 16-7 RF Domain Analytics - Traffic screen

- 5 Refer to the upper, right-hand, portion of the analytics interface and define the trending period for the data displayed. Options include *Yesterday*, *Last 24 Hours*, *Last 3 Days*, *Last 1 Week*, *Last 2 Weeks*, *Last 3 Weeks*, *Last 1 Month*, *Last 2 Months* or *Last 3 Months*. Today is the default setting for trending analytics data.
- 6 Refer to the following **Traffic** analytic data trended and reported for RF Domain member devices:

Throughput	Lists RF Domain member device throughput (in Mbps) as an overall indicator of RF traffic activity of all RF Domain member devices. Assess whether specific times of the day require additional RF domain member device support to adequately support RF traffic requirements.
Tx/Rx Bps	Displays <i>transmit</i> and <i>receive</i> data (in Bps) for RF Domain member devices over the listed trending period.
Bandwidth Usage	Lists RF Domain member bandwidth utilization (in Kbps) to help an administrator assess periods of sustainable versus unsustainable activity.
Average Client Count per AP	Displays RF Domain member Access Points and their connected client counts. Assess whether particular client counts are excessive, and whether loads can be better distributed amongst RF Domain member Access Points. Client analytics are trended every 75 minutes.
Client Count	Lists RF Domain member Access Point connected client counts. Use the trending data to assess periods of high versus low client connection activity. Client analytics are trended every 75 minutes.

Wireless Traffic Distribution	Displays a chart of unicast versus management frames transmitted by RF Domain member devices.

- 7 Select **RF** to display RF Domain member device RF quality, detected network interference (noise) and device connection retries.

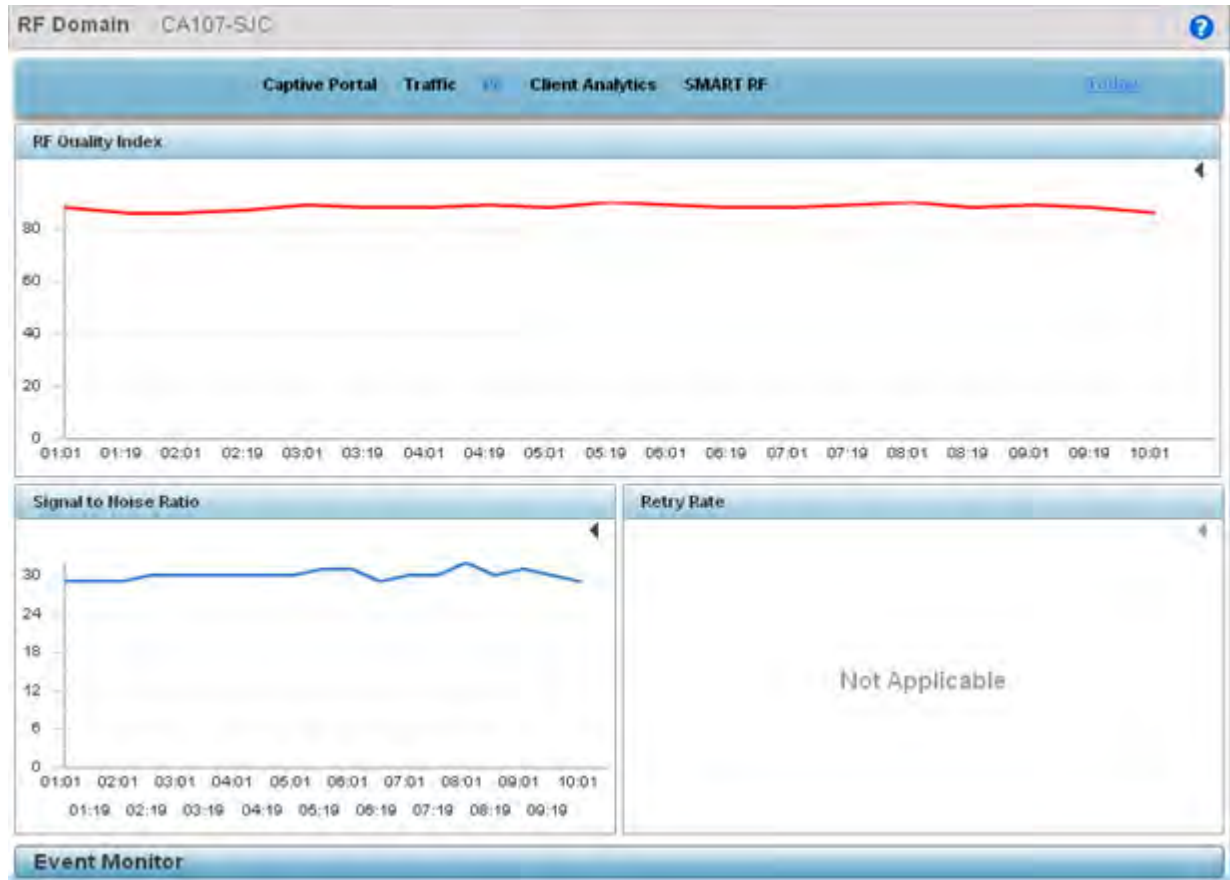


Figure 16-8 RF Domain Analytics - RF screen

- 8 Refer to the following **RF** analytics trended for a selected RF Domain:

RF Quality Index	Displays the trended graph of the effectiveness of a selected RF Domain's RF environment as a percentage of the connect rate in both directions. The RF quality index value can be interpreted as: 0 - 20 (<i>Very low utilization</i>) 20 - 40 (<i>Low utilization</i>) 40 - 60 (<i>Moderate utilization</i>) 60 and above (<i>High utilization</i>).
Signal to Noise Ratio	Displays a selected RF Domain's connected client <i>signal to noise ratio</i> (SNR) and a time stamp of its reporting. A high SNR could warrant power compensation to account for poorly performing radios.
Retry Rate	Lists the number of retry attempts for requesting client connections to RF Domain member device radios.