CHAPTER 1

Overview

This chapter describes the role of the Cisco 3300 series mobility services engine (MSE) and the Cisco Adaptive Wireless Intrusion Prevention System (wIPS) within the overall Cisco Unified Wireless Network (CUWN).

This chapter contains the following sections:

Overview of wIPS

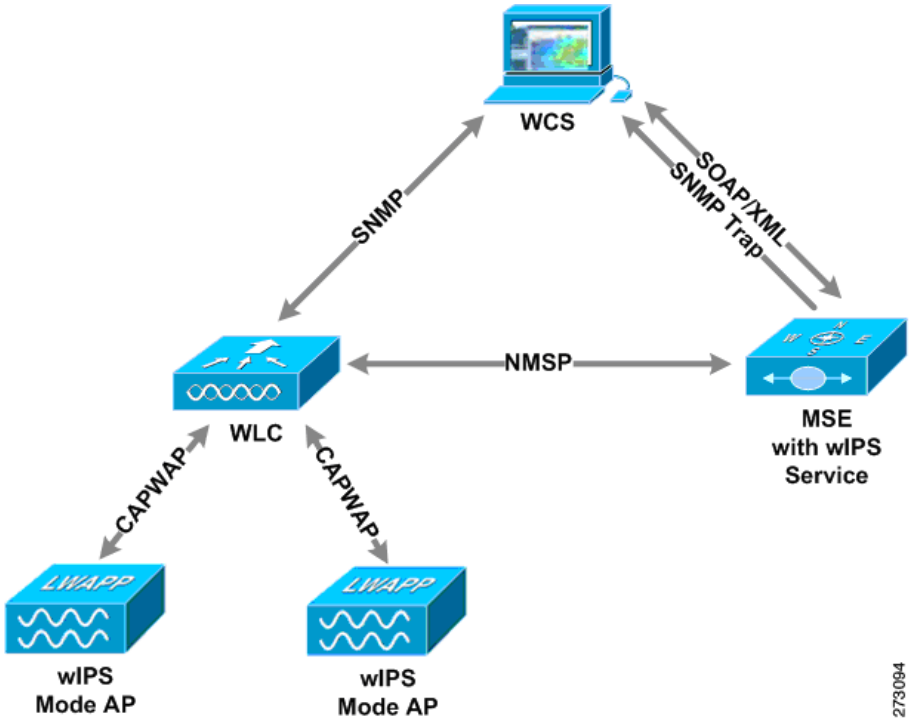
The wIPS performs rogue access point, rogue client, and ad-hoc connection detection and mitigation, over-the-air wireless hacking and threat detection, security vulnerability monitoring, performance monitoring and self-optimization, network hardening for proactive prevention of threats, and complete wireless security management and reporting.

Built on the CUWN and leveraging the efficiencies of Cisco Motion, wIPS is deployment-hardened and enterprise-ready. The wIPS is made up of the following components that work together to provide a unified security monitoring solution:

- A mobility services engine running wIPS software—Serves as the central point of alarm aggregation for all controllers and their respective wIPS monitor mode access points. Alarm information and forensic files are stored on the mobility services engine for archival purposes.
- A wIPS monitor mode access point—Provides constant channel scanning with attack detection and forensics (packet capture) capabilities.
- Local mode access point—Provides wireless service to clients in addition to time-sliced rogue scanning.
- Wireless LAN Controller—Forwards attack information received from wIPS monitor mode access points to the mobility services engine and distributes configuration parameters to access points.

- Wireless Control System (WCS)—Provides a centralized management platform for the administrator to configure the wIPS Service on the mobility services engine, push wIPS configurations to the controller, and configure access points in wIPS monitor mode. WCS is also used to view wIPS alarms, forensics, reporting, and to access the attack encyclopedia. (See Figure 1-1).

Figure 1-1 Wireless Intrusion Prevention System



Note The HREAP mode access points also support wIPS.

Communication among the system components involves the following protocols:

- Control and Provisioning of Wireless Access Points (CAPWAP)—This protocol is the successor to LWAPP and is used for communication between access points and controllers. It provides a bi-directional tunnel in which alarm information is sent to the controller and configuration information is sent to the access point.
- Network Mobility Services Protocol (NMSP)—The protocol handles communication between controllers and the mobility services engine. In a wIPS deployment, this protocol provides a pathway for alarm information to be aggregated from controllers and forwarded to the mobility services engine and for wIPS configuration information to be pushed to the controller. This protocol is encrypted.
  - Controller TCP Port: 16113
- Simple Object Access Protocol (SOAP/XML)—The method of communication between the mobility services engine and WCS. This protocol is used to distribute configuration parameters to the wIPS service running on the mobility services engine.
  - MSE TCP Port: 443
- Simple Network Management Protocol (SNMP)—This protocol is used to forward wIPS alarm information from the mobility services engine to the WCS. It is also employed to communicate rogue access point information from the controller to WCS.

wIPS in a Cisco Unified Wireless Network

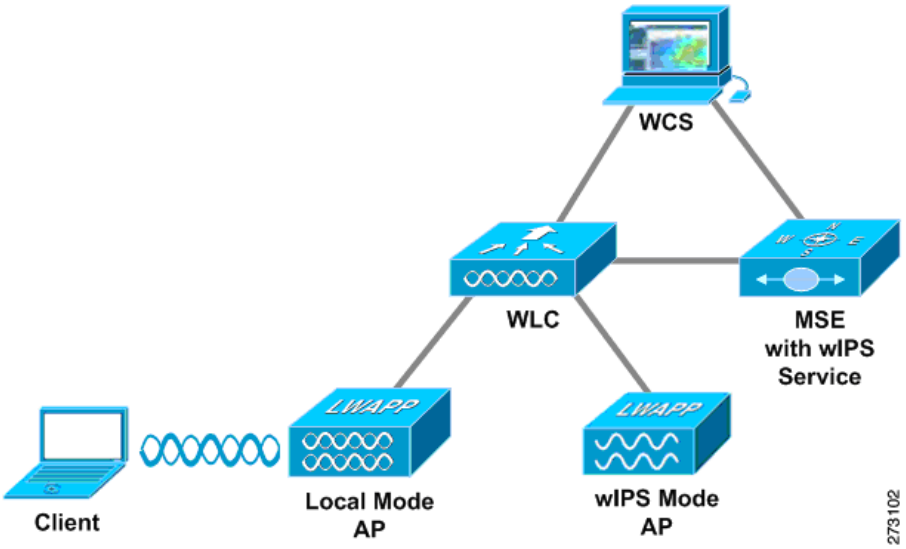
You can integrate wIPS within the CUWN infrastructure or overlay wIPS on the CUWN or Cisco autonomous wireless network (or third-party wireless network).

This section contains the following topics:

wIPS Integrated Within a Cisco Unified Wireless Network

An integrated wIPS deployment is a system design in which both *local* mode and wIPS *monitor mode* access points are intermixed on the same controller, and managed by the same WCS. We recommend this configuration because it allows the tightest integration between the client serving and monitoring infrastructure (See Figure 1-2).

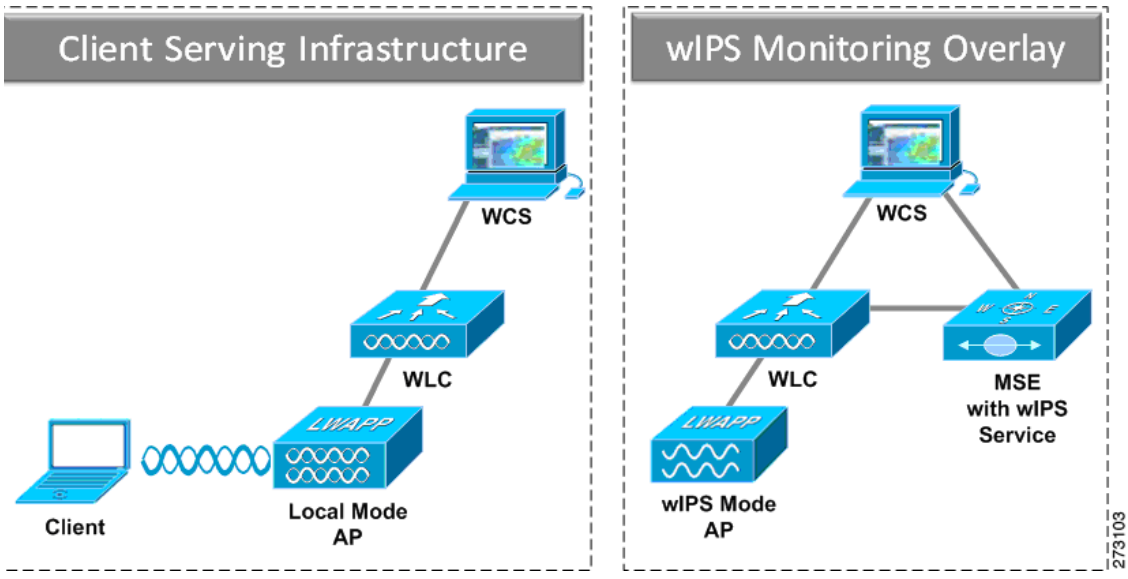
Figure 1-2 wIPS Integrated Within CUWN



wIPS Overlay Deployment in a Cisco Unified Wireless Network

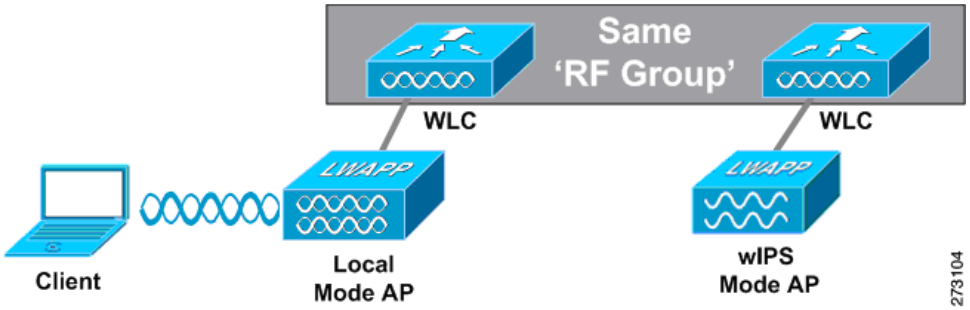
In a wIPS Overlay deployment, the wIPS monitoring infrastructure is completely separate from the client serving infrastructure. Each distinct system has its own set of controllers, access points and WCS. The reason for selecting this deployment model often stems from business mandates that require distinct network infrastructure and security infrastructure systems with separate management consoles (Figure 1-3). This deployment model is also used when the total number of access points (wIPS monitor and local mode) exceed the 3000 access point limit contained in WCS.

Figure 1-3 wIPS Overlay Monitoring Network Deployment in CUWN



To configure the wIPS Overlay Monitoring network to provide security assessment of the client serving infrastructure, specific configuration items must be completed. The wIPS system operates on the assumption that only attacks against trusted devices must be logged. For an overlay system to view a separate Cisco Unified WLAN infrastructure as trusted, the controllers must be in the same RF Group (Figure 1-4).

Figure 1-4 Controllers in Same RF Group for wIPS Overlay Deployment



As a result of separating the client serving infrastructure from the wIPS monitoring overlay infrastructure, several monitoring caveats arise:

- wIPS alarms are only shown on the wIPS Overlay WCS instance
- Management Frame Protection (MFP) alarms are only shown on the client infrastructure WCS instance
- Rogue alarms are shown in both WCS instances
- Rogue location accuracy is greater on the client serving infrastructure WCS because this deployment employs a greater density of access points than the wIPS overlay deployment
- Over-the-air rogue mitigation is more scalable in an integrated wIPS model, as the local-mode access points are employed in mitigation actions
- The security monitoring dashboard is incomplete on both WCS instances because some events such as wIPS only exist on the wIPS Overlay WCS. To monitor the comprehensive security of the wireless network, both security dashboard instances must be observed

Table 1-1 summarizes some of the key differences between client serving and overlay deployments.

Table 1-1 wIPS Client Serving and wIPS Monitoring Overlay Comparison

	Client Serving Infrastructure WCS	wIPS Monitoring Overlay WCS
wIPS alarms	No	Yes
MFP alarms	Yes	No
Rogue alarms	Yes	Yes
Rogue location	High accuracy	Low accuracy
Rogue containment	Yes	Yes, but scalable

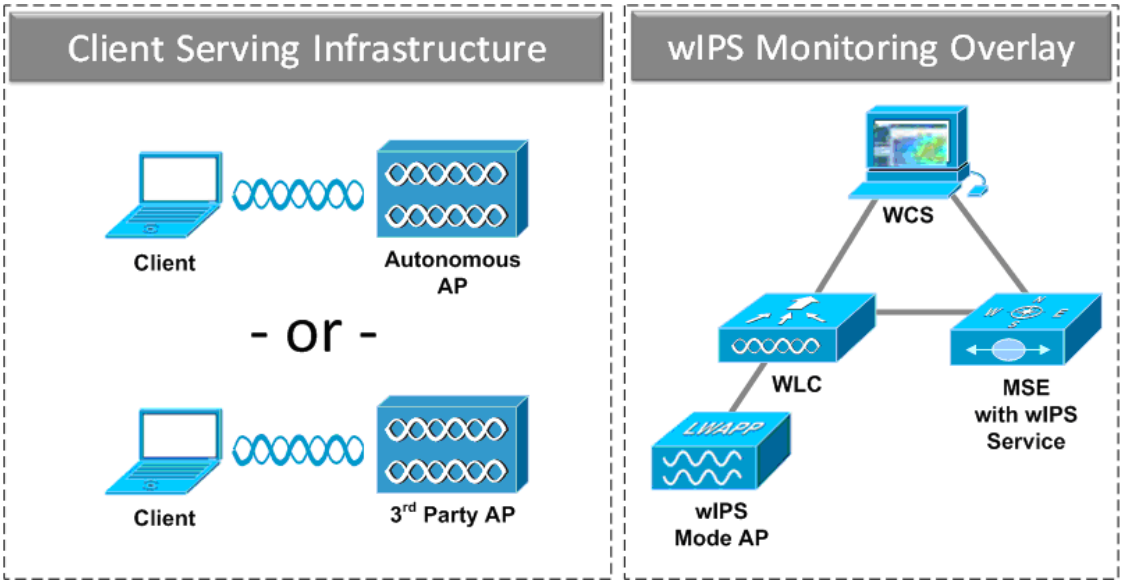
One challenge of the overlay solution is the possibility of lightweight access points on either the client serving infrastructure or wIPS monitoring overlay associating to the wrong controller. Association with the wrong controller can be addressed by specifying the primary, secondary and tertiary controller names for each access point (both local and wIPS monitor mode). In addition, We recommend that the

controllers for each respective solution have separate management VLANs for communication with their respective access points and that access control lists (ACLs) are used to prevent CAPWAP traffic from crossing these VLAN boundaries.

wIPS Overlay in Autonomous or Other Wireless Network

The Adaptive wIPS solution is also capable of performing security monitoring over an existing WLAN infrastructure other than CUWN. In this case, the client serving infrastructure is completely separate and uncoordinated with the wIPS overlay. The application for this deployment is security monitoring of either Cisco autonomous access points or third-party access points (Figure 1-5).

Figure 1-5 wIPS Overlay in Autonomous



Differences Between Controller IDS and Adaptive wIPS

This section contains the following topics:

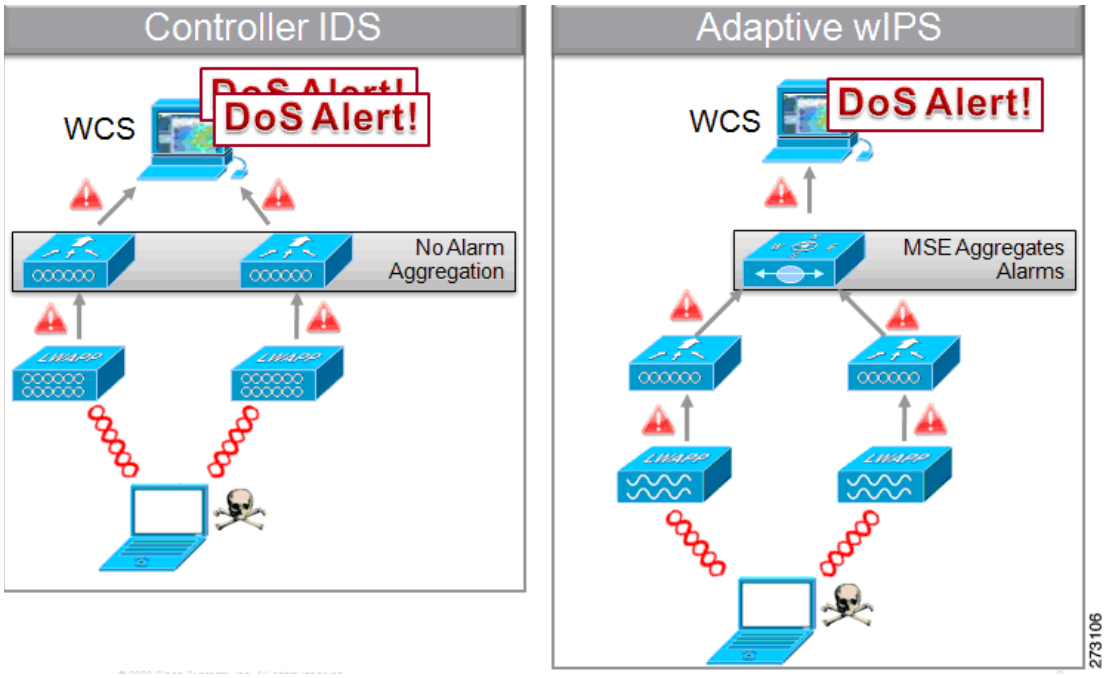
Reduction in False Positives

The wIPS facilitates a reduction in false positives with respect to security monitoring of the wireless network. In contrast to the controller-based solution of Cisco, which triggers an alarm when it detects a number of management frames over the air, wIPS only triggers an alarm when it detects a number of management frames over the air that are causing damage to the wireless infrastructure network. This a result of the wIPS system being able to dynamically identify the state and validity of access points and clients present in the wireless infrastructure. Only when attacks are launched against the infrastructure are alarms raised.

Alarm Aggregation

One major differentiation between the existing controller-based IDS system of Cisco and its wIPS system is that the unique attacks seen over the air are correlated and aggregated into a single alarm. This is accomplished by the wIPS system automatically assigning a unique hash key to each particular attack the first time it is identified. If the attack is received by multiple wIPS access points, it will only be forwarded to the WCS once because alarm aggregation takes place on the mobility services engine. The existing controller-based IDS system does not aggregate alarms (Figure 1-6).

Figure 1-6 Alarm Aggregation Using Controller-based IDS of Cisco versus Adaptive wIPS



Another major differentiation between the controller-based IDS and wIPS is the number of attacks that each system can detect. As described in the sub-sections and showcased in the tables Table 1-2 and Table 1-3, wIPS can detect a multitude of attacks and attack tools. These attacks include both denial of service (DoS) attacks and security penetration attacks.

DoS Attacks

A DoS attack involves mechanisms that are designed to prohibit or slow successful communication within a wireless network. These often incorporate a number of spoofed frames which are designed to drop or falter legitimate connections within the wireless network. Although a DoS attack can be devastating to the ability of a wireless network to deliver reliable services, they do not result in a data breach and their negative consequences are often over once the attack has stopped. Table 1-2 compares the DoS attacks detected by the controller-based IDS and wIPS service.

Table 1-2 DoS Attack Detection By Controller IDS and wIPS

Alarm Name	Detected by Controller IDS	Detected by wIPS
Association flood	X	X
Association table overflow		X
Authentication flood	X	X
EAPOL-Start attack	X	X
PS-Poll flood		X
Unauthenticated Association		X
CTS Flood		X
Queensland University of Technology Exploit		X
RF jamming attack		X
RTS flood		X
Virtual carrier attack	X	X
Authentication-failure attack		X
Deauthentication broadcast attack	X	X
Deauthentication flood attack	X	X
Disassociation broadcast attack		X
Disassociation flood attack	X	X
EAPOL-logoff attack	X	X
FATA-jack tool detected		X
Premature EAP-failure attack		X
Premature EAP-success attack		X

Security Penetration Attacks

Arguably the more harmful of the two attack types threatening wireless networks, a security penetration is designed to capture or expose information such as sensitive data or encryption keys that can later be used for exposing confidential data. A security penetration attack can involve targeted queries against the infrastructure or replay attacks that aim to break cryptographic keys. Security penetration attacks can also be harmful to the client by which an attempt to lure the client onto a fake access point such as a Honeypot. Table 1-3 compares the security penetration attacks detected by the controller-based IDS and wIPS service.

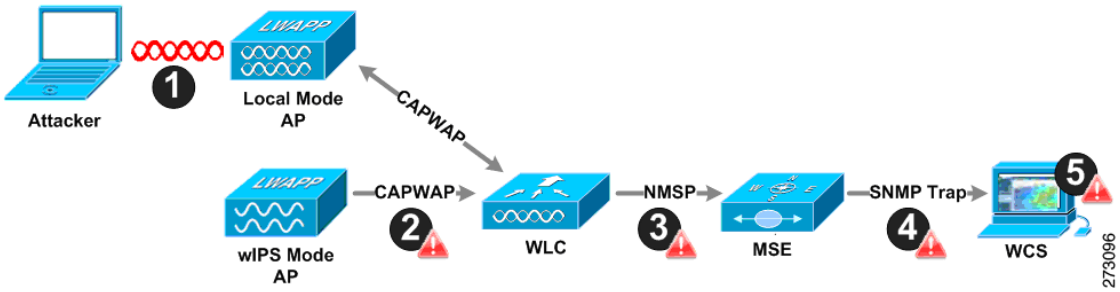
Table 1-3 Security Penetration Attack Detection by Controller IDS and wIPS

Alarm Name	Detected by Controller IDS	Detected by wIPS
Airsnarf attack		X
ChopChop Attack		X
Day-zero attack by WLAN security anomaly		X
Day-zero attack by device security anomaly		X
Device probing for access points		X
Dictionary attack on EAP methods		X
EAP attack against 802.1x authentication		X
Fake access points detected	X	X
Fake DHCP server detected		X
Fast WEP crack detected		X
Fragmentation Attack		X
Hotspotter tool detected		X
Malformed 802.11 packets detected		X
Man in the middle attack detected		X
NetStumbler detected	X	X
PSPF violation		X
ASLEAP attack detected		X
Honey pot access point detected	X	X
Soft access point or Host access point detected		X
Spoofed MAC address detected		X
Suspicious after-hours traffic		X
Unauthorized association by vendor list		X
Unauthorized association detected		X
Wellenreiter detected	X	X

wIPS Alarm Flow

The Adaptive wIPS system follows a linear chain of communication to propagate attack information obtained from initially scanning the airwaves to forwarding information to WCS.

Figure 1-7 Alarm Flow Within Network



1. For an alarm to be triggered on the wIPS system, an attack must be launched against a legitimate access point or client. Legitimate access points and clients are discovered automatically in a CUWN by trusting devices broadcasting the same RF-Group name. In this configuration, the system dynamically maintains a list of local-mode access points and their associated clients. The system can also be configured to trust devices by SSID using the SSID Groups feature. Only attacks which are considered harmful to the WLAN infrastructure are propagated upwards to the rest of the system.
2. Once an attack is identified by the wIPS monitor mode access point, an alarm update is sent to the controller and is encapsulated inside the CAPWAP control tunnel.
3. The controller transparently forwards the alarm update from the access point to the wIPS service running on the mobility services engine. The protocol used for this communication is Network Mobility Service Protocol (NMSP).
4. Once received by the wIPS service on the mobility services engine, the alarm update is added to the alarm database for archival and attack tracking. An SNMP trap is forwarded to WCS. The SNMP trap contains the attack information. If multiple alarm updates are received referencing the same attack (for example, if multiple access points hear the same attack) only one SNMP trap is sent to WCS.
5. The SNMP trap containing the alarm information is received and displayed by WCS.

Forensics

The Adaptive wIPS system of Cisco provides the ability to capture attack forensics for further investigation and troubleshooting purposes. At a base level, the forensics capability is a toggle-based packet capture facility which logs and retrieves a set of wireless frames. This feature is enabled on a per attack basis within a wIPS profile. wIPS profiles are configured on WCS.

Once enabled, the forensics feature is triggered when a specific attack alarm is seen over the airwaves. The forensic file created is based on the packets contained within the buffer of the wIPS monitor mode access point that triggered the original alarm. This file is transferred to the controller via CAPWAP, which then forwards the forensic file via NMSP to wIPS running on the mobility services engine. The file is stored within the forensic archive on the mobility services engine until the user configured disk space limit for forensics is reached. By default, this limit is 20 Gigabytes, which when reached, causes the oldest forensic files to be removed. Access to the forensic file is obtained by opening the alarm in WCS which contains a hyperlink to the forensic file. The files are stored in a .CAP file format which is accessed by either WildPacket Omnipeek, AirMagnet WiFi Analyzer, Wireshark or any other packet capture program which supports this format. Wireshark is available at http://www.wireshark.org.

Note We recommend that the forensics capability of wIPS system be used sparingly and disabled after the desired information is captured. This primarily because it places an intensive load on the access point as well as interrupts scheduled channel scanning. A wIPS access point cannot simultaneously perform channel scanning and produce a forensic file. While the forensic file is being dumped, channel scanning is delayed.

Rogue Detection

An access point in wIPS-optimized monitor mode performs rogue threat assessment and mitigation using the same logic as current CUWN implementations. This allows a wIPS mode access point to scan, detect and contain rogue access points and ad-hoc networks. Once discovered, this information regarding rogue wireless devices is reported to WCS where rogue alarm aggregation takes place.

However, with this functionality comes the caveat that if a containment attack is launched using a wIPS mode access point, its ability to perform methodical attack-focused channel scanning is interrupted for the duration of the containment.

Anomaly Detection

wIPS includes specific alarms pertaining to anomalies in attack patterns or device characteristics captured. The anomaly detection system takes into account the historic attack log and device history contained within the mobility services engine to baseline the typical characteristics of the wireless network. The anomaly detection engine is triggered when events or attacks on the system undergo a measurable change as compared to historical data kept on the mobility services engine. For example, if the system regularly captures a few MAC spoofing events each day, and then on another day MAC spoofing events are up 200%, an anomaly alarm is triggered on the mobility services engine. This alarm is then sent to WCS to inform the administrator that something else is going on in the wireless network beyond traditional attacks that they system may encounter. The anomaly detection alarm can also be employed to detect day-zero attacks that might not have a preexisting signature in the wIPS system.

Default Configuration Profiles

To simplify the configuration tuning for each specific WLAN security deployment, wIPS includes a number of default profiles tailored to meet the security needs of specific industries or deployments. The templates summarize the differing risk profiles and requirements for security monitoring of varying deployments. The specific profiles include Education, Enterprise (Best), Enterprise (Rogue), Financial, Healthcare, Hotspot (Open Security), Hotspot (802.1x Security), Military, Retail, Tradeshow, and Warehouse. The profiles can be further customized to address the specific needs of the prospective deployment.

Integration into Release 7.0 Features

wIPS tightly integrates into an existing CUWN to leverage the security features introduced in previous releases. On the security dashboard, wIPS events display under their own category.

Configuration Overview

This guide addresses the configuration of wIPS and mobility services engine. This section lists and describes the following topics:

Adding and Deleting Mobility Services Engine

You can use WCS to add and delete mobility services engines within the network. You are also able to define the service supported on the mobility services engine. Refer to Chapter 2, "Adding and Deleting Systems" for configuration details.

Editing Mobility Services Engine Properties

You can use WCS to configure the following parameters on the mobility services engine. Refer to Chapter 4, "Configuring and Viewing System Properties" for configuration details.

- General Properties: Enables you to assign a contact name, username, password, and HTTP for the mobility services engine.
- Active Sessions: Enables you to view active user sessions on the mobility services engine.
- Trap Destinations: Enables you to specify which WCS or Cisco Security Monitoring, Analysis and Response System (CS-MARS) network management platform is the recipient of SNMP traps generated by the mobility services engine.
- Advanced Parameters: Enables you set Number of days to keep events, reboot hardware, shutdown hardware or clear the database.

Managing Users and Groups

You can use WCS to add, delete, and edit user session and user group parameters as well as add and delete host access records. Refer to Chapter 5, "Managing Users and Groups" for configuration details.

Mobility Services Engine Synchronization

WCS pushes wIPS information to the mobility services engine to maintain accurate information between the mobility services engine and controller. WCS provides you with two ways to synchronize: manual and automatic (auto-sync). Refer to Chapter 3, "Synchronizing Mobility Services Engines" for more information.

Configuring wIPS and Profile Management

You can use WCS to configure the Cisco Adaptive wIPS service.

Refer to Chapter 6, "Configuring wIPS and Profiles" for specifics.

Monitoring Capability

You can use WCS to monitor alarms, events, and logs generated by mobility services engine. You can also monitor the status of mobility services engines, clients, and tagged assets. Additionally, you can generate a utilization report for the mobility services engine to determine CPU and memory utilization as well as counts for clients, tags and rogue access points and clients. Refer to Chapter 7, "Monitoring the System and Services" for specifics.

Maintenance Operations

You can use WCS to recover a password, back up mobility services engine data to a predefined FTP folder on WCS at defined intervals, and restore the mobility services engine data from that WCS. Other mobility services engine maintenance operations that you can perform includes: downloading new software images to all associated mobility services engines from any WCS station, restarting a mobility services engine, shutting down a mobility services engines and clearing mobility services engine configurations. Refer to Chapter 8, "Performing Maintenance Operations" for specifics.

MSE System and Appliance Hardening

The System and Appliance Hardening requires some services and processes to be exposed to function properly. Hardening of MSE would involve disabling unnecessary services, upgrading to latest server versions, and applying appropriate restrictive permissions to files, services, and end points. See Appendix D, "MSE System and Appliance Hardening Guidelines".

System Compatibility

Note Refer to the *Cisco 3300 Mobility Services Engine Release Note* for the latest system (controller, WCS, mobility services engine) compatibility information, feature support, and operational notes for your current release at: http://www.cisco.com/en/US/products/ps9742/prod_release_notes_list.html