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# Wi-Fi Protected Access 2 (WPA 2) Configuration Example

Document ID: 67134

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## Introduction

### Prerequisites

- Requirements
- Components Used
- Conventions

### Background Information

- WPA 2 Support with Cisco Aironet Equipment

### Configure in Enterprise Mode

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- Configure the AP
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## Introduction

This document explains the advantages of the use of Wi-Fi Protected Access 2 (WPA 2) in a Wireless LAN (WLAN) network. The document provides two configuration examples on how to implement WPA 2 on a WLAN network. The first example shows how to configure WPA 2 in enterprise mode, and the second example configures WPA 2 in personal mode.

## Prerequisites

### Requirements

Ensure that you have basic knowledge of these topics before you attempt this configuration:

- WPA
- WLAN security solutions

**Note:** For information on Cisco WLAN security solutions, refer to Cisco Aironet Wireless LAN Security Overview.

## Components Used

The information in this document is based on these software and hardware versions:

- Cisco Aironet 1310G Access Point (AP)/Bridge that runs Cisco IOS® Software Release 12.3(2)JA
- Aironet 802.11a/b/g CB21AG Client Adapter that runs firmware 2.5
- Aironet Desktop Utility (ADU) that runs firmware 2.5

**Note:** The Aironet CB21AG and PI21AG client adapter software is incompatible with other Aironet client adapter software. You must use the ADU with CB21AG and PI21AG cards, and you must use the Aironet Client Utility (ACU) all other Aironet client adapters. For more information on how to install the CB21AG card and ADU, refer to *Installing the Client Adapter*.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

## Background Information

WPA is a standard-based security solution from the Wi-Fi Alliance that addresses the vulnerabilities in native WLANs. WPA provides enhanced data protection and access control for WLAN systems. WPA addresses all known Wired Equivalent Privacy (WEP) vulnerabilities in the original IEEE 802.11 security implementation and brings an immediate security solution to WLAN networks in both enterprise and small office, home office (SOHO) environments.

WPA 2 is the next generation of Wi-Fi security. WPA 2 is the Wi-Fi Alliance interoperable implementation of the ratified IEEE 802.11i standard. WPA 2 implements the National Institute of Standards and Technology (NIST)-recommended Advanced Encryption Standard (AES) encryption algorithm with the use of Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP). AES Counter Mode is a block cipher that encrypts 128-bit blocks of data at a time with a 128-bit encryption key. The CCMP algorithm produces a message integrity code (MIC) that provides data origin authentication and data integrity for the wireless frame.

**Note:** CCMP is also referred to as CBC-MAC.

WPA 2 offers a higher level of security than WPA because AES offers stronger encryption than Temporal Key Integrity Protocol (TKIP). TKIP is the encryption algorithm that WPA uses. WPA 2 creates fresh session keys on every association. The encryption keys that are used for each client on the network are unique and specific to that client. Ultimately, every packet that is sent over the air is encrypted with a unique key. Security is enhanced with the use of a new and unique encryption key because there is no key reuse. WPA is still considered secure and TKIP has not been broken. However, Cisco recommends that customers transition to WPA 2 as soon as possible. For more information on WPA and WPA 2, refer to *Wi-Fi Protected Access, WPA2 and IEEE 802.11i*.

WPA and WPA 2 both support two modes of operation:

- Enterprise mode

- Personal mode

This document discusses the implementation of these two modes with WPA 2.

## WPA 2 Support with Cisco Aironet Equipment

WPA 2 is supported on this equipment:

- Aironet 1130AG AP series and 1230AG AP series
- Aironet 1100 AP series
- Aironet 1200 AP series
- Aironet 1300 AP series

**Note:** Equip these APs with 802.11g radios and use Cisco IOS Software Release 12.3(2)JA or later.

WPA 2 and AES is also supported on:

- Aironet 1200 series radio modules with the part numbers AIR-RM21A and AIR-RM22A

**Note:** The Aironet 1200 radio module with the part number AIR-RM20A does not support WPA 2.

- Aironet 802.11a/b/g Client Adapters with firmware version 2.5

**Note:** Cisco Aironet 350 series products do not support WPA 2 because their radios lack AES support.

## Configure in Enterprise Mode

The term "enterprise mode" refers to products that are tested to be interoperable in both Pre-Shared Key (PSK) and IEEE 802.1x modes of operation for authentication. The 802.1x is considered to be more secure than any of the legacy authentication frameworks because of its flexibility in support of a variety of authentication mechanisms and stronger encryption algorithms. WPA 2 in enterprise mode performs authentication in two phases. Configuration of open authentication occurs in the first phase. The second phase is 802.1x authentication with one of the Extensible Authentication Protocol (EAP) methods. AES provides the encryption mechanism.

In Enterprise mode, clients and authentication servers authenticate each other with the use of an EAP authentication method, and the client and server generate a Pairwise Master Key (PMK). With WPA 2, the server generates the PMK dynamically and passes the PMK to the AP.

This section discusses the configuration that is necessary to implement WPA 2 in enterprise mode of operation.

## Network Setup

In this setup, an Aironet 1310G AP/Bridge that runs Cisco LEAP authentication authenticates a user with a WPA 2-compatible client adapter. Key management occurs with the use of WPA 2, on which AES-CCMP encryption is configured. The AP is configured as a local RADIUS server that runs LEAP authentication. You must configure the client adapter and the AP in order to implement this setup. The sections Configure the AP and Configure the Client Adapter show the configuration on the AP and the client adapter.

# Configure the AP

Complete these steps:

1. Configure the AP as a local RADIUS server that runs LEAP authentication.
  - a. Choose **Security > Server Manager** in the menu on the left and define the IP address, ports, and shared secret of the RADIUS server.

Because this configuration configures the AP as a local RADIUS server, use the IP address of the AP. Use the ports 1812 and 1813 for local RADIUS server operation.

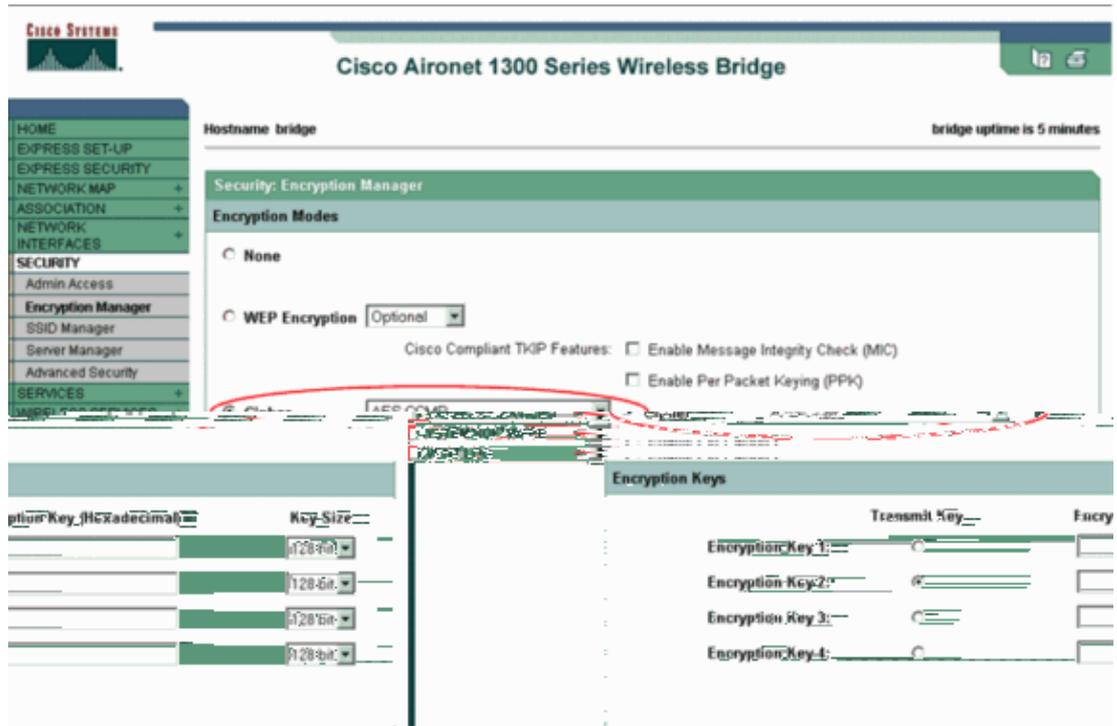
- b. In the **Default Server Priorities** area, define the default EAP authentication priority as 10.0.0.1.

**Note:** 10.0.0.1 is the local RADIUS server.

The screenshot displays the configuration interface for a Cisco Aironet 1300 Series Wireless Bridge. The left sidebar shows the navigation menu with 'Server Manager' selected. The main content area is titled 'SERVER MANAGER' and 'GLOBAL PROPERTIES'. The 'Security: Server Manager' section is active, showing the 'Backup RADIUS Server' configuration with fields for 'Backup RADIUS Server' (Hostname or IP Address) and 'Shared Secret'. Below this is the 'Corporate Servers' section, which includes a 'Current Server List' with a 'RADIUS' dropdown. A server entry for '10.0.0.1' is listed, with its 'Server' field set to '10.0.0.1' and 'Shared Secret' field. The 'Authentication Port (optional)' is set to '1812' and the 'Accounting Port (optional)' is set to '1813'. At the bottom, the 'Default Server Priorities' section shows 'EAP Authentication' with 'Priority 1' set to '10.0.0.1'. The 'MAC Authentication' and 'Accounting' sections have 'Priority 1' set to '<NONE >'. Red circles highlight the '10.0.0.1' server entry, its ports, and the EAP Authentication priority.

2. Choose **Security > Encryption Manager** from the menu on the left and complete these steps:
  - a. From the Cipher menu, choose **AES CCMP**.

This option enables AES encryption with the use of Counter Mode with CBC-MAC.



- b. Click **Apply**.
3. Choose **Security > SSID Manager** and create a new Service Set Identifier (SSID) for use with WPA 2.

- a. Check the **Network EAP** check box in the Authentication Methods Accepted area.

This action enables LEAP authentication.



- b. Scroll down the Security SSID Manager window to the Authenticated Key Management area and complete these steps:

- a. From the Key Management menu, choose **Mandatory**.

- b. Check the **WPA** check box on the right.
- c. Click **Apply**.

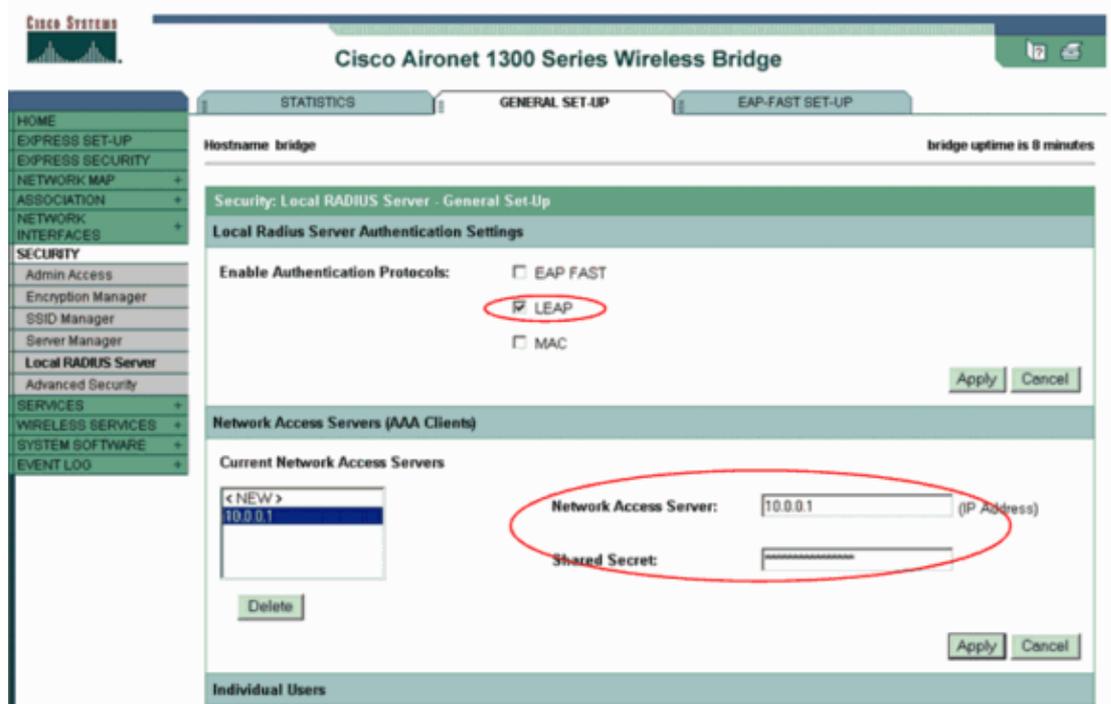
**Note:** The definition of VLANs is optional. If you define VLANs, client devices that associate with use of this SSID are grouped into the VLAN. For more information on how to implement VLANs, refer to Configuring VLANs.

The screenshot shows the configuration page for WPA2 security, divided into three sections: **Authenticated Key Management**, **Accounting Settings**, and **General Settings**.

- Authenticated Key Management:** The **Key Management** dropdown is set to **Mandatory**. The **WPA** checkbox is checked, while **CCM** is unchecked. Below, the **WPA Pre-shared Key** field is empty, and the **ASCII** radio button is selected over **Hexadecimal**.
- Accounting Settings:** The **Enable Accounting** checkbox is unchecked. Under **Accounting Server Priorities**, the **Use Defaults** radio button is selected, with **Define Defaults** as a link. The **Customize** radio button is unselected. Below, three priority dropdown menus are all set to **<NONE >**.
- General Settings:** The **Advertise Extended Capabilities of this SSID** checkbox is unchecked. Under it, **Advertise Wireless Provisioning Services (WPS) Support** and **Advertise this SSID as a Secondary Broadcast SSID** are also unchecked. The **Enable IP Redirection on this SSID** checkbox is unchecked. Below, the **IP Address** field is set to **DISABLED**, and the **IP Filter (optional)** dropdown is set to **<NONE >** with a **Define Filter** link.

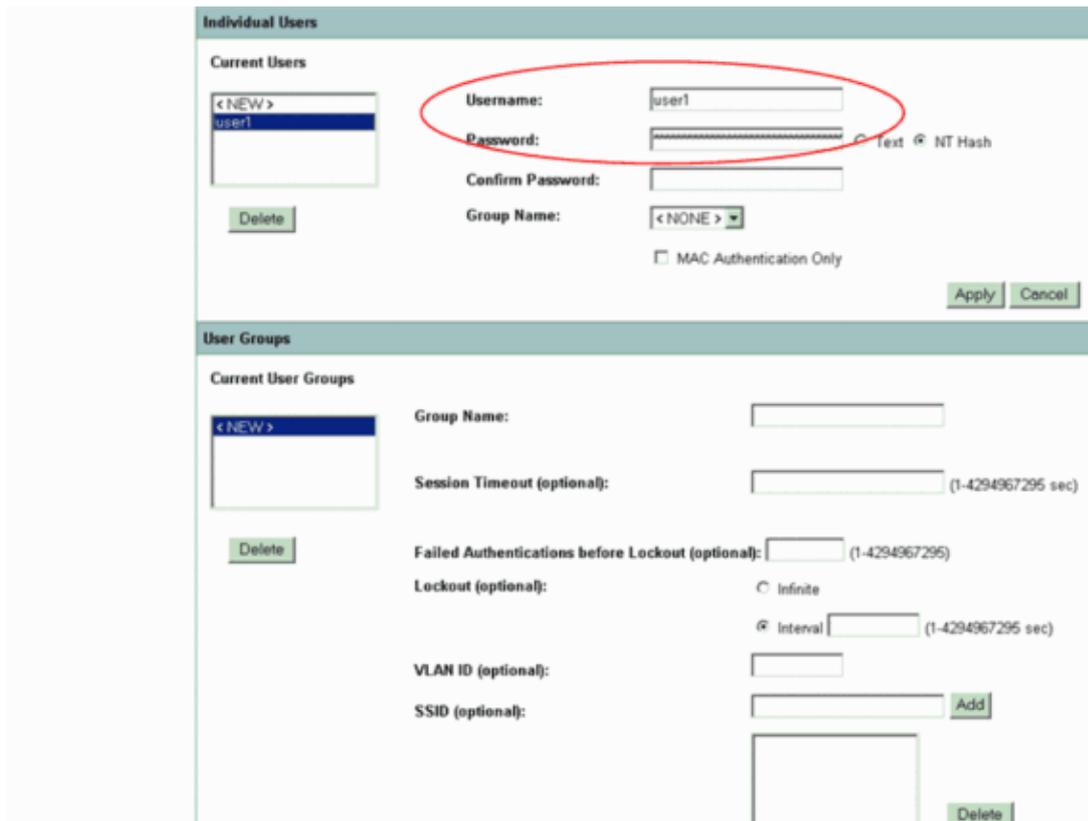
- 4. Choose **Security > Local Radius Server** and complete these steps:
  - a. Click the **General Set-Up** tab located at the top of the window.
  - b. Check the **LEAP** check box and click **Apply**.
  - c. In the Network Access Servers area, define the IP address and shared secret of the RADIUS server.

For the local RADIUS server, use the IP address of the AP.



- d. Click **Apply**.
5. Scroll down the General Set-Up window to the Individual Users area and define the individual users.

The definition of the user groups is optional.



This configuration defines a user with the name "user1" and a password. Also, the configuration selects NT hash for the password. After completion of the procedure in this section, the AP is ready to accept authentication requests from clients. The next step is to configure the client adapter.

## Configure the Client Adapter

Complete these steps:

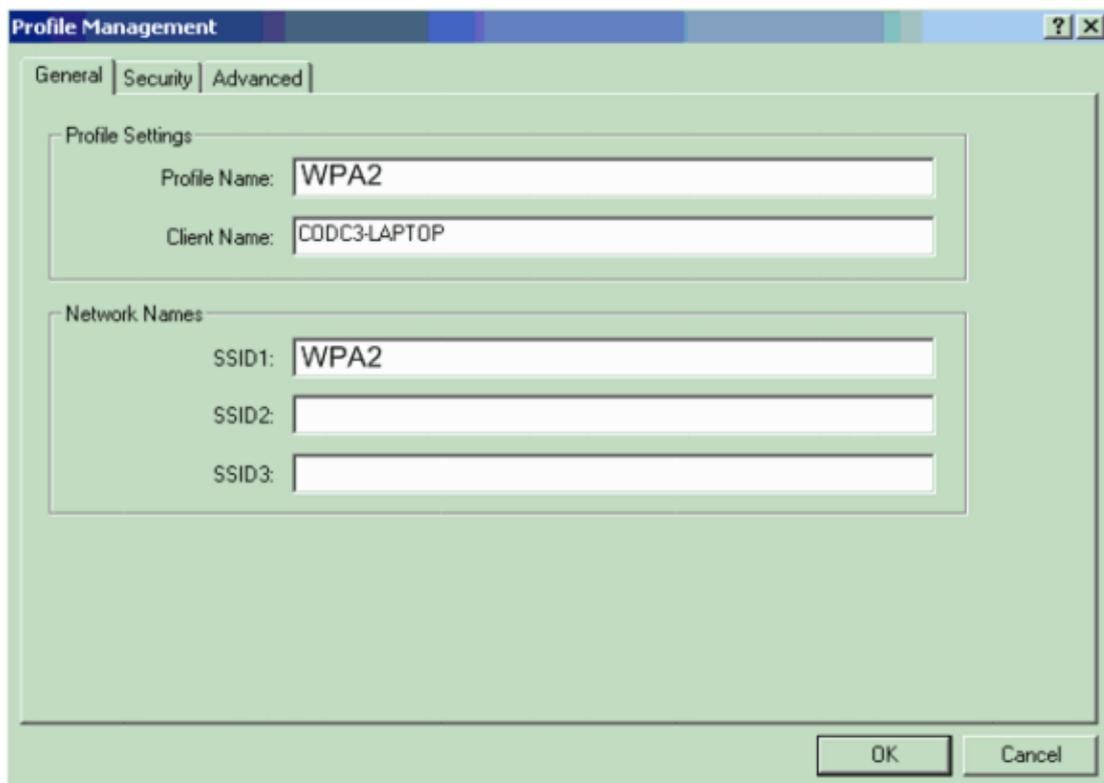
**Note:** This document uses an Aironet 802.11 a/b/g Client Adapter that runs firmware 2.5 and explains the configuration of the client adapter with ADU version 2.5.

1. In the Profile Management window on the ADU, click **New** to create a new profile.

A new window displays where you can set the configuration for WPA 2 enterprise mode operation. Under the General tab, enter the Profile Name and the SSID that the client adapter will use.

In this example, the profile name and the SSID are WPA2:

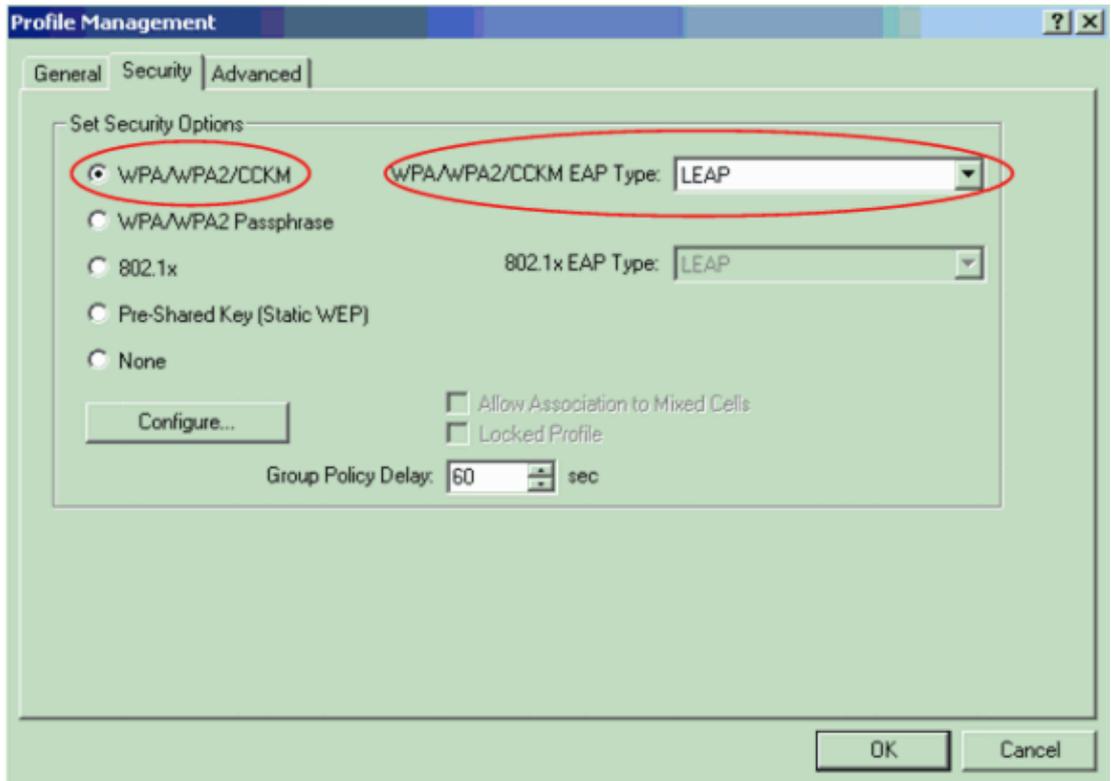
**Note:** The SSID must match the SSID that you configured on the AP for WPA 2.



The screenshot shows a window titled "Profile Management" with three tabs: "General", "Security", and "Advanced". The "General" tab is selected. Under "Profile Settings", the "Profile Name" field contains "WPA2" and the "Client Name" field contains "CODC3-LAPTOP". Under "Network Names", the "SSID1" field contains "WPA2", while "SSID2" and "SSID3" are empty. At the bottom right, there are "OK" and "Cancel" buttons.

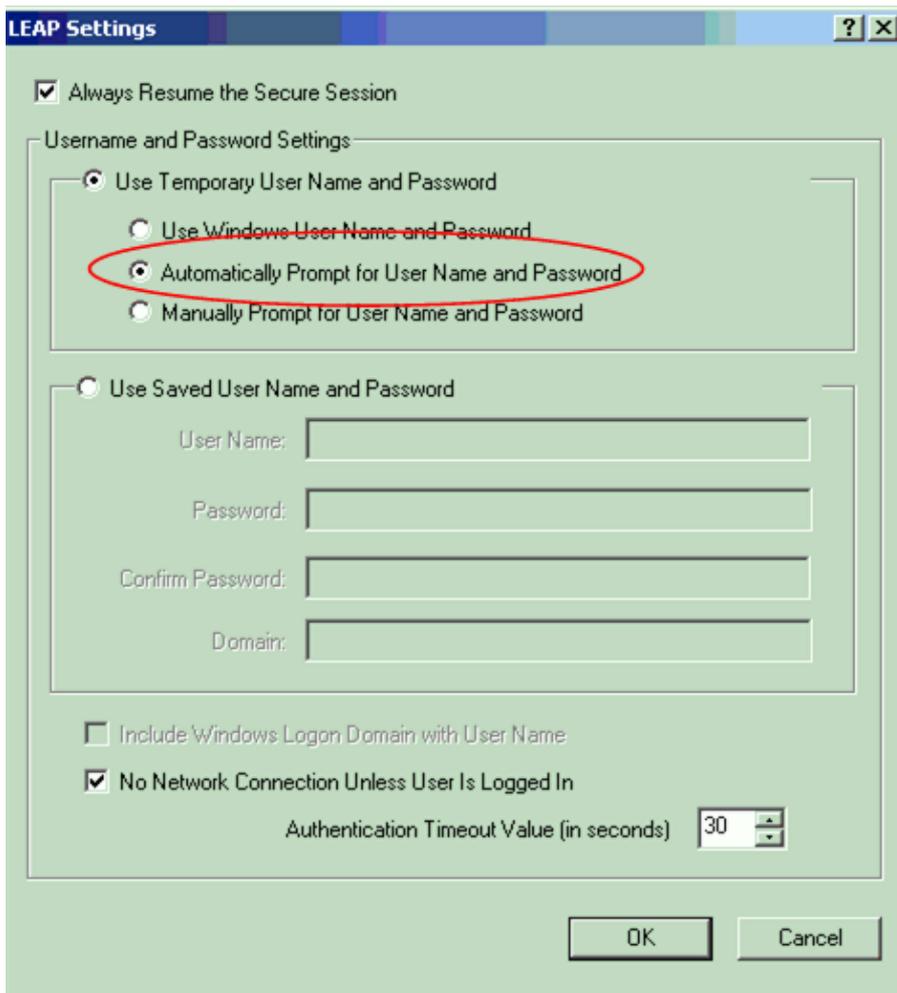
2. Click the **Security** tab, click **WPA/WPA2/CCKM**, and choose **LEAP** from the WPA/WPA2/CCKM EAP Type menu.

This action enables either WPA or WPA 2, whichever you configure on the AP.

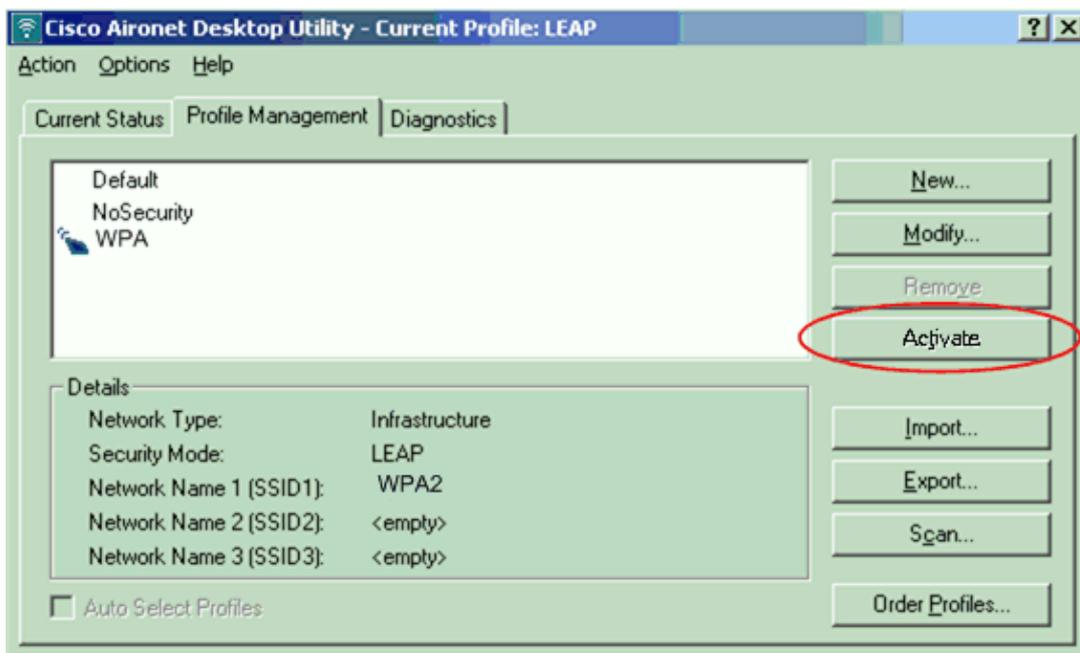


3. Click **Configure** to define LEAP settings.
4. Choose the appropriate Username and Password Settings, based on the requirements, and click **OK**.

This configuration chooses the option Automatically Prompt for Username and Password. This option enables you to manually enter the user name and password when LEAP authentication takes place.



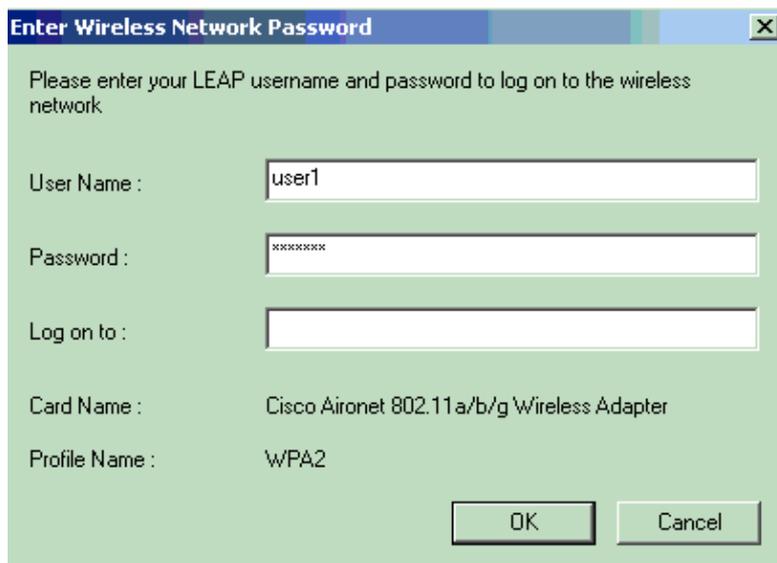
5. Click **OK** in order to exit the Profile Management window.
6. Click **Activate** in order to enable this profile on the client adapter.



## Verify

Use this section to confirm that your configuration works properly.

1. When the Enter Wireless Network Password window displays, enter the user name and password.



Enter Wireless Network Password

Please enter your LEAP username and password to log on to the wireless network

User Name : user1

Password : \*\*\*\*\*

Log on to :

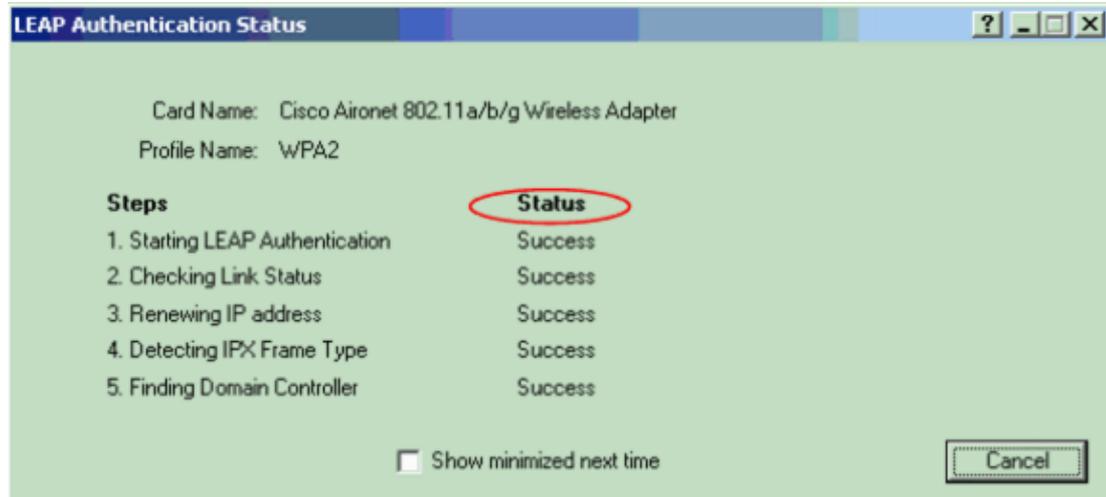
Card Name : Cisco Aironet 802.11 a/b/g Wireless Adapter

Profile Name : WPA2

OK Cancel

The next window is LEAP Authentication Status. This phase verifies the user credentials against the local RADIUS server.

2. Check the Status area in order to see the result of the authentication.



LEAP Authentication Status

Card Name: Cisco Aironet 802.11 a/b/g Wireless Adapter

Profile Name: WPA2

Steps	Status
1. Starting LEAP Authentication	Success
2. Checking Link Status	Success
3. Renewing IP address	Success
4. Detecting IPX Frame Type	Success
5. Finding Domain Controller	Success

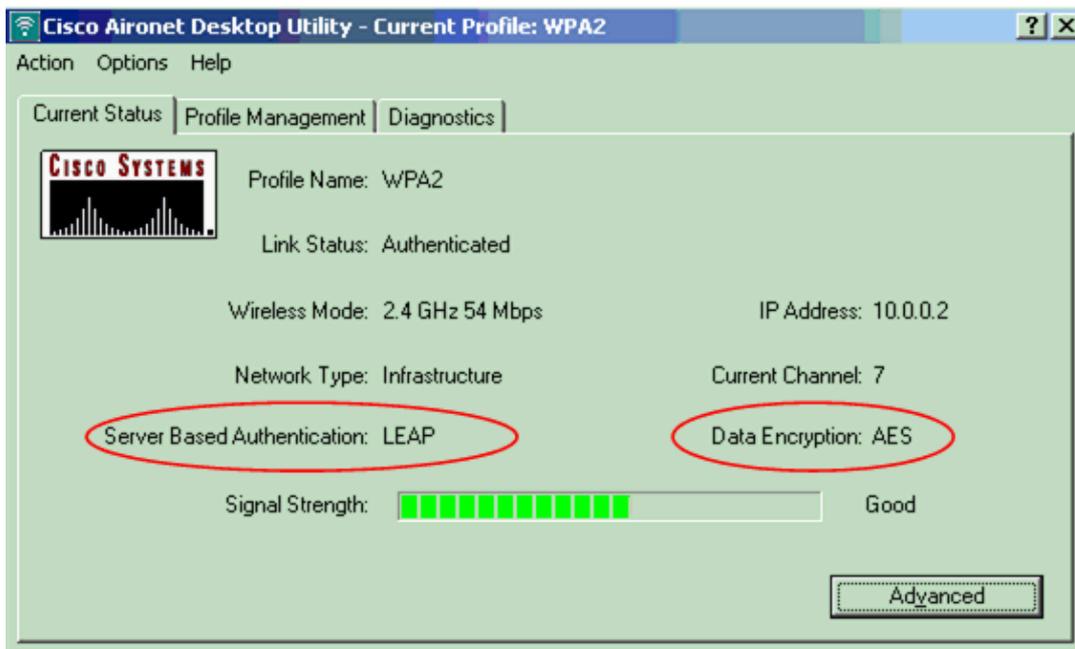
Show minimized next time

Cancel

When authentication is successful, the client connects to the wireless LAN.

3. Check the ADU Current Status in order to verify that the client uses AES encryption and LEAP authentication.

This shows that you have implemented WPA 2 with LEAP authentication and AES encryption in the WLAN.



4. Check the AP/bridge Event Log in order to verify that the client has been authenticated successfully with WPA 2.



## Troubleshoot

There is currently no specific troubleshooting information available for this configuration.

## Configure in Personal Mode

The term "personal mode" refers to products that are tested to be interoperable in the PSK-only mode of operation for authentication. This mode requires manual configuration of a PSK on the AP and clients. PSK authenticates users via a password, or identification code, on both the client station and the AP. No authentication server is necessary. A client can gain access to the network only if the client password matches the AP password. The password also provides the keying material that TKIP or AES uses to generate an encryption key for the encryption of the data packets. Personal mode is targeted to SOHO environments and is

not considered secure for enterprise environments. This section provides the configuration that you need to implement WPA 2 in personal mode of operation.

## Network Setup

In this setup, a user with a WPA 2-compatible client adapter authenticates to an Aironet 1310G AP/Bridge. Key management occurs with the use of WPA 2 PSK, with AES-CCMP encryption configured. The sections Configure the AP and Configure the Client Adapter show the configuration on the AP and the client adapter.

## Configure the AP

Complete these steps:

1. Choose **Security > Encryption Manager** in the menu on the left and complete these steps:
  - a. From the Cipher menu, choose **AES CCMP**.

This option enables AES encryption with the use of Counter Mode with CCMP.

The screenshot shows the configuration page for the Cisco Aironet 1300 Series Wireless Bridge. The page title is "Cisco Aironet 1300 Series Wireless Bridge" and the hostname is "bridge". The bridge uptime is 5 minutes. The left sidebar shows the navigation menu with "Security" expanded and "Encryption Manager" selected. The main content area is titled "Security: Encryption Manager" and contains the following sections:

- Encryption Modes:** Radio buttons for "None", "WEP Encryption" (with a dropdown menu set to "Optional"), and "Cipher" (with a dropdown menu set to "AES CCMP"). Under "WEP Encryption", there are checkboxes for "Enable Message Integrity Check (MIC)" and "Enable Per Packet Keying (PPK)".
- Encryption Keys:** A table with four rows for "Encryption Key 1" through "Encryption Key 4". Each row has a "Transmit Key" radio button (Key 2 is selected), an "Encryption Key (Hexadecimal)" input field, and a "Key Size" dropdown menu (all set to "128 bit").

- b. Click **Apply**.
2. Choose **Security > SSID Manager** and create a new SSID for use with WPA 2.
    - a. Check the **Open Authentication** check box.

**Cisco Systems**  
Cisco Aironet 1300 Series Wireless Bridge

Hostname: bridge | bridge uptime is 7 minutes

**Security: SSID Manager**

**SSID Properties**

Current SSID List

- < NEW >
- WPA2PSK**
- tsundori

SSID: WPA2PSK  
 VLAN: < NONE > | Define VLANs  
 Network ID: (0-4096)

Authentication Settings

Authentication Methods Accepted:

- Open Authentication: < NO ADDITION >
- Shared Authentication: < NO ADDITION >
- Network EAP: < NO ADDITION >

b. Scroll down the Security: SSID Manager window to the Authenticated Key Management area and complete these steps:

- From the Key Management menu, choose **Mandatory**.
- Check the **WPA** check box on the right.

**Authenticated Key Management**

Key Management: Mandatory |  CCKM |  WPA

WPA Pre-shared Key: [Redacted] |  ASCII  Hexadecimal

**Accounting Settings**

Enable Accounting

Accounting Server Priorities:

- Use Defaults | Define Defaults
- Customize
- Priority 1: < NONE >
- Priority 2: < NONE >
- Priority 3: < NONE >

**General Settings**

- Advertise Extended Capabilities of this SSID
  - Advertise Wireless Provisioning Services (WPS) Support
  - Advertise this SSID as a Secondary Broadcast SSID
- Enable IP Redirection on this SSID
  - IP Address: DISABLED
  - IP Filter (optional): < NONE > | Define Filter

c. Enter the WPA PSK shared secret key or the WPA PSK passphrase key.

This key must match the WPA PSK key that you configure on the client adapter.  
d. Click **Apply**.

The AP can now receive authentication requests from the wireless clients.

## Configure the Client Adapter

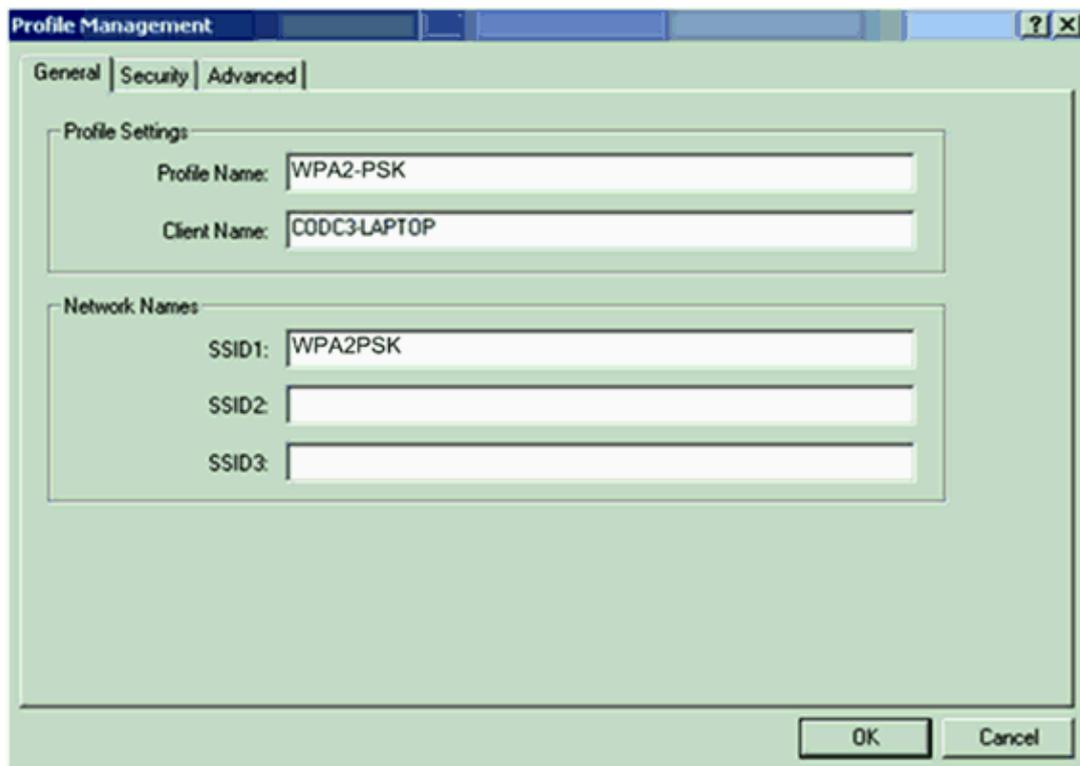
Complete these steps:

1. In the Profile Management window on the ADU, click **New** to create a new profile.

A new window displays where you can set the configuration for WPA 2 PSK mode of operation. Under the General tab, enter the Profile Name and the SSID that the client adapter will use.

In this example, the profile name is WPA2-PSK and the SSID is WPA2PSK.

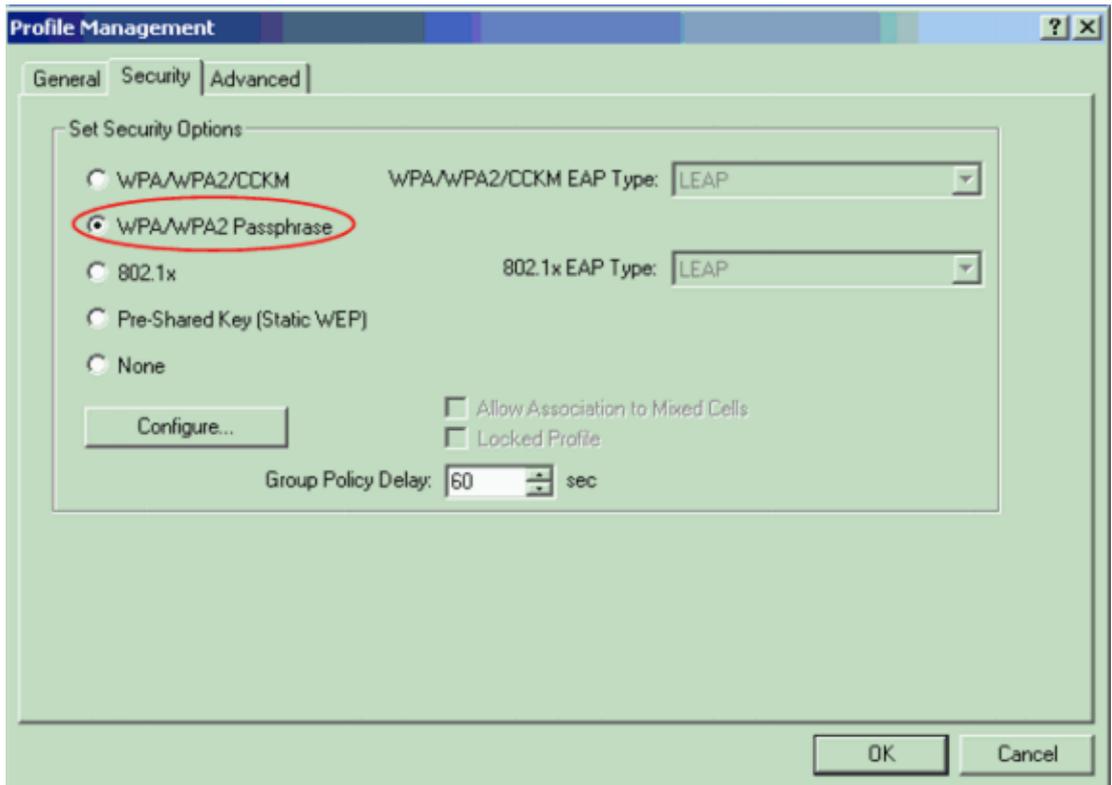
**Note:** The SSID must match the SSID that you configured on the AP for WPA 2 PSK.



The screenshot shows a window titled "Profile Management" with three tabs: "General", "Security", and "Advanced". The "General" tab is selected. Under "Profile Settings", the "Profile Name" field contains "WPA2-PSK" and the "Client Name" field contains "CODC3-LAPTOP". Under "Network Names", the "SSID1" field contains "WPA2PSK", while "SSID2" and "SSID3" are empty. At the bottom right, there are "OK" and "Cancel" buttons.

2. Click the **Security** tab and click **WPA/WPA2 Passphrase**.

This action enables either WPA PSK or WPA 2 PSK, whichever you configure on the AP.



3. Click **Configure**.

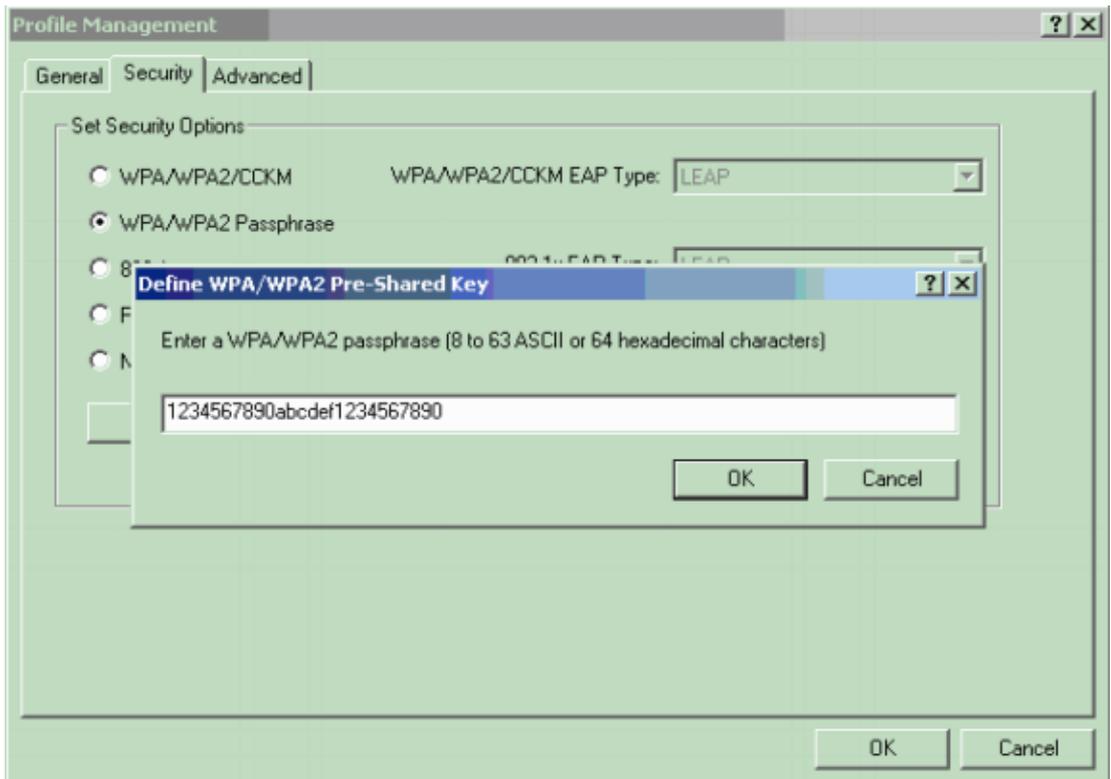
The Define WPA/WPA2 Pre-Shared Key window displays.

4. Obtain the WPA/WPA2 passphrase from your system administrator and enter the passphrase in the WPA/WPA2 passphrase field.

Obtain the passphrase for the AP in an infrastructure network or the passphrase for other clients in an ad hoc network.

Follow these guidelines in order to enter a passphrase:

- ◆ WPA/WPA2 passphrases must contain between 8 and 63 ASCII text characters or 64 hexadecimal characters.
- ◆ Your client adapter WPA/WPA2 passphrase must match the passphrase of the AP with which you plan to communicate.



5. Click **OK** in order to save the passphrase and return to the Profile Management window.

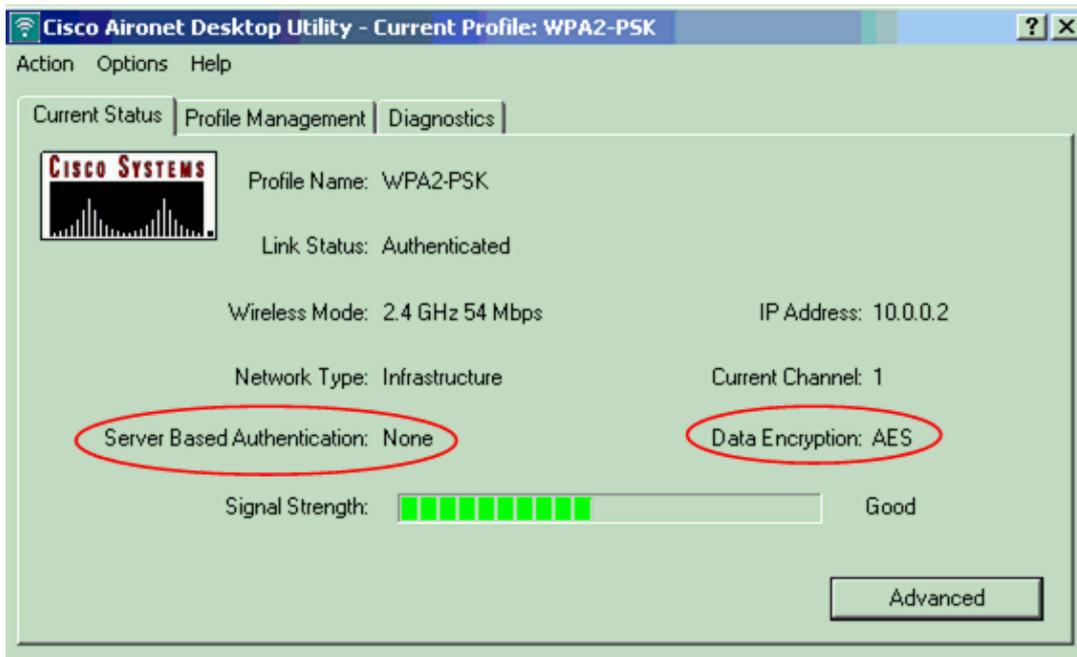
## Verify

Use this section to confirm that your configuration works properly.

Once the WPA 2 PSK profile is activated, the AP authenticates the client based on the WPA 2 passphrase (PSK) and provides access to the WLAN network.

1. Check the ADU Current Status in order to verify successful authentication.

This window provides an example. The window shows that the encryption that is used is AES and that no server-based authentication is performed:



2. Check the AP/bridge Event Log in order to verify that the client has been authenticated successfully with WPA 2 PSK mode of authentication.



## Troubleshoot

There is currently no specific troubleshooting information available for this configuration.

## NetPro Discussion Forums – Featured Conversations

Networking Professionals Connection is a forum for networking professionals to share questions, suggestions, and information about networking solutions, products, and technologies. The featured links are some of the most recent conversations available in this technology.

NetPro Discussion Forums – Featured Conversations for Wireless

Wireless – Mobility: WLAN Radio Standards
Wireless – Mobility: Security and Network Management
Wireless – Mobility: Getting Started with Wireless
Wireless – Mobility: General

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## Related Information

- [Configuring Cipher Suites and WEP](#)
- [Configuring Authentication Types](#)
- [WPA Configuration Overview](#)
- [WPA2 – Wi-Fi Protected Access 2](#)
- [Wi-Fi Protected Access, WPA2 and IEEE 802.11i](#)
- [Wireless Support Page](#)
- [Technical Support & Documentation – Cisco Systems](#)

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