



CHAPTER 1

Overview

Introduction

802.11 wireless has truly blossomed in the past decade, moving from a technology that was once thought of as primarily a productivity enhancement for vertical industries to one now pervasive throughout society. The wide-spread acceptance of Wi-Fi networks has fueled this dramatic adoption, from deployments in offices and distribution centers to homes and ever-multiplying wireless metropolitan areas. Maturing rapidly and reaching critical mass, this widespread adoption has driven down the cost of wireless infrastructure dramatically and has resulted in the availability of higher quality equipment at lower cost.

The rapid increase in the adoption rate of Wi-Fi coupled with the availability of high quality infrastructure at reasonable cost are key factors behind the flurry of activity regarding Wi-Fi location-based services. Not to be confused with solutions requiring a dedicated, independent infrastructure of location receivers and RFID tag readers, research and development in Wi-Fi location prediction techniques has facilitated the emergence of indoor RF location tracking systems based fundamentally on IEEE 802.11 infrastructure. In combination with the frenetic race to implement RFID systems in the consumer and distribution supply chains, these have all combined to form a “perfect storm” of sorts, transforming what was once a general market passing interest in location-based services into one that well positions 802.11-based location-based services as a potential *must-have* application for Wi-Fi wireless.

It is not difficult to understand why this is so. With integrated location tracking, enterprise wireless LANs become much more valuable as a corporate business asset. This is especially true in today’s fast-paced and highly competitive marketplace, where an otherwise well-positioned enterprise may falter against its peers not because of a lack of necessary assets, but rather due to its inability to quickly locate and re-deploy those assets to address today’s rapidly changing business climate. Enterprise network administrators, security personnel, users, asset owners and others have expressed great interest in location-based services to allow them to better address key issues in their environments, such as the following:

- The need to quickly and efficiently locate valuable assets and key personnel.
- Improving productivity via effective asset and personnel allocation.
- Reducing loss because of the unauthorized removal of assets from company premises.
- Improving customer satisfaction by rapid location of critical service-impacting assets.
- Improving WLAN planning and tuning capabilities.
- Coordinating Wi-Fi device location with security policy enforcement.
- Determining the location of rogue devices.

- Monitoring the health and status of key assets in their environment and receiving prompt notification of changes.
- Receiving prompt notification when unauthorized addition or removal of assets occurs.

This guide discusses the location-aware Cisco Unified Wireless Network (UWN). It is focused on indoor location-based services design considerations and select deployment topics. References to applicable existing documentation are made throughout the document, and a wealth of material is provided addressing topics such as:

- The fundamentals of positioning technologies including lateration, angulation, and pattern recognition approaches.
- How Cisco RF Fingerprinting operates and how it compares to other approaches.
- The architecture of the location-aware Cisco UWN.
- Design best practices, including voice, data, and location-based service coexistence.
- Tips on proper installation and configuration.

About the Guide

Target Audience

This guide is intended for individuals interested in designing and deploying indoor Cisco wireless LAN (WLAN) solutions that include the Cisco Wireless Location Appliance, the Cisco Wireless Control System (WCS), and other components of the Cisco Unified Wireless Network (UWN).

Objective

This guide is intended to accomplish the following objectives:

- Provide the reader unfamiliar with location-based services with a basic foundation in technical aspects of location tracking and positioning systems. [Chapter 2, “Location Tracking Approaches,”](#) provides substantial background information on positioning system techniques such as cell of origin, time of arrival, time difference of arrival, angle of arrival, and pattern recognition.
- Describe and define RF Fingerprinting, the technology at the heart of the location-aware Cisco UWN. [Chapter 3, “Cisco Location-Based Services Architecture,”](#) discusses the similarities and differences between RF Fingerprinting and other approaches described in [Chapter 2, “Location Tracking Approaches,”](#) and how RF Fingerprinting addresses the deployment of cost-effective indoor Wi-Fi location tracking solutions. This knowledge is useful when comparing the location-aware Cisco Unified Wireless Network to other approaches for indoor location tracking.
- Review the procedures required to install and configure a location-aware Cisco UWN consisting of LWAPP-enabled access points, third-party chokepoint triggers, WLAN controllers, WCS, and the location appliance.
- Provide information that aids in proper installation and understanding of some of the more advanced parameters used (see [Chapter 4, “Installation and Configuration”](#)).
- Describe best practices that should be followed in designing and deploying location-aware wireless LANs. [Chapter 5, “Best Practices—Location-Aware WLAN Design Considerations,”](#) focuses on a variety of topics from access point placement and separation, multiple location appliance designs

and antenna considerations to calibration, and challenging location environments. All the information contained in this section is aimed at assisting designers in optimizing location-aware designs for improved location fidelity.

- Provide the reader having limited exposure to RFID tag technology with a basic understanding of how these various types of tags relate to the location-aware Cisco UWN. [Chapter 6, “RFID Tag Considerations,”](#) provides details regarding RFID asset tags and how these products function. This section also places considerable emphasis on the proper configuration of Cisco WLAN controllers, the WCS, and the location appliance when using RFID tags.

Additional Reference Documents

It is assumed the reader is familiar with the following documents:

- Cisco Wireless Location Appliance Support Documentation for Release 3.0
http://www.cisco.com/en/US/products/ps6386/tsd_products_support_series_home.html
- Cisco Wireless Control System Support Documentation for Release 4.1
http://www.cisco.com/en/US/products/ps6305/tsd_products_support_series_home.html
- Cisco 4400 Series WLAN Controller Support Documentation for Release 4.1
http://www.cisco.com/en/US/products/ps6366/tsd_products_support_series_home.html
- Cisco 2100 Series WLAN Controller Support Documentation for Release 4.1
http://www.cisco.com/en/US/products/ps7206/tsd_products_support_model_home.html
- Cisco Catalyst 3750 Series Integrated Wireless LAN Controllers Support Documentation
http://www.cisco.com/en/US/products/ps6915/tsd_products_support_model_home.html
- Cisco Wireless LAN Controller Module Support Documentation
http://www.cisco.com/en/US/products/ps6730/tsd_products_support_model_home.html
- Cisco Catalyst 6500 Series Wireless Services Module (WiSM) Support Documentation
http://www.cisco.com/en/US/products/ps6526/tsd_products_support_model_home.html



Note

Despite the difference in nomenclature, software Release 3.0 of the Cisco Location Appliance is generally included in any reference made to software Release 4.1 of the Cisco Unified Wireless Network (UWN) within this document.

Additional design considerations surrounding the use of the InnerWireless (formerly PanGo) Vision Locator location client in an integrated Cisco – InnerWireless solution can be found in the following document:

- *Design Considerations for Cisco – PanGo Asset Tracking*
<http://www.cisco.com/univercd/cc/td/doc/solution/pangoex.pdf>

The following guide is recommended as a design reference when considering the deployment of voice over WLAN (VoWLAN) handsets and supporting infrastructure in conjunction with location based services:

- *Voice over Wireless LAN 4.1 Design Guide*
<http://www.cisco.com/en/US/docs/solutions/Enterprise/Mobility/vowlan/41dg/vowlan41dg-book.html>

Hardware and Software Components

Table 1-1 lists the hardware and software used in the writing of this guide.



Note

Other supported hardware or software can be found by referring to the information located at the following URL: <http://www.cisco.com/en/US/products/ps6386/index.html>.

Table 1-1 **Tested Hardware and Software**

Location Appliance	
AIR-LOC2700-L-K9 ¹	Location Appliance 2700 Series; software release 3.0.42.0.
Wireless Control System (WCS)	
WCS-STANDARD-K9-4.1.91.0.exe	Wireless Control System Release 4.1.91.0 for Windows 2003 Server ²
WLAN Controllers	
AIR-WLC4402-12-K9	4400 Series WLAN Controller; Release 4.1.185.0
AIR-WLC2106-K9	2106 Series WLAN Controller, Release 4.1.185.0
Access Points	
AIR-LAP1242AG-A-K9	802.11ag LWAPP AP North American; version 12.3(11)JX
External Antennas	
AIR-ANT4941	2.4 GHz, 2.2 dBi Dipole
AIR-ANT5135D-R	5 GHz 3.5 dBi Dipole

1. The Cisco Wireless Location Appliance 2710 (AIR-LOC2710-L-K9) model is the successor to the 2700 (AIR-LOC2700-L-K9) model. There is no functional difference between the 2700 and 2710 models, both models support the same features and functionality.

2. Requires appropriate licensing for Location-Based Services support and total number of access points supported.

Table 1-2 **Additional Hardware and Software Components**

AeroScout Ltd.	System Manager	Version 3.2.20.1
	Network Exciter Manager (ANEM)	version 1.2
	EX-3100 Exciter Manager	1.0.20
	Exciter EX-2000	DSP 216, SB 50008, HW v2
	Exciter EX-3100	310.01
	Exciter EX-3200	DSP 30007, SB 60007, HW v2
	ADP-030 power supply	NA
	ADP-040 power supply	NA
	Tag Manager	3.0.4

Table 1-2 Additional Hardware and Software Components

	Tag Activator BWH1000-02-TA	DSP 22059, FPGA 5201, SB 175, CPLD 5107
	BWH-3000CT T2 RFID Tag	4.33
	EDK-200 T2 Telemetry Tag	4.33
	ExciterConfig.exe	1.3.1

