

# Implementing Cisco Unified Wireless Networking Essentials

- **Course Number:** 640-721 (IUWNE)
- **Course Length:** 5 Days

## Course Overview

This instructor-led provides students with information and practice activities to prepare them to design, install, configure, monitor, and conduct basic troubleshooting tasks of a Cisco WLAN in SMB and Enterprise installations. Students will be able to discuss and describe wireless fundamentals, Cisco Unified Wireless networks basics, configuration of a Cisco Unified Wireless Network Controller and a Mobility Express Controller, default OS wireless client configuration tools, configuration of wireless security, management of the wireless network from the Wireless Control System (WCS), maintenance and troubleshooting of the entire system.

## Prerequisites

Students should complete Interconnecting Cisco Networking Devices Part 1 (ICND1) and Interconnecting Cisco Networking Devices Part 2 (ICND2) before taking this course.

## Certification Exam

640-721 Implementing Cisco Unified Wireless Network Essential (IUWNE)

## Course Outline

### Course Introduction

Course Introduction

3 min

### Module 01 - Wireless Fundamentals

Wireless Fundamentals

Introducing Wireless Networks and Topologies

Wireless Today

Wireless Usage and Topologies

Wireless Personal Area Network

1h 5m

Wireless LAN  
Wireless Metro Area Network  
Wireless WAN  
Ad Hoc Networks  
Infrastructure Mode  
Service Set Identifier  
Workgroup Bridge  
Repeaters  
Outdoor Wireless Bridges  
Mesh Networks  
Section 01 Summary  
Introducing WLAN RF Principles  
Wireless Spectrum  
Frequency  
Wavelength  
Amplitude  
Free Path Loss  
Absorption  
Reflection  
Multipath  
Multipath: Phase  
Scattering  
Refraction  
Line of Sight  
Fresnel Zone  
RSSI and SNR  
Section 02 Summary  
Understanding Radio Frequency Mathematics  
Watts, Milliwatts, and Decibels  
Decibels  
dBm  
Decibel Referenced to Isotropic Antenna  
Decibel Referenced to Dipole Antenna  
Effective Isotropic Radiated Power  
Section 03 Summary  
Describing Antennae  
Antenna Principles  
Polarization  
Magnetic Field  
Diversity  
Antenna Types  
Basic Omnidirectional  
Omnidirectionals  
AIR ANT 2506/24120  
Special “Omnis”  
Directional Antennae  
Directional  
Cables and Connectors  
Attenuators and Amplifiers  
Lightening Arrestors

Splitters  
Section 04 Summary  
Understanding Spread Spectrum Technologies  
Spread Spectrum  
FHSS Versus DSSS  
DSSS: Encoding  
DSSS Modulations: DBPSK and DQPSK  
DSSS Modulation: CCK  
Orthogonal Frequency-Division Multiplexing  
OFDM Modulations: BPSK and QPSK  
OFDM Modulation: QAM  
Channels and Overlap Issues  
Section 05 Summary  
Introducing Wireless Regulation Bodies, Standards, and Certifications  
The IEEE  
The Wi-Fi Alliance  
Regulatory Bodies  
FCC Part 15 Antenna Requirements  
2.4-GHz EIRP Output Rules—FCC Example  
2.4-GHz EIRP Output Rules—ETSI Example  
Wireless Spectrum  
Current State of 5-GHz 802.11a Spectrum  
Some IEEE 802.11 Standard Activities  
802.11 Standards for Spectrums and Speeds  
802.11  
802.11b  
802.11b Speed Coverage  
802.11g  
802.11b/g Cell Speeds  
802.11b/g Encoding and Modulations  
802.11b and 802.11g Coexistence  
802.11a  
802.11a Spectrum  
802.11a Speeds  
Comparing the Technologies 802.11a Data Rates  
802.11n: State of the Protocol  
Greater Reliability and Predictability  
802.11n Channel Aggregation  
Block Acknowledgment  
Spatial Multiplexing  
Transmit Beamforming  
Maximal Ratio Combining  
MIMO Benefits  
Section 06 Summary  
Examining Wireless Media Access  
Sending a Frame  
After a Frame Is Sent  
802.11 Frame Shape  
Frame Types  
802.11 Frame Speeds

Discovering the Network (Mgmt Frames)  
Connecting (Mgmt Frames)  
Staying Connected (Mgmt Frames)  
Control Frames  
WMM Enhancement  
Power Save Mode  
Section 07 Summary  
Understanding Non-802.11 Wireless Technologies and Their Impact on WLANs  
Bluetooth  
Cordless Phones  
ZigBee  
ZigBee Networks  
Other Non-802.11 Interferers  
WiMAX Technology  
Section 08 Summary  
Reviewing the Wireless Frame Journey: End-to-End  
Discovering the Network  
Getting Connected  
Clients in Cells  
Sending in the Cell  
Creating the 802.11 Frame  
Acknowledging the Frame  
AP Forwarding to Network  
AP Forwarding to Controller  
In the Controller, Header Is Rewritten  
Wired Segment  
In the Controller, on the Way Back  
The AP Forwards the Answer  
Using the Optimal Speed  
The Right Client Processes the Frame  
All Frames Are Sent to the Same AP Radio  
Controller Needs to Keep SSIDs Separated  
VLANs  
VLAN Operation  
802.1Q Trunking 01  
Understanding Native VLANs  
Mapping SSIDs to VLANs  
Configuring VLANs and Trunks  
VLAN Creation Guidelines  
Adding a VLAN  
Assigning Switch Ports to a VLAN  
Verifying VLAN Membership  
802.1Q Trunking 02  
Configuring 802.1Q Trunking  
Verifying a Trunk  
Section 09 Summary  
Module 01 Review

## **Module 02 - Basic Cisco WLAN Installation**

3h 51m

Basic Cisco WLAN Installation  
Understanding Cisco Unified Wireless Networks Basic Architecture  
Cisco Unified Wireless Networks Basics  
Standalone and Lightweight APs  
Cisco Unified Controller-Based Solution  
Cisco “Split MAC” Design  
Dynamic RF Management  
Dynamic Channel Assignment and Transmit Power Optimization  
Wireless Virtual LAN Support  
Client Roaming and Dynamic Load Balancing  
Cisco Unified Wireless Network Components  
Cisco Unified Wireless LAN Access Points  
Cisco Aironet 1130AG Series Access Point  
Cisco Aironet 1240AG Series Access Point  
Cisco Aironet 1250 AG  
Cisco Aironet 1300 Series and 1400 Series Bridges  
Wireless LAN Controllers  
Cisco 4400 Series WLC  
Integrated 3750G WLAN Controller Switch  
Cisco WiSM  
Cisco 2106 WLC, Cisco WLCM  
Branch Office WLC Limitations  
Cisco WCS, WCS Navigator, and Location Appliance  
Section 01 Summary  
Configuring a Controller  
Terminology  
Ports  
Interfaces  
Management Interface  
AP Manager Interface  
AP Manager Interface: Controller > Interfaces > Edit  
Virtual Interface  
Virtual Interface: Controller > Interfaces > Edit  
Service Port Interface  
Service Port Interface: Controller > Interfaces > Edit  
Dynamic Interfaces  
Dynamic Interfaces: Controller > Interfaces > New and Edit  
Controller Initial Setup Options  
Boot Options  
Run Primary or Backup Image  
CLI Wizard Configuration Tool  
Command Line Interface (CLI) Basic Command Set  
Command Line Interface (CLI) config and debug Commands  
Controller Web Configuration Wizard Login  
Controller Web Configuration Wizard  
Connect to the Controller Web Interface  
Menu Bar  
Administrative Commands  
Management > Local Management Users

Security > TACACS+  
Management > Mgmt via Wireless  
Example: Interface Creation  
Example: WLAN Creation  
Example: Mapping WLAN to AP  
Controller Files  
Controller Code Releases  
show run-config  
show running-config  
Section 02 Summary  
Discovering and Associating with a Controller  
LWAPP Modes  
Layer 3 Lightweight AP Protocol (LWAPP)  
Controller > General  
Access Point Association Sequence  
AP LWAPP Discover and Join Overview  
AP LWAPP Discovery  
LWAPP Layer 3 Discovery  
Access Point Join Order  
Access Point Join Phase Without Master  
Access Point Join Phase With Master  
Primary Controller Name  
Controller > Advanced > Master Controller Mode  
AP LWAPP Join Messages  
AP States  
LWAPP Configuration Phase  
Design: AP Redundancy  
Controller Redundancy  
Controller Redundancy Designs—N + 1  
Controller Redundancy Designs—N + N  
Controller Redundancy Designs—N + N + 1  
Section 03 Summary  
Describing Access Point Operational Modes  
AP Mode: Wireless > Access Points > All APs > Detail  
Access Point Local Mode  
Access Point Local Mode Monitor Timing  
Access Point Monitor Mode  
Access Point Monitor Mode Monitor Timing  
Access Point Sniffer Mode  
AP Sniffer Mode Operation  
Access Point Rogue Detector Mode  
Hybrid REAP  
H-REAP  
H-REAP in Connected Mode  
HREAP in Standalone Mode  
AP Bridging Mode  
Section 04 Summary  
Roaming  
Mobility Groups, Mobility Domains  
Controller > General

Controller > Mobility Management > Mobility Groups  
Roaming Concept  
Cisco Wireless Layer 2 Roaming  
Client Roaming Within a Subnetwork  
Cisco Wireless Layer 3 Roaming  
Client Roaming Across Subnetworks  
Roaming Example—Preroaming  
Roaming Example—Layer 3 Asymmetric  
Roaming Example—Layer 3 Symmetric  
Symmetric or Asymmetric Tunnelling  
Roaming: Tunnels (Symmetric Example)  
Cisco Wireless Mobility Anchor  
Cisco Wireless Mobility Anchor Considerations  
WLANs > Mobility Anchors  
Controller > Mobility Management > Mobility Anchor Config  
Section 05 Summary  
Managing the Network from the Controller  
Controller Monitor Page  
Access Point Summary  
Access Point > Configure  
Monitor 802.11b/g/n Radios  
Radios > Statistics  
Monitor Rogue  
Monitor > Active Rogue AP > Detail  
Monitor > Active Rogue AP > Detail > Edit  
Rogue Containment  
Monitor Clients  
Monitor Clients > Details  
Disabled Clients  
Excluded Clients  
Clients: Internal DHCP Server  
Section 06 Summary  
Configuring and Migrating Standalone Access Points  
Managing the Access Point  
Main Menu: Home  
Express Setup Menu  
Express Security Setup  
Network Interfaces  
Radio1-802.11A Network Interface  
Aironet AP Cisco IOS-to-LWAPP Conversion  
Cisco IOS-to-LWAPP Conversion Utility  
LWAPP-to-Cisco IOS Conversion  
Adding Standalone Access Points to WCS  
Converting APs to LWAPP Using WCS  
Section 07 Summary  
Understanding the Cisco Mobility Express Architecture  
Cisco Smart Business Communication System  
WLAN Solutions Overview Positioning of Different WLAN Options  
Cisco 521 Wireless Express Lightweight Access Point  
Cisco 526 Wireless Express Mobility Controller

Deployment Recommendations  
Configuring Cisco 521 APs in Standalone Mode  
Configuring the Mobility Express Solution  
Cisco Configuration Assistant Configuring Standalone 521 AP  
Configuring the Cisco 526 Mobility Controller  
Configuring the 526 Controller  
Section 08 Summary  
Module 02 Review

## **Module 03 - Wireless Clients**

1h 5m

Wireless Clients  
Using Default Configuration Tools  
Linux NetworkManager  
Profiles with NetworkManager  
Enterprise Type of Profile  
MAC AirPort Extreme  
Connecting to a Network  
Configuring an Ad Hoc Profile  
Infrastructure Profile  
Advanced Configuration  
Advanced Parameters  
Wireless Connection Details  
Diagnostic  
Windows Wireless Zero Configuration (WZC) Overview  
Connecting to Preferred WLANs using WZC  
Configuring a Profile Using the Wireless Zero Configuration Tool  
Configuring a Profile Using the WZC— PSK Authentication  
Profile Configuration Example  
State Table  
Section 01 Summary  
Describing Cisco Aironet WLAN Client Adaptors  
Cisco ADU and ACAU Overview  
Installing the Cisco ADU  
Installing Site Survey Utility  
Using the Cisco ADU or a Third-Party Tool  
Detecting the Adapter and Rebooting  
Cisco ADU Current Status Page  
Advanced Information  
Cisco ADU Profile Manager  
Cisco ADU: Creating Profiles  
Cisco ADU: Profile Security  
Cisco ADU: Advanced Parameters  
Cisco ADU: Other Tools—Diagnostic  
Cisco Aironet Site Survey Utility  
Cisco Aironet Site Survey Utility: Thresholds  
Cisco Aironet Site Survey Utility: AP Scan List  
Cisco Aironet Configuration Administration Utility  
Cisco Aironet Configuration Administration Utility: Profile Management  
Cisco ACAU: Global Settings  
Section 02 Summary

Describing the Cisco Secure Services Client  
The Cisco SSC Overview  
The Cisco SSC Licenses  
Cisco Secure Services Client Installation  
The Cisco SSC—Configuration  
The Cisco SSC—Creating New Groups  
The Cisco SSC—Creating New SSIDs  
Cisco Secure Services Client Administration Utility  
Section 03 Summary  
Understanding the Cisco Compatible Extensions Program  
The Cisco Compatible Extensions Program  
Cisco Compatible Extensions Program for Wi-Fi Tags  
Cisco Compatible Extensions Explained  
Cisco Compatible Extensions Example: Cisco Centralized Key Management  
Cisco Compatible Extensions Example: AP-Specified Maximum Power  
Cisco Compatible Extensions Example: Enhanced Roaming  
Cisco Compatible Extensions Example: Client Link Test  
Cisco Compatible Extensions Example: Client Reporting  
Cisco Compatible Extensions Example: Client MFP  
Section 04 Summary  
Module 03 Review

## **Module 04 - WLAN Security**

2h 15m

WLAN Security  
Overview of WLAN Security  
Wired vs. Wireless Privacy  
Authentication  
Authenticating Devices vs. Users  
Encryption  
Symmetric and Asymmetric Encryption  
Common Keys  
Individual Keys  
Wireless Threats  
Wireless IDS  
Wireless IPS  
Management Frame Protection  
Infrastructure MFP  
Client MFP  
Section 01 Summary  
Establishing IEEE 802.11 Security  
Authentication: Open  
WLANs > Edit > Security  
Authentication: PSK (WEP)  
WEP Configuration  
WEP Engine  
WEP Limitations  
MAC Filtering  
WLAN > Edit  
Security > AAA > Mac Filtering  
Section 02 Summary

Centralizing WLAN Authentication  
802.1X  
802.1X over Wireless  
Unique Encryption Keys  
EAP Process  
EAP Frame Format  
RADIUS  
Security > AAA > RADIUS > Authentication  
Security > AAA > RADIUS > Authentication > New  
WLAN > Edit > Security > AAA Servers  
Local EAP  
Security > Local EAP > Profiles  
Security > Local EAP > Profiles > Edit  
Security > Local EAP > EAP-FAST Parameters  
Security > AAA > Local Net Users  
Security > Local EAP > Authentication Priority  
Security > AAA > LDAP  
WLAN > Edit  
Section 03 Summary  
Describing EAP Authentications  
Symmetric Keys  
Asymmetric Keys  
Digital Signature  
Trusted Third Party  
Certificates  
PKI  
EAP-TLS  
EAP-FAST  
PAC Creation  
PAC Exchange  
EAP-FAST Authentication  
PEAP  
PEAP Authentication  
LEAP  
LEAP Authentication  
Section 04 Summary  
Managing Authentication and Encryption with WPA and WPA2  
Wi-Fi Protected Access (WPA)  
WPA Authentication Modes  
WPA Authentication Process  
Purpose of Each WPA Phase  
Unicast Keys: Four-Way Handshake  
Group Key Handshake  
WPA: Longer Key, Longer Initialization Vector  
WPA: Per-Packet Key Mixing  
Message Integrity Check  
WPA Pre-Shared Key (PSK) Authentication: Offline Dictionary Attack  
WPA2 and IEEE 802.11i  
IEEE 802.11i and AES Encryption  
WPA/WPA2/802.11i Comparison

802.11i Key Caching and Preauthentication  
Cisco Centralized Key Management  
Section 05 Summary  
Configuring Wireless Security on Controllers and Clients  
Security Policy Logic  
WLAN > Edit > Security  
Security  
802.1X  
802.1X + WEP  
WPA + WPA2  
WZC Association  
WZC Authentication  
WZC Authentication: Smart Card or Certificate  
WZC: PEAP  
NetworkManager  
Mac AirPort Extreme  
Cisco ADU: Profile Security  
Web Authentication  
Web Authentication Process  
WLAN > Edit > Security > Layer 3  
Security > Web Auth > Web Login Page  
Security > Web Auth > Web Authentication Certificate  
Section 06 Summary  
Module 04 Review

## **Module 05 - Cisco WCS Administration**

1h 41m

Cisco WCS Administration  
Introducing Cisco WCS and Cisco WCS Navigator  
WLAN Management Tools  
Cisco WCS Location Tracking  
Cisco WCS with Location Appliance  
Cisco WCS Versions  
Cisco WCS Licenses  
Cisco Spectrum Intelligence Licenses  
Cisco WCS Features  
Cisco WCS Home Page  
Cisco WCS System Management  
Cisco WCS WLAN Monitoring  
Portal into WLAN Performance  
Cisco WCS WLAN Planning  
Cisco Spectrum Intelligence  
Cisco WCS Navigator Overview  
Cisco WCS Navigator Product Specifications  
Cisco WCS Navigator Features  
Adding Regional Cisco WCS  
Administration > AAA > Users WCS  
Network Summary  
Inventory Reports  
Section 01 Summary  
Installing Cisco WCS

Cisco WCS System Requirements  
Cisco WCS Port Requirements  
Cisco WCS Installation  
Install or Upgrade  
Upgrade  
Installation  
Access Ports  
Cisco WCS Passwords  
FTP and TFTP Root Folders  
Multihomed Server  
Install Folder and Shortcut Folder  
Cisco WCS Preinstallation Summary and File Installation  
Cisco WCS Installation Complete and Installation Log  
Cisco WCS Group  
Connecting to Cisco WCS  
Adding a License to Cisco WCS  
Section 02 Summary  
Administering Cisco WCS  
Cisco WCS Login  
Initial Screen—Home  
Administration Menu  
Administration > Background Tasks  
Administration > AAA  
Administration > AAA > Users > Add User  
Administration > AAA> Groups > Group Name  
Administration > AAA> Users > Audit Trail  
Administration > Logging  
Administration> Settings > Data Management  
Administration> Settings > Mail Server  
Administration > User Preferences  
Section 03 Summary  
Working with Controllers from Cisco WCS  
Configuration Tab Overview  
Configure > Controllers  
Configure > Controller > Add Controllers  
Controller Configuration  
Configure > Access Points  
Audits  
Configure > Controllers > Controller Name > System > Commands > Audit Config > Go  
Configuration Policy Templates  
Creating a Template  
Applying Saved Template  
Configuration Groups  
Configuration Group Settings  
AP/Radio Templates  
Auto Provisioning  
Auto Provisioning Settings  
Section 04 Summary  
Working with Maps  
Maps Overview

Monitor > Maps > Campus  
Monitor > Maps > Building  
Monitor > Maps > Building > New Floor Area  
Monitor > Maps > Building > New Floor Area > Add Access Points  
Monitor > Maps > Building > Floor > Add Access Points > Go > OK > Save  
Cisco WCS Prediction Versus Site Survey  
Map Editor  
Map Editor Before and After  
Planning Tool  
Planning Tool: Add AP  
Generate Proposal  
Section 05 Summary  
Monitoring the Network with Cisco WCS  
Initial Screen—Home  
Home > Edit Tabs  
Home > Edit Content  
Home > Personalized Tab  
The Monitor Menu  
The Alarm Dashboard  
Monitor > Controllers  
Monitor > Access Points  
Monitor > Clients  
Associated Clients (vs. Time)  
Monitor > Clients > Troubleshoot  
Monitor > Security  
Monitor > Security—Rogues  
Monitor > Security—Miscellaneous  
Monitor > Alarms  
Monitor > Events  
Cisco WCS Location  
Location Tracking Methods  
Location Tracking Using Closest AP  
Location Tracking Using Triangulation  
Location Tracking Using RF Fingerprinting  
Cisco WCS Location Without Appliance  
Cisco WCS Location with Appliance  
Searching for a Device  
Search > Clients  
Recent/Present Map  
Section 06 Summary  
Module 05 Review

## **Module 06 - WLAN Maintenance and Troubleshooting**

1h 3m

WLAN Maintenance and Troubleshooting  
Maintaining the System  
Controller Platform and Code Version  
Wireless > All APs > Detail > Inventory  
Upgrade: GUI Recommended  
Apply vs. Save Configuration  
Commands > Upload File

show running-config  
show run-config  
Wireless > All APs > Detail  
Commands > Reset to Factory Default  
Commands > Reboot System > Save And Reboot or Reboot Without Save  
Cisco WCS Automated Backup  
Cisco WCS Manual Backup  
Cisco WCS Code Upgrade  
Section 01 Summary  
Design and Site Survey Considerations  
Building Materials  
Identify Problematic Areas  
Signal Attenuation  
Non-802.11 Sources of Interference  
Microwave Ovens  
Bluetooth  
Wireless Phones  
Analog Cameras  
Verifying Coverage with Site Survey  
Which Coverage for Which Usage  
WLAN Coverage and Capacity  
Recommended Parameters for 2.4-GHz Data Networks  
Voice Cell Overlap Guidelines  
AP Placement for Location  
Coverage Overlap  
Multifloor Coverage  
Site Survey Tools  
Basic Survey Tools  
Section 02 Summary  
Troubleshooting  
Visual Elements  
Common Controller Issues  
Common Client Issues  
Hidden Node Issue  
Exposed Node Issue  
Near-Far Issue  
Backward Compatibility Issues  
CLI Command: debug  
Per-Client Debug Option  
CLI Command: show  
Layer 2 and Layer 3 Troubleshooting  
CLI debug Commands: debug dot11 ? and debug dhcp ?  
CLI Command: show client detail  
Monitor Clients > Details > Select Client  
CLI debug Commands: debug aaa ? and debug dot1x ?  
Management > Logs > Config  
Management > Logs > Message Logs  
Management > SNMP > General  
Management > SNMP > Communities and Trap Receiver  
Management > SNMP > Trap Logs

Management > SNMP > Trap Controls  
Management > Tech Support > Controller Crash  
Management > Tech Support > AP Crash Log > Get Log  
Cisco WCS Client Troubleshooting Tool  
Monitor Client > Troubleshoot  
Monitor Clients > Troubleshoot > Log Analysis  
Third-Party Tools: Sniffers  
Cisco Spectrum Expert  
Section 03 Summary  
Module 06 Review  
Course Closure

**Total Duration:** 11h 5m