



Fundamentals of Wireless LANs

Version 1.2

Scope and Sequence



Modules



Take the Fundamentals of Wireless LANs Curriculum Tour

If you have question on this course [click here](#).



Fundamentals of Wireless LANs

This introductory course to Wireless LANs focuses on the design, planning, implementation, operation and troubleshooting of Wireless LANs. It covers a comprehensive overview of technologies, security, and design best practices with particular emphasis on hands on skills in the areas of Wireless LAN setup and troubleshooting, 802.11a and 802.11b technologies, products and solutions, Site Surveys, Resilient WLAN design, installation and configuration, WLAN Security – 802.1x, EAP, LEAP, WEP, SSID and Vendor interoperability strategies.

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TABLE OF CONTENTS

TARGET AUDIENCE	3
<i>Prerequisites</i>	<i>3</i>
<i>Target Certifications</i>	<i>3</i>
<i>Course Description</i>	<i>3</i>
<i>Course Objectives</i>	<i>4</i>
<i>Lab Requirements.....</i>	<i>4</i>
<i>Minimum System Requirements</i>	<i>4</i>
<i>Course Overview.....</i>	<i>7</i>
<i>Course Outline</i>	<i>8</i>
<i>Module 1: Introduction to Wireless LANs.....</i>	<i>8</i>
<i>Module 2: 802.11 (a,b,g) and Network Interface Cards.....</i>	<i>9</i>
<i>Module 3: Wireless Radio Technology</i>	<i>11</i>
<i>Module 4: Wireless Topologies.....</i>	<i>13</i>
<i>Module 5: Access Points</i>	<i>14</i>
<i>Module 6: Bridges.....</i>	<i>16</i>
<i>Module 7: Antennas</i>	<i>17</i>
<i>Module 8: Security.....</i>	<i>19</i>
<i>Module 9: Application Design and Site Survey Prep.....</i>	<i>21</i>
<i>Module 10: Site Survey</i>	<i>22</i>
<i>Module 11: Troubleshooting Management, Monitoring, and Diagnostics.....</i>	<i>24</i>
<i>Module 12: Emerging Technologies</i>	<i>25</i>

Target Audience

High School, Community College (and equivalent), Military and University students as well as transitional workers enrolled in the Cisco Networking Academy Program.

Prerequisites

Continuing Academy students should have completed at least CCNA module 3. Students without previous Academy experience should have equivalent knowledge and experience, specifically fundamental knowledge of modern computer networks.

Target Certifications

This course will prepare students to take the Wireless LAN for Field Engineers (WLANFE) exam 642-582. This exam is one of several requirements for Field Engineers supporting a Partner Wireless LAN Specialization. Full details of the exam can be found at:

http://www.cisco.com/web/learning/le3/current_exams/642-582.html#addrec

A current CCNA certification is a pre-requisite to taking the Wireless LAN for Field Engineers (WLANFE) target certification exam.

Course Description

This introductory course to Wireless LANs focuses on the design, planning, implementation, operation and troubleshooting of Wireless LANs. It contains a comprehensive overview of technologies, security, and design best practices with particular emphasis on hands on skills in the following areas:-

- Wireless LAN setup and troubleshooting
- 802.11 (a, b, and g) technologies, products and solutions
- Radio Technologies
- WLAN applications and site surveys
- Resilient WLAN products, design, installation, configuration and troubleshooting
- WLAN security
- Vendor interoperability strategies
- Emerging wireless technologies

Course Objectives

Upon completion of this course, students will be able to:

- demonstrate an understanding of wireless radio technologies and topologies
- discriminate between and describe the IEEE 802.11 wireless standards
- configure and install various Cisco wireless access points, bridges, adapters, and antennae
- demonstrate the concepts of wireless LAN design and installation
- configure, monitor and maintain a WLAN using both CLI and web-based Device Manager tools
- identify wireless security threats and vulnerabilities
- configure wireless LAN security using MAC filtering, WEP, LEAP, EAP and 802.1x technologies
- demonstrate an understanding of proper site survey techniques and safety practices
- configure various network monitoring technologies including Syslog, SNMP and logging
- troubleshoot wireless installations and configurations
- demonstrate an understanding of vertical and horizontal wireless implementations and uses

Lab Equipment Requirements

Lab Bundles:

The equipment required for this curriculum is fully described in the Lab Configuration and Pricing Guide to be found in the FWL Course catalog section of the Cisco Networking Academy web site. This is kept up to date in terms of pricing and equipment changes.

Click here to go to the latest version:

<http://cisco.netacad.net/cnams/content/FWLLab.jsp>

(you will need a valid Academy logon)

This spreadsheet is specific to the United States Networking Academies. Other countries and domains have different licensing and regulatory requirements for radio and wireless equipment. You may need to work with your local Academy Technical Manager to determine specific equipment bundles and pricings for your country.

Minimum System Requirements

In order to view and deliver the FWL curriculum, an Academy will need to have the following equipment:

Curriculum Requirements: 1 PC per student and 1 curriculum server

Lab Requirements: 4 Lab PCs or laptops (Win 2000 or Win XP (recommended))

2 Lab Handhelds (Windows CE) (optional)

1 Lab Server (Win Server 2000 or better is recommended, but other configurations can be utilized eg Linux, Unix)

Curriculum Requirements

Student PC

The curriculum may be viewed on a wide range of computers that use various operating systems – Windows; MAC OS; Linux; Unix etc. The machine and associated OS must host a browser such as Netscape 7.0x or 7.1 (only); Internet Explorer 5.5 (SP2); or Firefox 1.x. Other browsers may work but are not supported.

Java, Javascript and StyleSheets must be enabled in the browser preference setting.

The Macromedia Flash 7 plugin should be downloaded and enabled. The computer should also have the free Adobe Acrobat Reader software loaded.

The monitor should support, as a minimum, 800 x 600 resolution with a video card supporting a color depth of 256 colors. The minimum size monitor recommended for a desktop machine is 15 inch (38 cm). If available, a 17 inch (43 cm) monitor with a 16 bit color depth video card is preferred.

The computer will require a sound card, speakers or headphones (preferred) and a mouse. In addition, it should be fitted with a network interface card (NIC) that supports a minimum of 10MB/s Ethernet.

Curriculum Server

As with the curriculum viewing computers, a wide range of computers and operating systems are available to host the curriculum locally. However, consideration needs to be given to the number of students that may be accessing the machine when considering suitability.

The recommended operating system is Microsoft Windows 2000 Server (SP2) or later.

The server computer will require 5 to 10GB of hard disk space for the curriculum. The minimum recommended memory requirement is 256MB.

Lab Computer Requirements (Student Pod)

PC / Laptop (2 students per machine)

Recommended OS - Windows2000 or Windows XP (recommended)

600Mhz processor or better

Minimum 256MB of RAM

Available PCI slot

10GB of available hard-disk space for all applications

Color Monitor with 256-color (8-bit) or better video card

Monitor resolution 800x600 dpi or better

CD-ROM drive

IE 5.0, Netscape Navigator 4.7 or Firefox 1.x (or later versions)

Cisco Demo and Freeware Applications for Lab Exercises

- Cisco Secure ACS v3.1.1 or better (to deliver the optional 802.1x security labs)
- A 90 day trial version of Cisco Secure ACS is available via CCO software center.
- <http://www.cisco.com/cgi-bin/tablebuild.pl/acs-win-eval>. A valid CCO license is required.
- The instructor *may* have to update the CCO account by completing the high encryption license agreement
- Cisco VPN Client (3.6 or later) (Optional)
- <http://www.cisco.com/kobayashi/sw-center/vpn/client/>
- The instructor may have to update the CCO account by completing the high encryption license agreement.

Demo and Freeware Applications for Lab Exercises

- PUTTY SSH Client or equivalent
 - <http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html>
- SolarWinds TFTP Server or equivalent
 - http://www.solarwinds.net/Tools/Free_tools/TFTP_Server
- Kiwi Enterprises Syslog Server or equivalent
 - <http://www.kiwisyslog.com/products.htm#syslog>
- SNMP Trap Watcher or equivalent
 - <http://www.bttsoftware.co.uk/snmptrap.html>

Server: (to deliver optional 802.1x Security Labs)

Software Platforms

- Windows 2000 Server with Service Pack 3 installed (eval version or standard 5 or 10 user versions)
- Windows 2000 Advanced Server, with these additional requirements:
 - 120 day evaluation copy may be available via Microsoft
 - without Microsoft Clustering Services installed
 - with Service Pack 3 installed
- Microsoft products can be economically acquired in the United States under the MSDN Academic Alliance program for \$799 USD. See <http://www.msdnaa.net> for more information.

COST CALCULATOR

The Wireless Networks [Cost Calculator](#) may help to estimate the costs for offering the course.

ORDERING

Your Cisco Account Manager can help you when placing an order for equipment.

If your Academy is in the United States and you are having difficulty contacting your Cisco Account Manager, please email lab-bundle@external.cisco.com and we will have someone contact you.

If your Academy is outside the United States, please contact your Area Academy Manager. To find out who your Area Academy Manager is, go to your homepage and click on “View Information” under the “Teach” section.

Please include the following information in your email:

- Your full name
- Your username/userid
- Academy Name
- Academy Address
- Academy City, State/Province, Country, and Postal Code
- Academy Contact Name and Telephone Number

Course Overview

1. [Introduction to Wireless LANs](#)
2. [802.11\(a, b, & g\) and Network Interface Cards](#)
3. [Wireless Radio Technology](#)
4. [Wireless Topologies](#)
5. [Access Points](#)
6. [Bridges](#)
7. [Antennas](#)
8. [Security](#)
9. [Application Design and Site Survey Prep](#)
10. [Site Survey](#)
11. [Troubleshooting, Management, Monitoring and Diagnostics](#)
12. [Emerging Technologies](#)

Course Outline

Module 1 - 12 Outline

Module 1: Introduction to Wireless LANs

1.1 Introduction to Wireless LANs

- 1.1.1 What is a wireless LAN?
- 1.1.2 No more wires?
- 1.1.3 Why wireless?
- 1.1.4 Evolution of wireless LANs

1.2 Networking Media

- 1.2.1 Physical layer media
- 1.2.2 STP
- 1.2.3 UTP
- 1.2.4 Coaxial cable
- 1.2.5 Optical fiber
- 1.2.6 Atmosphere: the wireless medium
- 1.2.7 Media installation

Lab: Wireless Component and Media Identification

1.3 Wireless Technologies

- 1.3.1 Overview
 - Interactive Activity: From LAN to WLAN
- 1.3.2 Digital wireless and cellular

1.4 Components and Topologies

- 1.4.1 Components overview
 - Interactive Activity: Devices Function at OSI Layers
- 1.4.2 Client adapters
- 1.4.3 Access points
- 1.4.4 Bridges
- 1.4.5 Antennas
- 1.4.6 Cables and accessories
- 1.4.7 802.11 enabled devices

Lab: Wireless Lab Setup

- 1.4.8 Consumer wireless products

1.4.9 Wireless LAN Topologies

1.5 Wireless LAN Market

1.5.1 Implications

1.5.2 WLAN growth and applications

1.5.3 Market requirements

1.6 Challenges and Issues

1.6.1 Radio signal interference and degradation

Lab: Challenges of Wireless Regulations

1.6.2 Power management

1.6.3 Interoperability

1.6.4 Network security

1.6.5 Reliability and connectivity

1.6.6 Installation and site design issues

1.6.7 Health issues

1.6.8 Future directions

Lab: Challenges of Wireless Media

Module Summary

Module Quiz

Module 2: 802.11 (a,b,g) and Network Interface Cards

Module Overview

2.1 802.11 Standards

2.1.1 Overview

2.1.2 IEEE and 802.11

Interactive Activity: IEEE 802 Standards

2.1.3 IEEE 802.2 LLC review

2.1.4 Wireless LAN general description

2.1.5 Logical architecture

Interactive Activity: WLAN Logical Architecture: Acronym Recognition

2.2 802.11 MAC Layer

2.2.1 MAC services

2.2.2 MAC frame structure, architecture, and operation

Interactive Activity: 802.11 MAC Frame Format

2.2.3 Carrier-sense mechanism, MAC-level acknowledgements, and interframe spaces

2.3 Physical Layer (PHY)

2.3.1 Scope and functions

2.3.2 IEEE 802.11b (High-Rate) DSSS PHY specification

2.3.3 802.11b modulation

2.3.4 IEEE 802.11a PHY specification

2.3.5 IEEE 802.11g PHY specification

2.3.6 FHSS and Infrared (IR) PHY specifications

2.4 Client Adapters

2.4.1 Introduction

Photozoom: Cisco Aironet Client Adapters

2.4.2 Parts of the client adapter

2.4.3 Driver types and client support

Lab: Install a WLAN adapter card

2.4.4 Network configurations using the client adapters

2.5 Aironet Client Utility (ACU)

2.5.1 Overview

2.5.2 Installation

Lab: Install Aironet Client Utility (ACU)

2.5.3 Create and select profiles

2.5.4 Edit, import, and export profiles

2.5.5 Manage profiles

Lab: Configure Auto Profiles

2.5.6 Configure the client adapter

Demonstration Activity: The Aironet Client Utility

2.5.7 Aironet Client monitor (ACM)

2.5.8 Configure the client IP address

2.6 ACU Monitoring and Troubleshooting Tools

2.6.1 Overview

2.6.2 Status and statistics

2.6.3 Cisco WLAN troubleshooting

2.6.4 Survey and Link Test Tool

2.6.5 Link Status Meter

Interactive Activity: Link Status Meter and Free Space Loss Simulator

Lab: ACU Utilities

Lab: Creating an Adhoc Network

Module Summary

Module Quiz

Module 3: Wireless Radio Technology

Module Overview

3.1 Waves

3.1.1 Overview of waves

Interactive Activity: Longitudinal Pulse

Interactive Activity: Digital Modulation

3.1.2 Sine waves

Interactive Activity: Amplitude and Frequency

Interactive Activity: Amplitude, Frequency, and Phase

3.1.3 Analog to digital conversion

Interactive Activity: Analog to Digital Conversion

3.2 Mathematics for Studying Radio

3.2.1 Watts

3.2.2 Decibels

3.2.3 Decibel references

Interactive Activity: Calculating Decibels

Interactive Activity: Using Decibels

Lab: Wireless Mathematics

3.3 Electromagnetic (EM) Waves

3.3.1 Basics of EM waves

Interactive Activity: Propagation of Light in Matter

Interactive Activity: Electromagnetic Fields

Interactive Activity: Electromagnetic Calculator

3.3.2 EM spectrum chart

Interactive Activity: Electromagnetic Spectrum

3.3.3 Fourier synthesis

3.3.4 Spectrum uses

3.4 Signals

3.4.1 Viewing signals in time

3.4.2 Viewing signals in frequency

3.4.3 Signals in time and frequency

Interactive Activity: Tone Generator Modulation

3.4.4 Noise in time and frequency

3.5 Modulation Techniques

3.5.1 Carrier frequency

3.5.2 Basic modulation techniques

Interactive Activity: Digital Modulation

3.5.3 FHSS

Interactive Activity: Frequency Hopping Spread Spectrum

3.5.4 DSSS

3.5.5 OFDM

3.6 Multiple Access and Bandwidth

3.6.1 Multiple access to shared medium

3.6.2 WLAN DSSS and CSMA/CA

Interactive Activity: Allocating Communications Resources

3.6.3 Bandwidth

3.7 Radio Wave Propagation

3.7.1 Propagation of RF

3.7.2 Refraction

Interactive Activity: Optical Refraction

3.7.3 Reflection

Interactive Activity: Law of Reflection

3.7.4 Diffraction and scattering

3.7.5 Multipath

Interactive Activity: Multipath

3.7.6 Path-loss

Interactive Activity: The Free-Space Loss (FSL) Equation

Interactive Activity: Free Space Loss Simulation

Module Summary

Module Quiz

Module 4: Wireless Topologies

Module Overview

4.1 Components

- 4.1.1 Laptops and workstations
- 4.1.2 Mobile computers, PDAs, and barcode readers
- 4.1.3 Clients and adapters
- 4.1.4 Access points and bridges
- 4.1.5 Antennas
- 4.1.6 Ethernet and wired LANs
 - Interactive Activity: Layer Launch
 - Interactive Activity: Devices Function at OSI Layers

4.2 WLAN Topologies

- 4.2.1 Modularity
 - Interactive Activity: Cisco Three-Layer Internetwork Design Model
- 4.2.2 WLAN categories
 - Interactive Activity: Bridged WLANs
- 4.2.3 Local area networks (LAN)
- 4.2.4 Wireless repeater
- 4.2.5 System redundancy and load balancing
- 4.2.6 Roaming
- 4.2.7 Scalability

4.3 Channel Setup

- 4.3.1 Overview
- 4.3.2 Access point coverage and comparison
- 4.3.3 Multirate implementation
- 4.3.4 Channel usage and interference

4.4 Bridge Topologies

- 4.4.1 Root modes

4.4.2 Point-to-point configuration

Interactive Activity: Bridge's Line of Sight

4.4.3 Point-to-multipoint configuration

4.4.4 Distance limitations

4.4.5 Bandwidth

4.5 Sample Topologies

4.5.1 Basic topologies

Interactive Activity: Name that Topology

4.5.2 Campus topologies

4.5.3 WLAN addition to AVVID

Interactive Activity: Vocabulary Check

Interactive Activity: Cisco Integrated Solution

Lab: Topology Design with Cisco Network Designer (CND)

4.6 VLAN, QoS, and Proxy Mobile IP

4.6.1 VLAN features

4.6.2 Quality of Service (QoS) feature

4.6.3 eDCF

4.6.4 Proxy mobile IP

Module Summary

Module Quiz

Module 5: Access Points

Module Overview

5.1 Access Point Connection

5.1.1 Introduction

Photozoom: Cisco AP1100 Access Point

Photozoom: Aironet 1200 series

Photozoom: Cisco AP350 Access Point

5.1.2 Radio upgrade

5.1.3 Cable and power the AP

5.1.4 LED Indicators

5.1.5 Connecting to the AP

5.1.6 Reset the AP

5.2 Basic Configuration

5.2.1 Configure IP address and SSID via IPSU

5.2.2 Navigating the GUI

Lab: Configuring Basic AP Settings

5.2.3 Configure basic settings via GUI

5.2.4 Navigating the CLI

Lab: Using features of the Internetworking Operating System (IOS) command line interface (CLI)

5.2.5 Configure basic settings via CLI

Demonstration Activity: Configure IP Address using VxWorks Menu

Demonstration Activity: Configure Radio Interface using VxWorks Menu

Lab: Manage AP Configuration and Image Files

5.3 Verify AP Operation

5.3.1 Overview

5.3.2 Summary status (HOME) page

5.3.3 Network map

5.3.4 Associations

5.3.5 ACM and ACU

Lab: Configure Ethernet/FastEthernet Interface

5.4 Network Interface Configuration

5.4.1 Overview

5.4.2 IP address

5.4.3 Configure the FastEthernet interface

5.4.4 Configure radio interfaces via GUI

Demonstration Activity: AP Radio Advanced

Lab: Configure Radio Interfaces through the GUI

5.4.5 Configure radio interfaces via IOS CLI

Lab: Configure Radio Interface through the IOS CLI

5.4.6 Verify radio status

5.4.7 Carrier busy test

5.4.8 Debugging the radio

Lab: Configure an AP as a repeater through the IOS CLI

5.5 Configure Services

- 5.5.1 Overview
- 5.5.2 Telnet/SSH
- 5.5.3 Hot standby
- 5.5.4 CDP
- 5.5.5 DNS
- 5.5.6 HTTP
- 5.5.7 Proxy Mobile IP
- 5.5.8 QoS
- 5.5.9 NTP

5.6 Wireless Services

- 5.6.1 Overview
- 5.6.2 AP
- 5.6.3 WDS

Module Summary

Module Quiz

Module 6: Bridges

Module Overview

6.1 Bridge Connection

- 6.1.1 Introduction
 - Photozoom: Cisco BR350 Wireless Bridge
 - Photozoom: Cisco 1400 Wireless Bridge
- 6.1.2 Bridge roles in the network
- 6.1.3 Cable and power the bridge
- 6.1.4 LED indicators
- 6.1.5 Connecting to the bridge
- 6.1.6 Reset the bridge

6.2 Basic Configuration

- 6.2.1 Configure IP address and SSID via IPSU
- 6.2.2 Navigating the GUI
- 6.2.3 Configure basic settings via GUI
 - Demonstration Activity: Using the IP Setup Utility (IPSU)
- 6.2.4 Navigating the menu
- 6.2.5 Configure basic settings via menu

6.3 Configuring the radio and Ethernet ports

- 6.3.1 Basic radio port configuration
- 6.3.2 Extended radio configuration – hardware page
- 6.3.3 Extended radio configuration – advanced page
- 6.3.4 Configuring the Ethernet port – identification page
- 6.3.5 Configuring the Ethernet port – hardware page
- 6.3.6 Configuring the Ethernet port – advanced page

Lab: Configure Site-to-Site Wireless Link

6.4 Configuring Services

- 6.4.1 Configuring time services
- 6.4.2 Configuring boot services
- 6.4.3 Configuring name services
- 6.4.4 Configuring routing setup

Lab: Configure Bridge Services

6.5 Cisco Services

- 6.5.1 Services overview
- 6.5.2 CDP
- 6.5.3 Firmware upgrade and distribution

Lab: Manage Bridge Configuration and Image Files

- 6.5.4 Hot standby management
- 6.5.5 Manage system configuration

Lab: Configure Layer 3 Site-to-Site Wireless Link—OPTIONAL Challenge Lab

6.6 1400 Series Bridge

- 6.6.1 Overview
- 6.6.2 Models and options
- 6.6.3 Components and accessories
- 6.6.4 IOS features

Module Summary

Module Quiz

Module 7: Antennas

Module Overview

7.1 Antennas

7.1.1 Introduction

7.1.2 Variables

7.1.3 Bandwidth

7.1.4 Beamwidth

 Lab: Antenna Setup

7.1.5 Gain

7.1.6 Polarization

7.1.7 Radiation patterns

7.1.8 Diversity

 Interactive Activity: Diversity

 Lab: Configure AP Diversity Settings

 Lab: Configure Bridge Diversity Settings

7.2 Omnidirectional Antennas

7.2.1 Introduction

7.2.2 2.2 dBi Dipole “rubber duck” antenna(s)

7.2.3 Ceiling antennas

7.2.4 Mast antennas

7.2.5 Pillar antennas

7.2.6 Integrated antennas

 Lab: Omnidirectional Antennas

7.3 Directional Antennas

7.3.1 Introduction

7.3.2 Patch antennas

7.3.3 Yagi

7.3.4 Solid dish

 Lab: Directional Antennas

7.3.5 5 GHz sector

7.4 Cable and Accessories

7.4.1 Cable selection

7.4.2 Cable loss

7.4.3 Cable connectors and splitters

- 7.4.4 Amplifiers
- 7.4.5 Lightning arrestor

7.5 Link Engineering and RF Path Planning

- 7.5.1 Overview
- 7.5.2 Earth bulge
- 7.5.3 Site survey and path profiling
- 7.5.4 Alignment and interference

7.6 Antenna Installation

- 7.6.1 Overview
 - Interactive Activity: Line of Sight of an Antenna
- 7.6.2 Ladder safety
- 7.6.3 Installation safety
- 7.6.4 Legal issues
- 7.6.5 EIRP rules

Module Summary

Module Quiz

Module 8: Security

Module Overview

8.1 Security Fundamentals

- 8.1.1 What is security?
 - Interactive Activity: Fill Security Holes
- 8.1.2 WLAN vulnerabilities
- 8.1.3 WLAN threats
- 8.1.4 Reconnaissance
- 8.1.5 Access
- 8.1.6 Denial of service

8.2 Basic WLAN Security Technologies

- 8.2.1 The WLAN security wheel
- 8.2.2 First generation wireless security
- 8.2.3 Wired equivalent privacy (WEP)
- 8.2.4 Authentication and association

Interactive Activity: IEEE 802.11 Authentication and Association

Lab: Wireless Attacks and Countermeasures

8.3 Configuring Basic WLAN Security

8.3.1 Basic WLAN security

Lab: Configure Basic AP security via GUI

Lab: Configure Basic AP Security via IOS CLI

8.3.2 Enabling protocol and MAC filters on APs

Lab: Configure Filters on AP

8.3.3 Securing clients and APs

Lab: Configure WEP on AP and Client

Lab: Configure an AP as a repeater using WEP

8.3.4 Monitoring WLAN equipment

8.3.5 Disable unneeded services

8.4 Enterprise WLAN Authentication

8.4.1 Second generation authentication

8.4.2 Authenticating wireless users

8.4.3 802.1x basics

8.4.4 How 802.1x works

Interactive Activity: Security Issues

8.4.5 802.1x authentication types

Demonstration Activity: Configure LEAP/EAP using VxWorks GUI

Lab: Configuring LEAP/EAP using Local RADIUS Authentication

Lab: Configuring LEAP/EAP using Cisco Secure ACS (OPTIONAL)

8.4.6 Choosing an 802.1x type

8.5 Enterprise Wireless Encryption

8.5.1 Strengthening WEP

8.5.2 Message integrity check

8.5.3 Broadcast key rotation (BKR)

8.5.4 Second generation encryption

Lab: Configure Enterprise Security on AP

Lab: Configuring Site-to-Site Wireless Link using Enterprise Security

8.5.5 Using VPNs

8.6 Other Enterprise Security Services

8.6.1 VLANs

8.6.2 Spanning tree

Lab: Configure VLANs on the AP

Module Summary

Module Quiz

Module 9: Application Design and Site Survey Prep

Module Overview

9.1 Site Survey

9.1.1 Site survey

9.1.2 Site survey considerations

9.1.3 Standards and topologies

9.1.4 Important considerations

9.2 Applications

9.2.1 Changing technology and applications

Demonstration Activity: WLAN Application Studies

9.3 WLAN Design

9.3.1 Design guidelines

Interactive Activity: Site Survey

9.3.2 Applications and data collection

9.3.3 Load and coverage

9.3.4 Bandwidth and throughput

9.3.5 Mobile users

9.3.6 Power consumption

9.3.7 Interference

9.3.8 Encryption

9.3.9 Fire code and safety issues

Lab: WLAN Design

9.4 Building-to-building Design

9.4.1 Building-to-building overview

9.4.2 Design examples

- 9.4.3 Path considerations
- 9.4.4 Installation considerations

9.5 Site Survey Equipment

- 9.5.1 Equipment
 - Interactive Activity: Survey Materials
- 9.5.2 APs and cards
- 9.5.3 Antennas and attenuators
- 9.5.4 Battery packs, cables, mounting, and markers
- 9.5.5 Measuring devices and digital cameras
 - Lab: Link Status Meter and Preferences
- 9.5.6 Travel case
- 9.5.7 RF test device

9.6 Site Survey Documentation and Utilities

- 9.6.1 Site drawing and walkthrough
- 9.6.2 Bridge range calculation utility
 - Lab: Using Bridge Range Calculation Utility
- 9.6.3 ACU site survey
- 9.6.4 Link status meter (LSM)
 - Demonstration Activity: Aironet Client Utility (ACU)

Module Summary

Module Quiz

Module 10: Site Survey

Module Overview

10.1 Infrastructure Awareness

- 10.1.1 Working with personnel
- 10.1.2 LAN infrastructure
- 10.1.3 Network map
- 10.1.4 LAN media
- 10.1.5 Firewalls, risers, cable paths, and service loops
- 10.1.6 Existing Network
- 10.1.7 Check the existing network health

10.1.8 Network performance baseline

10.2 Survey

10.2.1 Preparation

10.2.2 Getting started

Interactive Activity: Site Survey

10.2.3 Channel selection, data rates, and overlap

10.2.4 Work with existing conditions

10.2.5 Freezers

10.2.6 Multifloor survey

10.2.7 Interference and RF propagation

Lab: Site Survey Active Mode

Lab: Survey the Facility

10.3 Mounting and Installation

10.3.1 AP mounting

10.3.2 Column mounting

10.3.3 Bridge mounting

10.3.4 Antenna mounting

10.3.5 Power

10.3.6 NEMA enclosures

Lab: Mounting and Installation

10.4 Documentation

10.4.1 Documenting the WLAN design

10.4.2 Request for proposal

Lab: Request for Proposal

Lab: Request for Proposal Response

Lab: Review of Response to the RFP

10.4.3 WLAN site survey specifics

10.4.4 Site survey report

Demonstration Activity: Project Management Checklist

Module Summary

Module Quiz

Module 11: Troubleshooting Management, Monitoring, and Diagnostics

Module Overview

11.1 General Approach to Troubleshooting

11.1.1 Overview

11.1.2 Symptom - diagnosis - solution

Process Chart: Symptom-Diagnosis-Solution

11.1.3 Preparing for network failure

11.1.4 Network and fault management

Lab: Basic Troubleshooting on AP

11.2 OSI Troubleshooting

11.2.1 Model overview

11.2.2 Troubleshooting layers

11.2.3 Layer 1: media, connectors, and devices

11.2.4 Layer 2: bridges and switches

11.2.5 Layer 3: routers

11.2.6 Troubleshooting TCP/IP

Lab: Troubleshooting TCP/IP Issues

11.3 Diagnostic Tools

11.3.1 Cable testers, multimeters, and network monitors

11.3.2 Sniffers

11.3.3 Spectrum analyzers

11.3.4 Gauss and tesla meters

11.4 WLAN Troubleshooting

11.4.1 Firmware

11.4.2 Configuration files

11.4.3 Unit status and password recovery

11.4.4 Antenna cable

11.4.5 Placement and obstacles

11.5 System Message Logging

11.5.1 Overview

11.5.2 Configure event notification via GUI

11.5.3 Configure event notification via IOS CLI

- 11.5.4 SNMP
- 11.5.5 Configure SNMP
- 11.5.6 Syslog and SNMP applications
 - Lab: Configure Syslog on AP
 - Lab: Configure SNMP on AP
 - Lab: Configure Syslog and SNMP on the Bridge

11.6 Enterprise Management

- 11.6.1 Overview
- 11.6.2 WLSE
 - Demonstration Activity: WLSE Key Features
 - Demonstration Activity: Managing with WLSE
- 11.6.3 Cisco Structured Wireless Aware Network Solution
- 11.6.4 Aironet Configuration Administration Tool (ACAT)
- 11.6.5 Wavelink
- 11.6.6 Airwave

Module Summary

Module Quiz

Module 12: Emerging Technologies

Module Overview

12.1 Ultra-wideband Wireless

- 12.1.1 Overview of ultra-wideband (UWB) wireless
- 12.1.2 UWB applications
- 12.1.3 UWB acceptance
- 12.1.4 Interference
- 12.1.5 Avoiding interference from other devices
- 12.1.6 UWB specifics

12.2 VoIP and Voice over WLANs

- 12.2.1 Overview of voice over IP (VoIP)
- 12.2.2 Components of VoIP
 - Process Chart: How a VoIP Telephone Call is Made
- 12.2.3 Centralized and distributed VoIP architectures

- 12.2.4 The ITU-T umbrella protocol: H.323
- 12.2.5 Session Initiation Protocol (SIP)
- 12.2.6 MGCP and H.248/Megaco
- 12.2.7 Miscellaneous VoIP protocols
- 12.2.8 VoIP and Quality of Service (QoS)
- 12.2.9 VoIP and WLANs

12.3 Mobile Wireless

- 12.3.1 Brief history of mobile wireless
- 12.3.2 Overview of mobile wireless systems
- 12.3.3 Roaming in a mobile wireless system
- 12.3.4 Mobile wireless middleware
- 12.3.5 Wireless Application Protocol (WAP)
- 12.3.6 The Open Mobile Alliance (OMA)
- 12.3.7 The future of mobile wireless

12.4 Wireless Organizations and Certification

- 12.4.1 The Wireless Fidelity (Wi-Fi) Alliance
- 12.4.2 Wireless LAN Association (WLANA)
- 12.4.3 Federal Communications Commission (FCC)
- 12.4.4 ETSI
- 12.4.5 UL
- 12.4.6 Cisco Wireless Certifications
- 12.4.7 CWNA
- 12.4.8 Case studies of wireless installations

Demonstration Activity: Case Studies of Wireless Installations

Lab: Wireless Case Study of a School

Lab: Wireless Case Study of an Organization

Module Summary

Module Quiz

Course Labs

The Fundamentals of Wireless LAN course contains labs that are designed to teach students how to create secure, reliable wireless access. Some labs are based on skills learned in previous labs. Furthermore, labs increase in difficulty as the course progresses.

Chapter	Lab #	Title
1	1.2.7	Wireless Component and Media Identification
1	1.4.7	Wireless Setup
1	1.6.1	Challenges of Wireless Regulations
1	1.6.8	Challenges of Wireless Media
2	2.4.3	Install a WLAN Adapter Card
2	2.5.2	Install Aironet Client Utility (ACU)
2	2.5.5	Configure Auto Profiles
2	2.6.5.1	ACU Utilities
2	2.6.5.2	Creating an Adhoc Network
3	3.2.3	Wireless Mathematics
4	4.5.3	Topology Design with Cisco Network Designer (CND)
5	5.2.2	Configuring Basic AP Settings
5	5.2.4	Using features of the Internetworking Operating System (IOS) command line interface (CLI)
5	5.2.5	Manage AP Configuration and Image Files
5	5.3.5	Configure Ethernet/FastEthernet Interface
5	5.4.4	Configure Radio Interfaces via GUI
5	5.4.5	Configure Radio Interface via IOS CLI
5	5.4.8	Configure an AP as a repeater via IOS CLI
6	6.3.6	Configure Site-to-Site Wireless Link
6	6.4.4	Configure Bridge Services
6	6.5.3	Manage Bridge Configuration and Image Files
6	6.5.5	Configure Layer 3 Site-to-Site Wireless Link – OPTIONAL Challenge
7	7.1.4	Antenna Setup
7	7.1.8.1	Configure AP Diversity Settings
7	7.1.8.2	Configure Bridge Diversity Settings
7	7.2.6	Omnidirectional Antennas
7	7.3.4	Directional Antennas
8	8.2.4	Wireless Attacks and Countermeasures
8	8.3.1.1	Configure Basic AP Security via GUI
8	8.3.1.2	Configure Basic AP Security via IOS CLI
8	8.3.2	Configure Filters on AP
8	8.3.3.1	Configure WEP on AP and Client
8	8.3.3.2	Configure AP as a repeater using WEP
8	8.4.5.1	Configuring LEAP/EAP using Local RADIUS Authentication

Chapter	Lab #	Title
8	8.5.4.1	Configure Enterprise Security on AP
8	8.4.5.2	Configuring LEAP/EAP using Cisco Secure ACS (OPTIONAL)
8	8.5.4.2	Configuring Site-to-Site Wireless Link using Enterprise Security
8	8.6.2	Configure VLANs on the AP
9	9.3.9	WLAN Design
9	9.5.3	Using Bridge Range Calculation Utility
9	9.5.5	Link Status Meter and Preferences
10	10.2.7.1	Site Survey Active Mode
10	10.2.7.2	Survey the Facility
10	10.3.6	Mounting and Installation
10	10.4.2.1	Request for Proposal
10	10.4.2.2	Request for Proposal Response
10	10.4.2.3	Review of Response to the RFP
11	11.1.4	Basic Troubleshooting on AP
11	11.2.6	Troubleshooting TCP/IP Issues
11	11.5.6.1	Configure Syslog on AP
11	11.5.6.2	Configure SNMP on AP
11	11.5.6.3	Configure Syslog and SNMP on the Bridge
12	12.4.8.1	Wireless Case Study of a School
12	12.4.8.2	Wireless Case Study of an Organization
n/a		Student Skills-Based Final

Fundamentals of Wireless LANs 802.11g Labs

The purpose of these **additional** labs is to allow FWL Academies to practice the use of 802.11g equipment. Specifically, these labs were designed to support the 802.11a/b/g client adapter and the Aironet Desktop Utility (ADU) software as well as the Aironet 1310 Outdoor AP/BR. Each of these labs was created from an existing in FWL 1.2 and covers the same skills. There are no rewritten labs for the 1200 series access point with the dot11g radio upgrade, as the current labs can be used with the upgraded AP.

The labs can be divided into 2 main categories:

1. labs to support the 802.11a/b/g client adapter and
2. labs to support the 1310 bridge.

There is also a document intended as additional help when installing the G radio upgrade in the 1200 series access.