1
Overview

This chapter describes the controller components and features. Its contains these sections:

Americas Headquarters:
Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134-1706 USA

Cisco Unified Wireless Network Solution Overview

The Cisco Unified Wireless Network (Cisco UWN) Solution is designed to provide 802.11 wireless networking solutions for enterprises and service providers. The Cisco UWN Solution simplifies deploying and managing large-scale wireless LANs and enables a unique best-in-class security infrastructure. The operating system manages all data client, communications, and system administration functions, performs radio resource management (RRM) functions, manages system-wide mobility policies using the operating system security solution, and coordinates all security functions using the operating system security framework.

The Cisco UWN Solution consists of Cisco Wireless LAN Controllers and their associated lightweight access points controlled by the operating system, all concurrently managed by any or all of the operating system user interfaces:

- An HTTP and/or HTTPS full-featured Web User Interface hosted by Cisco Wireless LAN Controllers can be used to configure and monitor individual controllers. See Chapter 2.
- A full-featured command-line interface (CLI) can be used to configure and monitor individual Cisco Wireless LAN Controllers. See Chapter 2.
- The Cisco Wireless Control System (WCS), which you use to configure and monitor one or more Cisco Wireless LAN Controllers and associated access points. WCS has tools to facilitate large-system monitoring and control. WCS runs on Windows 2000, Windows 2003, and Red Hat Enterprise Linux ES servers.

  Note WCS software release 6.0 must be used with controllers running controller software release 6.0. Do not attempt to use older versions of WCS software with controllers running controller software release 6.0.

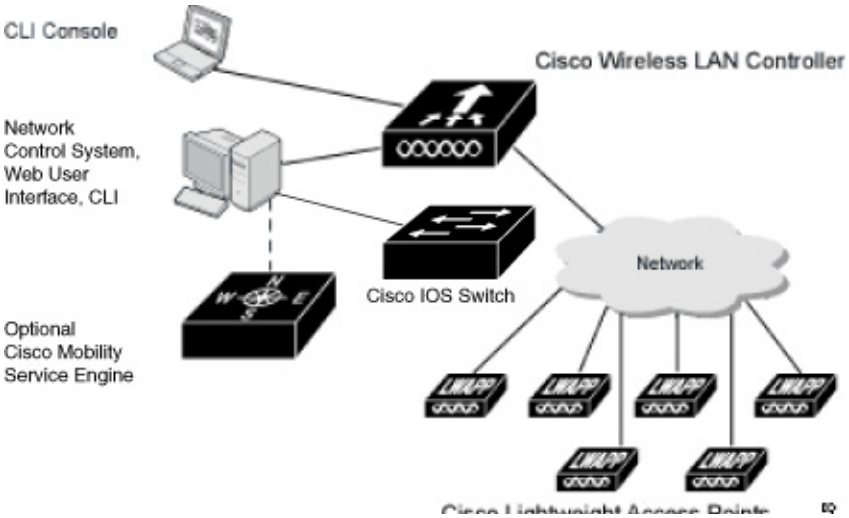
- An industry-standard SNMP V1, V2c, and V3 interface can be used with any SNMP-compliant third-party network management system.

The Cisco UWN Solution supports client data services, client monitoring and control, and all rogue access point detection, monitoring, and containment functions. It uses lightweight access points, Cisco Wireless LAN Controllers, and the optional Cisco WCS to provide wireless services to enterprises and service providers.

Note Unless otherwise noted, all of the Cisco wireless LAN controllers are hereafter referred to as *controllers*, and all of the Cisco lightweight access points are hereafter referred to as *access points.*

Figure 1-1 shows the Cisco Wireless LAN Solution components, which can be simultaneously deployed across multiple floors and buildings.

Figure 1 Cisco UWN Solution Components



Single-Controller Deployments

A standalone controller can support lightweight access points across multiple floors and buildings simultaneously, and supports the following features:

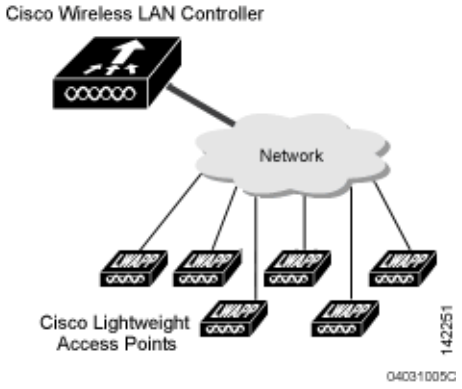
- Autodetecting and autoconfiguring lightweight access points as they are added to the network.
- Full control of lightweight access points.
- Lightweight access points connect to controllers through the network. The network equipment may or may not provide Power over Ethernet to the access points.

Note that some controllers use redundant Gigabit Ethernet connections to bypass single network failures.

Note Some controllers can connect through multiple physical ports to multiple subnets in the network. This feature can be helpful when operators want to confine multiple VLANs to separate subnets.

Figure 1-2 shows a typical single-controller deployment.

Figure 2 Single-Controller Deployment



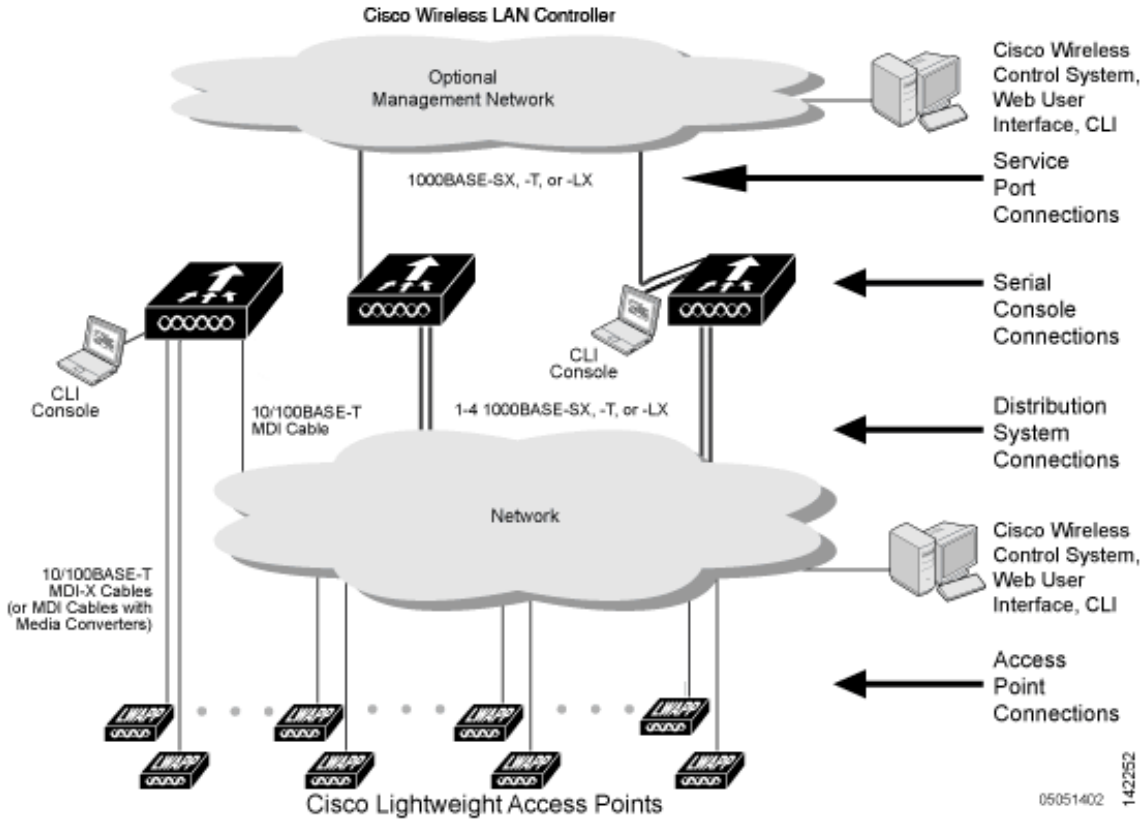
Multiple-Controller Deployments

Each controller can support lightweight access points across multiple floors and buildings simultaneously. However, full functionality of the Cisco Wireless LAN Solution is realized when it includes multiple controllers. A multiple-controller system has the following additional features:

- Autodetecting and autoconfiguring RF parameters as the controllers are added to the network.
- Same-Subnet (Layer 2) Roaming and Inter-Subnet (Layer 3) Roaming.
- Automatic access point failover to any redundant controller with a reduced access point load (refer to the "Cisco Wireless LAN Controller Failover Protection" section on page 1-16).

Figure 1-3 shows a typical multiple-controller deployment. The figure also shows an optional dedicated Management Network and the three physical connection types between the network and the controllers.

Figure 3 Typical Multi-Controller Deployment



Operating System Software

The operating system software controls controllers and lightweight access points. It includes full operating system security and radio resource management (RRM) features.

Operating System Security

Operating system security bundles Layer 1, Layer 2, and Layer 3 security components into a simple, Cisco WLAN Solution-wide policy manager that creates independent security policies for each of up to 16 wireless LANs. (Refer to the "Cisco UWN Solution WLANs" section on page 1-13.)

The 802.11 Static WEP weaknesses can be overcome using robust industry-standard security solutions, such as:

- 802.1X dynamic keys with extensible authentication protocol (EAP).
- Wi-Fi protected access (WPA) dynamic keys. The Cisco WLAN Solution WPA implementation includes:
  - Temporal key integrity protocol (TKIP) + message integrity code checksum (Michael) dynamic keys, or
  - WEP keys, with or without Pre-Shared key Passphrase.
- RSN with or without Pre-Shared key.
- Optional MAC filtering.

The WEP problem can be further solved using industry-standard Layer 3 security solutions, such as:

- Passthrough VPNs
- The Cisco Wireless LAN Solution supports local and RADIUS MAC address filtering.
- The Cisco Wireless LAN Solution supports local and RADIUS user/password authentication.
- The Cisco Wireless LAN Solution also uses manual and automated disabling to block access to network services. In manual disabling, the operator blocks access using client MAC addresses. In automated disabling, which is always active, the operating system software automatically blocks access to network services for an operator-defined period of time when a client fails to authenticate for a fixed number of consecutive attempts. This can be used to deter brute-force login attacks.

These and other security features use industry-standard authorization and authentication methods to ensure the highest possible security for your business-critical wireless LAN traffic.

Cisco WLAN Solution Wired Security

Many traditional access point vendors concentrate on security for the Wireless interface similar to that described in the "Operating System Security" section on page 1-5. However, for secure Cisco Wireless LAN Controller Service Interfaces, Cisco Wireless LAN Controller to access point, and inter-Cisco Wireless LAN Controller communications during device servicing and client roaming, the operating system includes built-in security.

Each Cisco Wireless LAN Controller and lightweight access point is manufactured with a unique, signed X.509 certificate. These signed certificates are used to verify downloaded code before it is loaded, ensuring that hackers do not download malicious code into any Cisco Wireless LAN Controller or lightweight access point.

Cisco Wireless LAN Controllers and lightweight access points also use the signed certificates to verify downloaded code before it is loaded, ensuring that hackers do not download malicious code into any Cisco Wireless LAN Controller or lightweight access point.

Layer 2 and Layer 3 Operation

Lightweight Access Point Protocol (LWAPP) communications between the controller and lightweight access points can be conducted at ISO Data Link Layer 2 or Network Layer 3. Control and Provisioning of Wireless Access Points protocol (CAPWAP) communications between the controller and lightweight access points are conducted at Network Layer 3. Layer 2 mode does not support CAPWAP.

Note Controller software release 5.2 or later supports only Layer 3 CAPWAP mode, controller software releases 5.0 and 5.1 support only Layer 3 LWAPP mode, and controller software releases prior to 5.0 support Layer 2 or Layer 3 LWAPP mode.

Note The IPv4 network layer protocol is supported for transport through a CAPWAP or LWAPP controller system. IPv6 (for clients only) and Appletalk are also supported but only on 5500 series controllers, 4400 series controllers, and the Cisco WiSM. Other Layer 3 protocols (such as IPX, DECnet Phase IV, OSI CLNP, and so on) and Layer 2 (bridged) protocols (such as LAT and NetBeui) are not supported.

Operational Requirements

The requirement for Layer 3 LWAPP communications is that the controller and lightweight access points can be connected through Layer 2 devices on the same subnet or connected through Layer 3 devices across subnets. Another requirement is that the IP addresses of access points should be either statically assigned or dynamically assigned through an external DHCP server.

The requirement for Layer 3 CAPWAP communications across subnets is that the controller and lightweight access points are connected through Layer 3 devices. Another requirement is that the IP addresses of access points should be either statically assigned or dynamically assigned through an external DHCP server.

Configuration Requirements

When you are operating the Cisco Wireless LAN Solution in Layer 2 mode, you must configure a management interface to control your Layer 2 communications.

When you are operating the Cisco Wireless LAN Solution in Layer 3 mode, you must configure an AP-manager interface to control lightweight access points and a management interface as configured for Layer 2 mode.

Cisco Wireless LAN Controllers

When you are adding lightweight access points to a multiple Cisco Wireless LAN Controller deployment network, it is convenient to have all lightweight access points associate with one master controller on the same subnet. That way, the operator does not have to log into multiple controllers to find out which controller newly-added lightweight access points associated with.

One controller in each subnet can be assigned as the master controller while adding lightweight access points. As long as a master controller is active on the same subnet, all new access points without a primary, secondary, and tertiary controller assigned automatically attempt to associate with the master Cisco Wireless LAN Controller. This process is described in the "Cisco Wireless LAN Controller Failover Protection" section on page 1-16.

The operator can monitor the master controller using the WCS Web User Interface and watch as access points associate with the master controller. The operator can then verify access point configuration and assign a primary, secondary, and tertiary controller to the access point, and reboot the access point so it reassociates with its primary, secondary, or tertiary controller.

Note Lightweight access points without a primary, secondary, and tertiary controller assigned always search for a master controller first upon reboot. After adding lightweight access points through the master controller, assign primary, secondary, and tertiary controllers to each access point. Cisco recommends that you disable the master setting on all controllers after initial configuration.

Client Location

When you use Cisco WCS in your Cisco Wireless LAN Solution, controllers periodically determine client, rogue access point, rogue access point client, radio frequency ID (RFID) tag location and store the locations in the Cisco WCS database. For more information on location solutions, refer to these documents:

Cisco Wireless Control System Configuration Guide:

http://www.cisco.com/c/en/us/support/wireless/wireless-control-system/products-installation-and-configuration-guides-list.html

Cisco Location Appliance Configuration Guide:

http://www.cisco.com/c/en/us/support/wireless/wireless-location-appliance/products-installation-and-configuration-guides-list.html

Cisco 3300 Series Mobility Services Engine Configuration Guide:

http://www.cisco.com/c/en/us/support/wireless/mobility-services-engine/products-installation-and-configuration-guides-list.html

Controller Platforms

Controllers are enterprise-class high-performance wireless switching platforms that support 802.11a/n and 802.11b/g/n protocols. They operate under control of the operating system, which includes the radio resource management (RRM), creating a Cisco UWN Solution that can automatically adjust to real-time changes in the 802.11 RF environment. The controllers are built around high-performance network and security hardware, resulting in highly-reliable 802.11 enterprise networks with unparalleled security.

The following controllers are supported for use with software release 6.0:

- Cisco 2100 series controllers
- Cisco 4400 series controllers
- Cisco 5500 series controllers
- Catalyst 6500 Series Wireless Services Module (WiSM)
- Cisco 7600 Series Router Wireless Services Module (WiSM)
- Cisco 28/37/38xx Series Integrated Services Router with Controller Network Module
- Catalyst 3750G Integrated Wireless LAN Controller Switch

The first three controllers are stand-alone platforms. The remaining four controllers are integrated into Cisco switch and router products.

Cisco 2100 Series Controllers

The Cisco 2100 Series Wireless LAN Controllers work in conjunction with Cisco lightweight access points and the Cisco Wireless Control System (WCS) to provide system-wide wireless LAN functions. Each 2100 series controller controls up to 6, 12, or 25 lightweight access points for multi-controller architectures typical of enterprise branch deployments. It may also be used for single controller deployments for small and medium-sized environments.

Caution Do not connect a Power-over-Ethernet (PoE) cable to the controller's console port. Doing so may damage the controller.

Note Wait at least 20 seconds before reconnecting an access point to the controller. Otherwise, the controller may fail to detect the device.

Features Not Supported

This hardware feature is not supported on 2100 series controllers:

- Service port (separate out-of-band management 10/100-Mbps Ethernet interface)

These software features are not supported on 2100 series controllers:

- VPN termination (such as IPSec and L2TP)
- VPN passthrough option

Note You can replicate this functionality on a 2100 series controller by creating an open WLAN using an ACL.

- Termination of guest controller tunnels (origination of guest controller tunnels is supported)
- External web authentication web server list
- Spanning Tree Protocol (STP)
- Port mirroring
- AppleTalk
- QoS per-user bandwidth contracts
- IPv6 pass-through
- Link aggregation (LAG)
- Multicast-unicast mode

Cisco 4400 Series Controllers

The Cisco 4400 Series Wireless LAN Controller is available in two models: 4402 and 4404. The 4402 supports up to 50 lightweight access points while the 4404 supports up to 100, making it ideal for large enterprises and high-density applications.

Figure - Cisco 4400 Series Wireless LAN Controller

The Cisco 4400 Series Wireless LAN Controller can be factory-ordered with a VPN/Enhanced Security Module (Crypto Card) to support VPN, IPSec and other processor-intensive tasks. The VPN/Enhanced Security Module can also be installed in the field.
The 4400 series controller can be equipped with one or two Cisco 4400 series power supplies. When the controller is equipped with two Cisco 4400 series power supplies, the power supplies are redundant, and either power supply can continue to power the controller if the other power supply fails.

Cisco 5500 Series Controllers

The Cisco 5500 Series Wireless LAN Controller is currently available in one model: 5508. The 5508 controller supports up to 250 lightweight access points and 7000 wireless clients (or 5000 wireless clients and 2500 RFID tags when using the client location feature), making it ideal for large enterprises and high-density applications.

Figure - Cisco 4400 Series Wireless LAN Controller

The Cisco 4400 Series Wireless LAN Controller can be factory-ordered with a VPN/Enhanced Security Module (Crypto Card) to support VPN, IPSec and other processor-intensive tasks. The VPN/Enhanced Security Module can also be installed in the field.

The 5500 series controller can be equipped with one or two Cisco 5500 series power supplies. When the controller is equipped with two Cisco 5500 series power supplies, the power supplies are redundant, and either power supply can continue to power the controller if the other power supply fails.

Features Not Supported

These software features are not supported on 5500 series controllers:

- Static AP-manager interface

Note For 5500 series controllers, you are not required to configure an AP-manager interface. The management interface acts like an AP-manager interface by default, and the access points can join on this interface.

- Asymmetric mobility tunneling
- Spanning Tree Protocol (STP)
- Port mirroring
- Layer 2 access control list (ACL) support
- VPN termination (such as IPSec and L2TP)
- VPN passthrough option

Note You can replicate this functionality on a 5500 series controller by creating an open WLAN using an ACL.

- Configuration of 802.3 bridging, AppleTalk, and Point-to-Point Protocol over Ethernet (PPPoE)

Note The 5500 series controllers bridge these packets by default. If desired, you can use ACLs to block the bridging of these protocols.

Catalyst 6500 Series Wireless Services Module

The Catalyst 6500 Series Wireless Services Module (WiSM) is an integrated Catalyst 6500 switch and two Cisco 4404 controllers that supports up to 300 lightweight access points. The switch has eight internal Gigabit Ethernet ports that connect the switch and the controller. The switch and the internal controller run separate software versions, which must be upgraded separately.

Note Without any other service module installed, the Catalyst 6509 switch chassis can support up to seven Cisco WiSMs, and the Catalyst 6506 with a Supervisor 720 can support up to four Cisco WiSMs. If one or more service modules are installed, the chassis can support up to a maximum of four service modules (WiSMs included). Redundant supervisors cannot be used with these maximum configurations.

Note The Cisco WiSM controllers do not support port mirroring.

Refer to the following documents for additional information:

- *Catalyst 6500 Series Switch Installation Guide*
- *Catalyst 6500 Series Switch Wireless Services Module Installation and Configuration Note*
- *Release Notes for Catalyst 6500 Series Switch Wireless LAN Services Module*

- *Configuring a Cisco Wireless Services Module and Wireless Control System*
- *Catalyst 6500 Series Switch and Cisco 7600 Series Router Wireless Services Module Installation and Verification Note*

You can find these documents at these URLs:

http://www.cisco.com/c/en/us/support/switches/catalyst-6500-series-switches/tsd-products-support-series-home.html

http://www.cisco.com/c/en/us/td/docs/wireless/technology/wism/technical/reference/appnote.html

http://www.cisco.com/c/en/us/td/docs/wireless/technology/wism/installation/note/78_17121.html

Cisco 7600 Series Router Wireless Services Module

The Cisco 7600 Series Router Wireless Services Module (WiSM) is an integrated Cisco 7600 router and two Cisco 4404 controllers that supports up to 300 lightweight access points. The router has eight internal Gigabit Ethernet ports that connect the router and the controller. The router and the internal controller run separate software versions, which must be upgraded separately.

Note The WiSM is supported on Cisco 7600 series routers running only Cisco IOS Release 12.2(18)SXF5 or later.

Note Without any other service module installed, the Cisco 7609 router chassis can support up to seven Cisco WiSMs, and any other Cisco 7600 series router chassis can support up to six Cisco WiSMs. If one or more service modules are installed, the chassis can support up to a maximum of four service modules (WiSMs included). Redundant supervisors cannot be used with these maximum configurations.

Note The Cisco WiSM controllers do not support port mirroring.

Refer to the following documents for additional information:

- *Cisco 7600 Series Router Installation Guide*
- *Cisco 7600 Series Router Software Configuration Guide*
- *Cisco 7600 Series Router Command Reference*
- *Configuring a Cisco Wireless Services Module and Wireless Control System*
- *Catalyst 6500 Series Switch and Cisco 7600 Series Router Wireless Services Module Installation and Verification Note*

You can find these documents at these URLs:

http://www.cisco.com/c/en/us/support/routers/7600-series-routers/tsd-products-support-series-home.html

http://www.cisco.com/c/en/us/td/docs/wireless/technology/wism/technical/reference/appnote.html

http://www.cisco.com/c/en/us/td/docs/wireless/technology/wism/installation/note/78_17121.html

Cisco 28/37/38xx Series Integrated Services Router

The Cisco 28/37/38xx Series Integrated Services Router is an integrated 28/37/38xx router and Cisco controller network module that supports up to 6, 8, 12, or 25 lightweight access points, depending on the version of the network module. The versions that support 8, 12, or 25 access points and the NME-AIR-WLC6-K9 6-access-point version feature a high-speed processor and more on-board memory than the NM-AIR-WLC6-K9 6-access-point version. An internal Fast Ethernet port (on the NM-AIR-WLC6-K9 6-access-point version) or an internal Gigabit Ethernet port (on the 8-, 12-, and 25-access-point versions and on the NME-AIR-WLC6-K9 6-access-point version) connects the router and the integrated controller. The router and the internal controller run separate software versions, which must be upgraded separately. Refer to the following documents for additional information:

- *Cisco Wireless LAN Controller Network Module Feature Guide*
- *Cisco 28/37/38xx Series Hardware Installation Guide*

You can find these documents at this URL:

http://www.cisco.com/c/en/us/products/wireless/product-listing.html

Note The controller network module does not support port mirroring.

Note The Cisco 2801 Integrated Services Router does not support the controller network module.

Catalyst 3750G Integrated Wireless LAN Controller Switch

The Catalyst 3750G Integrated Wireless LAN Controller Switch is an integrated Catalyst 3750 switch and Cisco 4400 series controller that supports up to 25 or 50 lightweight access points. The switch has two internal Gigabit Ethernet ports that connect the switch and the controller. The switch and the internal controller run separate software versions, which must be upgraded separately.

Note The controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch does not support Spanning Tree Protocol (STP).

Refer to the following documents for additional information:

- *Catalyst 3750G Integrated Wireless LAN Controller Switch Getting Started Guide*
- *Catalyst 3750 Switch Hardware Installation Guide*
- *Release Notes for the Catalyst 3750 Integrated Wireless LAN Controller Switch, Cisco IOS Release 12.2(25)FZ*

You can find these documents at this URL:

http://www.cisco.com/c/en/us/support/switches/catalyst-3750-series-switches/tsd-products-support-series-home.html

Cisco UWN Solution Wired Connections

The Cisco UWN Solution components communicate with each other using industry-standard Ethernet cables and connectors. The following paragraphs contain details of the wired connections.

- The 2100 series controller connects to the network using from one to six 10/100BASE-T Ethernet cables.
- The 4402 controller connects to the network using one or two fiber-optic Gigabit Ethernet cables, and the 4404 controller connects to the network using up to four fiber-optic Gigabit Ethernet cables.
- The 5508 controller connects to the network using up to eight fiber-optic Gigabit Ethernet cables.
- The controllers in the Wireless Services Module (WiSM), installed in a Cisco Catalyst 6500 Series Switch or a Cisco 7600 Series Router, connect to the network through ports on the switch or router.
- The Wireless LAN Controller Network Module, installed in a Cisco Integrated Services Router, connects to the network through the ports on the router.
- The controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch connects to the network through the ports on the switch.
- Cisco lightweight access points connects to the network using 10/100BASE-T Ethernet cables. The standard CAT-5 cable can also be used to conduct power for the lightweight access points from a network device equipped with Power over Ethernet (PoE) capability. This power distribution plan can be used to reduce the cost of individual AP power supplies and related cabling.

Cisco UWN Solution WLANs

The Cisco UWN Solution can control up to 512 WLANs for lightweight access points. Each WLAN has a separate WLAN ID (1 through 512), a separate profile name, and a WLAN SSID and can be assigned unique security policies. The lightweight access points broadcast all active Cisco UWN Solution WLAN SSIDs and enforce the policies defined for each WLAN.

Note Cisco 2106, 2112, and 2125 controllers support only up to 16 WLANs.

Note Cisco recommends that you assign one set of VLANs for WLANs and a different set of VLANs for management interfaces to ensure that controllers operate with optimum performance and ease of management.

If management over wireless is enabled across the Cisco UWN Solution, the operator can manage the system across the enabled WLAN using CLI and Telnet, http/https, and SNMP.

To configure WLANs, refer to Chapter 6.

File Transfers

The Cisco UWN Solution operator can upload and download operating system code, configuration, and certificate files to and from the controller using the GUI, CLI, or Cisco WCS.

- To use the controller GUI or CLI, refer to Chapter 9, "Managing Controller Software and Configurations".
- To use Cisco WCS to upgrade software, refer to the *Cisco Wireless Control System Configuration Guide*. Click this URL to browse to this document:

  http://www.cisco.com/c/en/us/support/wireless/wireless-control-system/products-installation-and-configuration-guides-list.html

Power over Ethernet

Lightweight access points can receive power via their Ethernet cables from 802.3af-compatible Power over Ethernet (PoE) devices, which can reduce the cost of discrete power supplies, additional wiring, conduits, outlets, and installer time. PoE also frees installers from having to mount lightweight access points or other powered equipment near AC outlets, providing greater flexibility in positioning the access points for maximum coverage.

When you are using PoE, the installer runs a single CAT-5 cable from each lightweight access point to PoE-equipped network elements, such as a PoE power hub or a Cisco WLAN Solution Single-Line PoE Injector. When the PoE equipment determines that the lightweight access point is PoE-enabled, it sends 48 VDC over the unused pairs in the Ethernet cable to power the access point.

The PoE cable length is limited by the 100BASE-T or 10BASE-T specification to 100 m or 200 m, respectively.

Lightweight access points can receive power from an 802.3af-compliant device or from the external power supply.

Cisco Wireless LAN Controller Memory

The controller contains two kinds of memory: volatile RAM, which holds the current, active controller configuration, and NVRAM (non-volatile RAM), which holds the reboot configuration. When you are configuring the operating system in controller, you are modifying volatile RAM; you must save the configuration from the volatile RAM to the NVRAM to ensure that the controller reboots in the current configuration.

Knowing which memory you are modifying is important when you are:

- Using the Configuration Wizard
- Clearing the Controller Configuration
- Saving Configurations
- Resetting the Controller
- Logging Out of the CLI

Cisco Wireless LAN Controller Failover Protection

Each controller has a defined number of communication ports for lightweight access points. This means that when multiple controllers with unused access point ports are deployed on the same network, if one controller fails, the dropped access points automatically poll for unused controller ports and associate with them.

During installation, Cisco recommends that you connect all lightweight access points to a dedicated controller, and configure each lightweight access point for final operation. This step configures each lightweight access point for a primary, secondary, and tertiary controller and allows it to store the configured mobility group information.

During failover recovery, the configured lightweight access points obtain an IP address from the local DHCP server (only in Layer 3 operation), attempt to contact their primary, secondary, and tertiary controllers, and then attempt to contact the IP addresses of the other controllers in the mobility group. This prevents the access points from spending time sending out blind polling messages, resulting in a faster recovery period.

In multiple-controller deployments, this means that if one controller fails, its dropped access points reboot and do the following under direction of the radio resource management (RRM):

- Obtain an IP address from a local DHCP server (one on the local subnet).
- If the lightweight access point has a primary, secondary, and tertiary controller assigned, it attempts to associate with that controller.
- If the access point has no primary, secondary, or tertiary controllers assigned or if its primary, secondary, or tertiary controllers are unavailable, it attempts to associate with a master controller on the same subnet.
- If the access point finds no master controller on the same subnet, it attempts to contact stored mobility group members by IP address.
- Should none of the mobility group members be available, and if the lightweight access point has no primary, secondary, and tertiary controllers assigned and there is no master controller active, it attempts to associate with the least-loaded controller on the same subnet to respond to its discovery messages with unused ports.

This means that when sufficient controllers are deployed, should one controller fail, active access point client sessions are momentarily dropped while the dropped access point associates with an unused port on another controller, allowing the client device to immediately reassociate and reauthenticate.

Network Connections to Cisco Wireless LAN Controllers

Regardless of operating mode, all controllers use the network as an 802.11 distribution system. Regardless of the Ethernet port type or speed, each controller monitors and communicates with its related controllers across the network. The following sections give details of these network connections:

- Cisco 2100 Series Wireless LAN Controllers, page 1-17
- Cisco 4400 Series Wireless LAN Controllers, page 1-17
- Cisco 5500 Series Wireless LAN Controllers, page 1-18

Note Chapter 3 provides information on configuring the controller's ports and assigning interfaces to them.

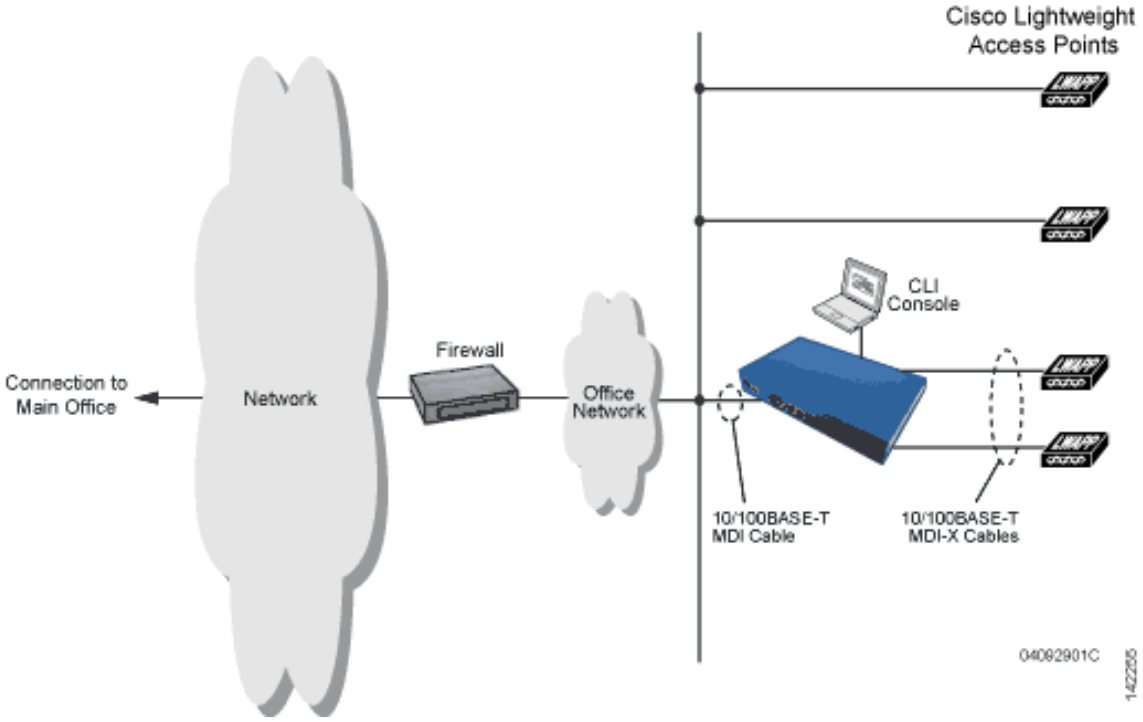
Cisco 2100 Series Wireless LAN Controllers

Cisco 2100 series controllers can communicate with the network through any one of their physical data ports, as the logical management interface can be assigned to one of the ports. The physical port description is as follows:

- Up to six 10/100BASE-T cables can plug into the six back-panel data ports on the 2100 series controller chassis. The 2100 series also has two PoE ports (ports 7 and 8).

Figure 1-4 shows connections to the 2100 series controllers.

Figure 4 Physical Network Connections to the 2100 Series Controller



Cisco 4400 Series Wireless LAN Controllers

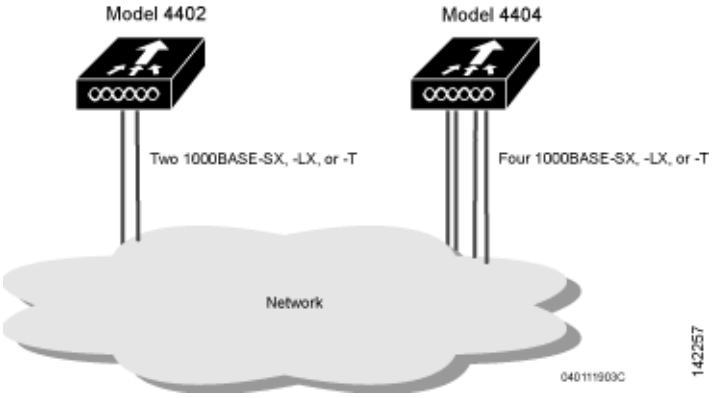
Cisco 4400 series controllers can communicate with the network through one or two pairs of physical data ports, and the logical management interface can be assigned to the ports.

- For the 4402 controller, up to two of the following connections are supported in any combination:
  - 1000BASE-T (Gigabit Ethernet, front panel, RJ-45 physical port, UTP cable).
  - 1000BASE-SX (Gigabit Ethernet, front panel, LC physical port, multi-mode 850nM (SX) fiber-optic links using LC physical connectors).
  - 1000BASE-LX (Gigabit Ethernet, front panel, LC physical port, multi-mode 1300nM (LX/LH) fiber-optic links using LC physical connectors).

- For the 4404 controller, up to four of the following connections are supported in any combination:
  - 1000BASE-T (Gigabit Ethernet, front panel, RJ-45 physical port, UTP cable).
  - 1000BASE-SX (Gigabit Ethernet, front panel, LC physical port, multi-mode 850nM (SX) fiber-optic links using LC physical connectors).
  - 1000BASE-LX (Gigabit Ethernet, front panel, LX physical port, multi-mode 1300nM (LX/LH) fiber-optic links using LC physical connectors).

Figure 1-5 shows connections to the 4400 series controller.

Figure 5 Physical Network Connections to 4402 and 4404 Series Controllers



Cisco 5500 Series Wireless LAN Controllers

Cisco 5500 series controllers can communicate with the network through up to eight physical data ports, and the logical management interface can be assigned to the ports.

For the 5508 controller, up to eight of the following connections are supported in any combination:

- 1000BASE-T (Gigabit Ethernet, front panel, RJ-45 physical port, UTP cable).
- 1000BASE-SX (Gigabit Ethernet, front panel, LC physical port, multi-mode 850nM (SX) fiber-optic links using LC physical connectors).
- 1000BASE-LX (Gigabit Ethernet, front panel, LX physical port, multi-mode 1300nM (LX/LH) fiber-optic links using LC physical connectors).