



## Configuring Ports and Interfaces

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This chapter describes the controller's physical ports and interfaces and provides instructions for configuring them. It contains these sections:

- [Overview of Ports and Interfaces, page 3-2](#)
- [Configuring the Management, AP-Manager, Virtual, and Service-Port Interfaces, page 3-12](#)
- [Configuring Dynamic Interfaces, page 3-18](#)
- [Configuring Ports, page 3-22](#)
- [Configuring the Management, AP-Manager, Virtual, and Service-Port Interfaces, page 3-12](#)
- [Choosing Between Link Aggregation and Multiple AP-Manager Interfaces, page 3-34](#)
- [Enabling Link Aggregation, page 3-35](#)
- [Configuring Multiple AP-Manager Interfaces, page 3-39](#)

# Overview of Ports and Interfaces

Three concepts are key to understanding how controllers connect to a wireless network: ports, interfaces, and WLANs.

## Ports

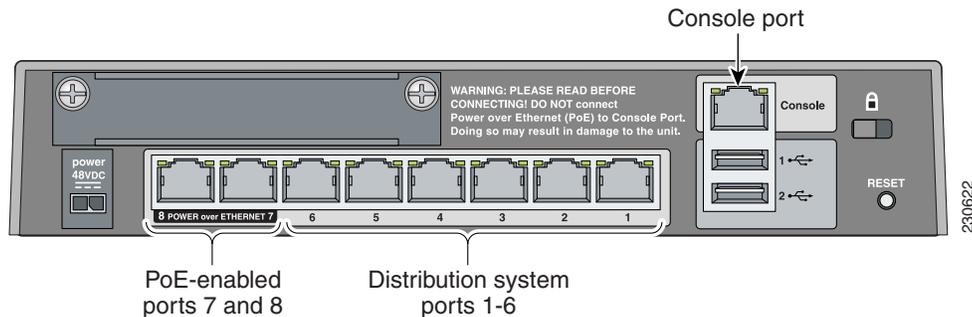
A port is a physical entity that is used for connections on the controller platform. Controllers have two types of ports: distribution system ports and a service port. The following figures show the ports available on each controller.



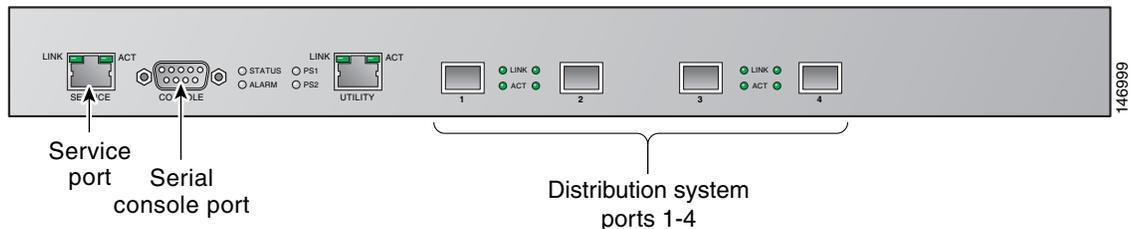
### Note

The controller in a Cisco Integrated Services Router and the controllers on the Cisco WiSM do not have external physical ports. They connect to the network through ports on the router or switch.

**Figure 3-1** Ports on the Cisco 2100 Series Wireless LAN Controllers



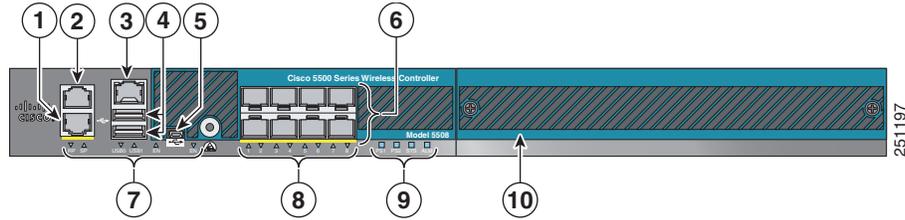
**Figure 3-2** Ports on the Cisco 4400 Series Wireless LAN Controllers



### Note

Figure 3-2 shows a Cisco 4404 controller. The Cisco 4402 controller is similar but has only two distribution system ports. The utility port, which is the unlabeled port in Figure 3-2, is currently not operational.

**Figure 3** Ports on the Cisco 5500 Series Wireless LAN Controllers



<b>1</b>	Redundant port for future use (RJ-45)	<b>6</b>	SFP distribution system ports 1-8
<b>2</b>	Service port (RJ-45)	<b>7</b>	Management port LEDs
<b>3</b>	Console port (RJ-45) <sup>1</sup>	<b>8</b>	SFP distribution port Link and Activity LEDs
<b>4</b>	USB ports 0 and 1 (Type A)	<b>9</b>	Power supply (PS1 and PS2), System (SYS), and Alarm (ALM) LEDs
<b>5</b>	Console port (Mini USB Type B) <sup>1</sup>	<b>10</b>	Expansion module slot

1. You can use only one console port (either RJ-45 or mini USB). When you connect to one console port, the other is disabled.

**Figure 3-4** Ports on the Catalyst 3750G Integrated Wireless LAN Controller Switch

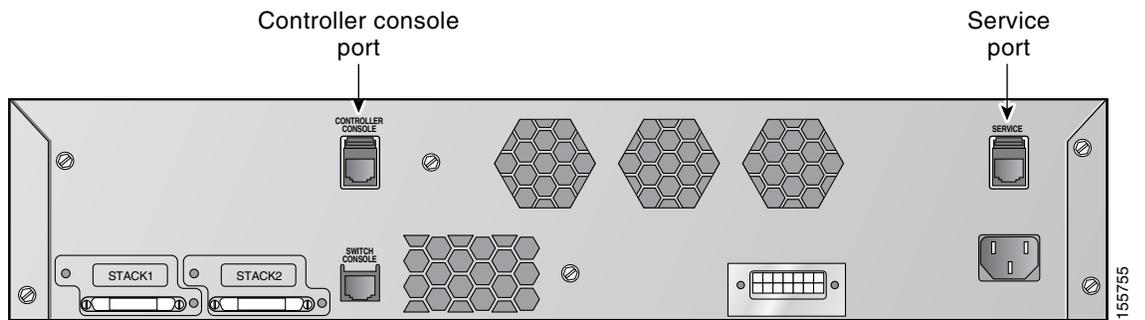


Table 3-1 provides a list of ports per controller.

**Table 3-1 Controller Ports**

Controller	Service Ports	Distribution System Ethernet Ports	Serial Console Port
2100 series	None	8 (6 + 2 PoE ports)	1
4402	1	2	1
4404	1	4	1
5508	1	8 (ports 1-8)	1
Cisco WiSM	2 (ports 9 and 10)	8 (ports 1-8)	2
Controller Network Module within the Cisco 28/37/38xx Series Integrated Services Routers	None	1	1 <sup>1</sup>
Catalyst 3750G Integrated Wireless LAN Controller Switch	1	2 (ports 27 and 28)	1

1. The baud rate for the Gigabit Ethernet version of the controller network module is limited to 9600 bps while the baud rate for the Fast Ethernet version supports up to 57600 bps.



**Note**

*Appendix E, Logical Connectivity Diagrams* provides logical connectivity diagrams and related software commands for the integrated controllers.

## Distribution System Ports

A distribution system port connects the controller to a neighbor switch and serves as the data path between these two devices.

- Cisco 2100 series controllers have eight 10/100 copper Ethernet distribution system ports through which the controller can support up to 6, 12, or 25 access points. Two of these ports (7 and 8) are power-over-Ethernet (PoE) enabled and can be used to provide power directly to access points that are connected to these ports.



**Note**

All client connections to the 2100 series controllers are limited to the 10/100 Ethernet uplink port connection between the switch and the controller, even though their connection speeds might be higher. The exception is for access points running in local hybrid-REAP mode because this traffic is switched at the access point level and not forwarded back to the controller.

- Cisco 4402 controllers have two Gigabit Ethernet distribution system ports, each of which is capable of managing up to 48 access points. However, Cisco recommends no more than 25 access points per port due to bandwidth constraints. The 4402-25 and 4402-50 models allow a total of 25 or 50 access points to join the controller.

- Cisco 4404 controllers have four Gigabit Ethernet distribution system ports, each of which is capable of managing up to 48 access points. However, Cisco recommends no more than 25 access points per port due to bandwidth constraints. The 4404-25, 4404-50, and 4404-100 models allow a total of 25, 50, or 100 access points to join the controller.



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**Note** The Gigabit Ethernet ports on the 4402 and 4404 controllers accept these SX/LC/T small form-factor plug-in (SFP) modules:

- 1000BASE-SX SFP modules, which provide a 1000-Mbps wired connection to a network through an 850nm (SX) fiber-optic link using an LC physical connector
- 1000BASE-LX SFP modules, which provide a 1000-Mbps wired connection to a network through a 1300nm (LX/LH) fiber-optic link using an LC physical connector
- 1000BASE-T SFP modules, which provide a 1000-Mbps wired connection to a network through a copper link using an RJ-45 physical connector

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- Cisco 5508 controllers have eight Gigabit Ethernet distribution system ports, through which the controller can manage multiple access points. The 5508-12, 5508-25, 5508-50, 5508-100, and 5508-250 models allow a total of 12, 25, 50, 100, or 250 access points to join the controller. Cisco 5508 controllers have no restrictions on the number of access points per port. However, Cisco recommends using link aggregation (LAG) or configuring dynamic AP-manager interfaces on each Gigabit Ethernet port to automatically balance the load. If more than 100 access points are connected to the 5500 series controller, make sure that more than one gigabit Ethernet interface is connected to the upstream switch.



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**Note** The Gigabit Ethernet ports on the 5508 controllers accept these SX/LC/T small form-factor plug-in (SFP) modules:

- 1000BASE-SX SFP modules, which provide a 1000-Mbps wired connection to a network through an 850nm (SX) fiber-optic link using an LC physical connector
- 1000BASE-LX SFP modules, which provide a 1000-Mbps wired connection to a network through a 1300nm (LX/LH) fiber-optic link using an LC physical connector
- 1000BASE-T SFP modules, which provide a 1000-Mbps wired connection to a network through a copper link using an RJ-45 physical connector

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- The Cisco Catalyst 6500 Series Switch Wireless Services Module (WiSM) and the Cisco 7600 Series Router Wireless Services Module (WiSM) have eight internal Gigabit Ethernet distribution system ports (ports 1 through 8) that connect the switch or router and the integrated controller. These internal ports are located on the backplane of the switch or router and are not visible on the front panel. Through these ports, the controller can support up to 300 access points.
- The controller network module within the Cisco 28/37/38xx Series Integrated Services Router can support up to 6, 8, 12, or 25 access points (and up to 256, 256, 350, or 350 clients, respectively), depending on the version of the network module. The network module supports these access points through a Fast Ethernet distribution system port (on the NM-AIR-WLC6-K9 6-access-point version) or a Gigabit Ethernet distribution system port (on the 8-, 12-, and 25-access-point versions and on the NME-AIR-WLC6-K9 6-access-point version) that connects the router and the integrated controller. This port is located on the router backplane and is not visible on the front panel. The Fast Ethernet port operates at speeds up to 100 Mbps, and the Gigabit Ethernet port operates at speeds up to 1 Gbps.
- The Catalyst 3750G Integrated Wireless LAN Controller Switch has two internal Gigabit Ethernet distribution system ports (ports 27 and 28) that connect the switch and the integrated controller. These internal ports are located on the switch backplane and are not visible on the front panel. Each

port is capable of managing up to 48 access points. However, Cisco recommends no more than 25 access points per port due to bandwidth constraints. The -S25 and -S50 models allow a total of 25 or 50 access points to join the controller.

**Note**

Refer to the [“Choosing Between Link Aggregation and Multiple AP-Manager Interfaces”](#) section on page 3-34 if you want to configure your Cisco 4400 series controller to support more than 48 access points.

Each distribution system port is, by default, an 802.1Q VLAN trunk port. The VLAN trunking characteristics of the port are not configurable.

**Note**

Some controllers support link aggregation (LAG), which bundles all of the controller’s distribution system ports into a single 802.3ad port channel. Cisco 4400 series controllers support LAG in software release 3.2 or later, Cisco 5500 series controllers support LAG in software release 6.0 or later, and LAG is enabled automatically on the controllers within the Cisco WiSM and the Catalyst 3750G Integrated Wireless LAN Controller Switch. Refer to the [“Enabling Link Aggregation”](#) section on page 3-35 for more information.

## Service Port

Cisco 4400 and 5500 series controllers also have a 10/100 copper Ethernet service port. The service port is controlled by the service-port interface and is reserved for out-of-band management of the controller and system recovery and maintenance in the event of a network failure. It is also the only port that is active when the controller is in boot mode. The service port is not capable of carrying 802.1Q tags, so it must be connected to an access port on the neighbor switch. Use of the service port is optional.

**Note**

The Cisco WiSM’s controllers use the service port for internal protocol communication between the controllers and the Supervisor 720.

**Note**

The Cisco 2100 series controllers and the controller in the Cisco Integrated Services Router do not have a service port.

**Note**

The service port is not auto-sensing. You must use the correct straight-through or crossover Ethernet cable to communicate with the service port.

**Caution**

Do not configure wired clients in the same VLAN or subnet of the service port on the network.

## Interfaces

An interface is a logical entity on the controller. An interface has multiple parameters associated with it, including an IP address, default-gateway (for the IP subnet), primary physical port, secondary physical port, VLAN identifier, and DHCP server.

These five types of interfaces are available on the controller. Four of these are static and are configured at setup time:

- Management interface (Static and configured at setup time; mandatory)
- AP-manager interface (Static and configured at setup time; mandatory)



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**Note** You are not required to configure an AP-manager interface on 5500 series controllers.

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- Virtual interface (Static and configured at setup time; mandatory)
- Service-port interface (Static and configured at setup time; optional)
- Dynamic interface (User-defined)

Each interface is mapped to at least one primary port, and some interfaces (management and dynamic) can be mapped to an optional secondary (or backup) port. If the primary port for an interface fails, the interface automatically moves to the backup port. In addition, multiple interfaces can be mapped to a single controller port.



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**Note** For 5500 series controllers in a non-link-aggregation (non-LAG) configuration, the management interface must be on a different VLAN than any dynamic AP-manager interface. Otherwise, the management interface cannot fail over to the port that the AP-manager is on.

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**Note** Cisco 5500 series controllers do not support fragmented pings on any interface. Similarly, Cisco 4400 series controllers, the Cisco WiSM, and the Catalyst 3750G Integrated Wireless LAN Controller Switch do not support fragmented pings on the AP-manager interface.

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**Note** Refer to the [“Enabling Link Aggregation” section on page 3-35](#) if you want to configure the controller to dynamically map the interfaces to a single port channel rather than having to configure primary and secondary ports for each interface.

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## Management Interface

The management interface is the default interface for in-band management of the controller and connectivity to enterprise services such as AAA servers. It is also used for communications between the controller and access points. The management interface has the only consistently “pingable” in-band interface IP address on the controller. You can access the controller’s GUI by entering the controller’s management interface IP address in Internet Explorer’s or Mozilla Firefox’s Address field.

For CAPWAP, the controller requires one management interface to control all inter-controller communications and one AP-manager interface to control all controller-to-access point communications, regardless of the number of ports.



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**Note** If the service port is in use, the management interface must be on a different supernet from the service-port interface.

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**Note**

Do not map a guest WLAN to the management interface. This is because if the EoIP tunnel breaks, the client could obtain an IP and be placed on the management subnet.

**Caution**

Do not configure wired clients in the same VLAN or subnet of the service port on the network. If you configure wired clients on the same subnet or VLAN as the service port, you will not be able to access the management interface.

## AP-Manager Interface

A controller has one or more AP-manager interfaces, which are used for all Layer 3 communications between the controller and lightweight access points after the access points have joined the controller. The AP-manager IP address is used as the tunnel source for CAPWAP packets from the controller to the access point and as the destination for CAPWAP packets from the access point to the controller.

**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.

The AP-manager interface communicates through any distribution system port by listening across the Layer 3 network for access point CAPWAP or LWAPP join messages to associate and communicate with as many lightweight access points as possible.

For 4404 and WiSM controllers, configure the AP-manager interface on all distribution system ports (1, 2, 3, and 4). For 4402 controllers, configure the AP-manager interface on distribution system ports 1 and 2. In both cases, the static (or permanent) AP-manager interface is always assigned to distribution system port 1 and given a unique IP address. Configuring the AP-manager interface on the same VLAN or IP subnet as the management interface results in optimum access point association, but this is not a requirement.

**Note**

If only one distribution system port can be used, you should use distribution system port 1.

If link aggregation (LAG) is enabled, there can be only one AP-manager interface. But when LAG is disabled, one or more AP-manager interfaces can be created, generally one per physical port.

**Note**

The 2100 series controllers do not support LAG.

**Note**

Port redundancy for the AP-manager interface is not supported. You cannot map the AP-manager interface to a backup port.

**Note**

Refer to the [“Configuring Multiple AP-Manager Interfaces”](#) section on page 3-39 for information on creating and using multiple AP-manager interfaces.

## Virtual Interface

The virtual interface is used to support mobility management, Dynamic Host Configuration Protocol (DHCP) relay, and embedded Layer 3 security such as guest web authentication and VPN termination. It also maintains the DNS gateway host name used by Layer 3 security and mobility managers to verify the source of certificates when Layer 3 web authorization is enabled.

Specifically, the virtual interface plays these two primary roles:

- Acts as the DHCP server placeholder for wireless clients that obtain their IP address from a DHCP server.
- Serves as the redirect address for the web authentication login page.



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**Note** See the *Configuring Security Solutions* chapter for additional information on web authentication.

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The virtual interface IP address is used only in communications between the controller and wireless clients. It never appears as the source or destination address of a packet that goes out a distribution system port and onto the switched network. For the system to operate correctly, the virtual interface IP address must be set (it cannot be 0.0.0.0), and no other device on the network can have the same address as the virtual interface. Therefore, the virtual interface must be configured with an unassigned and unused gateway IP address. The virtual interface IP address is not pingable and should not exist in any routing table in your network. In addition, the virtual interface cannot be mapped to a backup port.



**Note**

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All controllers within a mobility group must be configured with the same virtual interface IP address. Otherwise, inter-controller roaming may appear to work, but the hand-off does not complete, and the client loses connectivity for a period of time.

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## Service-Port Interface

The service-port interface controls communications through and is statically mapped by the system to the service port. The service port can obtain an IP address using DHCP, or it can be assigned a static IP address, but a default gateway cannot be assigned to the service-port interface. Static routes can be defined through the controller for remote network access to the service port.



**Note**

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Only Cisco 4400 and 5500 series controllers have a service-port interface.

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**Note**

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You must configure an IP address on the service-port interface of both Cisco WiSM controllers. Otherwise, the neighbor switch is unable to check the status of each controller.

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## Dynamic Interface

Dynamic interfaces, also known as VLAN interfaces, are created by users and designed to be analogous to VLANs for wireless LAN clients. A controller can support up to 512 dynamic interfaces (VLANs). Each dynamic interface is individually configured and allows separate communication streams to exist on any or all of a controller's distribution system ports. Each dynamic interface controls VLAN and other communications between controllers and all other network devices, and each acts as a DHCP relay for

wireless clients associated to WLANs mapped to the interface. You can assign dynamic interfaces to distribution system ports, WLANs, the Layer 2 management interface, and the Layer 3 AP-manager interface, and you can map the dynamic interface to a backup port.

You can configure zero, one, or multiple dynamic interfaces on a distribution system port. However, all dynamic interfaces must be on a different VLAN or IP subnet from all other interfaces configured on the port. If the port is untagged, all dynamic interfaces must be on a different IP subnet from any other interface configured on the port.

**Note**


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A controller's WLAN dynamic interface and all wireless clients in the WLAN that are local to the controller must have IP addresses in the same subnet.

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**Note**


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Cisco recommends using tagged VLANs for dynamic interfaces.

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## Dynamic AP Management

A dynamic interface is created as a WLAN interface by default. However, any dynamic interface can be configured as an AP-manager interface, with one AP-manager interface allowed per physical port. A dynamic interface with the Dynamic AP Management option enabled is used as the tunnel source for packets from the controller to the access point and as the destination for CAPWAP packets from the access point to the controller. The dynamic interfaces for AP management must have a unique IP address and are usually configured on the same subnet as the management interface.

**Note**


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If link aggregation (LAG) is enabled, there can be only one AP-manager interface.

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Cisco recommends having a separate dynamic AP-manager interface per controller port. Refer to the [“Configuring Multiple AP-Manager Interfaces”](#) section on page 3-39 for instructions on configuring multiple dynamic AP-manager interfaces.

## WLANs

A WLAN associates a service set identifier (SSID) to an interface. It is configured with security, quality of service (QoS), radio policies, and other wireless network parameters. Up to 512 access point WLANs can be configured per controller.

**Note**

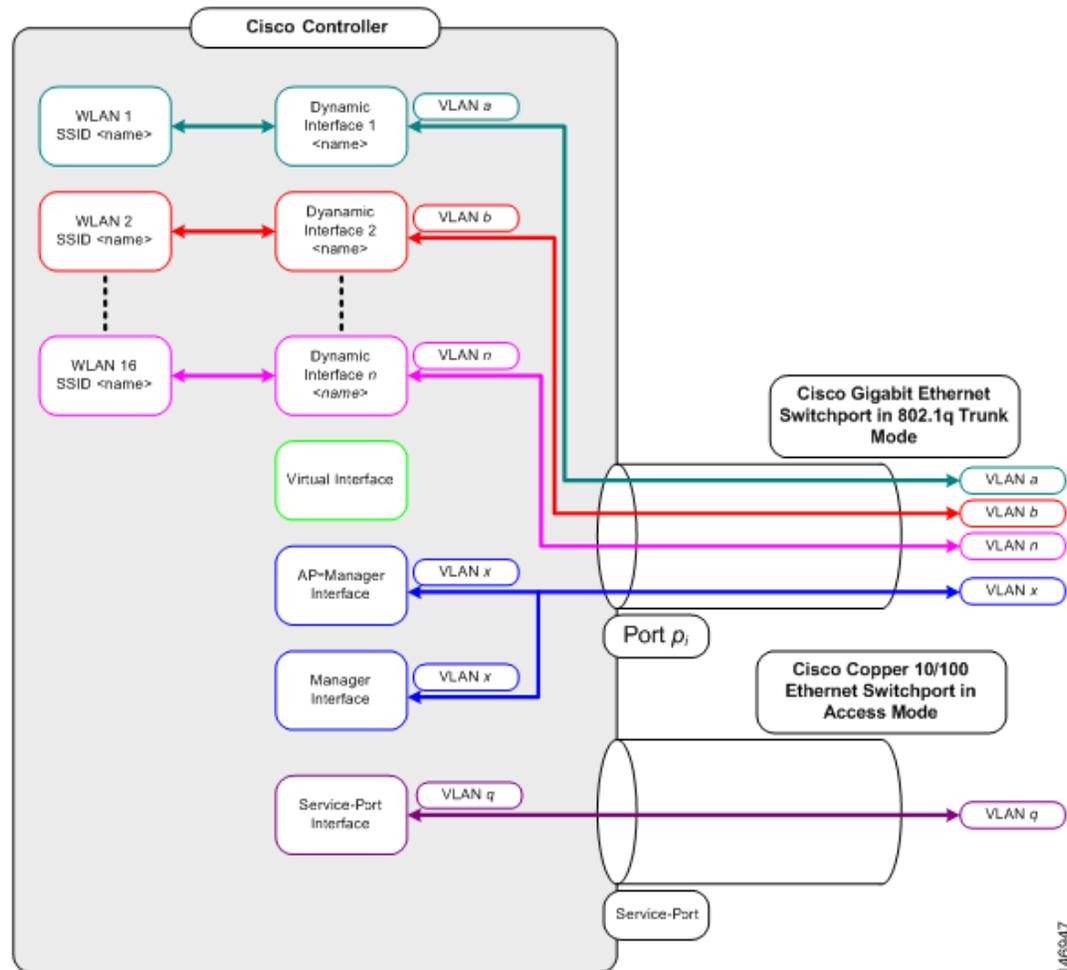

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The *Configuring WLANs* chapter provides instructions for configuring WLANs.

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[Figure 3-5](#) illustrates the relationship between ports, interfaces, and WLANs.

Figure 3-5 Ports, Interfaces, and WLANs



As shown in Figure 3-5, each controller port connection is an 802.1Q trunk and should be configured as such on the neighbor switch. On Cisco switches, the native VLAN of an 802.1Q trunk is an untagged VLAN. Therefore, if you configure an interface to use the native VLAN on a neighboring Cisco switch, make sure you configure the interface on the controller to be untagged.

**Note**

A zero value for the VLAN identifier (on the Controller > Interfaces page) means that the interface is untagged.

The default (untagged) native VLAN on Cisco switches is VLAN 1. When controller interfaces are configured as tagged (meaning that the VLAN identifier is set to a non-zero value), the VLAN must be allowed on the 802.1Q trunk configuration on the neighbor switch and not be the native untagged VLAN.

Cisco recommends that tagged VLANs be used on the controller. You should also allow only relevant VLANs on the neighbor switch's 802.1Q trunk connections to controller ports. All other VLANs should be disallowed or pruned in the switch port trunk configuration. This practice is extremely important for optimal performance of the controller.

**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 properly route VLAN traffic.

Follow the instructions on the pages indicated to configure your controller's interfaces and ports:

- [Configuring the Management, AP-Manager, Virtual, and Service-Port Interfaces, page 3-12](#)
- [Configuring Dynamic Interfaces, page 3-18](#)
- [Configuring Ports, page 3-22](#)
- [Configuring the Management, AP-Manager, Virtual, and Service-Port Interfaces, page 3-12](#)
- [Choosing Between Link Aggregation and Multiple AP-Manager Interfaces, page 3-34](#)
- [Enabling Link Aggregation, page 3-35](#)
- [Configuring Multiple AP-Manager Interfaces, page 3-39](#)

## Configuring the Management, AP-Manager, Virtual, and Service-Port Interfaces

Typically, you define the management, AP-manager, virtual, and service-port interface parameters using the Startup Wizard. However, you can display and configure interface parameters through either the GUI or CLI after the controller is running.

**Note**

When assigning a WLAN to a DHCP server, both should be on the same subnet. Otherwise, you need to use a router to route traffic between the WLAN and the DHCP server.

## Using the GUI to Configure the Management, AP-Manager, Virtual, and Service-Port Interfaces

Follow these steps to display and configure the management, AP-manager, virtual, and service-port interface parameters using the GUI.

- Step 1** Choose **Controller > Interfaces** to open the Interfaces page (see [Figure 3-6](#)).

**Figure 3-6** *Interfaces Page*

Interface Name	VLAN Identifier	IP Address	Interface Type	Dynamic AP Management
<a href="#">ap-manager</a>	untagged	209.165.200.225	Static	Enabled
<a href="#">management</a>	untagged	209.165.200.226	Static	Not Supported
<a href="#">service-port</a>	N/A	209.165.200.227	Static	Not Supported
<a href="#">virtual</a>	N/A	209.165.200.228	Static	Not Supported

This page shows the current controller interface settings.

**Step 2** If you want to modify the settings of a particular interface, click the name of the interface. The Interfaces > Edit page for that interface appears.

**Step 3** Configure the following parameters for each interface type:

### Management Interface



**Note** The management interface uses the controller's factory-set distribution system MAC address.

- Quarantine and quarantine VLAN ID, if applicable



**Note** Check the **Quarantine** check box if you want to configure this VLAN as unhealthy or you want to configure network access control (NAC) out-of-band integration. Doing so causes the data traffic of any client that is assigned to this VLAN to pass through the controller. See the *Configuring WLANs* chapter for more information about NAC out-of-band integration.

- NAT address (only for 5500 series controllers configured for dynamic AP management)



**Note** Check the **Enable NAT Address** check box and enter the external NAT IP address if you want to be able to deploy your 5500 series controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT). NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.



**Note** The NAT parameters are supported for use only with one-to-one-mapping NAT, whereby each private client has a direct and fixed mapping to a global address. They do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

- VLAN identifier



**Note** Enter **0** for an untagged VLAN or a non-zero value for a tagged VLAN. Cisco recommends using tagged VLANs for the management interface.

- Fixed IP address, IP netmask, and default gateway
- Dynamic AP management (for 5500 series controllers only)



**Note** For 5500 series controllers, the management interface acts like an AP-manager interface by default. If desired, you can disable the management interface as an AP-manager interface and create another dynamic interface as an AP manager.

- Physical port assignment (for all controllers except the 5500 series)
- Primary and secondary DHCP servers

- Access control list (ACL) setting, if required



**Note** To create ACLs, follow the instructions in the *Configuring Security Solutions* chapter.

### 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.

- Physical port assignment
- VLAN identifier



**Note** Enter **0** for an untagged VLAN or a non-zero value for a tagged VLAN. Cisco recommends using tagged VLANs for the AP-manager interface.

- Fixed IP address, IP netmask, and default gateway



**Note** The AP-manager interface's IP address must be different from the management interface's IP address and may or may not be on the same subnet as the management interface. However, Cisco recommends that both interfaces be on the same subnet for optimum access point association.

- Primary and secondary DHCP servers
- Access control list (ACL) name, if required



**Note** To create ACLs, follow the instructions in the *Configuring Security Solutions* chapter.

### Virtual Interface

- Any fictitious, unassigned, and unused gateway IP address.
- DNS gateway host name



**Note** To ensure connectivity and web authentication, the DNS server should always point to the virtual interface. If a DNS host name is configured for the virtual interface, then the same DNS host name must be configured on the DNS server(s) used by the client.

### Service-Port Interface



**Note** The service-port interface uses the controller's factory-set service-port MAC address.

- DHCP protocol (enabled) or
- DHCP protocol (disabled) and IP address and IP netmask

- Step 4** Click **Save Configuration** to save your changes.
- Step 5** If you made any changes to the management or virtual interface, reboot the controller so that your changes take effect.

## Using the CLI to Configure the Management, AP-Manager, Virtual, and Service-Port Interfaces

This section provides instructions for displaying and configuring the management, AP-manager, virtual, and service-port interfaces using the CLI.

### Using the CLI to Configure the Management Interface

Follow these steps to display and configure the management interface parameters using the CLI.

- Step 1** Enter **show interface detailed management** to view the current management interface settings.



**Note** The management interface uses the controller's factory-set distribution system MAC address.

- Step 2** Enter **config wlan disable wlan-number** to disable each WLAN that uses the management interface for distribution system communication.

- Step 3** Enter these commands to define the management interface:

- **config interface address management** *ip-addr ip-netmask gateway*
- **config interface quarantine vlan management** *vlan\_id*



**Note** Use this command to configure a quarantine VLAN on the management interface.

- **config interface vlan management** {*vlan-id* | 0}



**Note** Enter 0 for an untagged VLAN or a non-zero value for a tagged VLAN. Cisco recommends using tagged VLANs for the management interface.

- **config interface ap-manager management** {**enable** | **disable**} (for 5500 series controllers only)



**Note** Use this command to enable or disable dynamic AP management for the management interface. For 5500 series controllers, the management interface acts like an AP-manager interface by default. If desired, you can disable the management interface as an AP-manager interface and create another dynamic interface as an AP manager.

- **config interface port management** *physical-ds-port-number* (for all controllers except the 5500 series)
- **config interface dhcp management** *ip-address-of-primary-dhcp-server* [*ip-address-of-secondary-dhcp-server*]

- **config interface acl management** *access-control-list-name*



**Note** See the *Configuring Security Solutions* chapter for more information on ACLs.

**Step 4** Enter these commands if you want to be able to deploy your 5500 series controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT):

- **config interface nat-address management** {enable | disable}
- **config interface nat-address management set** *public\_IP\_address*

NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.



**Note** These NAT commands can be used only on 5500 series controllers and only if the management interface is configured for dynamic AP management.



**Note** These commands are supported for use only with one-to-one-mapping NAT, whereby each private client has a direct and fixed mapping to a global address. They do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

**Step 5** Enter **save config** to save your changes.

**Step 6** Enter **show interface detailed management** to verify that your changes have been saved.

**Step 7** If you made any changes to the management interface, enter **reset system** to reboot the controller in order for the changes to take effect.

## Using the CLI to Configure the AP-Manager Interface

Follow these steps to display and configure the AP-manager interface parameters using the CLI.



**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.

**Step 1** Enter **show interface summary** to view the current interfaces.



**Note** If the system is operating in Layer 2 mode, the AP-manager interface is not listed.

**Step 2** Enter **show interface detailed ap-manager** to view the current AP-manager interface settings.

**Step 3** Enter **config wlan disable** *wlan-number* to disable each WLAN that uses the AP-manager interface for distribution system communication.

**Step 4** Enter these commands to define the AP-manager interface:

- **config interface address ap-manager** *ip-addr ip-netmask gateway*
- **config interface vlan ap-manager** { *vlan-id* | **0** }



---

**Note** Enter **0** for an untagged VLAN or a non-zero value for a tagged VLAN. Cisco recommends using tagged VLANs for the AP-manager interface.

---

- **config interface port ap-manager** *physical-ds-port-number*
- **config interface dhcp ap-manager** *ip-address-of-primary-dhcp-server*  
[*ip-address-of-secondary-dhcp-server*]
- **config interface acl ap-manager** *access-control-list-name*



---

**Note** See the *Configuring Security Solutions* chapter for more information on ACLs.

---

**Step 5** Enter **save config** to save your changes.

**Step 6** Enter **show interface detailed ap-manager** to verify that your changes have been saved.

---

## Using the CLI to Configure the Virtual Interface

Follow these steps to display and configure the virtual interface parameters using the CLI.

---

**Step 1** Enter **show interface detailed virtual** to view the current virtual interface settings.

**Step 2** Enter **config wlan disable** *wlan-number* to disable each WLAN that uses the virtual interface for distribution system communication.

**Step 3** Enter these commands to define the virtual interface:

- **config interface address virtual** *ip-address*



---

**Note** For *ip-address*, enter any fictitious, unassigned, and unused gateway IP address.

---

- **config interface hostname virtual** *dns-host-name*

**Step 4** Enter **reset system**. At the confirmation prompt, enter **Y** to save your configuration changes to NVRAM. The controller reboots.

**Step 5** Enter **show interface detailed virtual** to verify that your changes have been saved.

---

## Using the CLI to Configure the Service-Port Interface

Follow these steps to display and configure the service-port interface parameters using the CLI.

---

**Step 1** Enter **show interface detailed service-port** to view the current service-port interface settings.




---

**Note** The service-port interface uses the controller's factory-set service-port MAC address.

---

**Step 2** Enter these commands to define the service-port interface:

- To configure the DHCP server: **config interface dhcp service-port** *ip-address-of-primary-dhcp-server* [*ip-address-of-secondary-dhcp-server*]
- To disable the DHCP server: **config interface dhcp service-port none**
- To configure the IP address: **config interface address service-port** *ip-addr ip-netmask*

**Step 3** The service port is used for out-of-band management of the controller. If the management workstation is in a remote subnet, you may need to add a route on the controller in order to manage the controller from that remote workstation. To do so, enter this command:

**config route add** *network-ip-addr ip-netmask gateway*

**Step 4** Enter **save config** to save your changes.

**Step 5** Enter **show interface detailed service-port** to verify that your changes have been saved.

---

## Configuring Dynamic Interfaces

This section provides instructions for configuring dynamic interfaces using either the GUI or CLI.

### Using the GUI to Configure Dynamic Interfaces

Follow these steps to create new or edit existing dynamic interfaces using the GUI.

---

**Step 1** Choose **Controller > Interfaces** to open the Interfaces page (see [Figure 3-6](#)).

**Step 2** Perform one of the following:

- To create a new dynamic interface, click **New**. The Interfaces > New page appears (see [Figure 3-7](#)). Go to [Step 3](#).
- To modify the settings of an existing dynamic interface, click the name of the interface. The Interfaces > Edit page for that interface appears (see [Figure 3-8](#)). Go to [Step 5](#).
- To delete an existing dynamic interface, hover your cursor over the blue drop-down arrow for the desired interface and choose **Remove**.

Figure 3-7 Interfaces &gt; New Page

The screenshot shows the Cisco configuration interface for a new dynamic interface. The breadcrumb is 'Interfaces > New'. The 'Interface Name' field contains 'ap-manager 2' and the 'VLAN Id' field contains '3'. Navigation buttons for '< Back' and 'Apply' are visible in the top right corner.

**Step 3** Enter an interface name and a VLAN identifier, as shown in Figure 3-7.

**Step 4** Click **Apply** to commit your changes. The Interfaces > Edit page appears (see Figure 3-8).

Figure 3-8 Interfaces &gt; Edit Page

The screenshot shows the Cisco configuration interface for editing an existing dynamic interface. The breadcrumb is 'Interfaces > Edit'. The interface name is 'data' and the MAC address is '00:21:1b:fe:54:2f'. The configuration section includes checkboxes for 'Guest Lan' and 'Quarantine', and a 'Quarantine Vlan Id' field set to '0'. The physical information section shows 'The interface is attached to a LAG' and 'Enable Dynamic AP Management' checkbox. The interface address section includes fields for 'VLAN Identifier' (310), 'IP Address' (209.165.200.225), 'Netmask' (255.255.255.0), and 'Gateway' (10.10.116.1). The DHCP information section includes 'Primary DHCP Server' (10.10.19.18) and 'Secondary DHCP Server'. The access control list section includes 'ACL Name' (none). A note at the bottom states: 'Note: Changing the Interface parameters causes the WLANs to be temporarily disabled and thus may result in loss of connectivity for some clients.'

**Step 5** Configure the following parameters:

- Guest LAN, if applicable
- Quarantine and quarantine VLAN ID, if applicable



**Note**

Check the **Quarantine** check box if you want to configure this VLAN as unhealthy or you want to configure network access control (NAC) out-of-band integration. Doing so causes the data traffic of any client that is assigned to this VLAN to pass through the controller. See the *Configuring WLANs* chapter for more information about NAC out-of-band integration.

- Physical port assignment (for all controllers except the 5500 series)
- NAT address (only for 5500 series controllers configured for dynamic AP management)



**Note** Check the **Enable NAT Address** check box and enter the external NAT IP address if you want to be able to deploy your 5500 series controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT). NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.



**Note** The NAT parameters are supported for use only with one-to-one-mapping NAT, whereby each private client has a direct and fixed mapping to a global address. They do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

- Dynamic AP management



**Note** When you enable this feature, this dynamic interface is configured as an AP-manager interface (only one AP-manager interface is allowed per physical port). A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.



**Note** Set the APs in a VLAN that is different from the dynamic interface configured on the Controller. If the APs are in the same VLAN as the dynamic interface, the APs are not registered on the Controller and the 'LWAPP discovery rejected' and 'Layer 3 discovery request not received on management VLAN' errors are logged on the Controller.

- VLAN identifier
- Fixed IP address, IP netmask, and default gateway
- Primary and secondary DHCP servers
- Access control list (ACL) name, if required



**Note** See the *Configuring Security Solutions* chapter for more information on ACLs.



**Note** To ensure proper operation, you must set the Port Number and Primary DHCP Server parameters.

**Step 6** Click **Save Configuration** to save your changes.

**Step 7** Repeat this procedure for each dynamic interface that you want to create or edit.

## Using the CLI to Configure Dynamic Interfaces

Follow these steps to configure dynamic interfaces using the CLI.

- 
- Step 1** Enter **show interface summary** to view the current dynamic interfaces.
- Step 2** To view the details of a specific dynamic interface, enter **show interface detailed** *operator\_defined\_interface\_name*.
- Step 3** Enter **config wlan disable** *wlan\_id* to disable each WLAN that uses the dynamic interface for distribution system communication.
- Step 4** Enter these commands to configure dynamic interfaces:
- **config interface create** *operator\_defined\_interface\_name* {*vlan\_id* | *x*}
  - **config interface address** *operator\_defined\_interface\_name* *ip\_addr* *ip\_netmask* [*gateway*]
  - **config interface vlan** *operator\_defined\_interface\_name* {*vlan\_id* | 0}
  - **config interface port** *operator\_defined\_interface\_name* *physical\_ds\_port\_number*
  - **config interface ap-manager** *operator\_defined\_interface\_name* {**enable** | **disable**}




---

**Note** Use this command to enable or disable dynamic AP management. When you enable this feature, this dynamic interface is configured as an AP-manager interface (only one AP-manager interface is allowed per physical port). A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

---

- **config interface dhcp** *operator\_defined\_interface\_name* *ip\_address\_of\_primary\_dhcp\_server* [*ip\_address\_of\_secondary\_dhcp\_server*]
- **config interface quarantine vlan** *interface\_name* *vlan\_id*




---

**Note** Use this command to configure a quarantine VLAN on any interface.

---

- **config interface acl** *operator\_defined\_interface\_name* *access\_control\_list\_name*




---

**Note** See the *Configuring Security Solutions* chapter for more information on ACLs.

---

- Step 5** Enter these commands if you want to be able to deploy your 5500 series controller behind a router or other gateway device that is using one-to-one mapping network address translation (NAT):
- **config interface nat-address dynamic-interface** *operator\_defined\_interface\_name* {**enable** | **disable**}
  - **config interface nat-address dynamic-interface** *operator\_defined\_interface\_name* **set** *public\_IP\_address*

NAT allows a device, such as a router, to act as an agent between the Internet (public) and a local network (private). In this case, it maps the controller's intranet IP addresses to a corresponding external address. The controller's dynamic AP-manager interface must be configured with the external NAT IP address so that the controller can send the correct IP address in the Discovery Response.



**Note** These NAT commands can be used only on 5500 series controllers and only if the dynamic interface is configured for dynamic AP management.



**Note** These commands are supported for use only with one-to-one-mapping NAT, whereby each private client has a direct and fixed mapping to a global address. They do not support one-to-many NAT, which uses source port mapping to enable a group of clients to be represented by a single IP address.

- Step 6** Enter **config wlan enable** *wlan\_id* to re-enable each WLAN that uses the dynamic interface for distribution system communication.
- Step 7** Enter **save config** to save your changes.
- Step 8** Enter **show interface detailed** *operator\_defined\_interface\_name* and **show interface summary** to verify that your changes have been saved.



**Note** If desired, you can enter **config interface delete** *operator\_defined\_interface\_name* to delete a dynamic interface.

## Configuring Ports

The controller's ports are preconfigured with factory default settings designed to make the controllers' ports operational without additional configuration. However, you can view the status of the controller's ports and edit their configuration parameters at any time.

Follow these steps to use the GUI to view the status of the controller's ports and make any configuration changes if necessary.

- Step 1** Choose **Controller > Ports** to open the Ports page (see [Figure 3-9](#)).

**Figure 3-9** Ports Page

Port No	STP Status	Admin Status	Physical Mode	Physical Status	Link Status	Link Trap	POE	Mcast Appliance
1	Forwarding	Enable	Auto	1000 Mbps Full Duplex	Link Up	Enable	N/A	Enable
2	Disabled	Enable	Auto	Auto	Link Down	Enable	N/A	Enable
3	Disabled	Enable	Auto	Auto	Link Down	Enable	N/A	Enable
4	Disabled	Enable	Auto	Auto	Link Down	Enable	N/A	Enable

This page shows the current configuration for each of the controller's ports.

**Step 2** If you want to change the settings of any port, click the number for that specific port. The Port > Configure page appears (see [Figure 3-10](#)).



**Note** If the management and AP-manager interfaces are mapped to the same port and are members of the same VLAN, you must disable the WLAN before making a port-mapping change to either interface. If the management and AP-manager interfaces are assigned to different VLANs, you do not need to disable the WLAN.



**Note** The number of parameters available on the Port > Configure page depends on your controller type. For instance, 2100 series controllers and the controller in a Cisco Integrated Services Router have fewer configurable parameters than a 4400 series controller, which is shown in [Figure 3-10](#).

**Figure 3-10** Port > Configure Page

The screenshot shows the Cisco configuration interface for a port. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', 'WIRELESS', 'SECURITY', 'MANAGEMENT', 'COMMANDS', and 'HELP'. The left sidebar lists various configuration categories like 'General', 'Inventory', 'Interfaces', etc. The main content area is titled 'Port > Configure' and contains two sections: 'General' and 'Spanning Tree Protocol Configuration'. The 'General' section includes fields for Port No (1), Admin Status (Enable), Mirror Mode (Disable), Physical Mode (Auto), Physical Status (1000 Mbps Full Duplex), Link Status (Link Up), Link Trap (Enable), Power Over Ethernet (N/A), and Multicast Appliance Mode (Enable). The 'Spanning Tree Protocol Configuration' section includes fields for STP Port ID (8001), STP Mode (Off), STP State (Forwarding), and various STP parameters like Designated Root, Cost, Bridge, Port, Forward Transitions Count, Priority (128), Path Cost Mode (Auto), and Path Cost (4).

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Table 3-2 interprets the current status of the port.

**Table 3-2 Port Status**

Parameter	Description														
Port Number	The number of the current port.														
Admin Status	The current state of the port. <b>Values:</b> Enable or Disable														
Physical Mode	The configuration of the port physical interface. Varies by controller. <b>Values:</b> Auto, 100 Mbps Full Duplex, 100 Mbps Half Duplex, 10 Mbps Full Duplex, or 10 Mbps Half Duplex														
Physical Status	The data rate being used by the port. The available data rates vary based on controller type.  <div style="text-align: center;">   <b>Note</b> </div> As of Controller Release 5.2 the 4400 series controllers can only run with the speed and duplex set to Auto. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Controller</th> <th>Available Data Rates</th> </tr> </thead> <tbody> <tr> <td>5500 series</td> <td>1000 Mbps full duplex</td> </tr> <tr> <td>4400 series</td> <td>1000 Mbps full duplex</td> </tr> <tr> <td>2100 series</td> <td>10 or 100 Mbps, half or full duplex</td> </tr> <tr> <td>WiSM</td> <td>1000 Mbps full duplex</td> </tr> <tr> <td>Controller network module</td> <td>100 Mbps full duplex</td> </tr> <tr> <td>Catalyst 3750G Integrated Wireless LAN Controller Switch</td> <td>1000 Mbps full duplex</td> </tr> </tbody> </table>	Controller	Available Data Rates	5500 series	1000 Mbps full duplex	4400 series	1000 Mbps full duplex	2100 series	10 or 100 Mbps, half or full duplex	WiSM	1000 Mbps full duplex	Controller network module	100 Mbps full duplex	Catalyst 3750G Integrated Wireless LAN Controller Switch	1000 Mbps full duplex
Controller	Available Data Rates														
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4400 series	1000 Mbps full duplex														
2100 series	10 or 100 Mbps, half or full duplex														
WiSM	1000 Mbps full duplex														
Controller network module	100 Mbps full duplex														
Catalyst 3750G Integrated Wireless LAN Controller Switch	1000 Mbps full duplex														
Link Status	The port's link status. <b>Values:</b> Link Up or Link Down														
Link Trap	Indicates whether the port is set to send a trap when the link status changes. <b>Values:</b> Enable or Disable														
Power over Ethernet (PoE)	Determines if the connecting device is equipped to receive power through the Ethernet cable and if so provides -48 VDC. <b>Values:</b> Enable or Disable  <b>Note</b> Some older Cisco access points do not draw PoE even if it is enabled on the controller port. In such cases, contact the Cisco Technical Assistance Center (TAC).  <b>Note</b> The controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch supports PoE on all ports.														

**Step 3** Table 3-3 lists and describes the port's configurable parameters. Follow the instructions in the table to make any desired changes.

**Table 3-3 Port Parameters**

Parameter	Description														
Admin Status	<p>Enables or disables the flow of traffic through the port.</p> <p><b>Options:</b> Enable or Disable</p> <p><b>Default:</b> Enable</p> <p><b>Note</b> Administratively disabling the port on a controller does not affect the port's link status. The link can be brought down only by other Cisco devices. On other Cisco products, however, administratively disabling a port brings the link down.</p>														
Physical Mode	<p>Determines whether the port's data rate is set automatically or specified by the user. The supported data rates vary based on controller type.</p> <p><b>Default:</b> Auto</p> <p> <b>Note</b> As of Controller Release 5.2 the 4400 series controllers can only run with the speed and duplex set to Auto.</p> <table border="1"> <thead> <tr> <th>Controller</th> <th>Supported Data Rates</th> </tr> </thead> <tbody> <tr> <td>5500 series</td> <td>Auto or 1000 Mbps full duplex</td> </tr> <tr> <td>4400 series</td> <td>Auto or 1000 Mbps full duplex</td> </tr> <tr> <td>2100 series</td> <td>Auto or 10 or 100 Mbps, half or full duplex</td> </tr> <tr> <td>WiSM</td> <td>Auto or 1000 Mbps full duplex</td> </tr> <tr> <td>Controller network module</td> <td>Auto or 100 Mbps full duplex</td> </tr> <tr> <td>Catalyst 3750G Integrated Wireless LAN Controller Switch</td> <td>Auto or 1000 Mbps full duplex</td> </tr> </tbody> </table> <p><b>Note</b> Make sure that a duplex mismatch does not exist between a 2100 series controller and the Catalyst switch. A duplex mismatch is a situation where the switch operates at full duplex and the connected device operates at half duplex or vice versa. The results of a duplex mismatch are extremely slow performance, intermittent connectivity, and loss of connection. Other possible causes of data link errors at full duplex are bad cables, faulty switch ports, or client software or hardware issues.</p>	Controller	Supported Data Rates	5500 series	Auto or 1000 Mbps full duplex	4400 series	Auto or 1000 Mbps full duplex	2100 series	Auto or 10 or 100 Mbps, half or full duplex	WiSM	Auto or 1000 Mbps full duplex	Controller network module	Auto or 100 Mbps full duplex	Catalyst 3750G Integrated Wireless LAN Controller Switch	Auto or 1000 Mbps full duplex
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5500 series	Auto or 1000 Mbps full duplex														
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2100 series	Auto or 10 or 100 Mbps, half or full duplex														
WiSM	Auto or 1000 Mbps full duplex														
Controller network module	Auto or 100 Mbps full duplex														
Catalyst 3750G Integrated Wireless LAN Controller Switch	Auto or 1000 Mbps full duplex														
Link Trap	<p>Causes the port to send a trap when the port's link status changes.</p> <p><b>Options:</b> Enable or Disable</p> <p><b>Default:</b> Enable</p>														
Multicast Appliance Mode	<p>Enables or disables the multicast appliance service for this port.</p> <p><b>Options:</b> Enable or Disable</p> <p><b>Default:</b> Enable</p>														

- Step 4** Click **Apply** to commit your changes.
  - Step 5** Click **Save Configuration** to save your changes.
  - Step 6** Click **Back** to return to the Ports page and review your changes.
  - Step 7** Repeat this procedure for each additional port that you want to configure.
  - Step 8** Go to the following sections if you want to configure the controller's ports for these advanced features:
    - Port mirroring, see below
    - Spanning Tree Protocol (STP), [page 3-27](#)
- 

## Configuring Port Mirroring

Mirror mode enables you to duplicate to another port all of the traffic originating from or terminating at a single client device or access point. It is useful in diagnosing specific network problems. Mirror mode should be enabled only on an unused port as any connections to this port become unresponsive.



### Note

The 5500 series controllers, 2100 series controllers, controller network modules, and Cisco WiSM controllers do not support mirror mode. Also, a controller's service port cannot be used as a mirrored port.

---



### Note

Port mirroring is not supported when link aggregation (LAG) is enabled on the controller.

---



### Note

Cisco recommends that you do not mirror traffic from one controller port to another as this setup could cause network problems.

---

Follow these steps to enable port mirroring.

---

- Step 1** Choose **Controller > Ports** to open the Ports page (see [Figure 3-9](#)).
- Step 2** Click the number of the unused port for which you want to enable mirror mode. The Port > Configure page appears (see [Figure 3-10](#)).
- Step 3** Set the Mirror Mode parameter to **Enable**.
- Step 4** Click **Apply** to commit your changes.
- Step 5** Perform one of the following:
  - Follow these steps if you want to choose a specific client device that will mirror its traffic to the port you selected on the controller:
    - a. Choose **Wireless > Clients** to open the Clients page.
    - b. Click the MAC address of the client for which you want to enable mirror mode. The Clients > Detail page appears.
    - c. Under Client Details, set the Mirror Mode parameter to **Enable**.

- Follow these steps if you want to choose an access point that will mirror its traffic to the port you selected on the controller:
  - a. Choose **Wireless > Access Points > All APs** to open the All APs page.
  - b. Click the name of the access point for which you want to enable mirror mode. The All APs > Details page appears.
  - c. Choose the **Advanced** tab.
  - d. Set the Mirror Mode parameter to **Enable**.

**Step 6** Click **Save Configuration** to save your changes.

---

## Configuring Spanning Tree Protocol

Spanning Tree Protocol (STP) is a Layer 2 link management protocol that provides path redundancy while preventing loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two network devices. STP allows only one active path at a time between network devices but establishes redundant links as a backup if the initial link should fail.

The spanning-tree algorithm calculates the best loop-free path throughout a Layer 2 network. Infrastructure devices such as controllers and switches send and receive spanning-tree frames, called bridge protocol data units (BPDUs), at regular intervals. The devices do not forward these frames but use them to construct a loop-free path.

Multiple active paths among end stations cause loops in the network. If a loop exists in the network, end stations might receive duplicate messages. Infrastructure devices might also learn end-station MAC addresses on multiple Layer 2 interfaces. These conditions result in an unstable network.

STP defines a tree with a root bridge and a loop-free path from the root to all infrastructure devices in the Layer 2 network.



### Note

STP discussions use the term *root* to describe two concepts: the controller on the network that serves as a central point in the spanning tree is called the *root bridge*, and the port on each controller that provides the most efficient path to the root bridge is called the *root port*. The root bridge in the spanning tree is called the *spanning-tree root*.

STP forces redundant data paths into a standby (blocked) state. If a network segment in the spanning tree fails and a redundant path exists, the spanning-tree algorithm recalculates the spanning-tree topology and activates the standby path.

When two ports on a controller are part of a loop, the spanning-tree port priority and path cost settings determine which port is put in the forwarding state and which is put in the blocking state. The port priority value represents the location of a port in the network topology and how well it is located to pass traffic. The path cost value represents media speed.

The controller maintains a separate spanning-tree instance for each active VLAN configured on it. A bridge ID, consisting of the bridge priority and the controller's MAC address, is associated with each instance. For each VLAN, the controller with the lowest controller ID becomes the spanning-tree root for that VLAN.

STP is disabled for the controller's distribution system ports by default. The following sections provide instructions for configuring STP for your controller using either the GUI or CLI.

**Note**

STP cannot be configured for 2100 series controllers, 5500 series controllers, and the controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch.

## Using the GUI to Configure Spanning Tree Protocol

Follow these steps to configure STP using the GUI.

- Step 1** Choose **Controller > Ports** to open the Ports page (see [Figure 3-9](#)).
- Step 2** Click the number of the port for which you want to configure STP. The Port > Configure page appears (see [Figure 3-10](#)). This page shows the STP status of the port and enables you to configure STP parameters.

[Table 3-4](#) interprets the current STP status of the port.

**Table 3-4** Port Spanning Tree Status

Parameter	Description														
STP Port ID	The number of the port for which STP is enabled or disabled.														
STP State	The port's current STP state. It controls the action that a port takes upon receiving a frame. <b>Values:</b> Disabled, Blocking, Listening, Learning, Forwarding, and Broken														
	<table border="1"> <thead> <tr> <th>STP State</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Disabled</td> <td>The port is not participating in spanning tree because the port is shut down, the link is down, or STP is not enabled for this port.</td> </tr> <tr> <td>Blocking</td> <td>The port does not participate in frame forwarding.</td> </tr> <tr> <td>Listening</td> <td>The first transitional state after the blocking state when STP determines that the port should participate in frame forwarding.</td> </tr> <tr> <td>Learning</td> <td>The port prepares to participate in frame forwarding.</td> </tr> <tr> <td>Forwarding</td> <td>The port forwards frames.</td> </tr> <tr> <td>Broken</td> <td>The port is malfunctioning.</td> </tr> </tbody> </table>	STP State	Description	Disabled	The port is not participating in spanning tree because the port is shut down, the link is down, or STP is not enabled for this port.	Blocking	The port does not participate in frame forwarding.	Listening	The first transitional state after the blocking state when STP determines that the port should participate in frame forwarding.	Learning	The port prepares to participate in frame forwarding.	Forwarding	The port forwards frames.	Broken	The port is malfunctioning.
STP State	Description														
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Blocking	The port does not participate in frame forwarding.														
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Learning	The port prepares to participate in frame forwarding.														
Forwarding	The port forwards frames.														
Broken	The port is malfunctioning.														
STP Port Designated Root	The unique identifier of the root bridge in the configuration BPDUs.														
STP Port Designated Cost	The path cost of the designated port.														
STP Port Designated Bridge	The identifier of the bridge that the port considers to be the designated bridge for this port.														
STP Port Designated Port	The port identifier on the designated bridge for this port.														
STP Port Forward Transitions Count	The number of times that the port has transitioned from the learning state to the forwarding state.														

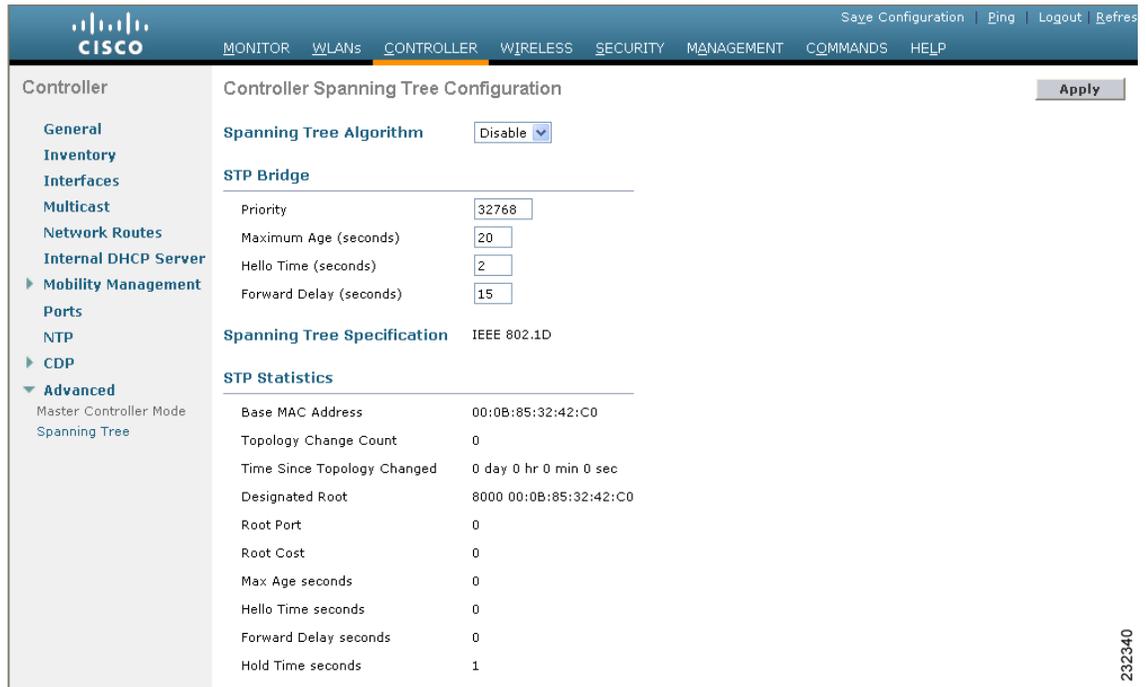
- Step 3** [Table 3-5](#) lists and describes the port's configurable STP parameters. Follow the instructions in the table to make any desired changes.

**Table 3-5** Port Spanning Tree Parameters

Parameter	Description	
STP Mode	The STP administrative mode associated with this port. <b>Options:</b> Off, 802.1D, or Fast <b>Default:</b> Off	
	<b>STP Mode</b>	
	<b>Description</b>	
	Off	Disables STP for this port.
	802.1D	Enables this port to participate in the spanning tree and go through all of the spanning tree states when the link state transitions from down to up.
	Fast	Enables this port to participate in the spanning tree and puts it in the forwarding state when the link state transitions from down to up more quickly than when the STP mode is set to 802.1D. <b>Note</b> In this state, the forwarding delay timer is ignored on link up.
STP Port Priority	The location of the port in the network topology and how well the port is located to pass traffic. <b>Range:</b> 0 to 255 <b>Default:</b> 128	
STP Port Path Cost Mode	Determines whether the STP port path cost is set automatically or specified by the user. If you choose User Configured, you also need to set a value for the STP Port Path Cost parameter. <b>Range:</b> Auto or User Configured <b>Default:</b> Auto	
STP Port Path Cost	The speed at which traffic is passed through the port. This parameter must be set if the STP Port Path Cost Mode parameter is set to User Configured. <b>Options:</b> 0 to 65535 <b>Default:</b> 0, which causes the cost to be adjusted for the speed of the port when the link comes up. <b>Note</b> Typically, a value of 100 is used for 10-Mbps ports and 19 for 100-Mbps ports.	

- Step 4** Click **Apply** to commit your changes.
- Step 5** Click **Save Configuration** to save your changes.
- Step 6** Click **Back** to return to the Ports page.
- Step 7** Repeat [Step 2](#) through [Step 6](#) for each port for which you want to enable STP.
- Step 8** Choose **Controller > Advanced > Spanning Tree** to open the Controller Spanning Tree Configuration page (see [Figure 3-11](#)).

Figure 3-11 Controller Spanning Tree Configuration Page



This page allows you to enable or disable the spanning tree algorithm for the controller, modify its characteristics, and view the STP status. Table 3-6 interprets the current STP status for the controller.

Table 3-6 Controller Spanning Tree Status

Parameter	Description
Spanning Tree Specification	The STP version being used by the controller. Currently, only an IEEE 802.1D implementation is available.
Base MAC Address	The MAC address used by this bridge when it must be referred to in a unique fashion. When it is concatenated with dot1dStpPriority, a unique bridge identifier is formed that is used in STP.
Topology Change Count	The total number of topology changes detected by this bridge since the management entity was last reset or initialized.
Time Since Topology Changed	The time (in days, hours, minutes, and seconds) since a topology change was detected by the bridge.
Designated Root	The bridge identifier of the spanning tree root. This value is used as the Root Identifier parameter in all configuration BPDUs originated by this node.
Root Port	The number of the port that offers the lowest cost path from this bridge to the root bridge.
Root Cost	The cost of the path to the root as seen from this bridge.
Max Age (seconds)	The maximum age of STP information learned from the network on any port before it is discarded.

**Table 3-6** *Controller Spanning Tree Status (continued)*

Parameter	Description
Hello Time (seconds)	The amount of time between the transmission of configuration BPDUs by this node on any port when it is the root of the spanning tree or trying to become so. This is the actual value that this bridge is currently using.
Forward Delay (seconds)	This value controls how fast a port changes its spanning tree state when moving toward the forwarding state. It determines how long the port stays in each of the listening and learning states that precede the forwarding state. This value is also used, when a topology change has been detected and is underway, to age all dynamic entries in the forwarding database.  <b>Note</b> This is the actual value that this bridge is currently using, in contrast to <i>Stp Bridge Forward Delay</i> , which is the value that this bridge and all others would start using if this bridge were to become the root.
Hold Time (seconds)	The minimum time period to elapse between the transmission of configuration BPDUs through a given LAN port.  <b>Note</b> At most, one configuration BPDU can be transmitted in any hold time period.

**Step 9** [Table 3-7](#) lists and describes the controller's configurable STP parameters. Follow the instructions in the table to make any desired changes.

**Table 3-7** *Controller Spanning Tree Parameters*

Parameter	Description
Spanning Tree Algorithm	Enables or disables STP for the controller.  <b>Options:</b> Enable or Disable <b>Default:</b> Disable
Priority	The location of the controller in the network topology and how well the controller is located to pass traffic.  <b>Range:</b> 0 to 65535 <b>Default:</b> 32768
Maximum Age (seconds)	The length of time that the controller stores protocol information received on a port.  <b>Range:</b> 6 to 40 seconds <b>Default:</b> 20 seconds
Hello Time (seconds)	The length of time that the controller broadcasts hello messages to other controllers.  <b>Options:</b> 1 to 10 seconds <b>Default:</b> 2 seconds

Table 3-7 Controller Spanning Tree Parameters (continued)

Parameter	Description
Forward Delay (seconds)	The length of time that each of the listening and learning states lasts before the port begins forwarding. <b>Options:</b> 4 to 30 seconds <b>Default:</b> 15 seconds

- Step 10** Click **Apply** to commit your changes.
- Step 11** Click **Save Configuration** to save your changes.

## Using the CLI to Configure Spanning Tree Protocol

Follow these steps to configure STP using the CLI.

- Step 1** Enter **show spanningtree port** and **show spanningtree switch** to view the current STP status.
- Step 2** If STP is enabled, you must disable it before you can change STP settings. Enter **config spanningtree switch mode disable** to disable STP on all ports.
- Step 3** Enter one of these commands to configure the STP port administrative mode:
- **config spanningtree port mode 802.1d** {port-number | all}
  - **config spanningtree port mode fast** {port-number | all}
  - **config spanningtree port mode off** {port-number | all}
- Step 4** Enter one of these commands to configure the STP port path cost on the STP ports:
- **config spanningtree port pathcost 1-65535** {port-number | all}—Specifies a path cost from 1 to 65535 to the port.
  - **config spanningtree port mode pathcost auto** {port-number | all}—Enables the STP algorithm to automatically assign the path cost. This is the default setting.
- Step 5** Enter **config spanningtree port priority 0-255 port-number** to configure the port priority on STP ports. The default priority is 128.
- Step 6** If necessary, enter **config spanningtree switch bridgepriority 0-65535** to configure the controller's STP bridge priority. The default bridge priority is 32768.
- Step 7** If necessary, enter **config spanningtree switch forwarddelay 4-30** to configure the controller's STP forward delay in seconds. The default forward delay is 15 seconds.
- Step 8** If necessary, enter **config spanningtree switch hellotime 1-10** to configure the controller's STP hello time in seconds. The default hello time is 2 seconds.
- Step 9** If necessary, enter **config spanningtree switch maxage 6-40** to configure the controller's STP maximum age. The default maximum age is 20 seconds.
- Step 10** After you configure STP settings for the ports, enter **config spanningtree switch mode enable** to enable STP for the controller. The controller automatically detects logical network loops, places redundant ports on standby, and builds a network with the most efficient pathways.

- Step 11** Enter **save config** to save your settings.
- Step 12** Enter **show spanningtree port** and **show spanningtree switch** to verify that your changes have been saved.
- 

## Using the Cisco 5500 Series Controller USB Console Port

The USB console port on the 5500 series controllers connects directly to the USB connector of a PC using a USB Type A-to-5-pin mini Type B cable.

**Note**

The 4-pin mini Type B connector is easily confused with the 5-pin mini Type B connector. They are not compatible. Only the 5-pin mini Type B connector can be used.

---

For operation with Microsoft Windows, the Cisco Windows USB console driver must be installed on any PC connected to the console port. With this driver, you can plug and unplug the USB cable into and from the console port without affecting Windows HyperTerminal operations.

**Note**

Only one console port can be active at a time. When a cable is plugged into the USB console port, the RJ-45 port becomes inactive. Conversely, when the USB cable is removed from the USB port, the RJ-45 port becomes active.

---

### USB Console OS Compatibility

- Microsoft Windows 2000, XP, Vista (Cisco Windows USB console driver required)
- Apple Mac OS X 10.5.2 (no driver required)
- Linux (no driver required)

To install the Cisco Windows USB console driver, follow these steps:

---

- Step 1** Follow these steps to download the USB\_Console.inf driver file:
- a. Click this URL to go to the Software Center:  
<http://tools.cisco.com/support/downloads/go/Redirect.x?mdfid=278875243>
  - b. Click **Wireless LAN Controllers**.
  - c. Click **Standalone Controllers**.
  - d. Click **Cisco 5500 Series Wireless LAN Controllers**.
  - e. Click **Cisco 5508 Wireless LAN Controller**.
  - f. Choose the USB driver file.
  - g. Save the file to your hard drive.
- Step 2** Connect the Type A connector to a USB port on your PC.
- Step 3** Connect the mini Type B connector to the USB console port on the controller.
- Step 4** When prompted for a driver, browse to the USB\_Console.inf file on your PC. Follow the prompts to install the USB driver.



**Note** Some systems might also require an additional system file. You can download the Usbser.sys file from Microsoft's website.

The USB driver is mapped to COM port 6. Some terminal emulation programs do not recognize a port higher than COM 4. If necessary, change the Cisco USB systems management console COM port to an unused port of COM 4 or lower. To do so, follow these steps:

- 
- Step 1** From your Windows desktop, right-click **My Computer** and choose **Manage**.
  - Step 2** From the list on the left side, choose **Device Manager**.
  - Step 3** From the device list on the right side, double-click **Ports (COM & LPT)**.
  - Step 4** Right-click **Cisco USB System Management Console 0108** and choose **Properties**.
  - Step 5** Click the **Port Settings** tab and click the **Advanced** button.
  - Step 6** From the COM Port Number drop-down box, choose an unused COM port of 4 or lower.
  - Step 7** Click **OK** to save; then close the Advanced Settings dialog box.
  - Step 8** Click **OK** to save; then close the Communications Port Properties dialog box.
- 

## Choosing Between Link Aggregation and Multiple AP-Manager Interfaces

As noted earlier, 4400 series controllers can support up to 48 access points per port. However, you can configure your 4400 series controller to support more access points by using link aggregation (LAG) or configuring dynamic AP-managers on each Gigabit Ethernet port. Cisco 5500 series controllers have no restrictions on the number of access points per port, but Cisco recommends using LAG or multiple AP-manager interfaces on each Gigabit Ethernet port to automatically balance the load.

The following factors should help you decide which method to use if your controller is set for Layer 3 operation:

- With LAG, all of the controller ports need to connect to the same neighbor switch. If the neighbor switch goes down, the controller loses connectivity.
- With multiple AP-manager interfaces, you can connect your ports to different neighbor devices. If one of the neighbor switches goes down, the controller still has connectivity. However, using multiple AP-manager interfaces presents certain challenges (as discussed in the [“Configuring Multiple AP-Manager Interfaces”](#) section below) when port redundancy is a concern.

Follow the instructions on the page indicated for the method you want to use:

- Link aggregation, [page 3-35](#)
- Multiple AP-manager interfaces, [page 3-39](#)

## Enabling Link Aggregation

Link aggregation (LAG) is a partial implementation of the 802.3ad port aggregation standard. It bundles all of the controller's distribution system ports into a single 802.3ad port channel, thereby reducing the number of IP addresses needed to configure the ports on your controller. When LAG is enabled, the system dynamically manages port redundancy and load balances access points transparently to the user.


**Note**

The 2100 series controllers do not support LAG.

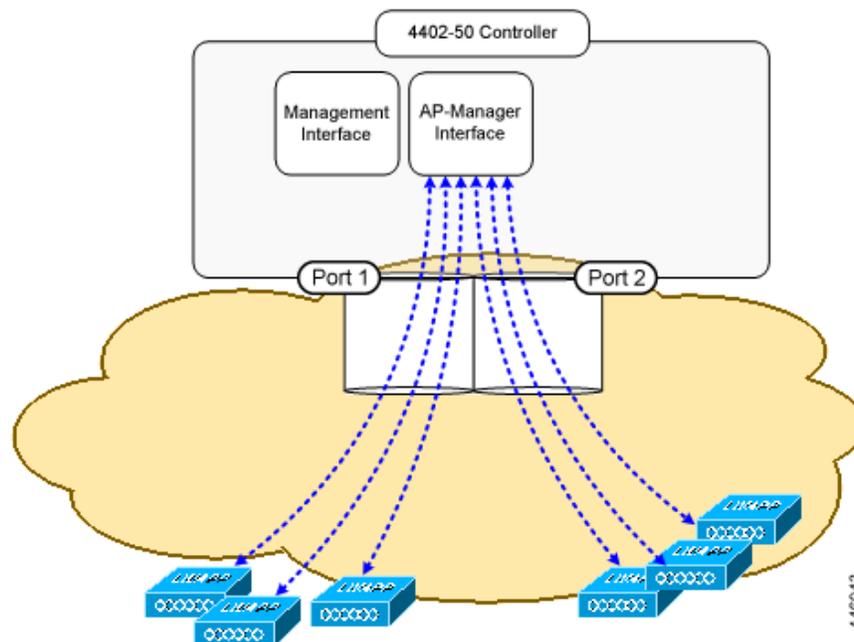

**Note**

You can bundle all four ports on a 4404 controller (or two on a 4402 controller) or all eight ports on a 5508 controller into a single link.

Cisco 5500 series controllers support LAG in software release 6.0 or later, Cisco 4400 series controllers support LAG in software release 3.2 or later, and LAG is enabled automatically on the controllers within the Cisco WiSM and the Catalyst 3750G Integrated Wireless LAN Controller Switch. Without LAG, each distribution system port on a 4400 series controller supports up to 48 access points. With LAG enabled, a 4402 controller's logical port supports up to 50 access points, a 4404 controller's logical port supports up to 100 access points, and the logical port on the Catalyst 3750G Integrated Wireless LAN Controller Switch and on each Cisco WiSM controller supports up to 150 access points.

Figure 3-12 illustrates LAG.

**Figure 3-12** Link Aggregation



LAG simplifies controller configuration because you no longer need to configure primary and secondary ports for each interface. If any of the controller ports fail, traffic is automatically migrated to one of the other ports. As long as at least one controller port is functioning, the system continues to operate, access points remain connected to the network, and wireless clients continue to send and receive data.

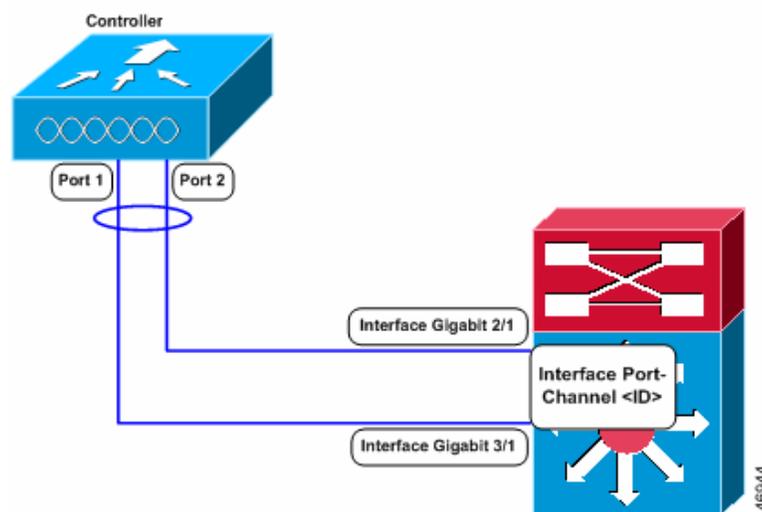
When configuring bundled ports on the controller, you may want to consider terminating on two different modules within a modular switch such as the Catalyst 6500; however, Cisco does not recommend connecting the LAG ports of a 5500 or 4400 series controller to multiple Catalyst 6500 or 3750G switches.

Terminating on two different modules within a single Catalyst 6500 switch provides redundancy and ensures that connectivity between the switch and the controller is maintained when one module fails. [Figure 3-13](#) illustrates this use of redundant modules. A 4402-50 controller is connected to two different Gigabit modules (slots 2 and 3) within the Catalyst 6500. The controller's port 1 is connected to Gigabit interface 3/1, and the controller's port 2 is connected to Gigabit interface 2/1 on the Catalyst 6500. Both switch ports are assigned to the same channel group.

When a 5500 series controller, 4404 controller, or WiSM controller module LAG port is connected to a Catalyst 3750G or a 6500 or 7600 channel group employing load balancing, note the following:

- LAG requires the Etherchannel to be configured for the “on” mode on both the controller and the Catalyst switch.
- Once the Etherchannel is configured as “on” at both ends of the link, it does not matter if the Catalyst switch is configured for either Link Aggregation Control Protocol (LACP) or Cisco proprietary Port Aggregation Protocol (PAgP) because no channel negotiation is done between the controller and the switch. Additionally, LACP and PAgP are not supported on the controller.
- The load-balancing method configured on the Catalyst switch must be a load-balancing method that terminates all IP datagram fragments on a single controller port. Not following this recommendation may result in problems with access point association.
- The recommended load-balancing method for Catalyst switches is `src-dest-ip` (CLI command: **port-channel load-balance *src\_dest\_ip***).
- If the recommended load-balancing method cannot be configured on the Catalyst switch, then configure the LAG connection as a single member link or disable LAG on the controller.

**Figure 3-13** Link Aggregation with Catalyst 6500 Neighbor Switch



## Link Aggregation Guidelines

Keep these guidelines in mind when using LAG:

- You cannot configure the controller's ports into separate LAG groups. Only one LAG group is supported per controller. Therefore, you can connect a controller in LAG mode to only one neighbor device.



---

**Note** The two internal Gigabit ports on the controller within the Catalyst 3750G Integrated Wireless LAN Controller Switch are always assigned to the same LAG group.

---

- When you enable LAG or make any changes to the LAG configuration, you must immediately reboot the controller.
- When you enable LAG, you can configure only one AP-manager interface because only one logical port is needed. LAG removes the requirement for supporting multiple AP-manager interfaces.
- When you enable LAG, all dynamic AP-manager interfaces and untagged interfaces are deleted, and all WLANs are disabled and mapped to the management interface. Also, the management, static AP-manager, and VLAN-tagged dynamic interfaces are moved to the LAG port.
- Multiple untagged interfaces to the same port are not allowed.
- When you enable LAG, you cannot create interfaces with a primary port other than 29.
- When you enable LAG, all ports participate in LAG by default. Therefore, you must configure LAG for all of the connected ports in the neighbor switch.
- When you enable LAG on the Cisco WiSM, you must enable port-channeling/Ether-channeling for all of the controller's ports on the switch.
- When you enable LAG, port mirroring is not supported.
- When you enable LAG, if any single link goes down, traffic migrates to the other links.
- When you enable LAG, only one functional physical port is needed for the controller to pass client traffic.
- When you enable LAG, access points remain connected to the switch, and data service for users continues uninterrupted.
- When you enable LAG, you eliminate the need to configure primary and secondary ports for each interface.
- When you enable LAG, the controller sends packets out on the same port on which it received them. If a CAPWAP packet from an access point enters the controller on physical port 1, the controller removes the CAPWAP wrapper, processes the packet, and forwards it to the network on physical port 1. This may not be the case if you disable LAG.
- When you disable LAG, the management, static AP-manager, and dynamic interfaces are moved to port 1.
- When you disable LAG, you must configure primary and secondary ports for all interfaces.
- When you disable LAG, you must assign an AP-manager interface to each port on the controller. Otherwise, access points are unable to join.
- Cisco 5500 and 4400 series controllers support a single static link aggregation bundle.
- LAG is typically configured using the Startup Wizard, but you can enable or disable it at any time through either the GUI or CLI.

**Note**

LAG is enabled by default and is the only option on the WiSM controller and the controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch.

## Using the GUI to Enable Link Aggregation

Follow these steps to enable LAG on your controller using the GUI.

- Step 1** Choose **Controller > General** to open the General page (see [Figure 3-14](#)).

**Figure 3-14** General Page

The screenshot shows the Cisco GUI for a controller. The top navigation bar includes 'MONITOR', 'WLANs', 'CONTROLLER', 'WIRELESS', 'SECURITY', 'MANAGEMENT', 'COMMANDS', and 'HELP'. The 'CONTROLLER' tab is selected. On the left, a sidebar lists various configuration sections: General, Inventory, Interfaces, Multicast, Network Routes, Internal DHCP Server, Mobility Management, Ports, NTP, CDP, and Advanced. The 'General' section is active, displaying a list of parameters and their current values. The 'Name' field is highlighted in yellow and contains '4404'. The 'LAG Mode on next reboot' parameter is set to 'Disabled'. The 'Multicast Group Address' field contains '224.0.0.1'. The 'Apply' button is visible in the top right corner. The page number '212227' is visible in the bottom right corner.

Parameter	Value	Notes
Name	4404	
802.3x Flow Control Mode	Disabled	
LWAPP Transport Mode	Layer 3	(Current Operating Mode is Layer3)
LAG Mode on next reboot	Disabled	(LAG Mode is currently disabled).
Ethernet Multicast Mode	Multicast	224.0.0.1
Broadcast Forwarding	Disabled	Multicast Group Address
Aggressive Load Balancing	Disabled	H-REAP supports 'unicast' mode only.
Over The Air Provisioning of AP	Disabled	
AP Fallback	Enabled	
Apple Talk Bridging	Disabled	
Fast SSID change	Disabled	
Default Mobility Domain Name	snmp_gui	
RF-Network Name	snmp_gui	
User Idle Timeout (seconds)	300	
ARP Timeout (seconds)	300	
Web Radius Authentication	PAP	
802.3 Bridging	Disabled	
Operating Environment	Commercial (0 to 40 C)	
Internal Temp Alarm Limits	0 to 65 C	

- Step 2** Set the LAG Mode on Next Reboot parameter to **Enabled**.

**Note**

Choose **Disabled** if you want to disable LAG. LAG is disabled by default on the Cisco 5500 and 4400 series controllers but enabled by default on the Cisco WiSM and the controller in the Catalyst 3750G Integrated Wireless LAN Controller Switch.

- Step 3** Click **Apply** to commit your changes.
- Step 4** Click **Save Configuration** to save your changes.
- Step 5** Reboot the controller.
- Step 6** Assign the WLAN to the appropriate VLAN.

## Using the CLI to Enable Link Aggregation

Follow these steps to enable LAG on your controller using the CLI.

**Step 1** Enter **config lag enable** to enable LAG.



**Note** Enter **config lag disable** if you want to disable LAG.

**Step 2** Enter **save config** to save your settings.

**Step 3** Reboot the controller.

## Using the CLI to Verify Link Aggregation Settings

To verify your LAG settings, enter this command:

```
show lag summary
```

Information similar to the following appears:

```
LAG Enabled
```

## Configuring Neighbor Devices to Support Link Aggregation

The controller's neighbor devices must also be properly configured to support LAG.

- Each neighbor port to which the controller is connected should be configured as follows:

```
interface GigabitEthernet <interface id>
  switchport
  channel-group <id> mode on
  no shutdown
```

- The port channel on the neighbor switch should be configured as follows:

```
interface port-channel <id>
  switchport
  switchport trunk encapsulation dot1q
  switchport trunk native vlan <native vlan id>
  switchport trunk allowed vlan <allowed vlans>
  switchport mode trunk
  no shutdown
```

## Configuring Multiple AP-Manager Interfaces



**Note**

Only Cisco 5500 series and 4400 series standalone controllers support the use of multiple AP-manager interfaces.

When you create two or more AP-manager interfaces, each one is mapped to a different port (see [Figure 3-15](#)). The ports should be configured in sequential order such that AP-manager interface 2 is on port 2, AP-manager interface 3 is on port 3, and AP-manager interface 4 is on port 4.

**Note**

AP-manager interfaces need not be on the same VLAN or IP subnet, and they may or may not be on the same VLAN or IP subnet as the management interface. However, Cisco recommends that you configure all AP-manager interfaces on the same VLAN or IP subnet.

**Note**

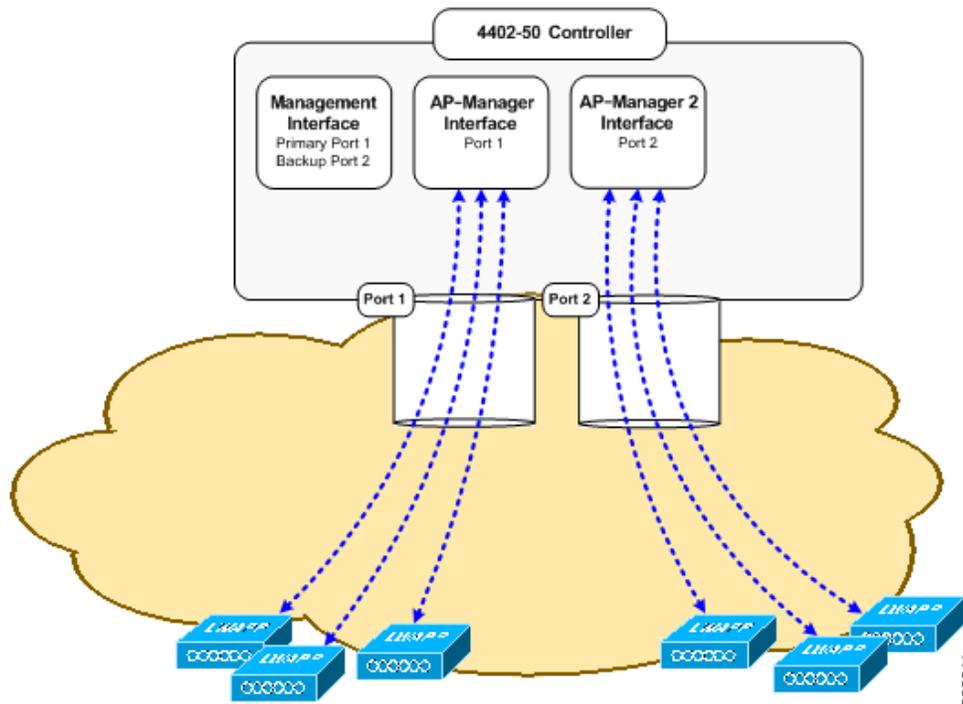
You must assign an AP-manager interface to each port on the controller.

Before an access point joins a controller, it sends out a discovery request. From the discovery response that it receives, the access point can tell the number of AP-manager interfaces on the controller and the number of access points on each AP-manager interface. The access point generally joins the AP-manager with the least number of access points. In this way, the access point load is dynamically distributed across the multiple AP-manager interfaces.

**Note**

Access points may not be distributed completely evenly across all of the AP-manager interfaces, but a certain level of load balancing occurs.

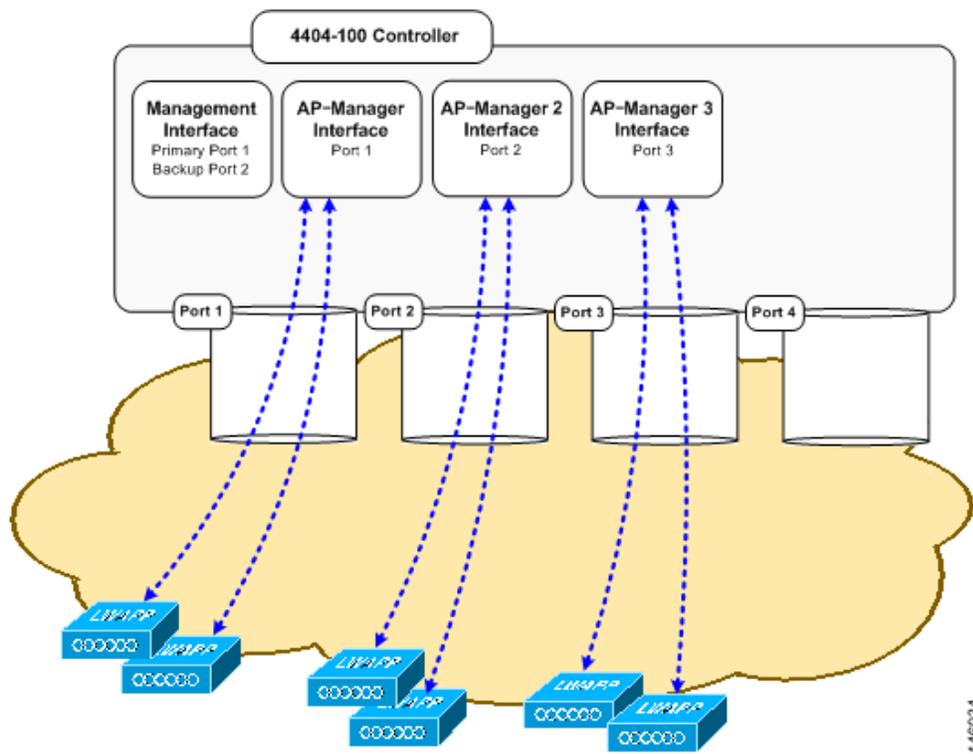
**Figure 3-15** Two AP-Manager Interfaces



Before implementing multiple AP-manager interfaces, you should consider how they would impact your controller's port redundancy.

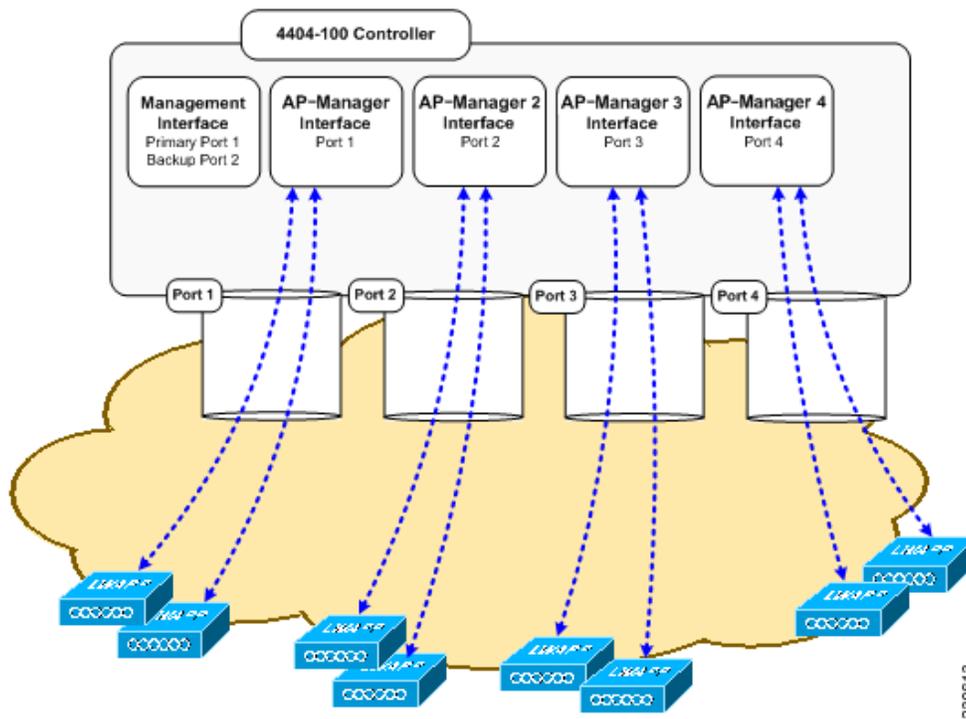
**Examples:**

1. The 4402-50 controller supports a maximum of 50 access points and has two ports. To support the maximum number of access points, you would need to create two AP-manager interfaces (see [Figure 3-15](#)) because a 4400 series controller can support only 48 access points on one port.
2. The 4404-100 controller supports up to 100 access points and has four ports. To support the maximum number of access points, you would need to create three (or more) AP-manager interfaces (see [Figure 3-16](#)). If the port of one of the AP-manager interfaces fails, the controller clears the access points' state, and the access points must reboot to reestablish communication with the controller using the normal controller join process. The controller no longer includes the failed AP-manager interface in the CAPWAP or LWAPP discovery responses. The access points then rejoin the controller and are load-balanced among the available AP-manager interfaces.

**Figure 3-16** Three AP-Manager Interfaces

[Figure 3-17](#) illustrates the use of four AP-manager interfaces to support 100 access points on a 4400 series controller.

Figure 3-17 Four AP-Manager Interfaces



This configuration has the advantage of load-balancing all 100 access points evenly across all four AP-manager interfaces. If one of the AP-manager interfaces fails, all of the access points connected to the controller would be evenly distributed among the three available AP-manager interfaces. For example, if AP-manager interface 2 fails, the remaining AP-manager interfaces (1, 3, and 4) would each manage approximately 33 access points.

## Using the GUI to Create Multiple AP-Manager Interfaces

Using the controller GUI, follow these steps to create multiple AP-manager interfaces.

- Step 1** Choose **Controller > Interfaces** to open the Interfaces page.
- Step 2** Click **New**. The Interfaces > New page appears (see [Figure 3-19](#)).

Figure 3-18 Interfaces &gt; New Page



- Step 3** Enter an AP-manager interface name and a VLAN identifier, as shown above.

**Step 4** Click **Apply** to commit your changes. The Interfaces > Edit page appears (see Figure 3-19).

**Figure 3-19** Interfaces > Edit Page

The screenshot shows the Cisco Wireless LAN Controller configuration page for an AP-Manager interface. The page is titled "Interfaces > Edit" and includes a navigation menu on the left with options like General, Inventory, Interfaces, Multicast, Network Routes, Internal DHCP Server, Mobility Management, Ports, NTP, CDP, and Advanced. The main configuration area is divided into several sections:

- General Information:** Interface Name (ap-manager 2), MAC Address (00:0b:85:40:90:c0).
- Configuration:** Guest Lan (checkbox), Quarantine (checkbox), Quarantine Vlan Id (0).
- Physical Information:** Port Number (1), Backup Port (2), Active Port (0), Enable Dynamic AP Management (checkbox).
- Interface Address:** VLAN Identifier (3), IP Address (209.165.200.225), Netmask (255.255.255.0), Gateway (10.3.3.1).
- DHCP Information:** Primary DHCP Server (192.168.50.3), Secondary DHCP Server (0.0.0.0).
- Access Control List:** ACL Name (none).

A note at the bottom of the page states: "Note: Changing the Interface parameters causes the WLANs to be temporarily disabled and thus may result in loss of connectivity for some clients." The page number 280644 is visible on the right side.

**Step 5** Enter the appropriate interface parameters.



**Note** Do not define a backup port for an AP-manager interface. Port redundancy is not supported for AP-manager interfaces. If the AP-manager interface fails, all of the access points connected to the controller through that interface are evenly distributed among the other configured AP-manager interfaces.

**Step 6** To make this interface an AP-manager interface, check the **Enable Dynamic AP Management** check box.



**Note** Only one AP-manager interface is allowed per physical port. A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

**Step 7** Click **Save Configuration** to save your settings.

**Step 8** Repeat this procedure for each additional AP-manager interface that you want to create.

## Using the CLI to Create Multiple AP-Manager Interfaces

Using the controller CLI, follow these steps to create multiple AP-manager interfaces.

**Step 1** Enter these commands to create a new interface:

- **config interface create** *operator\_defined\_interface\_name* {*vlan\_id* | *x*}
- **config interface address** *operator\_defined\_interface\_name* *ip\_addr* *ip\_netmask* [*gateway*]
- **config interface vlan** *operator\_defined\_interface\_name* {*vlan\_id* | **0**}
- **config interface port** *operator\_defined\_interface\_name* *physical\_ds\_port\_number*
- **config interface dhcp** *operator\_defined\_interface\_name* *ip\_address\_of\_primary\_dhcp\_server* [*ip\_address\_of\_secondary\_dhcp\_server*]
- **config interface quarantine vlan** *interface\_name* *vlan\_id*



**Note** Use this command to configure a quarantine VLAN on any interface.

- **config interface acl** *operator\_defined\_interface\_name* *access\_control\_list\_name*



**Note** See the *Configuring Security Solutions* chapter for more information on ACLs.

**Step 2** To make this interface an AP-manager interface, enter this command:

**config interface ap-manager** *operator\_defined\_interface\_name* {**enable** | **disable**}



**Note** Only one AP-manager interface is allowed per physical port. A dynamic interface that is marked as an AP-manager interface cannot be used as a WLAN interface.

**Step 3** To save your changes, enter this command:

**save config**

**Step 4** Repeat this procedure for each additional AP-manager interface that you want to create.

## 5500 Series Controller Example

For a 5500 series controller, Cisco recommends having eight dynamic AP-manager interfaces and associating them to the controller's eight Gigabit ports. If you are using the management interface, which acts like an AP-manager interface by default, you need to create only 7 more dynamic AP-manager interfaces and associate them to the remaining seven Gigabit ports. For example, [Figure 3-20](#) shows a dynamic interface that is enabled as a dynamic AP-manager interface and associated to port number 2, and [Figure 3-20](#) shows a 5500 series controller with LAG disabled, the management interface used as one dynamic AP-manager interface, and seven additional dynamic AP-manager interfaces, each mapped to a different Gigabit port.

Figure 3-20 Dynamic Interface Example with Dynamic AP Management

The screenshot shows the Cisco WLC configuration interface for a dynamic interface named 'dyn-1'. The left sidebar contains a navigation menu with options like General, Inventory, Interfaces, Multicast, Network Routes, Internal DHCP Server, Mobility Management, Ports, NTP, CDP, and Advanced. The main content area is titled 'Interfaces > Edit' and is divided into several sections:

- General Information:** Interface Name: dyn-1, MAC Address: 00:21:1b:fc:29:c1
- NAT Address:** Enable NAT Address:
- Physical Information:** Port Number: 2, Backup Port: 0, Active Port: 2, Enable Dynamic AP Management:
- Interface Address:** VLAN Identifier: 99, IP Address: 209.165.200.225, Netmask: 255.255.255.0, Gateway: 10.10.99.1
- DHCP Information:** Primary DHCP Server: 10.10.99.1, Secondary DHCP Server: (empty)

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Figure 3-21 5500 Series Controller Interface Configuration Example

The screenshot shows the Cisco WLC configuration interface displaying a list of interfaces. The left sidebar is the same as in Figure 3-20. The main content area is titled 'Interfaces' and contains a table with the following data:

Interface Name	VLAN Identifier	IP Address	Interface Type	Dynamic AP Management
<a href="#">dyn-1</a>	99	209.165.200.225	Dynamic	Enabled
<a href="#">dyn-2</a>	99	209.165.200.226	Dynamic	Enabled
<a href="#">dyn-3</a>	99	209.165.200.227	Dynamic	Enabled
<a href="#">dyn-4</a>	99	209.165.200.228	Dynamic	Enabled
<a href="#">dyn-5</a>	99	209.165.200.229	Dynamic	Enabled
<a href="#">dyn-6</a>	99	209.165.200.230	Dynamic	Enabled
<a href="#">dyn-7</a>	99	209.165.200.231	Dynamic	Enabled
<a href="#">management</a>	untagged	209.165.200.232	Static	Enabled
<a href="#">service-port</a>	N/A	209.165.200.233	Static	Not Supported
<a href="#">virtual</a>	N/A	209.165.200.234	Static	Not Supported

