



## Preface

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This section discusses the objectives, audience, conventions, and organization of the *N+1 High Availability Deployment Guide* and provides general information about Cisco IOS software documentation.

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM, a member of the Cisco Connection Family, is updated monthly. Therefore, it might be more up to date than printed documentation. To order additional copies of the Documentation CD-ROM, contact your local sales representative or call customer service. The CD-ROM package is available as a single package or as an annual subscription.

## Objectives

This guide provides information on the theory of operation and configuration for the Cisco Unified Wireless LAN controller (WLC) as it applies to N+1 High Availability (HA).

## Audience

This publication is intended primarily for users who configure and maintain routers, but are not necessarily familiar with tasks, the relationship between tasks, or the commands necessary to perform particular tasks to configure VoIP. In addition, this publication is intended for users with some familiarity with IP and telephony networks.

## Cisco IOS Software Documentation

In addition to the information provided in this publication, you might need to refer to the Cisco IOS documentation set. The Cisco IOS software documentation is divided into nine modules and two master indexes. Each module consists of two books: a configuration guide and a corresponding command reference. Chapters in a configuration guide describe protocols, configuration tasks, and Cisco IOS software functionality and contain comprehensive configuration examples. Chapters in a command reference provide complete command syntax information. Each configuration guide can be used in conjunction with its corresponding command reference.

# Organization

This chapter describes the contents of each chapter in this document.

**Table 1**      **Organization**

Chapter	Title	Description
Chapter 1	Introduction	N+1 HA feature set within the Cisco Unified Wireless Network (CUWN)
Chapter 2	N+1 HA Overview	High Availability architecture
Chapter 3	Licensing	High Availability licenses

# Command Syntax Conventions

Table 2 describes the syntax used with the commands in this document.

**Table 2**      **Command Syntax Guide**

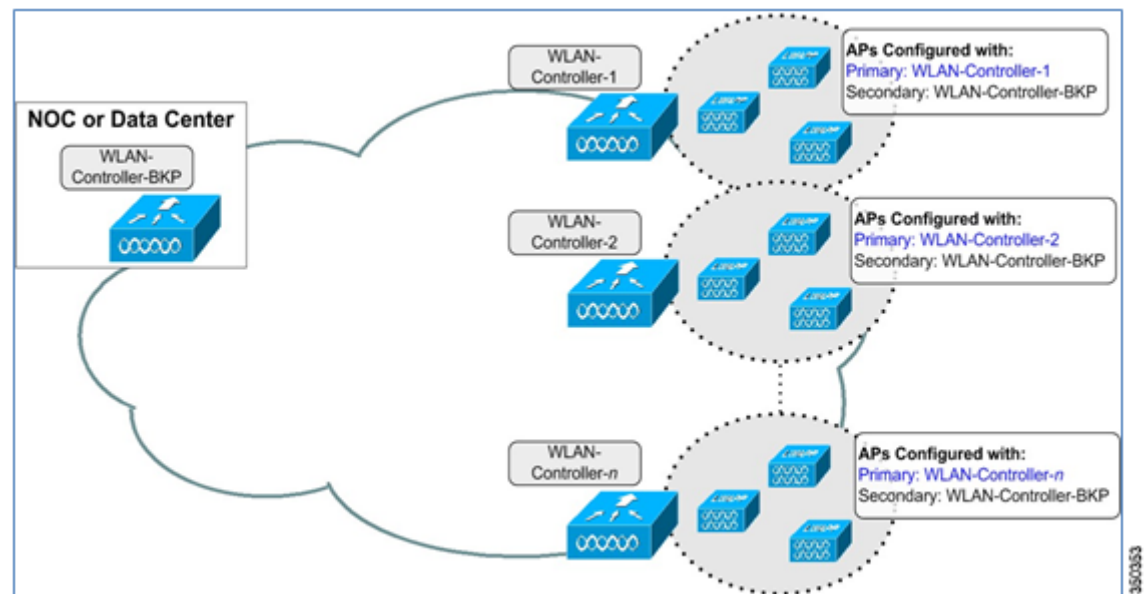
Convention	Description
<b>boldface</b>	Commands and keywords.
<i>italic</i>	Command input that is supplied by you.
[ ]	Keywords or arguments that appear within square brackets are optional.
{ x   x   x }	A choice of keywords (represented by x) appears in braces separated by vertical bars. You must select one.
^ or Ctrl	Represent the key labeled <i>Control</i> . For example, when you read ^D or <i>Ctrl-D</i> , you should hold down the Control key while you press the D key.
screen font	Examples of information displayed on the screen.
<b>boldface screen font</b>	Examples of information that you must enter.
< >	Nonprinting characters, such as passwords, appear in angled brackets.
[ ]	Default responses to system prompts appear in square brackets.



# Introduction

The N+1 HA feature set within the Cisco Unified Wireless Network (CUWN) framework allows a single WLC to be used as a backup WLC for N primary controllers. (See [Figure 1-1](#).) Earlier than release 7.4, the N+1 HA model requires a permanent AP count license on the backup controller. With Release 7.4 and later, an HA-SKU secondary controller can be used as the backup controller for multiple primary controllers. The overall goal for the addition of N+1 HA with HA-SKU is to reduce the total cost of ownership (TCO) for geographically separate HA deployments across the WAN link.

**Figure 1-1** N+1 HA Topology



## Prerequisites

## Requirements

There are no specific requirements for this document.

## Components Used

The information in this document is based on these software and hardware versions:

- 5500, 7500, and 8500 Series WLCs; Wireless Services Module 2 (WiSM-2) WLCs
- 1130, 1240, 1250, 1040, 1140, 1260, 3500, and 3600 Series APs; 1520 or 1550 Series Mesh APs

The information in this document was created from the devices in a specific lab environment. All devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

## Conventions

Refer to [Cisco Technical Tips Conventions](#) for more information on document conventions.



## N+1 High Availability Overview

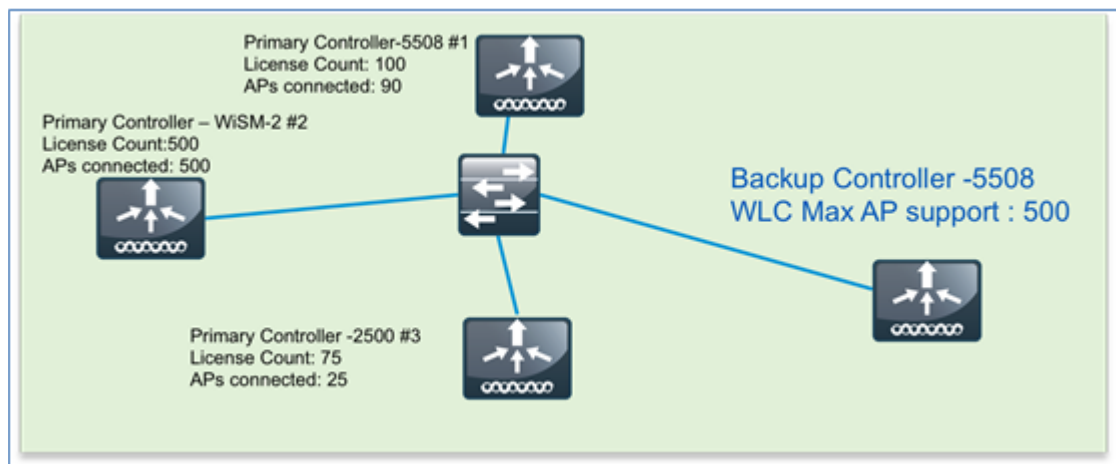
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### N+1 HA Overview

- The N+1 HA architecture provides redundancy for controllers across geographically separate data centers with low cost of deployment.
- A single backup controller can be used in order to provide backup for multiple primary WLCs, with consideration for appropriate compatibility in terms of AP mode. (See [Figure 2-1](#))
- These WLCs are independent of each other and do not share configuration or IP addresses on any of their interfaces. Each WLC needs to be managed separately by Cisco Prime, can run a different hardware and a different software version, and can be deployed in different datacenters across the WAN link.
- Access Point Stateful Switch Over (AP SSO) functionality is not supported for N+1 HA. The AP Control and Provisioning of Wireless Access Points (CAPWAP) state machine is restarted when the primary controller fails.
- When a primary WLC resumes operation, the APs fall back from the backup WLC to the primary WLC automatically if the AP fallback option is enabled.
- APs with high priority on the primary controller always connect first to the backup controller, even if they have to push out low priority APs.
- When using a permanent AP count license for the backup controller, the 90-day timer does not start when the APs join the backup controller.
- With Release 7.4, an HA-SKU secondary controller can be configured as a backup controller for N+1 HA. For example, the following can be used as an HA-SKU controller:
  - 5508 Series Standalone controller with 50 AP license
  - WiSM-2 Wireless LAN controller
  - 7500 Series Standalone controller
  - 8500 Series Standalone controller
  - 2504 Wireless LAN controller, Release 7.5, with a minimum of 5 Permanent AP licenses
- As soon as an AP joins the HA-SKU secondary controller, the 90-day timer starts, and the user sees a warning message after 90 days. In other words, an HA-SKU controller can be used as a secondary controller for 90 days without a warning message.

- The HA-SKU Unique Device Identifier (UDI) provides the capability of the maximum number of APs supported on that hardware. For instance, a 5508 HA-SKU controller provides support for 500 APs.
- The N+1 Secondary HA-SKU cannot be configured in combination with AP SSO. They are mutually exclusive.

**Figure 2-1** N+1 HA



## Supported Hardware

N+1 HA with HA-SKU is supported on the 2504, 5500, 7500, and 8500 Series of standalone controllers as well as the WiSM-2 WLCs.

## Configuration of N+1 HA with HA-SKU with the CLI

From the primary controller, configure the backup controller on the primary to point to the secondary controller. Use the config advanced backup-controller primary backup\_controller\_name backup\_controller\_IP\_address command. (See [Figure 2-2](#).)

**Figure 2-2** Primary WLC (CLI)

```
(5500) >config advanced backup-controller primary Secondary 9.5.56.2
(5500) >show advanced backup-controller
AP primary Backup Controller ..... Secondary 9.5.56.2
AP secondary Backup Controller ..... 0.0.0.0
```

## Configuration of HA-SKU UDI as HA-SKU Secondary Controller

On the HA-SKU UDI controller, execute the `config redundancy unit secondary` command to obtain support for Max AP count licenses on a given hardware. Evaluation license does not need to be enabled for this purpose.

The section below depicts the process of converting a permanent AP count WLC to a HA-SKU secondary controller.

## Configuration of Permanent AP Count WLC as HA-SKU Secondary Controller

On the permanent AP count WLC, use the `config redundancy unit secondary` command to convert the controller into an HA-SKU secondary controller. In order to convert a permanent AP count controller to an HA-SKU secondary controller, it should have a minimum number of base AP count licenses; if that minimum is not met, an error message appears. (See [Figure 2-3](#)).

**Figure 2-3** Secondary WLC (CLI)

```
(5500) >config redundancy unit secondary
In order to configure this controller secondary, Controller should at least have
a threshold base ap count. Please read the Documentation for further details
```

350356

On the CLI, use the `show redundancy summary` command to view the status of the primary and secondary controllers. (See [Figure 2-4](#) and [Figure 2-5](#).)



**Note**

With release 7.5 and 7.6, the HA SKU WLC has to be rebooted after issuing the command "config redundancy unit secondary" to make APs join it.

**Figure 2-4** Status of Primary WLC (CLI)

```
(5500) >show redundancy summary
Redundancy Mode = SSO DISABLED
Local State = ACTIVE
Peer State = N/A
Unit = Primary
Unit ID = 30:F7:0D:31:82:E0
Redundancy State = N/A
Mobility MAC = 6C:20:56:64:B9:A0
Redundancy Management IP Address..... 9.5.56.11
Peer Redundancy Management IP Address... 9.5.56.10
Redundancy Port IP Address..... 169.254.56.11
Peer Redundancy Port IP Address..... 169.254.56.10
```

350357

Figure 2-5 Status of HA-SKU Secondary WLC (CLI)

```

(5500) >show redundancy summary
Redundancy Mode = SSO DISABLED
Local State = ACTIVE
Peer State = N/A
Unit = Secondary - HA SKU
Unit ID = 6C:20:56:64:B9:A0
Redundancy State = N/A
Mobility MAC = 6C:20:56:64:B9:A0

Redundancy Management IP Address..... 9.5.56.10
Peer Redundancy Management IP Address..... 9.5.56.11
Redundancy Port IP Address..... 169.254.56.10
Peer Redundancy Port IP Address..... 169.254.56.11

```

350358

## Configuration of N+1 HA with HA-SKU with the GUI

From the primary controller, navigate to **Access Points > Global Configuration**, then configure the backup controller on the primary to point to the secondary controller. (See [Figure 2-6](#).)

Figure 2-6 Primary WLC (GUI)

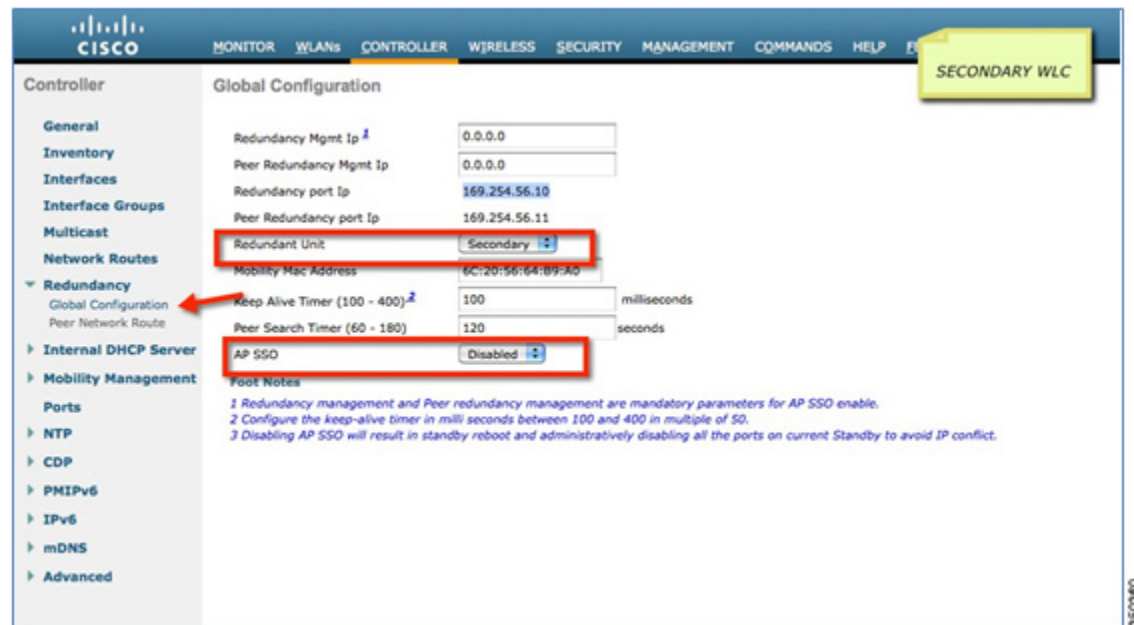
The screenshot shows the Cisco WLC GUI for a Primary WLC. The 'Global Configuration' page is open, and the 'High Availability' section is highlighted. The 'Back-up Primary Controller IP Address' is set to 9.5.56.2, and the 'Back-up Primary Controller name' is set to secondary. The 'Back-up Secondary Controller IP Address' and 'Back-up Secondary Controller name' fields are empty. The 'AP Primary Discovery Timeout' is set to 120. The 'LED State' is set to 'Enable'. The 'Login Credentials' section is also visible.

350359

On the secondary controller, navigate to **Redundancy > Global Configuration**, then configure the secondary controller to convert it to an HA-SKU secondary controller. (See [Figure 2-7](#).)



Figure 2-7 HA-SKU Secondary WLC (GUI)



**Note** AP SSO must be disabled to configure the controller to be an N+1 HA-SKU secondary controller.

## Primary, Secondary, and Tertiary Redundancy with HA-SKU

An HA-SKU secondary controller can also be used as a primary, secondary, or tertiary controller. This can be configured under the AP specific configuration. (See [Figure 2-8](#).)

Figure 2-8 Primary, Secondary, and Tertiary Configuration (GUI)

The screenshot shows the Cisco GUI for configuring a wireless controller. The 'High Availability' tab is selected, and the 'Secondary Controller' field is highlighted with a red arrow. The configuration table is as follows:

	Name	Management IP Address
Primary Controller	Primary	9.5.56.3
Secondary Controller	Secondary	9.5.56.2
Tertiary Controller		

Below the table, the 'AP Failover Priority' is set to 'Low'.

The configuration on HA-SKU secondary controller is the same as shown previously.



## Licensing

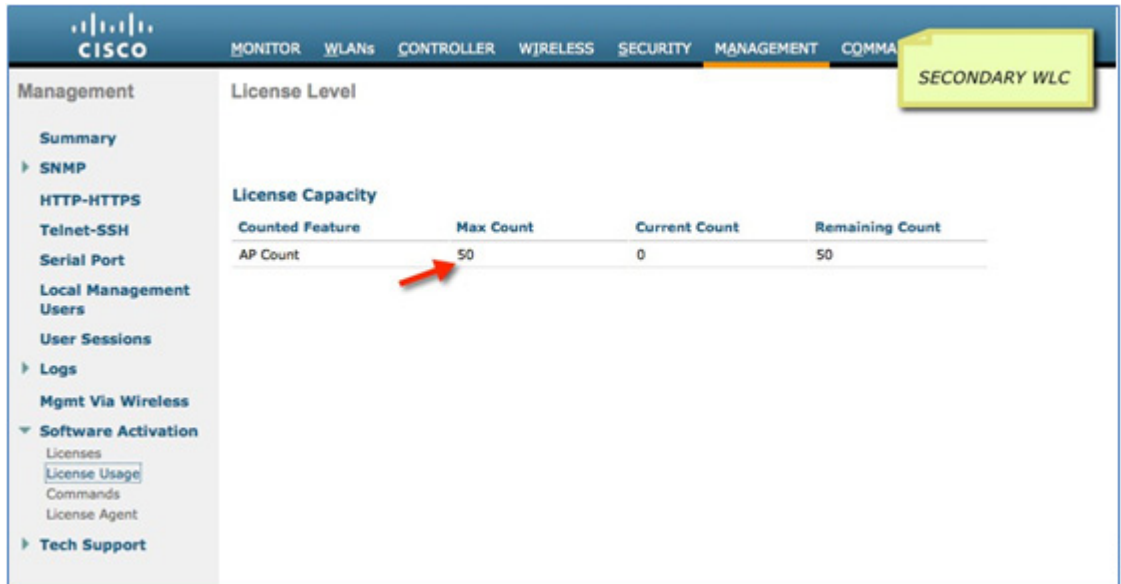
### Secondary Controller Running Permanent AP Count License

A secondary controller running a permanent AP count license provides support for the number of APs specified in the permanent license. For instance, a 5508 WLC running a 50 AP count license and configured as a secondary controller provides support for 50 APs. (See [Figure 3-1](#) and [Figure 3-2](#))  
2504 Wireless LAN controller, Release 7.5 (minimum of 5 AP license needed)

**Figure 3-1** Licenses on Secondary WLC (GUI)

License	Type	Time(expires)	Count	Priority	Status
base	permanent	No Expiry	NA	Medium	Not in Use
base-ap-count	permanent	No Expiry	12	Medium	Inactive
base-ap-count	permanent	No Expiry	50	Medium	In Use
base-ap-count	evaluation	8 weeks, 4 days	500	None	Inactive

Figure 3-2 License Capacity on Secondary WLC (GUI)



# HA-SKU Secondary Controller

A secondary controller running a minimum AP count license and configured as an HA- SKU controller provides the maximum AP capacity as supported by the hardware. For instance, a 5508 WLC running a 50 AP count license and configured as an HA-SKU secondary controller provides support for 500 APs. (See Figure 3-3 and Figure 3-4)

Figure 3-3 Licenses on HA-SKU Secondary WLC (GUI)

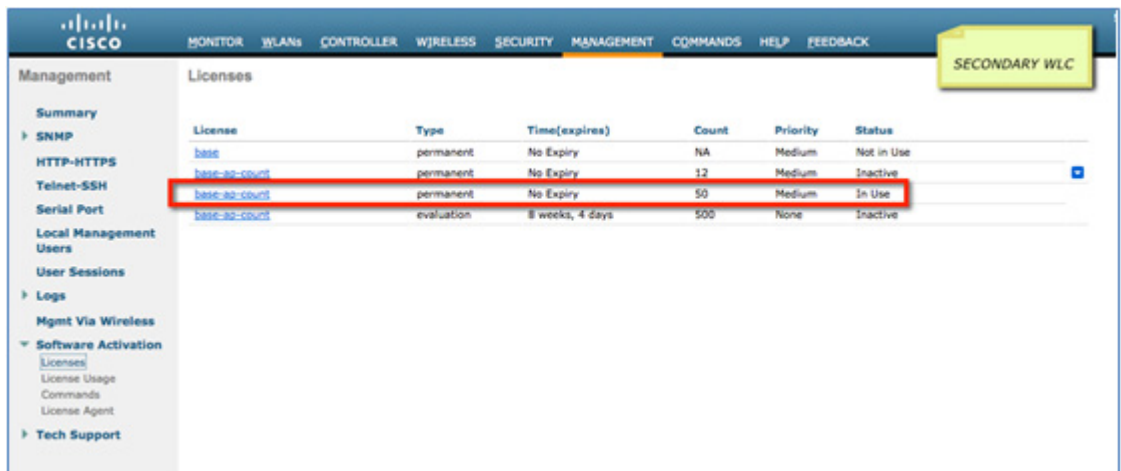
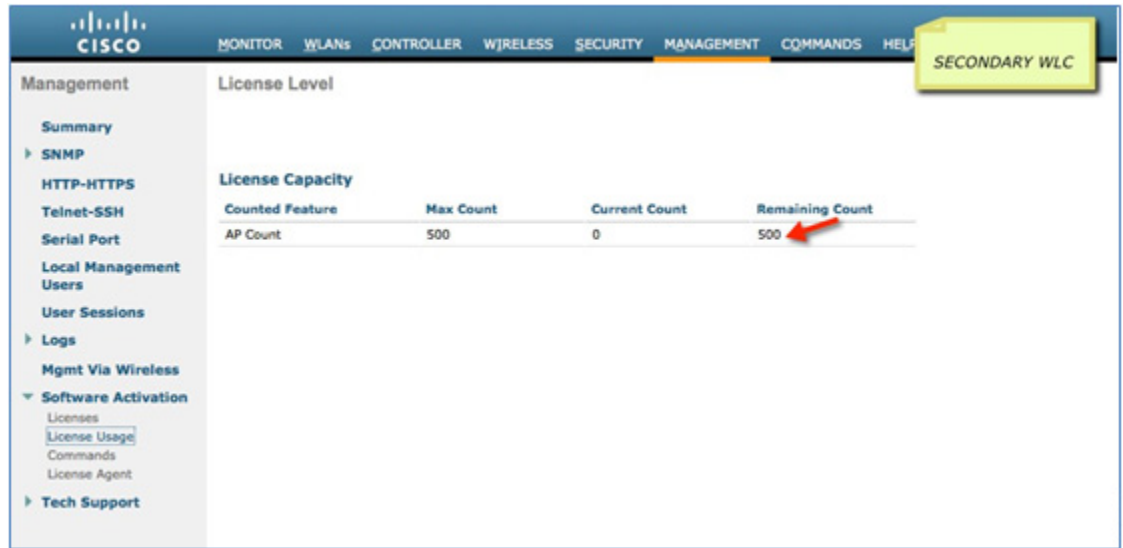


Figure 3-4 License Capacity on HA-SKU Secondary WLC (GUI)

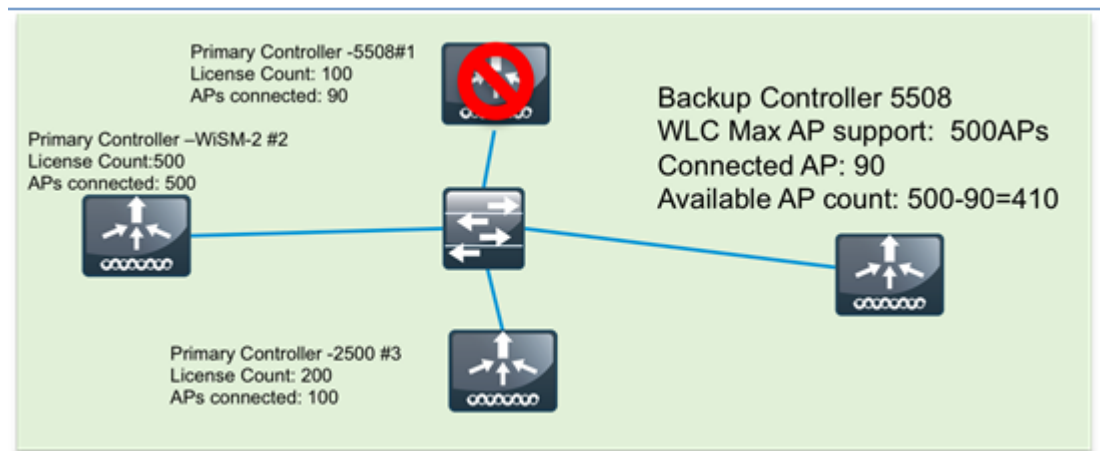


## Failover Process

In the N+1 HA redundancy model, one WLC serves as the backup controller for N primary controllers. When any of the primary WLCs fail, the APs connected to that controller fall back to the backup controller. The AP has to restart its CAPWAP state machine and go through a complete discovery phase before it joins the backup controller. The available AP count on the backup controller is reduced by the number of APs that fall back from the primary WLC to the backup WLC.

For example, when the primary controller supporting 90 APs fails, these APs fall back to the backup controller that has a maximum AP support of 500. The backup WLC is left with an available AP count of  $500 - 90 = 410$  APs. (See Figure 3-5.)

Figure 3-5 N+1 HA Failover



This is explained further in the following examples.

## AP Connected to Primary WLC Running 12 AP Permanent Count License

To see the license capacity, navigate to **Software Activation > License Usage**. (See [Figure 3-6](#))

**Figure 3-6 License Capacity on Primary WLC (GUI)**

The screenshot shows the Cisco WLC GUI interface. The top navigation bar includes MONITOR, WLANs, CONTROLLER, WIRELESS, SECURITY, MANAGEMENT, and COMMANDS. A yellow callout box labeled 'PRIMARY WLC' points to the 'MANAGEMENT' tab. On the left, the 'Software Activation' menu is expanded to 'License Usage'. The main content area displays 'License Level' and 'License Capacity'.

Counted Feature	Max Count	Current Count	Remaining Count
AP Count	12	1	11

On the CLI, use the `show license capacity` command. (See [Figure 3-7](#).)

**Figure 3-7 License Capacity on Primary WLC (CLI)**

```
(5500) >show ap uptime
Number of APs..... 1
Global AP User Name..... Not Configured
Global AP Dot1x User Name..... Not Configured
AP Name      AP Association Visibility  Ethernet MAC      AP Up Time      Association Up Time
-----
WLC-AP-13600 fc:99:47:b0:f9:9f  8 days, 04 h 15 m 09 s  0 days, 01 h 46 m 16 s

(5500) >show license capacity
Licensed Feature  Max Count  Current Count  Remaining Count
-----
AP Count         12         1              11
```

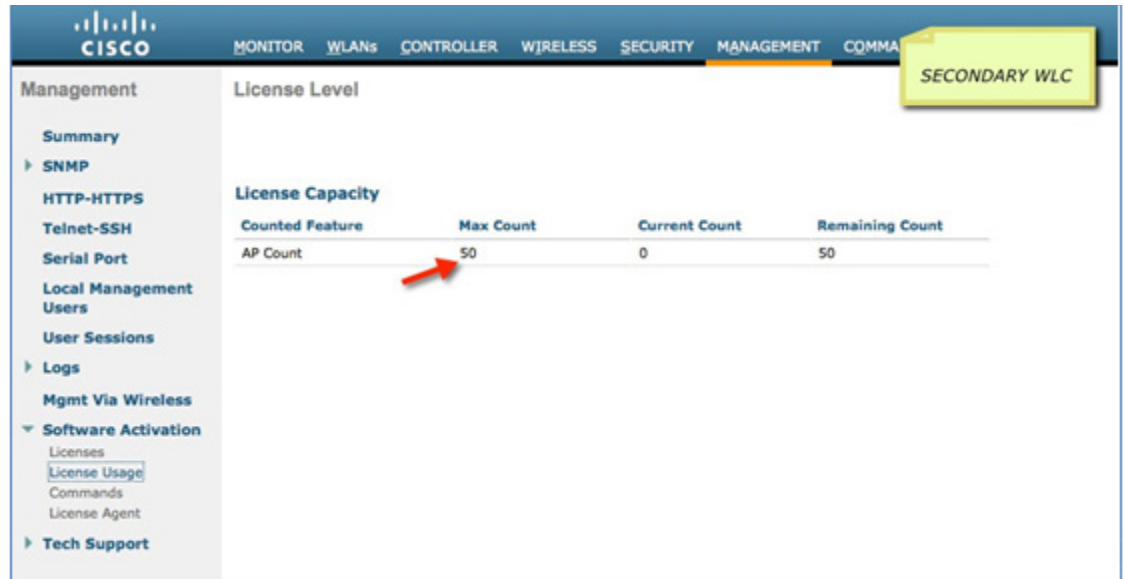
## AP Failover to Secondary Controller

With Release 7.4, the secondary controller can either be a permanent AP count controller or an HA-SKU controller.

## Secondary Controller Running Permanent AP Count License

In this example, the secondary controller is running a 50 AP permanent license and has a maximum AP capacity of 50. (See [Figure 3-8](#) and [Figure 3-9](#).)

**Figure 3-8** License Capacity of 50 on Secondary WLC (GUI)



The screenshot shows the Cisco WLC GUI for a Secondary WLC. The 'License Level' section displays the 'License Capacity' table. A red arrow points to the 'Max Count' value of 50 for the 'AP Count' feature.

Counted Feature	Max Count	Current Count	Remaining Count
AP Count	50	0	50

**Figure 3-9** License Capacity of 50 on Secondary WLC (CLI)

```
(5500) >show license capacity

Licensed Feature   Max Count   Current Count   Remaining Count
-----
AP Count          50          0               50

(5500) >show license in-use

StoreIndex: 2   Feature: base-ap-count   Version: 1.0
License Type: Permanent
License State: Active, In Use
License Count: 50 /50 (Active/In-use)
License Priority: Medium
```

The CLI output shows the license capacity and in-use status. A red box highlights the 'AP Count' row in the capacity table, and a red arrow points to the 'License Count: 50 /50 (Active/In-use)' line in the in-use output.

When the AP connected to the primary controller fails over to the secondary controller, the available AP license count is reduced from 50 to 49. (See [Figure 3-10](#).)

**Figure 3-10 License Capacity Reduced to 49 on Secondary WLC (GUI)**

Interface Name	VLAN Identifier	IP Address	Interface Type	Dynamic AP Ma
management	10	10.10.10.2	Static	Enabled
redundancy-management	10	0.0.0.0	Static	Not Supported
redundancy-port	N/A	0.0.0.0	Static	Not Supported
service-port	N/A	0.0.0.0	Static	Not Supported
virtual	N/A	1.1.1.1	Static	Not Supported

On the CLI, use the `show ap uptime` and `show license capacity` commands to verify the change in license count. (See Figure 3-11.)

**Figure 3-11 License Capacity Reduced to 49 on Secondary WLC (CLI)**

```
(5500) >show ap uptime
Number of APs..... 1
Global AP User Name..... Not Configured
Global AP Dot1x User Name..... Not Configured
AP Name      Ethernet MAC      AP Up Time      Association Up Time
-----
_3600      fc:99:47:b0:f9:9f  8 days, 05 h 23 m 56 s  0 days, 00 h 00 m 10 s
(5500) >show license capacity
Licensed Feature  Max Count  Current Count  Remaining Count
-----
AP Count         50         1              49
```

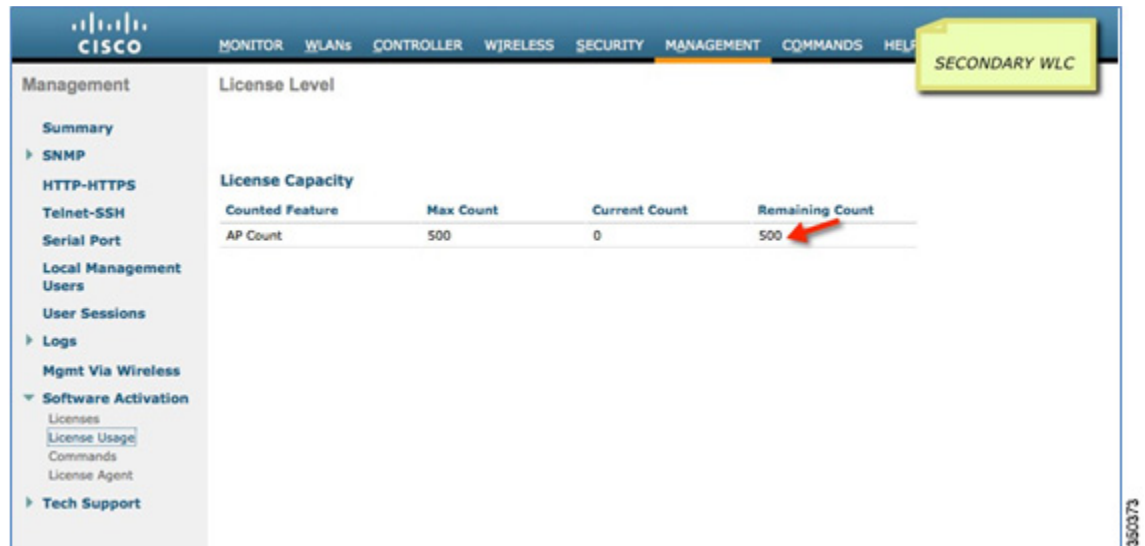
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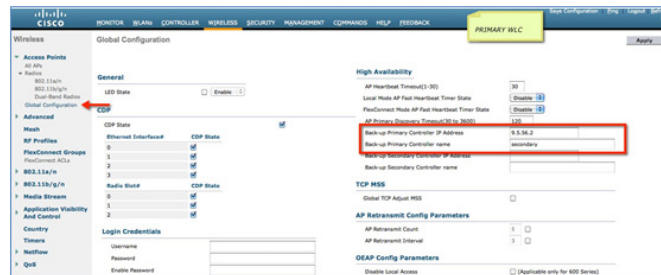
## HA-SKU as Secondary Controller

With Release 7.4, an HA-SKU controller can be used as a secondary controller. In this example, the secondary controller is running a 50 AP permanent license and is configured to be an HA-SKU controller. Therefore it has a maximum AP capacity of 500. (See [Figure 3-12](#) and [Figure 3-13](#).)

**Figure 3-12 License Capacity of 500 on HA-SKU Secondary WLC (GUI)**

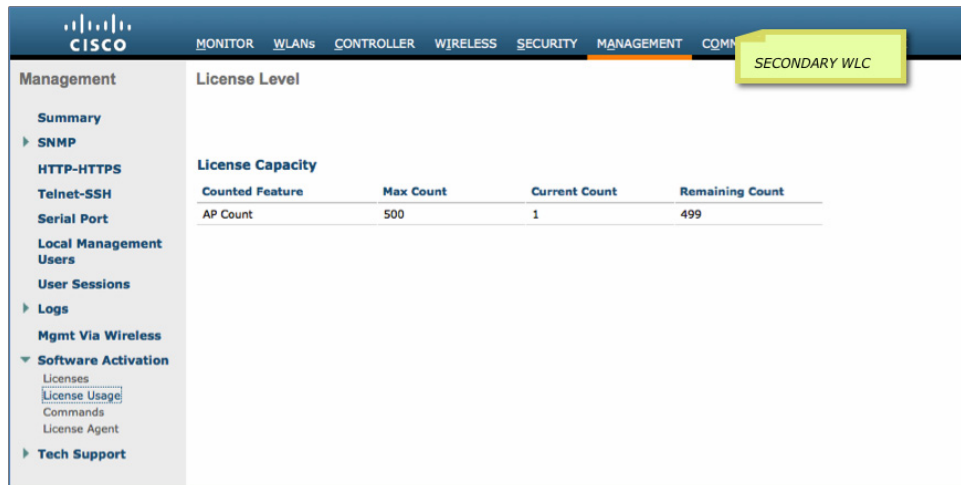


**Figure 3-13 License Capacity of 500 on HA-SKU Secondary WLC (CLI)**



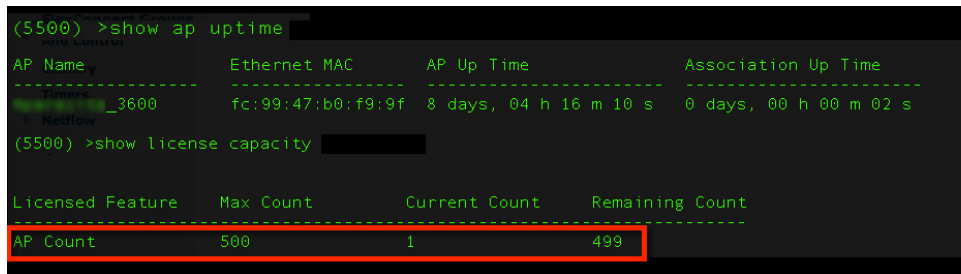
When the AP connected to the primary controller fails over to the secondary controller, the available AP license count is reduced from 500 to 499. (See [Figure 3-14](#).)

**Figure 3-14 License Capacity Reduced to 499 on HA-SKU Secondary WLC (GUI)**



On the CLI, use the `show ap uptime` and `show license capacity` commands to verify the change in license count. (See [Figure 3-15](#))

**Figure 3-15 License Capacity Reduced to 499 on HA-SKU Secondary WLC (CLI)**



Ninety days after the first AP joins the HA-SKU secondary controller, warning messages, as shown below, begin to appear on the console of the controller.

```
(Cisco Controller) >
=====
Dear Administrator,
Your Licenses are not sufficient to be able to serve AP's that your are serving
as of now. It is Cisco's (magnanimous) policy to allow the Controllers in HA-Mode
to serve APs without actually having AP Count Licese for 90 days.
But then, You seem to have already used it for 91 days, Which is Illegal.

Please treat this as a very important - and contact Cisco as early as possible
=====

(Cisco Controller) >
=====
Dear Administrator,
Your Licenses are not sufficient to be able to serve AP's that your are serving
as of now. It is Cisco's (magnanimous) policy to allow the Controllers in HA-Mode
to serve APs without actually having AP Count Licese for 90 days.
But then, You seem to have already used it for 92 days, Which is Illegal.

Please treat this as a very important - and contact Cisco as early as possible
=====
```

## Upgrade/Downgrade

Each of the controllers in the N+1 HA model needs to be upgraded or downgraded independently. However, when an AP fails over to a WLC running a version other than that on the primary, the corresponding image is downloaded to the AP. This adds to the failover time.

## Limitations

The AP SSO must be disabled to use the HA-SKU secondary as a backup for N primary controllers.

**Note**

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Starting release 7.6, if all the access points fall back to the primary controller within or after the 90 days period, the timer will be reset and warning messages will stop.

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