Cisco ACI Multi-Site Orchestrator Installation and Upgrade Guide, Release 2.2(x)

First Published: 2019-08-29

Last Modified: 2019-12-03

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

CONTENTS

Preface

This preface includes the following sections:

Document Conventions

Command descriptions use the following conventions:

Convention	Description
bold	Bold text indicates the commands and keywords that you enter literally as shown.
Italic	Italic text indicates arguments for which the user supplies the values.
[x]	Square brackets enclose an optional element (keyword or argument).
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical bar indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a vertical bar indicate a required choice.
[x {y | z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
`variable`	Indicates a variable for which you supply values, in context where italics cannot be used.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Examples use the following conventions:

Convention	Description
`screen font`	Terminal sessions and information the switch displays are in screen font.
`boldface screen font`	Information you must enter is in boldface screen font.
italic screen font	Arguments for which you supply values are in italic screen font.
< >	Nonprinting characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

This document uses the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Warning IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

SAVE THESE INSTRUCTIONS

Related Documentation

The following documentation provides additional information on Cisco ACI Multi-Site:

- *Cisco ACI Multi-Site Fundamentals Guide*
- *Cisco ACI Multi-Site Orchestrator Installation and Upgrade Guide*
- *Cisco ACI Multi-Site Configuration Guide*
- *Cisco ACI Multi-Site REST API Configuration Guide*
- *Cisco ACI Multi-Site Troubleshooting Guide*

All these documents are available at the following URL: http://www.cisco.com/c/en/us/support/cloud-systems-management/application-policy-infrastructure-controller-apic/tsd-products-support-series-home.html

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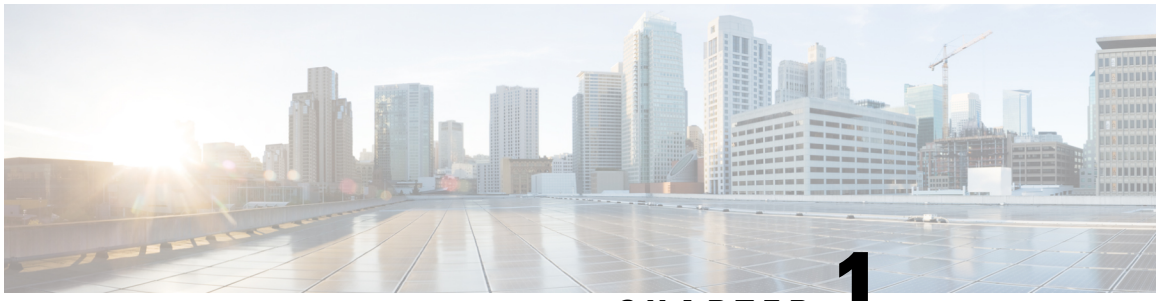


CHAPTER 1

New and Changed Information

This chapter contains the following sections:

New and Changed Information

The following table provides an overview of the significant changes to this guide up to the current release. The table does not provide an exhaustive list of all changes made to the guide or of the new features up to this release.

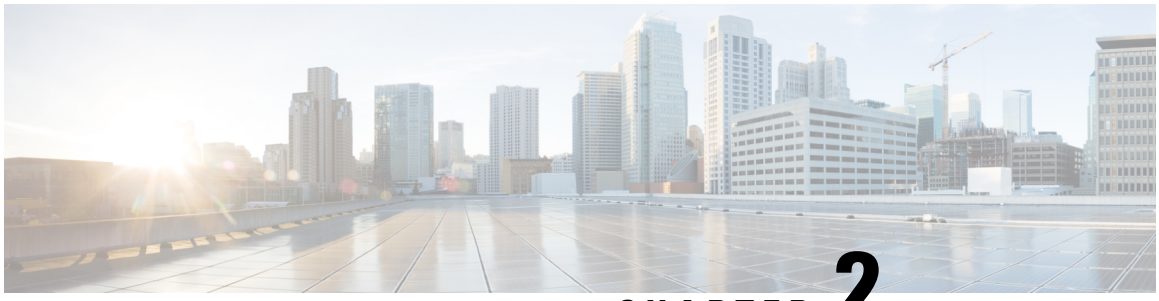
Table 1: New and Changed Information

Cisco ACI Multi-Site Orchestrator Version	Description	Where Documented
2.2(3)	Single node Orchestrator deployment procedures for lab and testing environments.	For more information, see Installing Single Node Orchestrator, on page 85.
2.2(3)	Support for deploying Multi-Site Orchestrator cluster on Cisco Application Service Engine.	For more information, see Deploying in Cisco Application Services Engine, on page 9.
2.2(2)	Support for custom Docker overlay and bridge subnets	For more information, see Prerequisites and Guidelines, on page 17.
2.2(1)	Cisco ACI Multi-Site and Cisco APIC Interoperability Support	For more information, see Cisco ACI Multi-Site and Cisco APIC Interoperability Support, on page 7.

New and Changed Information

PART I

Cluster Deployments



CHAPTER 2

Deployment Overview

This chapter contains the following sections:

Deployment Options

A typical Cisco ACI Multi-Site deployment requires a 3-node cluster of Multi-Site Orchestrators to manage all the sites' fabrics in your Multi-Site environment. You can choose to deploy the Orchestrator cluster in one of the following ways:

- Starting with Release 2.2(3), you can deploy the Multi-Site Orchestrator cluster in a Cisco Application Service Engine.

  Cisco Application Service Engine itself can be deployed using a number of different form factors, such as a Cisco Application Service physical appliance (`.iso`), in a VMware ESX virtual machine (`.ova`), in Amazon Web Services (`.ami`), or in Linux KVM (`.qcow`), all of which are supported for Multi-Site Orchestrator installations. Installing and configuring the Application Service Engine is outside the scope of this document and is described in Cisco Application Services Engine Documentation.

  We recommend this approach for all new ACI Multi-Site deployments, because it provides a common platform to streamline multi-product integrations, additional security through Cisco Secured Development Lifecyle (CSDL) and removal of `root` access to Orchestrator application, file system protection, and single click upgrades to future releases.

  Installing and configuring the Orchestrator cluster in an Application Service Engine is described in the Deploying in Cisco Application Services Engine, on page 9 chapter. Upgrading Service Engine Orchestrator deployments is described in the Upgrading or Downgrading Orchestrator Deployments in Application Service Engine, on page 63 chapter.

- Alternatively, you can deploy each Orchestrator node directly in VMware ESX VMs.

  When deploying in ESX VMs, you can choose one of the following 2 approaches:

  - Use Cisco-provided Python scripts to deploy the entire Multi-Site Orchestrator cluster. The scripts allow you to execute the deployment and later upgrades remotely, for example from your laptop, as long as you have access to the vCenter where the Orchestrator VMs are to be deployed.

This is the preferred approach when deploying an Orchestrator cluster in ESX VMs as it automates a number of manual steps and allows remote execution of Cisco ACI Multi-Site Orchestrator installation and subsequent software upgrades.

- Using an OVA image to deploy each Orchestrator VM individually. In this case you can also choose to deploy the image either using the vCenter or directly on the ESX server.

Installing and configuring the Orchestrator cluster in VMware ESX VMs is described in the Deploying in VMware ESX, on page 17 chapter. Upgrading VMware ESX Orchestrator deployments is described in the Upgrading Orchestrator Deployments in VMware ESX , on page 69 chapter.

Single Node Lab Deployments

While production Multi-Site Orchestrator deployments require a 3-node high availability (HA) cluster, single node Orchestrator deployments are supported for lab and testing purposes. The installation and upgrade steps for single node Orchestrator differ slightly from the 3-node cluster deployments and are covered in detail in the Installing Single Node Orchestrator, on page 85 chapter.

Multi-Site Orchestrator Communication Ports

There are three types of network communication to or from the Multi-Site Orchestrator cluster:

- Client traffic to the Multi-Site Orchestrator cluster.

  Multi-Site Orchestrator uses TCP port 433 (`https`) to allow user access via GUI or REST API for creating, managing, and deploying policy configurations.

- REST API traffic from the Multi-Site Orchestrator to the APIC controllers of the ACI fabrics that are part of the Multi-Site domain

  Multi-Site Orchestrator uses TCP port 433 for REST API traffic to deploy policies to each site.

- Intra-cluster communication.

  All control-plane and data-plane traffic between Cisco ACI Multi-Site Orchestrator nodes (including intra-cluster communication and container overlay network traffic) is encrypted with IPSec's Encapsulating Security Payload (ESP) using IP protocol number 50 to provide security and allow the cluster deployments over a round-trip time distance of up to 150ms. If there is firewall between any Orchestrator nodes, proper rules must be added to allow this traffic.

  If your Multi-Site Orchestrator cluster is deployed directly in VMware ESX without the Application Services Engine, the following ports are used for Docker communications between the cluster nodes:

  Note The following TCP and UDP ports are listed for educational perspective only as no traffic is ever sent in clear text across the network leveraging these ports.

  - TCP port 2377 for Cluster Management Communications
  - TCP and UDP port 7946 for Inter-Manager Communication
  - UDP port 4789 for Docker Overlay Network Traffic

Cisco ACI Multi-Site and Cisco APIC Interoperability Support

Prior to Release 2.2(1), you were required to run the same APIC versions in all sites and the version of the Orchestrator that corresponded to that APIC release. During fabric upgrade you were also required to upgrade all the APIC sites first before upgrading the Multi-Site Orchestrator. For example, if you were upgrading the fabrics from APIC Release 4.0(1) to Release 4.1(1), you had to remain on Release 2.0(1) of the Orchestrator until all sites were on APIC Release 4.1(1).

Starting with Release 2.2(1), Multi-Site Orchestrator releases have been decoupled from the APIC releases. The APIC clusters in each site as well as the Orchestrator itself can now be upgraded independently of each other and run in mixed operation mode.

Mixed operation mode is supported for sites running any of the following APIC releases:

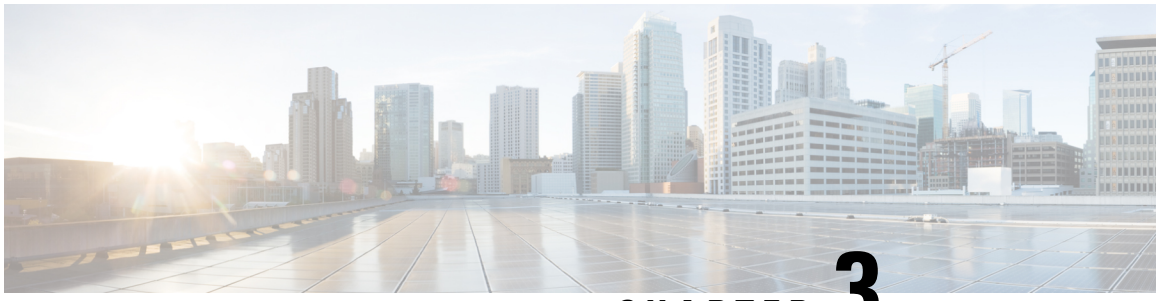
- 3.2(6) or later
- 4.0(1) or later
- 4.1(1) or later
- 4.2(1) or later

However, keep in mind that if you upgrade the Orchestrator before upgrading the APIC clusters in one or more sites, the new Orchestrator features may not yet be supported by an earlier APIC release. In that case a check is performed on each template to ensure that every configured option is supported by the target sites. The check is performed when you save a template or deploy a template. If the template is already assigned to a site, any unsupported configuration options will not be saved; if the template is not yet assigned, you will be able to assign it to a site, but not be able to save or deploy the schema if it contains configuration unsupported by the site. In case an unsupported configuration is detected, an error message will show, for example: `This APIC site version <site-version> is not supported by MSO. The minimum version required for this <feature> is <required-version> or above.`

The following table lists the features and the minimum required APIC release for each one:

Feature	Minimum APIC Version
ACI Multi-Pod Support	Release 3.2(6)
Service Graphs (L4-L7 Services)	Release 3.2(6)
External EPGs	Release 3.2(6)
ACI Virtual Edge VMM Support	Release 3.2(6)
DHCP Support	Release 3.2(6)
Consistency Checker	Release 3.2(6)
CloudSec Encryption	Release 4.0(1)
Layer 3 Multicast	Release 4.0(1)
MD5 Authentication for OSPF	Release 4.0(1)
EPG Preferred Group	Release 4.0(2)

Feature	Minimum APIC Version
Host Based Routing	Release 4.1(1)
Intersite L3Out	Release 4.2(1)



CHAPTER 3

Deploying in Cisco Application Services Engine

This chapter contains the following sections:

Prerequisites and Guidelines

This chapter covers deployment of a 3-node Multi-Site Orchestrator cluster. If you want to set up a single-node Orchestrator (for example, for testing purposes), follow the instruction in the Installing Single Node Orchestrator, on page 85 chapter instead.

Application Services Engine

You must have Cisco Application Services Engine installed and the cluster configured in Fabric External Mode as described in *Cisco Application Services Engine User Guide*.

Cisco Application Service Engine itself can be deployed using a number of different form factors, such as a Cisco Application Service physical appliance (`.iso`), in a VMware ESX virtual machine (`.ova`), in Amazon Web Services (`.ami`), or in Linux KVM (`.qcow`), all of which are supported for Multi-Site Orchestrator installations. Keep in mind however, you must use the same form factor Service Engine for all Orchestrator nodes, mixing different form factors within the same Orchestrator cluster is not supported.

Note that if you are deploying Services Engine in AWS, by default only PEM-based login is enabled for each node. If you'd like to be able to SSH into the nodes using a password, you will need to explicitly enable password-based logins. You can do that by logging into each node separately using the PEM file the first time, then executing the following command:

```
# acidiag login prompt enable
```

Internal Service Engine Networks

When first configuring Application Services Engine, two of the parameters that you provide are Application Overlay Network and Service Network.

The application overlay network defines the address space used by the application's services running in the Service Engine, such as the Multi-Site Orchestrator. Each Orchestrator node is assigned an IP address from this network, which is then used to communicate with each site's Cisco APIC. The services network is an internal network used by the Service Engine and its processes.

Both of these networks must be unique and not overlap with any other services in your environment.

Network Time Protocol (NTP)

Multi-Site Orchestrator uses NTP for clock synchronization, so you must have an NTP server configured in your environment. NTP server information is provided as part of the Application Services Engine installation procedure.

Application Services Engine Requirements

The following table summarizes the Application Services Engine requirements for Cisco ACI Multi-Site Orchestrator.

Table 2: Application Services Engine Requirements

Orchestrator Version	Requirements

Release 2.2(3) and 2.2(4)
Note For all Multi-Site Orchestrator, Release 3.0(x) information including upgrades, see Cisco ACI Multi-Site Orchestrator Installation and Upgrade Guide, Release 3.x
	Cisco Application Services Engine, Release 1.1.2i
	If the Application Services Engine is deployed in an ESX or KVM virtual machine, the following additional requirements apply:
	• The hypervisor must be one of the following:
	  • ESXi 6.0 or later
	  • Linux Kernel `3.10.0-957.el7.x86_64` or later with KVM `libvirt-4.5.0-23.el7_7.1.x86_64` or later
	• 16 vCPUs
	  10 GHz CPU reservation is applied automatically
	• 48 GB of RAM
	  36 GB reservation is applied automatically
	• 100 GB disk
	  We recommend thin provisioning with a maximum size of 620 GB with each Application Services Engine VM running on its own disk.
	• We recommend that each Application Services Engine VM is deployed in a different ESX or KVM server.

Deploying Orchestrator in Application Services Engine

This section describes how to deploy Cisco ACI Multi-Site Orchestrator in Cisco Application Services Engine.

Before you begin

- Ensure that you meet the requirements and guidelines described in Prerequisites and Guidelines, on page 9.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) From the left sidebar, choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site App Image* file (`Cisco-MSO-<version>.aci`) for the release.

Step 2 Copy the Orchestrator image to the Application Services Engine.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), or you have enabled password-based logins for your AWS (`.ami`) deployment, use the following command to copy the Orchestrator image into the `tmp` directory on the Services Engine:

```
# scp <app-local-path> rescue-user@<service-engine-ip>:/tmp/
```

However, if your Application Service Engine is deployed in AWS and you have not enabled password-based login, you must use the certificate (`.pem`) file that you created during the Application Services Engine deployment:

```
# scp <app-local-path>.aci -i <pem-file-name>.pem rescue-user@<service-engine-ip>:/tmp/
```

For example, assuming you're running the `scp` command from the same directory where you saved the Orchestrator image:

- For password-based authentication:

```
# scp ./Cisco-MSO-2.2.3.aci rescue-user@10.30.11.147:/tmp/
```

- For PEM-based authentication:

```
# scp ./Cisco-MSO-2.2.3.aci -i <pem-file-name>.pem rescue-user@10.30.11.147:/tmp/
```

Step 3 Install the Orchestrator app in your Application Services Engine.

When deploying the Orchestrator app, you need to install it in only one of the Service Engine nodes. The application will be replicated to the other nodes in the cluster automatically.

a) Log in to any one of your Services Engine nodes as `rescue-user`.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), simply SSH in using the following command:

```
# ssh rescue-user@<service-engine-ip>
```

However, if your Application Services Engine is deployed in AWS and you have not enabled password-based login, you must login using the certificate (`.pem` file) that you created during the Application Services Engine deployment:

```
# ssh -i <pem-file-name>.pem rescue-user@<service-engine-ip>
```

b) Verify Services Engine health.

```
# acidiag health
All components are healthy
```

c) Install the Orchestrator.

In the following command, replace <*application-path*> with the full path to the application image you copied in the previous step.

```
# acidiag app install <application-path>
```

For example:

```
# acidiag app install /tmp/Cisco-MSO-2.2.3.aci
Image uploaded succesfully
check image status using: acidiag image show cisco-mso-2.2.3.aci
```

Note In certain cases, the Service Engine's `app install` command may return the following error:

```
HTTPSConnectionPool(host='localhost', port=9090): Max retries exceeded with url:
/api/v1/firmware/uploads (Caused by
NewConnectionError('<urllib3.connection.VerifiedHTTPSConnection object at 0x788b6e1d2f50>:
Failed to establish a new connection: [Errno 111] Connection refused').
```

In this case, wait a couple of minutes and rerun the `acidiag app install` command again.

d) Verify that the application was loaded.

Use the following command to check the `operState` of the application.

While the application is loading and installing it will go through a number of operational states, which will be reflected in the `operState` field, for example `'operState': 'Initialize'`. This process can take up to 20 minutes and you must ensure that the state changes to `Disabled` before proceeding to the next step.

After the application's state changes to `Disabled`, make a note of the application's `id`, you will use it in the next step to enable the application.

```
# acidiag app show
[   {   'adminState': 'Disabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'PostInstall',
        'operState': 'Disabled',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

Step 4 Enable the Orchestrator app.

After installation is complete, the application will remain in the `Disabled` state by default and you must enable it.

In the following command, replace <*app-id*> with the application ID from the previous step:

```
# acidiag app enable <app-id>
```

For example:

```
# acidiag app enable cisco-mso:2.2.3
Application enabled succesfully
```

Step 5 Verify that the cluster was deployed successfully.

a) Verify that the application was enabled successfully.

While the application is being enabled, it will go through multiple operational states. You can use `acidiag app show` command to check the current state.

In the following output, ensure that the highlighted fields are `Enabled`, `Enable`, and `Running` respectively.

```
## acidiag app show
[   {   'adminState': 'Enabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'Enable',
        'operState': 'Running',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

b) Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Note After the application is enabled as described in the previous step, it may take up to 20 additional minutes for all the Orchestrator services to start and the GUI to become available.

After the GUI becomes available, you can access it by browsing to any one of your Application Services Engine nodes' IP addresses. The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

What to do next

For information on migrating your existing Mutli-Site Orchestrator configuration deployed in VMware ESX to Cisco Application Services Engine cluster, see #unique_25.

For more information about Day-0 Operations, see Adding Tenants and Schemas, on page 57.

Migrating Existing Cluster to Application Service Engine

This section provides an overview of how to migrate your existing Multi-Site deployment to a new cluster deployed in Cisco Application Service Engine.

Because the two platforms are vastly different in how they implement clustering and infrastructure, the migration process involves parallel deployment of the new platform and manual transfer of the current configuration database from the existing Orchestrator cluster.

Step 1 Deploy a brand new Orchestrator cluster in Application Service Engine.

The procedure is described in the Deploying in Cisco Application Services Engine, on page 9 chapter of this document.

Step 2 Backup existing deployment configuration.

a) Log in to your existing Cisco ACI Multi-Site Orchestrator.

b) From the left navigation pane, select **Admin** > **Backups**.
c) In the main window, click **New Backup**.

A **New Backup** window opens.

d) In the **Name** field, provide the name for the backup file.

The name can contain up to 10 alphanumeric characters, but no spaces or underscores (_).

e) Choose the **Backup Location**.

You can save the backup file locally on the Orchestrator nodes or export it to a remote location.

If you want to save the backup file locally, choose **Local**.

Otherwise, if you want to save the backup file to a remote location, choose **Remote** and provide the following:

- From the **Remote Location** dropdown menu, select the remote location.
- In the **Remote Path**, either leave the default target directory or you can choose to append additional subdirectories to the path. However, the directories must be under the default configured path and must have been already created on the remote server.

f) Click **Save** to create the backup.

Step 3 Copy the Backup file from the existing Orchestrator.

If you created the backup using a remote location, you can skip this step.

Otherwise, in the main window, click the actions ( ) icon next to the backup and select **Download**. This will download the backup file to your system.

Step 4 Bring down the existing Multi-Site Orchestrator cluster VMs.

Step 5 Import the backup file to your new Orchestrator cluster deployed on the Application Service Engine.

If you saved the backup locally, simply import the file:

a) Log in to your existing Cisco ACI Multi-Site Orchestrator.
b) From the left navigation menu, select **Admin** > **Backups**.
c) In the main window, click **Import**.
d) In the **Import from file** window that opens, click **Select File** and choose the backup file you want to import.

Importing a backup will add it to the list of the backups displayed the **Backups** page.

If you saved the backup to a remote location, add the remote location to the new Multi-Site Orchestrator:

a) Log in to your Cisco ACI Multi-Site Orchestrator.
b) From the left navigation pane, select **Admin** > **Remote Locations**.
c) In the top right of the main window, click **Add Remote Location**.

An **Add New Remote Location** screen appears.

d) Provide the same information for the remote location that you used in your old Orchestrator.
e) Click **Save** to add the remote server.

Step 6 Restore the configuration.

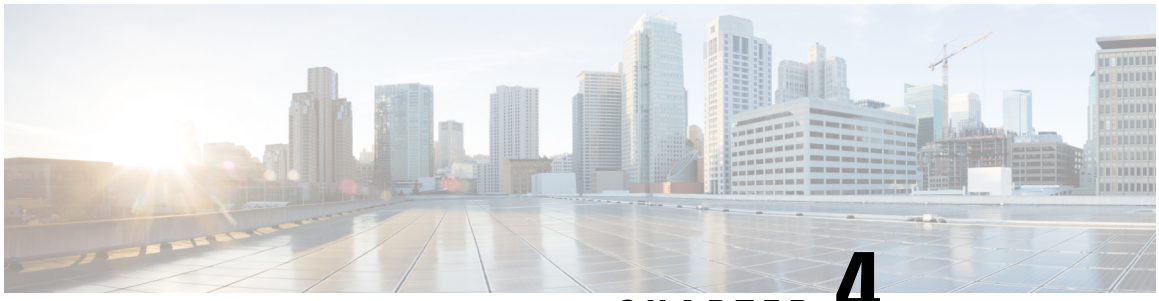
a) From the left navigation menu, select **Admin** > **Backups**.

b) In the main window, click the actions ( ) icon next to the backup you want to restore and select **Rollback to this backup**.

If the version of the selected backup is different from the running Multi-Site version, the rollback could cause a removal of the features that are not present in the backup version.

c) Click **Yes** to confirm that you want to restore the backup you selected.

If you click **Yes**, the system terminates the current session and the user is logged out.



CHAPTER 4

Deploying in VMware ESX

This chapter contains the following sections:

Prerequisites and Guidelines

For all new deployments, we recommend using Cisco Application Service Engine as described in Deploying in Cisco Application Services Engine, on page 9 instead. However, if you still want to deploy the Orchestrator cluster in VMware ESX VMs directly, you can follow the guidelines and procedures in this chapter.

This chapter covers deployment of a 3-node Multi-Site Orchestrator cluster. If you want to set up a single-node Orchestrator (for example, for testing purposes), follow the instruction in the Installing Single Node Orchestrator, on page 85 chapter instead.

Deployment Method

When deploying in ESX VMs, you can choose one of the following 2 approaches:

- Use Cisco-provided Python scripts to deploy the entire Multi-Site Orchestrator cluster. The scripts allow you to execute the deployment and later upgrades remotely, for example from your laptop, as long as you have access to the vCenter where the Orchestrator VMs are to be deployed.

  This is the preferred approach when deploying an Orchestrator cluster in ESX VMs as it automates a number of manual steps and allows remote execution of Cisco ACI Multi-Site Orchestrator installation and subsequent software upgrades.

- Using an OVA image to deploy each Orchestrator VM individually. In this case you can also choose to deploy the image either using the vCenter or directly on the ESX server.

Docker Subnet Considerations

The Multi-Site Orchestrator application services run in Docker containers. When deployed, Docker uses a number of internal networks for its own application services (`bridge`, `docker_gwbridge`) as well as the Orchestrator services (`msc_msc`).

Prior to Release 2.2(2), an internal `10.0.0.0/24` network was used for the Docker swarm application services by default and could not be changed during the Multi-Site Orchestrator installation. This meant no other services in your fabric could reside on the same network.

Starting with Release 2.2(2), you can configure custom networks for the Docker services during Orchestrator deployment. Two additional parameters are now available in the Python configuration file or the OVA template:

Note When configuring these networks, ensure that they are unique and do not overlap with any existing networks in the environment.

- **Application overlay**: The default address pool to be used for Docker internal bridge networks.

  Application overlay must be a `/16` network. Docker then splits this network into two `/24` subnets used for the internal `bridge` and `docker_gwbridge` networks.

  For example, if you set the application overlay pool to `192.168.0.0/16`, Docker will use `192.168.0.0/24` for the `bridge` network and `192.168.1.0/24` for the `docker_gwbridge` network.

- **Service overlay**: The default Docker overlay network IP.

  Service overlay must be a `/24` network and is used for the `msc_msc` Orchestrator Docker service network.

Network Time Protocol (NTP)

Multi-Site Orchestrator uses NTP for clock synchronization, so you must have an NTP server configured in your environment. You provide NTP server information as part of the Orchestrator installation procedure.

Note VMware Tools provides an option to synchronize VMs' time with the host, however you should use only one type of periodic time synchronization in your VMs. Because you will enable NTP during Multi-Site Orchestrator deployment, ensure that VMware Tools periodic time synchronization is disabled for the Orchestrator VMs.

VMware vSphere Requirements

The following table summarizes the VMware vSphere requirements for Multi-Site Orchestrator:

- You must not enable vMotion for Multi-Site Orchestrator VMs.

  vMotion is not supported with docker swarm, which is used by the Multi-Site Orchestrator.

- You must ensure that the following vCPUs, memory, and disk space requirements are reserved for each VM and are not part of a shared resource pool:

Table 3: VMware vSphere Requirements

Orchestrator Version	Requirements
Release 2.2(4) or later	• ESXi 6.0 or later • 6 vCPUs (8 vCPUs recommended) • 48 GB of RAM • 64 GB disk • 10 GHz CPU reservation CPU cycle reservation is automatically applied when first deploying the Orchestrator VMs.
Release 2.2(1)-2.2(3)	• ESXi 6.0 or later • 6 vCPUs (8 vCPUs recommended) • 24 GB of RAM • 64 GB disk • 10 GHz CPU reservation CPU cycle reservation is automatically applied when first deploying the Orchestrator VMs.

Deploying Cisco ACI Multi-Site Orchestrator Using Python

The following sections describe how to prepare for and deploy Cisco ACI Multi-Site Orchestrator using Python.

Setting Up Python Environment

This section describes how to set up the Python environment for deploying Cisco ACI Multi-Site Orchestrator using Python. You must set up the Python environment on the laptop or server from which you will run the installation scripts.

Note If you have already set up your python environment, for example for another Multi-Site deployment or upgrade, you can skip this section.

Before you begin

you will need:

- A laptop or a server from which you will run the scripts.

  You must not use any of the Multi-Site Orchestrator nodes for this purpose.

- Python already installed on the system from which you will run the scripts.

  If you are using Python 2.x, ensure it is version 2.7.14 or later.

  If you are using Python 3.x, ensure it is version 3.4 or later.

Step 1 Download the **ACI Multi-Site Tools** image from Cisco ACI Multi-Site Software Download link.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Tools Image* file (`tools-msc-<version>.tar.gz`).

Step 2 Extract the files.

```
# tar -xvzf tools-msc-<version>.tar.gz
```

Step 3 Change to the extracted directory.

```
# cd tools-msc-<version>
```

Step 4 Verify that you are running a correct version of Python.

- If you are using Python 2.x, ensure it is version 2.7.14 or later.

```
# python -V
Python 2.7.5
```

- If you are using Python 3.x, ensure it is version 3.4 or later.

```
# python3 -V
Python 3.4.5
```

Step 5 If you plan to use a proxy to access the Internet, make sure to configure the proxy as follows:

```
# export http_proxy=<proxy-ip-address>:<proxy-port>
```

Step 6 Install or update the Python package manager.

If you are using Python 3.x, replace `python` with `python3` in the following commands.

```
# python -m ensurepip
```

If the package is already installed, update it to the latest version:

```
# python -m ensurepip --upgrade
```

Step 7 (Optional) Set up Python virtual environment.

We recommend using `virutalenv` to install the packages, so they do not impact the existing packages in the system. The following steps provide a brief overview of how to set up `virutalenv`. For additional information on how to use `virtualenv`, see Installing packages using pip and virtualenv.

a) Install `virtualenv`.

```
# python -m pip install --user virtualenv
```

b) Change into the directory where you want the virtual environment files to be created.

c) Create a virtual environment.

In the following command, provide a name for the virtual environment, for example *mso-deployments*.

If you are using Python 2.x, use `virtualenv`:

```
# python -m virtualenv <env-name>
```

If you are using Python 3.x, use `venv`:

```
# python3 -m venv <env-name>
```

d) Activate the virtual environment.

You need to activate the virtual environment you created before installing the packages required for Orchestrator deployment or upgrade in the next step.

For Windows:

```
# .\<env-name>\Scripts\activate.bat
```

For Linux:

```
# source ./<env-name>/bin/activate
```

Step 8 Install the required packages.

The required packages are listed in the `requirements.txt` file.

If you are using Python 3.x, replace `python` with `python3` in the following command:

```
# python -m pip install -r requirements.txt
```

Note The Python installation must complete successfully. If you encounter any errors, you must address them before proceeding to the next section or the Cisco ACI Multi-Site Orchestrator Python scripts will not work.

Sample Deployment Configuration File

When you deploy Multi-Site Orchestrator using Python, several required configuration details are specified in a YAML configuration file. This section provides a sample `msc_cfg.yml` file.

In the following sample configuration file all the VMs are created under the same host. The “host” parameter in the configuration file can be given as a node-level parameter instead if you want to create the Multi-Site VMs in different hosts.

```
# vCenter parameters
vcenter:
  name: 192.168.142.59
  user: administrator@vsphere.local

  # Host under which the Orchestrator VMs will be created
  host: 192.64.142.55

  # Path to the Orchestrator OVA file
  msc_ova_file: ../images/msc-2.1.1h.ova

  # (Optional) If not provided, default library name 'msc-content-lib' will be used
  #library: content-library-name

  # Library datastore name
  library_datastore: datastore1
```

```
  # Host datastore name
  host_datastore: datastore1

  # Prefix for Orchestrator VM names, full VM names will be '<vm_name_prefix>-node1',
  # '<vm_name_prefix>-node2', and '<vm_name_prefix>-node3'
  vm_name_prefix: msc

  # Wait Time in seconds for VMs to come up
  vm_wait_time: 120


# Common parameters for all nodes
common:
  # Network mask
  netmask: 255.255.248.0

  # Gateway' IP address
  gateway: 192.64.136.1

  # Domain Name-Server IP. Leave blank for DHCP
  nameserver: 192.64.136.140

  # Network label of the Management network port-group
  management: "VM Network"

  # Time zone of the node, must be one of the values listed by 'timedatectl list-timezones'
 command
  time_zone: America/Los_Angeles

  # NTP (Network Time Protocol) servers, multiple servers can be listed separated by commas

  ntp_servers: ntp.company.com

  # Application Overlay IP for docker bridge type networks
  # Docker's bridge and docker_gwbridge networks are assigned addresses from this pool
  application_overlay: 192.168.0.0/16

  # Service Overlay IP for docker overlay type networks
  # Docker's msc_msc overlay network created at the time of deployment are assigned this
network address
  service_overlay: 2.1.1.0/24

# Node specific parameters over-ride the vCenter and common parameters
node1:
  # To use static IP, specify a valid IP address for the "ip" attribute
  # To obtain IP via DHCP, leave the "ip" field blank
  ip: 192.64.136.204

  # Node specific "netmask" parameter over-rides the common.netmask
  netmask: 255.255.248.0

  # (Optional) If hostname is not specified, the VM name will be used
  hostname: mso-node1

node2:
  # To use static IP, specify a valid IP address for the "ip" attribute
  # To obtain IP via DHCP, leave the "ip" field blank
  ip:

  # (Optional) If hostname is not specified, the VM name will be used
  hostname: mso-node2

node3:
  # To use static IP, specify a valid IP address for the "ip" attribute
```

```
# To obtain IP via DHCP, leave the "ip" field blank
ip:

# (Optional) If hostname is not specified, the VM name will be used
hostname: mso-node3
```

Deploying Multi-Site Orchestrator Using Python

This section describes how to deploy Cisco ACI Multi-Site Orchestrator using Python.

Before you begin

- Ensure that you meet the hardware requirements and compatibility that is listed in the *Cisco ACI Multi-Site Hardware Requirements Guide*.
- Ensure that you meet the requirements and guidelines described in Prerequisites and Guidelines, on page 17.
- Ensure that the NTP server is configured and reachable from the Orchestrator VMs and that VMware Tools periodic time synchronization is disabled.
- Ensure that the vCenter is reachable from the laptop or server where you will extract the tools and run the installation scripts.
- Ensure that your Python environment is set up as described in Setting Up Python Environment, on page 19.

Step 1 Download the Cisco ACI Multi-Site Orchestrator image and tools.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Image* file (`msc-<version>.tar.gz`) for the release.

e) Download the *ACI Multi-Site Tools Image* file (`tools-msc-<version>.tar.gz`) for the release.

Step 2 Extract the `tools-msc-<version>.tar.gz` file to the directory from which you want to run the install scripts.

```
# tar -xvzf tools-msc-<version>.tar.gz
```

Then change into the extracted directory:

```
# cd tools-msc-<version>
```

Step 3 Create a `msc_cfg.yml` configuration file for your install.

You can copy and rename the provided `msc_cfg_example.yml` file or you can create the file using the example provided in Sample Deployment Configuration File, on page 21.

Step 4 Edit the `msc_cfg.yml` configuration file and fill in all the parameters for your environment.

The parameters that must be filled in are in all caps, for example <*VCENTER_NAME*>. You will also need to update <*MSC_TGZ_FILE_PATH*> with the path to the `msc-<version>.tar.gz` image file you downloaded in Step 1.

For a complete list of available parameters, see the sample `msc_cfg.yml` file is provided in Sample Deployment Configuration File, on page 21.

Step 5 Execute the script to deploy the Orchestrator VMs and prepare them:

```
# python msc_vm_util.py -c msc_cfg.yml
```

Step 6 Enter vCenter, `node1`, `node2` and `node3` passwords when prompted.

The script creates three Multi-Site Orchestrator VMs and executes the initial deployment scripts. This process may take several minutes to complete. After successful execution, the Multi-Site Orchestrator cluster is ready for use.

It may take several minutes for the deployment to complete.

Step 7 Verify that the cluster was deployed successfully.

a) Log in to any one of the deployed Orchestrator nodes.

b) Verify that all nodes are up and running.

```
# docker node ls
ID                            HOSTNAME        STATUS      AVAILABILITY    [...]
y90ynithc3cejkeazcqlu1uqs *   node1           Ready       Active          [...]
jt67ag14ug2jgaw4r779882xp     node2           Ready       Active          [...]
hoae55eoute6l5zpqlnxsk8o8     node3           Ready       Active          [...]
```

Confirm the following:

- The `STATUS` field is `Ready` for all nodes.
- The `AVAILABILITY` field is `Active` for all node.
- The `MANAGER STATUS` field is `Leader` for one of the nodes and `Reachable` for the other two.

c) Verify that all replicas are fully up.

```
# docker service ls
ID                  NAME                       MODE            REPLICAS    [...]
p6tw9mflj06u        msc_auditservice           replicated      1/1         [...]
je7s2f7xme6v        msc_authyldapservice       replicated      1/1         [...]
dbd27y76eouq        msc_authytacacsservice     replicated      1/1         [...]
untetoygqn1q        msc_backupservice          global          3/3         [...]
n5eibyw67mbe        msc_cloudsecservice        replicated      1/1         [...]
8inekkof982x        msc_consistencyservice     replicated      1/1         [...]
0qeisrguy7co        msc_endpointservice        replicated      1/1         [...]
e8ji15eni1e0        msc_executionengine        replicated      1/1         [...]
s4gnm2vge0k6        msc_jobschedulerservice    replicated      1/1         [...]
av3bjvb9ukru        msc_kong                   global          3/3         [...]
rqie68m6vf9o        msc_kongdb                 replicated      1/1         [...]
51u1g7t6ic33        msc_mongodb1               replicated      1/1         [...]
vrl8xvvx6ky5        msc_mongodb2               replicated      1/1         [...]
0kwk9xw8gu8m        msc_mongodb3               replicated      1/1         [...]
qhejgjn6ctwy        msc_platformservice        global          3/3         [...]
l7co71lneegn        msc_schemaservice          global          3/3         [...]
1t37ew5m7dxi        msc_siteservice            global          3/3         [...]
tu37sw68a1gz        msc_syncengine             global          3/3         [...]
8dr0d7pq6j19        msc_ui                     global          3/3         [...]
swnrzrbcv60h        msc_userservice            global          3/3         [...]
```

d) Log in to the Cisco ACI Multi-Site Orchestrator GUI.

You can access the GUI using any of the 3 nodes' IP addresses.

The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

What to do next

For more information about Day-0 Operations, see Adding Tenants and Schemas, on page 57.

Deploying Orchestrator in vCenter

This section describes how to deploy Cisco ACI Multi-Site Orchestrator using an OVA in vCenter.

Before you begin

- Ensure that you meet the hardware requirements and compatibility that is listed in the *Cisco ACI Multi-Site Hardware Requirements Guide*.
- Ensure that you meet the requirements and guidelines described in Prerequisites and Guidelines, on page 17.
- Ensure that the NTP server is configured and reachable from the Orchestrator VMs and that VMware Tools periodic time synchronization is disabled.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) From the left sidebar, choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Image* file (`msc-<version>.ova`) for the release.

Step 2 Deploy the OVA using the VMware vCenter.

Note The OVA cannot be deployed directly in ESX, it must be deployed using vCenter. If you want to deploy Cisco ACI Multi-Site Orchestrator directly in ESX, see the "*Deploying Multi-Site Orchestrator in ESX Directly* " sections in this chapter.for instructions on how to extract the OVA and install the Orchestrator without vCenter.

Step 3 Configure the OVA properties.

In the **Properties** dialog box, enter the appropriate information for each VM:

- In the **Enter password** field, enter the root password for the VM.
- In the **Confirm password** field, enter the password again.
- In the **Hostname** field, enter the hostnames for each Cisco ACI Multi-Site Orchestrator node. You can use any valid Linux hostname.
- In the **Management Address** (network address) field, enter the network address or leave the field blank to obtain it via DHCP.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- In the **Management Netmask** (network netmask) field, enter the netmask netmask or leave the field blank to obtain it via DHCP.

- In the **Management Gateway** (network gateway) field, enter the network gateway or leave the field blank to obtain it via DHCP.
- In the **Domain Name System Server** (DNS server) field, enter the DNS server or leave the field blank to obtain it via DHCP.
- In the **Time-zone string (Time-zone)** field, enter a valid time zone string.

  You can find the time zone string for your region in the IANA time zone database or using the `timedatectl list-timezones` Linux command. For example, *America/Los_Angeles* .
- In the **NTP-servers** field, enter Network Time Protocol servers separated by commas.
- In the **Application overlay** field, enter the default address pool to be used for Docker internal bridge networks.

  Application overlay must be a `/16` network. Docker then splits this network into two `/24` subnets used for the internal `bridge` and `docker_gwbridge` networks.

  For example, if you set the application overlay pool to `192.168.0.0/16`, Docker will use `192.168.0.0/24` for the `bridge` network and `192.168.1.0/24` for the `docker_gwbridge` network.

  You must ensure that the application overlay network is unique and does not overlap with any existing networks in the environment.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- In the **Service overlay** field, enter the default Docker overlay network IP.

  Service overlay must be a `/24` network and is used for the `msc_msc` Orchestrator Docker service network.

  You must ensure that the service overlay network is unique and does not overlap with any existing networks in the environment.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- Click **Next**.
- In the **Deployment settings** pane, check all the information you provided is correct.
- Click **Power on after deployment**.
- Click **Finish**.

In addition to the above parameters, a 10GHz CPU cycle reservation is automatically applied to each Orchestrator VM when deploying the OVA.

Step 4 Repeat the previous two steps to deploy two more VMs.

The three VMs you deploy will join to form the Orchestrator cluster.

Step 5 Ensure that the virtual machines are able to ping each other.

Step 6 Initialize node1.

a) Connect to node1 using SSH.

b) Change to the initialization scripts directory.

```
# cd /opt/cisco/msc/builds/<build_number>/prodha
```

c) Run initialization script and note the generated secret.

```
# ./msc_cfg_init.py
Starting the initialization of the cluster...
.
.
.
Both secrets created successfully.

Join other nodes to the cluster by executing the following on each of the
other nodes:
./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3ym1s5gj5
 \
<node1-ip-address>
```

You will use the above token and IP address in the following steps to join `node2` and `node3` into the cluster.

d) Note the management IP address of the first node.

```
# ifconfig
inet 10.23.230.151  netmask 255.255.255.0  broadcast 192.168.99.255
```

You will use this IP address in the following steps to join node2 and node3 into the cluster.

Step 7 Join node2 to the cluster.

a) Connect to node2 using SSH.

b) Change to the `/opt/cisco/msc/builds/<build_number>/prodha` directory.

```
# cd /opt/cisco/msc/builds/<build_number>/prodha
```

c) Execute the `msc_cfg_join.py` command using the IP address of the first node.

```
# ./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3ym1s5gj5 \
10.23.230.151
```

Step 8 Join node3 to the cluster.

a) Connect to node3 using SSH.

b) Change to the `/opt/cisco/msc/builds/<build_number>/prodha` directory.

```
# cd /opt/cisco/msc/builds/<build_number>/prodha
```

c) Execute the `msc_cfg_join.py` command using the IP address of the first node.

```
# ./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3ym1s5gj5 \
10.23.230.151
```

Step 9 On any node, make sure the nodes are healthy.

```
# docker node ls
ID                            HOSTNAME        STATUS      AVAILABILITY    [...]
y90ynithc3cejkeazcqlu1uqs *   node1           Ready       Active          [...]
jt67ag14ug2jgaw4r779882xp     node2           Ready       Active          [...]
hoae55eoute6l5zpqlnxsk8o8     node3           Ready       Active          [...]
```

Confirm the following:

- The `STATUS` field is `Ready` for all nodes.

- The `AVAILABILITY` field is `Active` for all node.
- The `MANAGER STATUS` field is `Leader` for one of the nodes and `Reachable` for the other two.

Step 10 On any node, execute the `msc_deploy.py` command:

```
# cd /opt/cisco/msc/builds/<build_number>/prodha
# ./msc_deploy.py
```

Step 11 On any node, make sure that all REPLICAS are up.

```
# docker service ls
ID                  NAME                       MODE            REPLICAS    [...]
p6tw9mflj06u        msc_auditservice           replicated      1/1         [...]
je7s2f7xme6v        msc_authyldapservice       replicated      1/1         [...]
dbd27y76eouq        msc_authytacacsservice     replicated      1/1         [...]
untetoygqn1q        msc_backupservice          global          3/3         [...]
n5eibyw67mbe        msc_cloudsecservice        replicated      1/1         [...]
8inekkof982x        msc_consistencyservice     replicated      1/1         [...]
0qeisrguy7co        msc_endpointservice        replicated      1/1         [...]
e8ji15eni1e0        msc_executionengine        replicated      1/1         [...]
s4gnm2vge0k6        msc_jobschedulerservice    replicated      1/1         [...]
av3bjvb9ukru        msc_kong                   global          3/3         [...]
rqie68m6vf9o        msc_kongdb                 replicated      1/1         [...]
51u1g7t6ic33        msc_mongodb1               replicated      1/1         [...]
vrl8xvvx6ky5        msc_mongodb2               replicated      1/1         [...]
0kwk9xw8gu8m        msc_mongodb3               replicated      1/1         [...]
qhejgjn6ctwy        msc_platformservice        global          3/3         [...]
l7co71lneegn        msc_schemaservice          global          3/3         [...]
1t37ew5m7dxi        msc_siteservice            global          3/3         [...]
tu37sw68a1gz        msc_syncengine             global          3/3         [...]
8dr0d7pq6j19        msc_ui                     global          3/3         [...]
swnrzrbcv60h        msc_userservice            global          3/3         [...]
```

Step 12 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

You can access the GUI using any of the 3 nodes' IP addresses.

The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

What to do next

For more information about Day-0 Operations, see Adding Tenants and Schemas, on page 57.

Deploying Orchestrator in ESX Directly, Release 2.2(4) and Later

This section describes how to deploy Cisco ACI Multi-Site Orchestrator directly in ESX without using vCenter. Starting with Release 2.2(4), deploying directly in ESX has been simplified using a provided setup utility.

Before you begin

- Ensure that you meet the hardware requirements and compatibility that is listed in the *Cisco ACI Multi-Site Hardware Requirements Guide*.

- Ensure that you meet the requirements and guidelines described in Prerequisites and Guidelines, on page 17.
- Ensure that the NTP server is configured and reachable from the Orchestrator VMs and that VMware Tools periodic time synchronization is disabled.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Image (ESX Only)* file (`esx-msc-<version>.ova`) for the release.

Step 2 Untar the OVA file into a temporary directory:

```
# mkdir msc_ova
# cd msc_ova
# tar xvf ../esx-msc-<version>.ova
esx-msc-<version>.cert
esx-msc-<version>.mf
esx-msc-<version>.ovf
esx-msc-<version>-disk1.vmdk
```

Step 3 Use the ESX vSphere client to deploy the OVF.

a) Log in to vSphere.

b) Navigate to **File** > **Deploy OVF Template** > **Browse** and choose the `esx-msc-<version>.ovf` file.

c) Complete rest of the menu options and deploy the VM.

d) Repeat the steps for 2 additional Orchestrator nodes.

Step 4 Configure networking on Node2 and Node3.

After you configure networking on all 3 nodes, you will designate one of the nodes as `Primary` for the Docker swarm and use it to joint all 3 nodes into a cluster. Before you can do that, you must first configure networking on the two secondary nodes.

a) Log in to one of the secondary nodes (for example, `Node2`) as the `root` user.

The default password is `cisco`.

b) Change the default password.

The first time you log in, you will be prompted to change the default `root` password.

c) Run the Orchestrator setup utility.

```
# mso-setup
```

d) When prompted if it is a primary node, enter **n**.

```
  When first deploying, one node must be designated as primary.
  You must configure the other two nodes before configuring the primary node.
        If this is NOT the primary node, simply choose 'no' to proceed.
        If this is the primary node and the other nodes are ready, answer 'yes' to deploy.

Is this the primary node [y/N]? n
```

e) Confirm whether or not you will use a DHCP server to assign IP addresses to the node.

If you choose to use a DHCP server, you will not be prompted for specific IP configuration, otherwise you will enter it in the next step.

```
Is this system going to get it's network configuration from a DHCP server [y/N]? n
```

f) Provide the required information.

The setup utility will prompt for the following information:

- **Management address**, for example `10.195.223.200`

  If you chose to use a DHCP server, this field is skipped.

- **Management netmask**, for example `255.255.255.0`

  If you chose to use a DHCP server, this field is skipped.

- **Management gateway**, for example `10.195.223.1`

  If you chose to use a DHCP server, this field is skipped.

- **DNS server**, for example `171.70.168.183`

  If you chose to use a DHCP server, this field is skipped.

- **Hostname**, for example `mso-node2`

  You can use any valid Linux hostname.

- **Time zone string**, for example `America/Los_Angeles`

  You can find the time zone string for your region in the IANA time zone database or using the `timedatectl list-timezones` Linux command.

- **NTP servers**, for example `ntp.esl.cisco.com`

  You can provide multiple NTP servers separated by commas.

- **Application overlay network**, for example `192.168.0.0/16`

  Application overlay must be a `/16` network. Docker then splits this network into two `/24` subnets used for the internal `bridge` and `docker_gwbridge` networks.

  For example, if you set the application overlay pool to `192.168.0.0/16`, Docker will use `192.168.0.0/24` for the `bridge` network and `192.168.1.0/24` for the `docker_gwbridge` network.

  You must ensure that the application overlay network is unique and does not overlap with any existing networks in the environment.

- **Service overlay network**, for example `1.1.1.0/24`

  Service overlay must be a `/24` network and is used for the `msc_msc` Orchestrator Docker service network.

  You must ensure that the service overlay network is unique and does not overlap with any existing networks in the environment.

g) Verify the provided information.

After you finish entering the information, you will be prompted to verify it. Reply **y** to confirm or **n** to re-enter the information.

```
== Verify network configuration ==

     Management address: 10.195.223.200
```

```
        Management netmask: 255.255.255.0
        Management gateway: 10.195.223.1
        DNS server: 171.70.168.183
        Hostname: msc-node2
        Time zone string: America/Los_Angeles
        NTP servers: ntp.esl.cisco.com
        Application overlay network: 192.168.0.0/16
        Service overlay network: 1.1.1.0/24

Confirm the settings and proceed [Y/n]? y
```

Step 5 Repeat the previous step for the other secondary node (Node3).

Step 6 Configure the primary node (Node1) and deploy the cluster.

a) Log in to the primary node (Node1) as the `root` user.

The default password is `cisco`.

b) Change the default password.

The first time you log in, you will be prompted to change the default `root` password.

c) Run the Orchestrator setup utility.

```
# mso-setup
```

d) When prompted if it is a primary node, enter **y**.

```
  When first deploying, one node must be designated as primary.
  You must configure the other two nodes before configuring the primary node.
        If this is NOT the primary node, simply choose 'no' to proceed.
        If this is the primary node and the other nodes are ready, answer 'yes' to deploy.

Is this the primary node [y/N]? y
```

e) Confirm that the other two nodes have been configured.

If you have not configured the other two nodes, you can respond **n** and re-run the setup utility at a later time.

```
Are other two nodes network configured [y/N]? y
```

f) Provide the network configuration information like you did for the other two nodes.

g) After you verify and confirm the network settings, provide other two nodes' information.

You will be prompted to enter the IP addresses and `root` passwords for the other 2 nodes.

```
Confirm the settings and proceed [Y/n]? y
== MSO Network configuration done for node1 ==
== MSO Setup begins ==

Node2 IP address: 10.195.223.200
Node2 root password:
Node3 IP address: 10.195.223.201
Node3 root password:
msc_setup: Start
```

If for any reason the setup does not complete, you can re-run just the deployment part without the full network configuration using the following command:

```
# mso-setup --install-mso
```

Step 7 Wait for the cluster to be deployed.

After you confirm the settings on the primary node, the setup utility

Step 8 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

You can access the GUI using any of the 3 nodes' IP addresses.

The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

Deploying Orchestrator in ESX Directly, Release 2.2(3) and Earlier

This section describes how to deploy Cisco ACI Multi-Site Orchestrator directly in ESX without using vCenter. If you are deploying Release 2.2(4) or later, we recommend using the `mso-setup` utility as described in Deploying Orchestrator in ESX Directly, Release 2.2(4) and Later, on page 28

Before you begin

- Ensure that you meet the hardware requirements and compatibility that is listed in the *Cisco ACI Multi-Site Hardware Requirements Guide*.
- Ensure that you meet the requirements and guidelines described in Prerequisites and Guidelines, on page 17.
- Ensure that the NTP server is configured and reachable from the Orchestrator VMs and that VMware Tools periodic time synchronization is disabled.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Image (ESX Only)* file (`esx-msc-<version>.ova`) for the release.

Step 2 Untar the OVA file into a temporary directory:

```
# mkdir msc_ova
# cd msc_ova
# tar xvf ../esx-msc-<version>.ova
esx-msc-<version>.cert
esx-msc-<version>.mf
esx-msc-<version>.ovf
esx-msc-<version>-disk1.vmdk
```

Step 3 Use the ESX vSphere client to deploy the OVF.

a) Log in to vSphere.

b) Navigate to **File** > **Deploy OVF Template** > **Browse** and choose the `esx-msc-<version>.ovf` file.

c) Complete rest of the menu options and deploy the VM.

d) Repeat the substeps for 2 additional nodes.

Step 4 Update each node's `root` password.

a) Using the VM console, log in to node1 as the `root` user.

The default password is `cisco`.

b) Change the password.

The first time when you login, you will be prompted to change the password. Use the new password you choose for all subsequent logins.

c) Repeat the substeps for the other 2 nodes.

Step 5 Configure each node's networking settings.

When deploying directly in ESX VMware, vSphere does not support configuration of OVF parameters. As a result, you must manually configure all VM parameters.

a) Log in to a node.

b) Configure the IP address, netmask, and gateway for the node.

By default the VM is configured to use DHCP and will try to obtain network configuration automatically.

If you want to set up static IP configuration, use the `nmtui` or `nmcli` utility to provide the IP, netmask, and gateway information for the node. Remember to deactivate and re-activate the `eth0` interface to apply any changes.

c) Configure the hostname for the node.

You can use any valid Linux hostname.

```
# hostnamectl set-hostname <node-name>
```

d) Log out and log in after you changed the hostname.

e) Repeat the substeps to configure the other 2 nodes.

Step 6 Initialize the cluster.

a) Log in to Node1.

b) Change to the deployment scripts directory.

```
# cd /opt/cisco/msc/builds/<build-number>/prodha
```

c) Initiate the cluster.

```
# ./msc_cfg_init.py
Starting the initialization of the cluster...
.
.
.
Both secrets created successfully.

Join other nodes to the cluster by executing the following on each of the other nodes:
./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3yml5gj5 \
<node1-ip-address>
```

d) Note the management IP address of the first node.

```
# ifconfig
inet 10.23.230.151  netmask 255.255.255.0  broadcast 192.168.99.255
```

You will use this IP address in the following steps to join node2 and node3 into the cluster.

Step 7 Join Node2 to the cluster.

a) Log in to Node2.
b) Change to the deployment scripts directory.

```
# cd /opt/cisco/msc/builds/<build-number>/prodha
```

c) Join the node.

In the following command, use the token and the IP address you got when you initiated the cluster on the first node:

```
# ./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3ym1s5gj5 \
10.23.230.151
```

Step 8 Join Node3 to the cluster.

a) Log in to Node3.
b) Change to the deployment scripts directory.

```
# cd /opt/cisco/msc/builds/<build-number>/prodha
```

c) Join the node.

In the following command, use the token and the IP address you got when you initiated the cluster on the first node:

```
# ./msc_cfg_join.py \
SWMTKN-1-4pu9zc9d81gxxw6mxec5tuxdt8nbarq1qnmfw9zcme1w1tljZh-7w3iwsddvd97ieza3ym1s5gj5 \
10.23.230.151
```

Step 9 On any node, make sure the nodes are healthy.

```
# docker node ls
ID                            HOSTNAME        STATUS      AVAILABILITY    [...]
y90ynithc3cejkeazcqlu1uqs *   node1           Ready       Active          [...]
jt67ag14ug2jgaw4r779882xp     node2           Ready       Active          [...]
hoae55eoute6l5zpqlnxsk8o8     node3           Ready       Active          [...]
```

Confirm the following:

- The `STATUS` field is `Ready` for all nodes.
- The `AVAILABILITY` field is `Active` for all node.
- The `MANAGER STATUS` field is `Leader` for one of the nodes and `Reachable` for the other two.

Step 10 Deploy the cluster.

On any node, execute the `msc_deploy.py` command:

```
# ./msc_deploy.py
```

Step 11 On any node, make sure that all REPLICAS are up.

```
# docker service ls
ID                  NAME                      MODE            REPLICAS    [...]
p6tw9mflj06u        msc_auditservice          replicated      1/1         [...]
je7s2f7xme6v        msc_authyldapservice      replicated      1/1         [...]
dbd27y76eouq        msc_authytacacsservice    replicated      1/1         [...]
untetoygqn1q        msc_backupservice         global          3/3         [...]
n5eibyw67mbe        msc_cloudsecservice       replicated      1/1         [...]
8inekkof982x        msc_consistencyservice    replicated      1/1         [...]
0qeisrguy7co        msc_endpointservice       replicated      1/1         [...]
e8ji15eni1e0        msc_executionengine       replicated      1/1         [...]
s4gnm2vge0k6        msc_jobschedulerservice   replicated      1/1         [...]
av3bjvb9ukru        msc_kong                  global          3/3         [...]
```

```
rqie68m6vf9o        msc_kongdb              replicated      1/1         [...]
51u1g7t6ic33        msc_mongodb1            replicated      1/1         [...]
vrl8xvvx6ky5        msc_mongodb2            replicated      1/1         [...]
0kwk9xw8gu8m        msc_mongodb3            replicated      1/1         [...]
qhejgjn6ctwy        msc_platformservice     global          3/3         [...]
l7co71lneegn        msc_schemaservice       global          3/3         [...]
1t37ew5m7dxi        msc_siteservice         global          3/3         [...]
tu37sw68a1gz        msc_syncengine          global          3/3         [...]
8dr0d7pq6j19        msc_ui                  global          3/3         [...]
swnrzrbcv60h        msc_userservice         global          3/3         [...]
```

Step 12 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

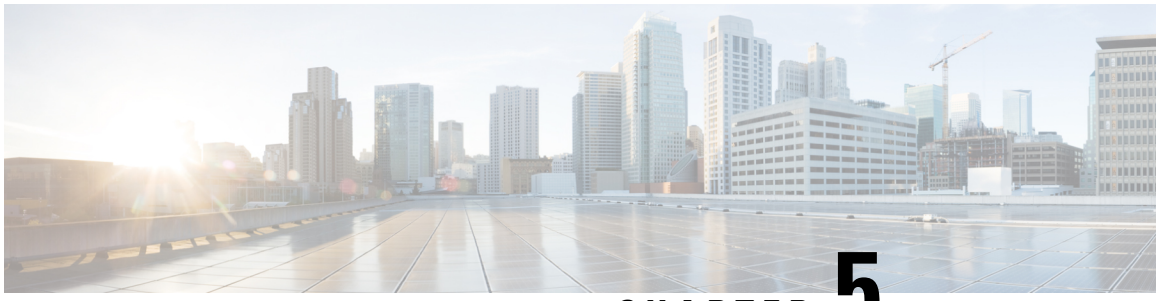
You can access the GUI using any of the 3 nodes' IP addresses.

The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

PART II

Day-0 Operations



CHAPTER 5

Configuring and Adding Sites

This chapter contains the following sections:

Pod Profile and Policy Group

In each site's APIC, you must have one Pod profile with a Pod policy group. If you site does not have a Pod policy group you must create one.

To check if the POD profile contains a POD policy group:

- Navigate to the Cisco APIC GUI, **Fabric** > **Fabric Policies** > **Pods** > **Profiles** > **Pod Profile default**.

To create a POD policy group:

- Navigate to the Cisco APIC GUI, **Fabric** > **Fabric Policies** > **Pods** > **Policy Groups**, right-click **Policy Groups** and click **Create Pod Policy Group**. Enter the appropriate information and click **Submit**.

To assign the new pod policy group to the default POD profile:

- Navigate to the Cisco APIC GUI, **Fabric** > **Fabric Policies** > **Pods** > **Profiles** > **Pod Profile default**. Click on the default, choose the new pod policy group and click **Update**.

Configuring Fabric Access Policies for All APIC Sites

Before your APIC fabrics can be added to and managed by the Multi-Site Orchestrator, there is a number of fabric-specific access policies that you must configure on each site.

Configuring Fabric Access Global Policies

This section describes the global fabric access policy configurations that must be created for each APIC site before it can be added to and managed by the Multi-Site Orchestrator.

Step 1 Log in directly to the site's APIC GUI.

Step 2 From the main navigation menu, select **Fabric** > **Access Policies**.

You must configure a number of fabric policies before the site can be added to the Multi-Site Orchestrator. From the APIC's perspective, this is something you do just like you would if you were connecting a bare-metal host, where you would configure domains, AEPs, policy groups, and interface selectors; you must configure the same options for connecting the spine switch interfaces to the inter-site network for all the sites that will be part of the same Multi-Site domain.

Step 3 Specify the VLAN pool.

The first thing you configure is the VLAN pool. We use Layer 3 sub-interfaces tagging traffic with VLAN-4 to connect the spine switches to the inter-site network.

a) In the left navigation tree, browse to **Pools** > **VLAN**.
b) Right-click the **VLAN** category and choose **Create VLAN Pool**.

In the **Create VLAN Pool** window, specify the following:

- For the **Name** field, specify the name for the VLAN pool, for example `msite`.
- For **Allocation Mode**, specify `Static Allocation`.
- And for the **Encap Blocks**, specify just the single VLAN 4. You can specify a single VLAN by entering the same number in both **Range** fields.

Step 4 Configure Attachable Access Entity Profiles (AEP).

a) In the left navigation tree, browse to **Global Policies** > **Attachable Access Entity Profiles**.
b) Right-click the **Attachable Access Entity Profiles** category and choose **Create Attachable Access Entity Profiles**.

In the **Create Attachable Access Entity Profiles** window, specify the name for the AEP, for example `msite-aep`.

c) Click **Next** and **Submit**

No additional changes, such as interfaces, are required.

Step 5 Configure domain.

The domain you configure is what you will select from the Multi-Site Orchestrator when adding this site.

a) In the left navigation tree, browse to **Physical and External Domains** > **External Routed Domains**.
b) Right-click the **External Routed Domains** category and choose **Create Layer 3 Domain**.

In the **Create Layer 3 Domain** window, specify the following:

- For the **Name** field, specify the name the domain, for example `msite-l3`.
- For **Associated Attachable Entity Profile**, select the AEP you created in Step 4.
- For the **VLAN Pool**, select the VLAN pool you created in Step 3.

c) Click **Submit**.

No additional changes, such as security domains, are required.

What to do next

After you have configured the global access policies, you must still add interfaces policies as described in Configure Fabric Access Interface Policies on Each APIC, on page 41.

Configure Fabric Access Interface Policies on Each APIC

This section describes the fabric access interface configurations that must be done for the Multi-Site Orchestrator on each APIC site.

Before you begin

Configure the global fabric access policies, such as VLAN Pool, AEP, and domain, in the site's APIC, as described in Configuring Fabric Access Global Policies, on page 39.

Step 1 Log in directly to the site's APIC GUI.

Step 2 From the main navigation menu, select **Fabric** > **Access Policies**.

In addition to the VLAN, AEP, and domain you have configured in previous section, you must also create the interface policies for the fabric's spine switch interfaces that connect to the Inter-Site Network (ISN).

Step 3 Configure a spine policy group.

a) In the left navigation tree, browse to **Interface Policies** > **Policy Groups** > **Spine Policy Groups**.

This is similar to how you would add a bare-metal server, except instead of a Leaf Policy Group, you are creating a Spine Policy Group.

b) Right-click the **Spine Policy Groups** category and choose **Create Spine Access Port Policy Group**.

In the **Create Spine Access Port Policy Group** window, specify the following:

- For the **Name** field, specify the name for the policy group, for example `Spine1-PolGrp`.
- For the **Link Level Policy** field, specify the link policy used between your spine switch and the ISN.
- For **CDP Policy**, choose whether you want to enable CDP.
- For the **Attached Entity Profile**, select the AEP you have configured in previous section, for example `msite-aep`.

Then click **Submit**. No additional changes, such as security domains, are required.

Step 4 Configure a spine profile.

a) In the left navigation tree, browse to **Interface Policies** > **Profiles** > **Spine Profiles**.

b) Right-click the **Spine Profiles** category and choose **Create Spine Interface Profile**.

In the **Create Spine Interface Profile** window, specify the following:

- For the **Name** field, specify the name for the profile, for example `Spine1-ISN`.
- For **Interface Selectors**, click the + sign to add the port on the spine switch that connects to the ISN. Then in the **Create Spine Access Port Selector** window, provide the following:
  - For the **Name** field, specify the name for the port selector, for example `Spine1-ISN`.
  - For the **Interface IDs**, specify the switch port that connects to the ISN, for example `5/32`.

- For the **Interface Policy Group**, choose the policy group you created in the previous step, for example `Spine1-PolGrp`.

Then click **OK** to save the port selector.

Then click **Submit** to save the spine interface profile.

Step 5 Configure a spine switch selector policy.

a) In the left navigation tree, browse to **Switch Policies** > **Profiles** > **Spine Profiles**.

b) Right-click the **Spine Profiles** category and choose **Create Spine Profile**.

In the **Create Spine Profile** window, specify the following:

- For the **Name** field, specify the name for the profile, for example `Spine1`.
- For **Spine Selectors**, click the +to add the spine and provide the following:
  - For the **Name** field, specify the name for the selector, for example `Spine1`.
  - For the **Blocks** field, specify the spine node, for example `201`.

Then click **Update** to save the selector.

Then click **Next** and on the next screen select the interface profile you have created in the previous step, for example `Spine1-ISN`.

Finally, click **Finish** to save the spine profile.

What to do next

If your fabrics contain Remote Leaf switches, you will need to make additional fabric-specific configuration changes as described in Configuring Sites That Contain Remote Leaf Switches, on page 42

Configuring Sites That Contain Remote Leaf Switches

Starting with Release 2.1(2), the Multi-Site architecture supports APIC sites with Remote Leaf switches. The following sections describe guidelines, limitations, and configuration steps required to allow Multi-Site Orchestrator to manage these sites.

Multi-Site and Remote Leaf Guidelines and Limitations

If you want to add an APIC site with a Remote Leaf to be managed by the Multi-Site Orchestrator, the following restrictions apply:

- You must upgrade your Cisco APIC to Release 4.1(2) or later.
- You must upgrade your Multi-Site Orchestrator to Release 2.1(2) or later.
- Only physical Remote Leaf switches are supported in this release
- Only -EX and -FX or later switches are supported as Remote Leaf switches for use with Multi-Site:

- Remote Leaf is not supported with back-to-back connected sites without IPN switches
- Remote Leaf switches in one site cannot use another site's L3out
- Stretching a bridge domain between one site and a Remote Leaf in another site is not supported

You must also perform the following tasks before the site can be added to and managed by the Multi-Site Orchestrator:

- You must enable Remote Leaf direct communication and configure routable subnets directly in the site's APIC, as described in the following sections.
- You must add the routable IP addresses of Cisco APIC nodes in the DHCP-Relay configuration applied on the interfaces of the Layer 3 routers connecting to the Remote Leaf switches.

  The routable IP address of each APIC node is listed in the **Routable IP** field of the **System** > **Controllers** > **<controller-name>** screen of the APIC GUI.

Configuring Routable Subnets for Remote Leaf Switches

Before you can add a site that contains one or more Remote Leaf switches to the Multi-Site Orchestrator, you must configure routable subnets for the pod with which the Remote Leaf nodes are associated.

Step 1 Log in directly to the site's APIC GUI.

Step 2 From the menu bar, select **Fabric** > **Inventory**.

Step 3 In the Navigation pane, click **Pod Fabric Setup Policy**.

Step 4 In the main pane, double-click the pod where you want to configure the subnets.

Step 5 In the **Routable Subnets** area, click the **+** sign to add a subnet.

Step 6 Enter the **IP** and **Reserve Address Count**, set the state to `Active` or `Inactive`, then click **Update** to save the subnet.

When configuring routable subnets, you must provide a netmask between `/22` and `/29`.

Step 7 Click **Submit** to save the configuration.

Enabling Direct Communication for Remote Leaf Switches

Before you can add a site that contains one or more Remote Leaf switches to the Multi-Site Orchestrator, you must configure direct remote leaf communication for that site. Additional information about remote leaf direct communication feature is available in the *Cisco APIC Layer 3 Networking Configuration Guide*. This section outlines the steps and guidelines specific to the integration with Multi-Site.

Note Once you enable Remote Leaf switch direct communication, the switches will function in the new mode only

Step 1 Log in directly to the site's APIC.

Step 2 Enable direct traffic forwarding for Remote Leaf switches.

a) From the menu bar, navigate to **System** > **System Settings**.
b) From the left side bar, select **Fabric Wide Setting**.
c) Check the **Enable Remote Leaf Direct Traffic Forwarding** checkbox.

Note You cannot disable this option after you enable it.

d) Click **Submit** to save the changes.

Adding Sites

This section describes how to add sites using the Cisco ACI Multi-Site Orchestrator GUI.

Before you begin

You must have completed the site-specific configurations in each site's APIC, as decribed in previous sections in this chapter.

Step 1 Log in to the Multi-Site GUI, in the **Main menu**, click **Sites**.

If you are logging in for the first time, log in as the **admin** user with the default password **We1come2msc!**, you will then be prompted to change that default password. The new password requirements are:

- At least 12 characters
- At least 1 letter
- At least 1 number
- At least 1 special character apart from * and space

Step 2 In the **Main menu**, select **Infrastructure** > **Sites**.

Step 3 In the top right of the main pane, click **Add Site**.

Step 4 In the **Add Site** screen, provide the site's details.

a) In the **Name** field, enter the site name.
b) In the **Labels** field, choose or create a label.

You can choose to provide multiple labels for the site.

c) In the **APIC Controller URL** field, enter the Cisco APIC URL.

For the APIC URL, you can use the `http` or `https` protocol and the IP address or the DNS hostname, such as`https://<ip-address>` or `https://<dns-hostname>`.

d) If you have a cluster of APICs in the fabric, click **+APIC Controller URL** and provide the additional URLs.
e) In the **Username** field, enter the admin user's username for the site's APIC.
f) In the **Password** field, enter the user's password.
g) You can turn on the **Specify Login Domain for Site** switch, if you want to specify a domain to be used for authenticating the user you provided.

If you turn on this option, enter the domain name in the **Domain Name** field.

h) In the **APIC Site ID** field, enter a unique site ID.

The site ID must be a unique identifier of the Cisco APIC site, ranged between `1` and `127`. Once specified, the site ID cannot be changed without factory resetting Cisco APIC.

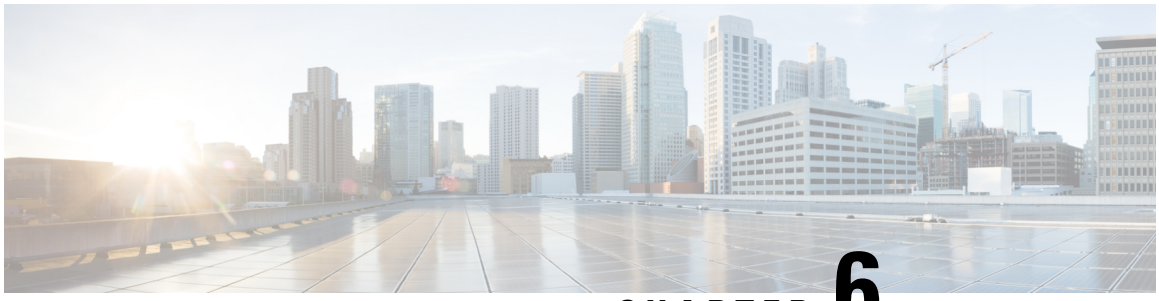
Step 5 Click **Save** to add the site.

Step 6 If prompted, confirm proxy configuration update.

If you have configured the Orchestrator to use a proxy server and are adding an on-premises site that is not already part of the "no proxy" list, the Orchestrator will inform you of the proxy settings update.

For additional information on proxy configuration, see the "Administrative Operations" chapter in *Cisco ACI Multi-Site Configuration Guide*.

Step 7 Repeat these steps to add any additional sites.



CHAPTER 6

Configuring Infra

This chapter contains the following sections:

Configuring Infra Prerequisites and Guidelines

The following sections describe the steps necessary to configure the general as well as site-specific fabric Infra settings.

Before you proceed with Infra configuration, you must have configured and added the sites as described in previous sections, which includes:

- Configuring each site's fabric access policies.
- Configuring direct communication and routable subnets for sites with remote leaf switches.

In addition, keep in mind the following:

- Any infrastructure changes such as adding and removing spine switches or spine node ID changes require a Multi-Site fabric connectivity information refresh described in the Refreshing Site Connectivity Information, on page 48 as part of the general Infra configuration procedures.
- The Overlay Unicast TEP, Overlay Multicast TEP, and BGP-EVPN Router-IDs IP addresses assigned on the Orchestrator should not be taken from the address space of the original fabric's `Infra` TEP pool or from the `0.x.x.x` range.

Configuring Infra: General Settings

This section describes how to configure general Infra settings for all the sites.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, click **Sites**.

Step 3 In the **Sites** view, click **Configure Infra**.

Step 4 In the left pane, under **Settings**, click **General Settings**.

Step 5 From the **BGP Peering Type** dropdown, choose either `full-mesh` or `route-reflector`.

The `route-reflector` option is effective only when all sites are part of the same BGP Autonomous System (AS).

Step 6 In the **Keepalive Interval (Seconds)** field, enter the keep alive interval seconds.

We recommend keeping the default value.

Step 7 In the **Hold Interval (Seconds)** field, enter the hold interval seconds.

We recommend keeping the default value.

Step 8 In the **Stale Interval (Seconds)** field, enter stale interval seconds.

We recommend keeping the default value.

Step 9 Choose whether you want to turn on the **Graceful Helper** option.

Step 10 In the **Maximum AS Limit** field, enter the maximum AS limit.

Step 11 In the **BGP TTL Between Peers** field, enter the BGP TTL between peers.

Refreshing Site Connectivity Information

Any infrastructure changes, such as adding and removing spines or changing spine node IDs, require a Multi-Site fabric connectivity site refresh. This section describes how to pull up-to-date connectivity information directly from each site's APIC.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, select **Infrastructure** > **Infra Configuration**.

Step 3 In the top right of the main **Infra Configuration** view, click the **Configure Infra** button.

Step 4 In the left pane, under **Sites**, select a specific site.

Step 5 In the main window, click the **Reload Site Data** button to pull fabric information from the APIC.

Step 6 (Optional) In the **Confirmation** dialog, check the box if you want to remove configuration for decommissioned spine switch nodes.

If you choose to enable this checkbox, all configuration info for any currently decommissioned spine switches will be removed from the database.

Step 7 Finally, click **Yes** to confirm and load the connectivity information.

This will discover any new or removed spines and all site-related fabric connectivity will be re-imported from the APIC.

Configuring Infra Site-Specific Settings

This section describes how to configure site-specific Infra settings for each site.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, click **Sites**.

Step 3 In the **Sites** view, click **Configure Infra**.

Step 4 In the left pane, under **Sites**, select a specific site.

Step 5 In the right ***<Site>*** **Settings** pane, enable the site by setting the **ACI Multi-Site** knob to `On`.

Step 6 (Optional) Turn on CloudSec encryption for the site.

CloudSec Encryption provides inter-site traffic encryption. The "Infrastructure Management" chapter in the *Cisco ACI Multi-Site Configuration Guide* covers this feature in detail.

Step 7 Specify the **Overlay Multicast TEP**.

This address is used for the inter-site L2 BUM and L3 multicast traffic. This IP address is deployed on all spine switches that are part of the same fabric, regardless of whether it is a single Pod or Multi-Pod fabric.

Step 8 Specify the **BGP Autonomous System Number**.

Step 9 Specify the **BGP Password**.

Step 10 Specify the **OSPF Area ID**.

When configuring the Multi-Site infra OSPF details, we recommend that you use OSPF Area `0`. If you use an Area ID other than `0`, in the next step configure it as a `regular` OSPF area type and not a `stub` area type.

Step 11 Select the **OSPF Area Type** from the dropdown menu.

The OSPF area type can be one of the following:

- `nssa`
- `regular`
- `stub`

Step 12 Select the external routed domain from the dropdown menu.

Choose an external router domain that you have created in the APIC GUI.

Step 13 Configure OSPF settings for the site.

You can either click an existing policy (for example, `msc-ospf-policy-default`) to modify it or click **+Add Policy** to add a new OSPF policy. Then in the **Add/Update Policy** window, specify the following:

- In the **Policy Name** field, enter the policy name.
- In the **Network Type** field, choose either `broadcast`, `point-to-point`, or `unspecified`.

  The default is `broadcast`.
- In the **Priority** field, enter the priority number.

  The default is `1`.

- In the **Cost of Interface** field, enter the cost of interface.

  The default is `0`.

- From the **Interface Controls** dropdown menu, choose one of the following:
  - **advertise-subnet**
  - **bfd**
  - **mtu-ignore**
  - **passive-participation**
- In the **Hello Interval (Seconds)** field, enter the hello interval in seconds.

  The default is `10`.

- In the **Dead Interval (Seconds)** field, enter the dead interval in seconds.

  The default is `40`.

- In the **Retransmit Interval (Seconds)** field, enter the retransmit interval in seconds.

  The default is `5`.

- In the **Transmit Delay (Seconds)** field, enter the transmit delay in seconds.

  The default is `1`.

Configuring Infra: Cloud Site Settings

This section describes how to configure site-specific Infra settings for Cloud APIC sites.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, select **Infrastructure** > **Infra Configuration**.

Step 3 In the top right of the main pane, click **Configure Infra**.

Step 4 In the left pane, under **Sites**, select a specific cloud site.

Most of the information in the cloud site area is automatically populated and cannot be changed, with the exception of the BGP password field.

Step 5 In the right **<*Site*> Settings** pane, enable the **ACI Multi-Site** knob to manage the site from the Orchestrator.

Step 6 Specify the **BGP Password**.

Configuring Infra: Pod Settings

This section describes how to configure pod-specific settings in each site.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, click **Sites**.

Step 3 In the **Sites** view, click **Configure Infra**.

Step 4 In the left pane, under **Sites**, select a specific site.

Step 5 In the main window, select a pod.

Step 6 In the right **POD Properties** pane, add the Overlay Unicast TEP for the POD.

This IP address is deployed on all spine switches that are part of the same pod and used for intersite known unicast traffic.

Step 7 Click **+Add TEP Pool** to add a routable TEP pool.

The routable TEP pools are used for public IP addresses for inter-site connectivity.

Step 8 Repeat the procedure for every pod in the site.

Configuring Infra: Spine Switches

This section describes how to configure spine switches in each site for Cisco ACI Multi-Site.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 In the **Main menu**, click **Sites**.

Step 3 In the **Sites** view, click **Configure Infra**.

Step 4 In the left pane, under **Sites**, select a specific site.

Step 5 In the main window, select a spine switch within a pod.

Step 6 In the right **<*Spine*> Settings** pane, click **+Add Port**.

Step 7 In the **Add Port** window, enter the following information:

- In the **Ethernet Port ID** field, enter the port ID, for example `1/29`.
- In the **IP Address** field, enter the IP address/netmask.

  The Orchestrator creates a sub-interface with VLAN 4 with the specified IP ADDRESS under the specified PORT.
- In the **MTU** field, enter the MTU. You can specify either `inherit` or a value between `576` and `9000`.

  MTU of the spine port should match MTU on IPN side.
- In the **OSPF Policy** field, choose the OSPF policy for the switch that you have configured in Configuring Infra Site-Specific Settings, on page 49.

  OSPF settings in the OSPF policy you choose should match on IPN side.
- For **OSPF Authentication**, you can pick either `none` or one of the following:
  - `MD5`
  - `Simple`

Step 8 Enable **BGP Peering** knob.

In a single Pod fabric with more than two spine switches, BGP peering should only be enabled on a pair (for redundancy) of spine switches called **BGP Speakers**. All other spine switches should have BGP peering disabled and will function as **BGP Forwarders**.

In a Multi-Pod fabric BGP peering should only be enabled on a couple of BGP speaker spine switches, each deployed in a different Pod. All other spines switches should have BGP peering disabled and function as BGP forwarders.

Step 9 In the **BGP-EVPN Router-ID** field, provide the IP address used for BGP-eVPN session between sites.

Step 10 Repeat the procedure for every spine switch.

Deploying Infra Configuration

This section describes how to deploy the Infra configuration to each APIC site.

In the top right of the main pane, choose the appropriate **Deploy** option to deploy the configuration.

If you are configuring only on-premises or only cloud sites, simply click **Deploy** to deploy the Infra configuration.

However, if you have both, on-premises and cloud site, the following two additional options become available:

- **Deploy & Download IPN Device config files:** Pushes the configuration to both the on-premises APIC site and the cloud site and enables the end-to-end interconnect between the on-premises and the cloud sites.

  In addition, this option downloads a zip file that contains configuration information that you will use to enable connectivity between the Cisco Cloud Services Router (CSR) deployed in your cloud sites and the on-premises IPsec termination device. A followup screen appears that allows you to select all or some of the configuration files to download.

- **Download IPN Device config files only:** Downloads a zip file that contains configuration information that you will use to enable connectivity between the Cisco Cloud Services Router (CSR) without deploying the configuration.

Enabling Connectivity Between On-Premises and Cloud Sites

If you have only on-premises or only cloud sites, you can skip this section.

This section describes how to enable connectivity between on-premises APIC sites and Cloud APIC sites.

By default, the Cisco Cloud APIC will deploy a pair of redundant Cisco Cloud Services Router 1000Vs. The procedures in this section creates two tunnels, one IPsec tunnel from the on-premises IPsec device to each of these Cisco Cloud Services Router 1000Vs.

The following information provides commands for Cisco Cloud Services Router 1000V as your on-premises IPsec termination device. Use similar commands if you are using a different device or platform.

Step 1 Gather the necessary information that you will need to enable connectivity between the CSRs deployed in the cloud site and the on-premises IPsec termination device.

You can get the required configuration details using either the **Deploy & Download IPN Device config files** or the **Download IPN Device config files only** option in ACI Multi-Site Orchestrator as part of the procedures provided in Deploying Infra Configuration, on page 52.

Step 2 Log into the on-premises IPsec device.

Step 3 Configure the tunnel for the *first* CSR.

Details for the first CSR are available in the configuration files for the ISN devices you downloaded from the Multi-Site Orchestrator.

In the following example, replace:

- <*first-CSR-tunnel-ID*> with a unique tunnel ID that you assign to this tunnel.
- <*first-CSR-elastic-IP-address*> with the elastic IP address of the third network interface of the first CSR.
- <*first-CSR-preshared-key*> with the preshared key of the first CSR.
- <*interface*> with the interface that is used for connecting to the Cisco Cloud Services Router 1000V deployed in Amazon Web Services.
- <*peer-tunnel-for-onprem-IPsec-to-first-CSR*> with the peer tunnel IP address for the on-premises IPsec device to the first cloud CSR.
- <*process-id*> with the OSPF process ID.
- <*area-id*> with the OSPF area ID.

```
crypto isakmp policy 1
    encryption  aes
    authentication pre-share
    group  2
    lifetime 86400
    hash sha
exit

crypto keyring infra:overlay-1-<first-CSR-tunnel-ID>
    pre-shared-key address <first-CSR-elastic-IP-address> key <first-CSR-preshared-key>
exit

crypto isakmp profile infra:overlay-1-<first-CSR-tunnel-ID>
    local-address <interface>
    match identity address <first-CSR-elastic-IP-address>
    keyring infra:overlay-1-<first-CSR-tunnel-ID>
exit

crypto ipsec transform-set infra:overlay-1-<first-CSR-tunnel-ID> esp-aes esp-sha-hmac
    mode tunnel
exit

crypto ipsec profile infra:overlay-1-<first-CSR-tunnel-ID>
    set pfs group2
    set security-association lifetime seconds 86400
exit

interface tunnel <first-CSR-tunnel-ID>
    ip address <peer-tunnel-for-onprem-IPsec-to-first-CSR> 255.255.255.252
    ip virtual-reassembly
    tunnel source <interface>
    tunnel destination <first-CSR-elastic-IP-address>
    tunnel mode ipsec ipv4
```

```
    tunnel protection ipsec profile infra:overlay-1-<first-CSR-tunnel-ID>
    ip mtu 1476
    ip tcp adjust-mss 1460
    ip ospf <process-id> area <area-id>
    no shut
exit
```

Example:

```
crypto isakmp policy 1
    encryption  aes
    authentication pre-share
    group  2
    lifetime 86400
    hash sha
exit

crypto keyring infra:overlay-1-1000
    pre-shared-key address 192.0.2.20 key 12345678900987654321234567890
exit

crypto isakmp profile infra:overlay-1-1000
    local-address GigabitEthernet1
    match identity address 192.0.2.20
    keyring infra:overlay-1-1000
exit

crypto ipsec transform-set infra:overlay-1-1000 esp-aes esp-sha-hmac
    mode tunnel
exit

crypto ipsec profile infra:overlay-1-1000
    set pfs group2
    set security-association lifetime seconds 86400
exit

interface tunnel 1000
    ip address 30.29.1.2 255.255.255.252
    ip virtual-reassembly
    tunnel source GigabitEthernet1
    tunnel destination 192.0.2.20
    tunnel mode ipsec ipv4
    tunnel protection ipsec profile infra:overlay-1-1000
    ip mtu 1476
    ip tcp adjust-mss 1460
    ip ospf 1 area 1
    no shut
exit
```

Step 4 Configure the tunnel for the *second* CSR.

Details for the second CSR are also available in the configuration files for the ISN devices you downloaded from the Multi-Site Orchestrator.

```
crypto isakmp policy 1
    encryption  aes
    authentication pre-share
    group  2
    lifetime 86400
    hash sha
exit

crypto keyring infra:overlay-1-<second-CSR-tunnel-ID>
    pre-shared-key address <second-CSR-elastic-IP-address> key <second-CSR-preshared-key>
exit
```

```
crypto isakmp profile infra:overlay-1-<second-CSR-tunnel-ID>
    local-address <interface>
    match identity address <second-CSR-elastic-IP-address>
    keyring infra:overlay-1-<second-CSR-tunnel-ID>
exit

crypto ipsec transform-set infra:overlay-1-<second-CSR-tunnel-ID> esp-aes esp-sha-hmac
    mode tunnel
exit

crypto ipsec profile infra:overlay-1-<second-CSR-tunnel-ID>
    set pfs group2
    set security-association lifetime seconds 86400
exit

interface tunnel <second-CSR-tunnel-ID>
    ip address <peer-tunnel-for-onprem-IPsec-to-second-CSR> 255.255.255.252
    ip virtual-reassembly
    tunnel source <interface>
    tunnel destination <second-CSR-elastic-IP-address>
    tunnel mode ipsec ipv4
    tunnel protection ipsec profile infra:overlay-1-<second-CSR-tunnel-ID>
    ip mtu 1476
    ip tcp adjust-mss 1460
    ip ospf <process-id> area <area-id>
    no shut
exit
```

Example:

```
crypto isakmp policy 1
    encryption  aes
    authentication pre-share
    group  2
    lifetime 86400
    hash sha
exit

crypto keyring infra:overlay-1-1001
    pre-shared-key address 192.0.2.21 key 12345678900987654321234567891
exit

crypto isakmp profile infra:overlay-1-1001
    local-address GigabitEthernet1
    match identity address 192.0.2.21
    keyring infra:overlay-1-1001
exit

crypto ipsec transform-set infra:overlay-1-1001 esp-aes esp-sha-hmac
    mode tunnel
exit

crypto ipsec profile infra:overlay-1-1001
    set pfs group2
    set security-association lifetime seconds 86400
exit

interface tunnel 1001
    ip address 30.29.1.6 255.255.255.252
    ip virtual-reassembly
    tunnel source GigabitEthernet1
    tunnel destination 192.0.2.21
    tunnel mode ipsec ipv4
    tunnel protection ipsec profile infra:overlay-1-1001
```

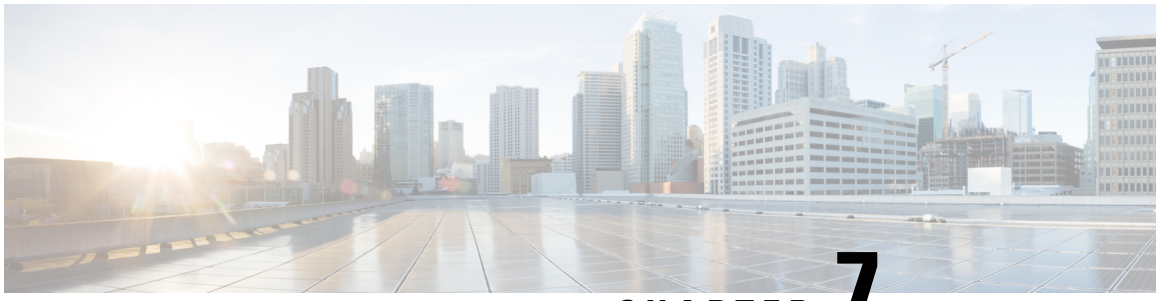
```
    ip mtu 1476
    ip tcp adjust-mss 1460
    ip ospf 1 area 1
    no shut
exit
```

Step 5 Repeat these steps for any additional CSRs that you need to configure.

Step 6 Verify that the tunnels are up on your on-premises IPsec device.

Use the following command to display the status. If you do not see that both tunnels are shown as up, verify the information that you entered in the steps in this section to determine where you might have an issue. Do not proceed to the next section until you see that both tunnels are shown as up.

```
ISN_CSR# show ip interface brief | include Tunnel
Interface              IP-Address      OK? Method Status                Protocol
Tunnel1000             30.29.1.2         YES manual up                    up
Tunnel1001             30.29.1.4         YES manual up                    up
```



CHAPTER 7

Adding Tenants and Schemas

This chapter contains the following sections:

Adding Tenants

This section describes how to add tenants using the Multi-Site Orchestrator GUI.

Before you begin

You must have a user with either `Power User` or `Site Manager` read-write role to create and manage tenants.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

Step 2 From the left navigation pane, select **Tenants**.

Step 3 In the main pane, click **Add Tenant**.

Step 4 In the **Display Name** field, provide the tenant's name.

The tenant's **Display Name** is used throughout the Orchestrator's GUI whenever the tenant is shown. However, due to object naming requirements on the Cisco APIC, any invalid characters are removed and the resulting **Internal Name** is used when pushing the tenant to sites. The **Internal Name** that will be used when creating the tenant is displayed below the **Display Name** textbox.

You can change the **Display Name** of the tenant at any time, but the **Internal Name** cannot be changed after the tenant is created.

Step 5 (Optional) In the **Description** field, enter a description of the tenant.

Step 6 In the **Associated Sites** section, add the sites.

a) Check all sites where you plan to deploy templates that use this tenant.

Only the selected sites will be available for any templates using this tenant.

b) From the **Security Domains** drop-down list, choose the site's security domains.

Security domains are created using the Cisco APIC GUI and can be assigned to various Cisco APIC policies and user accounts to control their access. For more information, see the *Cisco APIC Basic Configuration Guide*.

Step 7 In the **Associated Users** section, add Orchestrator users.

Only the selected users will be able to use this tenant when creating templates.

Step 8 (Optional) Enable consistency checker scheduler.

You can choose to enable regular consistency checks. For more information about the consistency checker feature, see *Cisco ACI Multi-Site Troubleshooting Guide*.

Step 9 Click **SAVE** to finish adding the tenant.

Adding Schemas

This section describes how to add schemas using the Cisco ACI Multi-Site Orchestrator GUI.

Step 1 Log in to the Cisco ACI Multi-Site Orchestrator GUI, in the **Main menu**, click **Schemas**.

Step 2 In the **Schemas List** area, click **ADD SCHEMA**.

Step 3 In the **Untitled Schema** field, enter the new schema's name.

Step 4 Select a tenant.

In the main window pane, click **To build your schema please click here to select a tenant** then select a tenant from the **SELECT A TENANT** drop-down list.

Step 5 (Optional) Import fabric elements.

You can create new objects and push them out to one or more sites or you can import existing site-local objects and manage them using the Multi-Site Orchestrator. To import existing objects:

a) Click **IMPORT** button.
b) Select the site from which you want to import objects
c) In the **Import** window that opens, select one or more objects you want to import.

Note The names of the objects imported into the Multi-Site Orchestrator must be unique across all sites. Importing different objects with duplicate names will cause a schema validation error and the import to fail. If you want to import objects that have the same name, you must first rename them.

Step 6 Add new fabric elements.

a) Click **+ Application profile**, in the **Master List**, enter the application profile name.
b) Click **+ Add EPG** field, in the **Master List**, perform the following actions:

1. In the **DISPLAY NAME** field, enter the EPG name.
2. Click **ADD SUBNET**, in the **Add Subnet** pane, perform the following actions:
   a. In the **GATEWAY IP** field, enter the gateway IP/netmask.
   b. In the **DESCRIPTION** field, enter a brief description.
   c. In the **SCOPE** section, choose **Private to VRF** or **Advertised Externally** radio button.
   d. In the **SHARED BETWEEN VRFS** section, place a check in the check box to share between VRFs.

e. In the **NO DEFAULT SVI GATEWAY** section, place a check in the check box to not have a default SVI gateway.

f. Click **SAVE**.

g. Repeat 3d to create another EPG. You should have two EPGs.

c) In the **BRIDGE DOMAIN** field, from the drop-down list, choose a bridge domain or enter a bridge domain name to create one.

d) Click **+ CONTRACT** field, perform the following actions:

1. In the **CONTRACT** field, from the drop-down list, choose a contract or enter a contract name to create one.
2. In the **TYPE** field, from the drop-down list, choose **consumer**.
3. Click **SAVE**.

e) Click **ADD CONTRACT** field to add a second contract, perform the following actions:

1. In the **CONTRACT** field, from the drop-down list, choose a contract or enter a contract name to create one.
2. In the **TYPE** field, from the drop-down list, choose **provider**.
3. Click **SAVE**.

f) Click **+ VRF**, in the **Master List**, perform the following actions:

1. In the **DISPLAY NAME** field, enter the VRF name.

g) Click **+ Add Bridge Domain**, in the **Master List**, perform the following actions:

1. In the **DISPLAY NAME** field, enter the bridge domain name.
2. In the **VIRTUAL ROUTING & FORWARDING** field, from the drop-down list, choose a VRF name or enter a VRF name to create one.
3. In the **L2STRETCH** section, place a check in the check box to enable Layer 2 stretch.
4. In the **INTERSITEBUMTRAFFICALLOW** section, place a check in the check box to allow intersite BUM traffic.
5. In the **L2UNKNOWNUNICAST** field, from the drop-down list, choose **proxy** or **flood**.
6. Click **[+] Add Subnet**, perform the following actions:

a. In the **GATEWAY IP** field, enter the gateway IP address/netmask.

b. In the **DESCRIPTION** field, enter a brief description of the subnet.

c. In the **SCOPE** field, choose **Private to VRF** or **Advertised Externally**.

d. In the **SHARED BETWEEN VRFS** section, place a check in the check box to share between VRFs.

e. In the **NO DEFAULT SVI GATEWAY** section, place a check in the check box to not have a default SVI gateway.

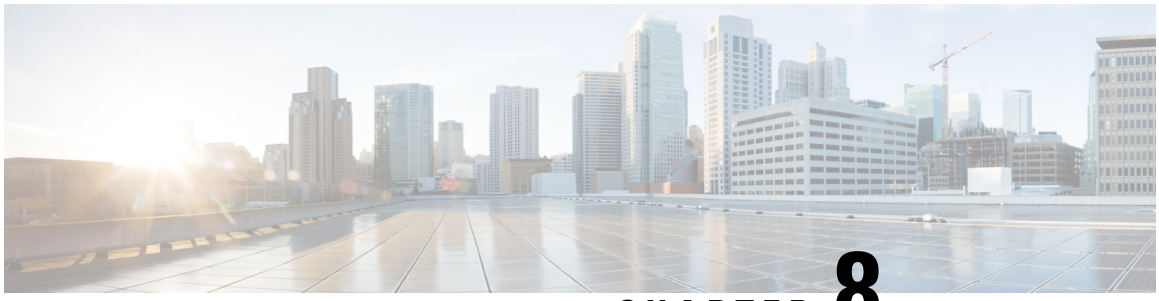
f. In the **QUERIER** section, place a check in the check box to querier.

g. Click **OK**.

h) Click **Sites +**, place a check in the check box for each site.
i) Click **SAVE**.
j) Click **Click DEPLOY TO SITES**.

PART III

Cluster Upgrades and Downgrades



CHAPTER 8

Upgrading or Downgrading Orchestrator Deployments in Application Service Engine

This chapter contains the following sections:

Prerequisites and Guidelines

This section describes how to upgrade or downgrade a 3-node Cisco ACI Multi-Site Orchestrator cluster that was deployed in Cisco Application Service Engine. If your Orchestrator cluster was deployed in VMware ESX VMs, see the Upgrading Orchestrator Deployments in VMware ESX , on page 69 chapter. If you deployed a single-node Orchestrator (for example, for testing purposes), the upgrade procedure differs slightly and is described in Installing Single Node Orchestrator, on page 85 chapter instead.

Before you upgrade your Cisco ACI Multi-Site Orchestrator cluster, you must:

- Ensure that you are running at least Cisco ACI Multi-Site Orchestrator, Release 2.2(3). If you are running an earlier release, your cluster was deployed in VMware ESX VMs and you must follow the Upgrading Orchestrator Deployments in VMware ESX , on page 69 chapter instead.
- Ensure that your current Cisco ACI Multi-Site Orchestrator installation is running properly.

The following sections provide steps specific to upgrading, however the same exact procedure can be used to switch to an earlier image to downgrade your installation. Keep in mind however, the Application Service Engine deployments cannot be downgraded to a release prior to Release 2.2(3).

Cisco ACI Multi-Site and Cisco APIC Interoperability Support

Prior to Release 2.2(1), you were required to run the same APIC versions in all sites and the version of the Orchestrator that corresponded to that APIC release. During fabric upgrade you were also required to upgrade all the APIC sites first before upgrading the Multi-Site Orchestrator. For example, if you were upgrading the fabrics from APIC Release 4.0(1) to Release 4.1(1), you had to remain on Release 2.0(1) of the Orchestrator until all sites were on APIC Release 4.1(1).

Starting with Release 2.2(1), Multi-Site Orchestrator releases have been decoupled from the APIC releases. The APIC clusters in each site as well as the Orchestrator itself can now be upgraded independently of each other and run in mixed operation mode.

Mixed operation mode is supported for sites running any of the following APIC releases:

- 3.2(6) or later
- 4.0(1) or later
- 4.1(1) or later
- 4.2(1) or later

However, keep in mind that if you upgrade the Orchestrator before upgrading the APIC clusters in one or more sites, the new Orchestrator features may not yet be supported by an earlier APIC release. In that case a check is performed on each template to ensure that every configured option is supported by the target sites. The check is performed when you save a template or deploy a template. If the template is already assigned to a site, any unsupported configuration options will not be saved; if the template is not yet assigned, you will be able to assign it to a site, but not be able to save or deploy the schema if it contains configuration unsupported by the site. In case an unsupported configuration is detected, an error message will show, for example: `This APIC site version <site-version> is not supported by MSO. The minimum version required for this <feature> is <required-version> or above.`

The following table lists the features and the minimum required APIC release for each one:

Feature	Minimum APIC Version
ACI Multi-Pod Support	Release 3.2(6)
Service Graphs (L4-L7 Services)	Release 3.2(6)
External EPGs	Release 3.2(6)
ACI Virtual Edge VMM Support	Release 3.2(6)
DHCP Support	Release 3.2(6)
Consistency Checker	Release 3.2(6)
CloudSec Encryption	Release 4.0(1)
Layer 3 Multicast	Release 4.0(1)
MD5 Authentication for OSPF	Release 4.0(1)
EPG Preferred Group	Release 4.0(2)
Host Based Routing	Release 4.1(1)
Intersite L3Out	Release 4.2(1)

Upgrading Multi-Site Orchestrator on Service Engine

This section describes how to upgrade Cisco ACI Multi-Site Orchestrator that is deployed on Cisco Application Service Engine.

Before you begin

- Ensure that you have completed the prerequisites described in Prerequisites and Guidelines, on page 69

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the ACI Multi-Site Orchestrator download page on Cisco DC App Center.

b) Click **Download** to download the image.

Step 2 Make the image accessible by the Orchestrator.

Note This release supports GUI image upload from an HTTP or HTTPS server only, so you must either make the image available on a web server accessible by the Orchestrator or manually upload the image to the Application Server Engine where the Orchestrator is hosted.

If you have a web server running in your environment, simply host the `.aci` image you downloaded on that server and proceed to the next step.

Otherwise, to manually upload the image:

a) Copy the application to the Application Service Engine.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), or you have enabled password-based logins for your AWS (`.ami`) deployment, use the following command to copy the Orchestrator image into the `tmp` directory on the Services Engine:

```
# scp <app-local-path> rescue-user@<service-engine-ip>:/tmp/
```

However, if your Service Engine is deployed in AWS and you have not enabled password-based login, you must use the certificate (`.pem`) file that you created during the Application Services Engine deployment:

```
# scp -i <pem-file-name>.pem <app-local-path>.aci rescue-user@<service-engine-ip>:/tmp/
```

For example, assuming you're running the `scp` command from the same directory where you saved the Orchestrator image:

- For password-based authentication:

```
# scp ./cisco-mso-2.2.3c.aci rescue-user@10.30.11.147:/tmp/
```

- For PEM-based authentication:

```
# scp -i <pem-file-name>.pem ./cisco-mso-2.2.3c.aci rescue-user@10.30.11.147:/tmp/
```

b) Log in to your Service Engine as `rescue-user`.

If your Cisco Application Service Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), simply SSH in using the following command:

```
# ssh rescue-user@<service-engine-ip>
```

However, if your Application Service Engine is deployed in AWS (`.ami`), you must login using the certificate (`.pem` file) that you created during the Application Service Engine deployment:

```
# ssh -i <pem-file-name>.pem rescue-user@<service-engine-ip>
```

c) Add the new image.

In the following command, replace <*application-path*> with the full path to the application image you copied in the previous step.

```
# acidiag app install <application-path>
```

For example:

```
# acidiag app install /tmp/cisco-mso-2.2.3c.aci
```

d) Verify that the application was loaded.

Use the following command to check the `operState` of the application.

While the application is loading and installing it will go through a number of operational states, which will be reflected in the `operState` field, for example `'operState': 'Initialize'`. This process can take up to 20 minutes and you must ensure that the state changes to `Disabled` before proceeding to the next step.

```
# acidiag app show
[   {   'adminState': 'Disabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'PostInstall',
        'operState': 'Disabled',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

Step 3 Log in to your Orchestrator.

Step 4 From the left navigation pane, select **Admin** > **Firmware Management**.

Step 5 Add the new image to the Application Service Engine cluster.

Note If you manually uploaded the image to the Service Node cluster, the image will be already available and you can skip this step.

a) In the main window, click **Add Image**.

An **Add Image** window opens.

b) In the **File Path** field, provide the URL to the new Orchestrator image.

For example, `https://www.my-web-server.com/mso/cisco-mso-2.2.3c.aci`.

c) Click **OK** to add the image.

The image will be uploaded to the Orchestrator's Service Engine nodes, unpacked, processed, and made available for the upgrade. The whole process may take several minutes and you will be able to see the status of the image.

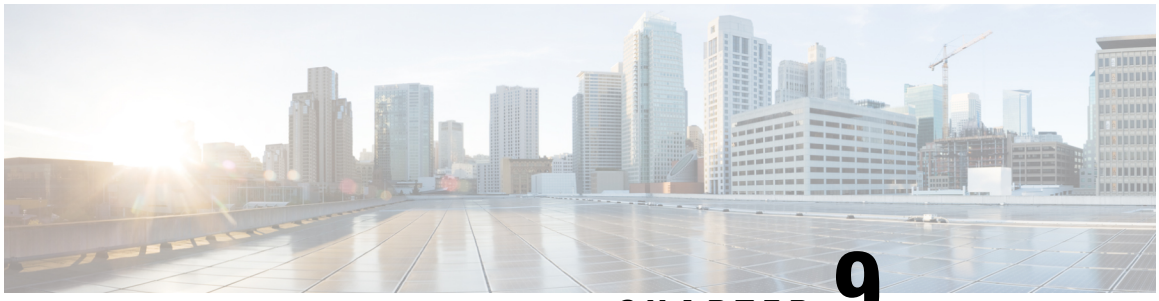
Wait for the status to change to `Available` before proceeding to the next step.

Step 6 Activate the new image.

Ensure that the new image's status is `Available`.

a) In the main window, click the actions menu next to the image you added.
b) Then click **Activate**.
c) In the **Activation Confirmation** window, click **Continue**.

It may take up to 20 additional minutes for all the Orchestrator services to start and the GUI to become available. The page automatically reloads when the process is completed.



CHAPTER 9

Upgrading Orchestrator Deployments in VMware ESX

This chapter contains the following sections:

Prerequisites and Guidelines

This section describes how to upgrade a 3-node Cisco ACI Multi-Site Orchestrator cluster that was deployed in VMware ESX VMs. If your Orchestrator cluster was deployed in Cisco Application Service Engine, see the Upgrading Multi-Site Orchestrator on Service Engine, on page 64 chapter. If you deployed a single-node Orchestrator (for example, for testing purposes), the upgrade procedure differs slightly and is described in Installing Single Node Orchestrator, on page 85 chapter instead.

Before you upgrade your Cisco ACI Multi-Site Orchestrator cluster, you must:

- Ensure that you are running at least Cisco ACI Multi-Site Orchestrator, Release 1.2(1). If you are running an earlier release, you must first upgrade it as described in *Upgrading Cisco ACI Multi-Site Orchestrator to Release 1.2(x)*.
- Ensure that your current Cisco ACI Multi-Site Orchestrator installation is running properly and each node in the cluster has at least 19 GB of free disk space.
- Ensure that all Cisco ACI Multi-Site Orchestrator node VMs have been upgraded to any new minimum CPU and RAM requirements that are listed in Prerequisites and Guidelines, on page 17.

  When upgrading the virtual machines:

  - It is recommended that all virtual machine CPU and RAM changes are done when the VM is powered down, as such we recommend updating the VMs one at a time to ensure that the cluster remains available.
  - Do not change the hard disk size of the Cisco ACI Multi-Site Orchestrator VMs.
- Ensure that you have set up the Python environment as described in Setting Up Python Environment, on page 19.
- If you are upgrading from a release prior to Release 2.1(1), configure at least 10GHz CPU cycle reservation for each Orchestrator VM.

Specific steps are described as part of the upgrade procedure.

Cisco ACI Multi-Site and Cisco APIC Interoperability Support

Prior to Release 2.2(1), you were required to run the same APIC versions in all sites and the version of the Orchestrator that corresponded to that APIC release. During fabric upgrade you were also required to upgrade all the APIC sites first before upgrading the Multi-Site Orchestrator. For example, if you were upgrading the fabrics from APIC Release 4.0(1) to Release 4.1(1), you had to remain on Release 2.0(1) of the Orchestrator until all sites were on APIC Release 4.1(1).

Starting with Release 2.2(1), Multi-Site Orchestrator releases have been decoupled from the APIC releases. The APIC clusters in each site as well as the Orchestrator itself can now be upgraded independently of each other and run in mixed operation mode.

Mixed operation mode is supported for sites running any of the following APIC releases:

- 3.2(6) or later
- 4.0(1) or later
- 4.1(1) or later
- 4.2(1) or later

However, keep in mind that if you upgrade the Orchestrator before upgrading the APIC clusters in one or more sites, the new Orchestrator features may not yet be supported by an earlier APIC release. In that case a check is performed on each template to ensure that every configured option is supported by the target sites. The check is performed when you save a template or deploy a template. If the template is already assigned to a site, any unsupported configuration options will not be saved; if the template is not yet assigned, you will be able to assign it to a site, but not be able to save or deploy the schema if it contains configuration unsupported by the site. In case an unsupported configuration is detected, an error message will show, for example: `This APIC site version <site-version> is not supported by MSO. The minimum version required for this <feature> is <required-version> or above.`

The following table lists the features and the minimum required APIC release for each one:

Feature	Minimum APIC Version
ACI Multi-Pod Support	Release 3.2(6)
Service Graphs (L4-L7 Services)	Release 3.2(6)
External EPGs	Release 3.2(6)
ACI Virtual Edge VMM Support	Release 3.2(6)
DHCP Support	Release 3.2(6)
Consistency Checker	Release 3.2(6)
CloudSec Encryption	Release 4.0(1)
Layer 3 Multicast	Release 4.0(1)
MD5 Authentication for OSPF	Release 4.0(1)

Feature	Minimum APIC Version
EPG Preferred Group	Release 4.0(2)
Host Based Routing	Release 4.1(1)
Intersite L3Out	Release 4.2(1)

Upgrading Cisco ACI Multi-Site Orchestrator Using Python

The following sections describe how to prepare for and upgrade Cisco ACI Multi-Site Orchestrator using Python.

Setting Up Python Environment

This section describes how to set up the Python environment for deploying Cisco ACI Multi-Site Orchestrator using Python. You must set up the Python environment on the laptop or server from which you will run the installation scripts.

Note If you have already set up your python environment, for example for another Multi-Site deployment or upgrade, you can skip this section.

Before you begin

you will need:

- A laptop or a server from which you will run the scripts.

  You must not use any of the Multi-Site Orchestrator nodes for this purpose.

- Python already installed on the system from which you will run the scripts.

  If you are using Python 2.x, ensure it is version 2.7.14 or later.

  If you are using Python 3.x, ensure it is version 3.4 or later.

Step 1 Download the **ACI Multi-Site Tools** image from Cisco ACI Multi-Site Software Download link.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Tools Image* file (`tools-msc-<version>.tar.gz`).

Step 2 Extract the files.

```
# tar -xvzf tools-msc-<version>.tar.gz
```

Step 3 Change to the extracted directory.

```
# cd tools-msc-<version>
```

Step 4 Verify that you are running a correct version of Python.

- If you are using Python 2.x, ensure it is version 2.7.14 or later.

```
# python -V
Python 2.7.5
```

- If you are using Python 3.x, ensure it is version 3.4 or later.

```
# python3 -V
Python 3.4.5
```

Step 5 If you plan to use a proxy to access the Internet, make sure to configure the proxy as follows:

```
# export http_proxy=<proxy-ip-address>:<proxy-port>
```

Step 6 Install or update the Python package manager.

If you are using Python 3.x, replace `python` with `python3` in the following commands.

```
# python -m ensurepip
```

If the package is already installed, update it to the latest version:

```
# python -m ensurepip --upgrade
```

Step 7 (Optional) Set up Python virtual environment.

We recommend using `virutalenv` to install the packages, so they do not impact the existing packages in the system. The following steps provide a brief overview of how to set up `virutalenv`. For additional information on how to use `virtualenv`, see Installing packages using pip and virtualenv.

a) Install `virtualenv`.

```
# python -m pip install --user virtualenv
```

b) Change into the directory where you want the virtual environment files to be created.

c) Create a virtual environment.

In the following command, provide a name for the virtual environment, for example *mso-deployments*.

If you are using Python 2.x, use `virtualenv`:

```
# python -m virtualenv <env-name>
```

If you are using Python 3.x, use `venv`:

```
# python3 -m venv <env-name>
```

d) Activate the virtual environment.

You need to activate the virtual environment you created before installing the packages required for Orchestrator deployment or upgrade in the next step.

For Windows:

```
# .\<env-name>\Scripts\activate.bat
```

For Linux:

```
# source ./<env-name>/bin/activate
```

Step 8 Install the required packages.

The required packages are listed in the `requirements.txt` file.

If you are using Python 3.x, replace `python` with `python3` in the following command:

```
# python -m pip install -r requirements.txt
```

Note The Python installation must complete successfully. If you encounter any errors, you must address them before proceeding to the next section or the Cisco ACI Multi-Site Orchestrator Python scripts will not work.

Sample Upgrade Configuration File

When you upgrade Multi-Site Orchestrator using Python, you can provide all the required information as command line arguments to the upgrade script or you can specify them all in a YAML configuration file and simply provide the configuration file.

This section provides sample `msc_cfg_upgrade.yml` files for two different upgrade scenarios:

- If your Multi-Site Orchestrator cluster was deployed using the Python installation scripts and within the same vCenter, you can use your vCenter login information to automatically find and upgrade all the nodes.

```
vcenter:
  name: 192.168.142.59
  user: administrator@vsphere.local

  # Update script will look for VMs with this prefix and Orchestrator label
  vm_name_prefix: msc


update:
  # Action can be 'upgrade' or 'downgrade'
  action: upgrade

  # Path to the Orchestrator upgrade image file
  msc_tgz_file: ~/tmp/msc-<version>.tar.gz
```

- If your Multi-Site Orchestrator cluster was deployed using the OVA, or in multiple different vCenters, or you simply do not wish to provide the vCenter login information, you can specify each node's IP address explicitly.

```
node1:
  ip: 192.64.136.204

node2:
  ip: 192.64.136.205

node3:
  ip: 192.64.136.206

update:
  # Action can be 'upgrade' or 'downgrade'
  action: upgrade

  # Path to the Orchestrator upgrade image file
  msc_tgz_file: ~/tmp/msc-<version>.tar.gz
```

Upgrading Multi-Site Orchestrator

This section describes how to upgrade Cisco ACI Multi-Site Orchestrator.

Note If you are upgrading from a release prior to Release 2.0(1), due to recent PSIRT updates the Cisco ACI Multi-Site Orchestrator nodes' kernels must be updated during the upgrade to Release 2.1(1) or later. This kernel update requires the nodes to be reloaded prior to performing the Orchestrator software upgrade. The python script performs the necessary update and reload automatically, followed by the Orchestrator software upgrade.

Before you begin

- Ensure that you have completed the prerequisites described in Prerequisites and Guidelines, on page 69
- Set up the Python environment as described in Setting Up Python Environment, on page 19

Step 1 If you are upgrading from a release prior to Release 2.1(1), configure at least 10GHz CPU cycle reservation for each Orchestrator VM.

This release of Multi-Site Orchestrator requires at least 10GHz CPU cycle reservation for each VM. New deployments of Release 2.1(1) or later apply CPU cycle reservation automatically, however if you're upgrading from an earlier release, you must manually update each Orchestrator VM's settings.

a) Log in to the vSphere client.
b) Navigate to the ESX host where your Orchestrator VMs are located.
c) Shut down one of the VMs.
d) Right click the VM and choose **`Edit Settings`**
e) In the **Virtual Hardware** tab, expand the **CPU** category.
f) In the **Reservation** field, enter `10 GHz`.
g) Click **OK** to save the changes.
h) Power on the VM and wait for the Orchestrator cluster to stabilize with all nodes healthy.
i) Repeat the steps for the other Orchestrator VMs.

Step 2 Download the Cisco ACI Multi-Site Orchestrator upgrade image and tools.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type
b) Click **ACI Multi-Site Software**.
c) Choose the Cisco ACI Multi-Site Orchestrator release version.
d) Download the *ACI Multi-Site Upgrade Image* file (`msc-<version>.tar.gz`) for the release.
e) Download the *ACI Multi-Site Tools Image* file (`tools-msc-<version>.tar.gz`) for the release.

Step 3 Extract the `tools-msc-<version>.tar.gz` file to the directory from which you want to run the upgrade.

```
# tar -xvzf tools-msc-<version>.tar.gz
```

Then change into the extracted directory:

```
# cd tools-msc-<version>
```

Step 4 (Optional) Create a configuration file for the upgrade.

We recommend creating an upgrade configuration file with your deployment and upgrade details. This allows you to provide the required information once and then re-use the file for future upgrades.

If you would rather pass all the required information directly to the upgrade script, you can skip this step.

If you choose to use a configuration file, you can copy and rename the provided `msc_cfg_upgrade_example.yml` file, create one using one of the samples provided in Sample Upgrade Configuration File, on page 73, or update one from a previous upgrade with the new image path.

Step 5 If your last upgrade was from a release prior to Release 1.2(x), update the version database.

If your current Multi-Site Orchestrator installation was a fresh install of Release 1.2(1) or later, or you have upgraded to Release 2.0(x) or later in the past, skip this step.

Otherwise, run the following command replacing *1.2.3b* with the currently installed version:

```
# /opt/cisco/msc/builds/msc_1.2.3b/bin/save_msc_version.sh 1.2.3b
```

Step 6 Upgrade the Cisco ACI Multi-Site nodes.

If you created a configuration file for the upgrade as descibed in Step 4, simply run the following command:

```
# python msc_vm_util.py -c msc_cfg_upgrade.yml
```

If you would rather specify all the information on the command line, use the following command:

```
# python msc_vm_util.py -u -f msc-<version>.tar.gz -n1ip <node1-ip> -n2ip <node2-ip> -n3ip <node3-ip>
```

Step 7 Enter the passwords when prompted.

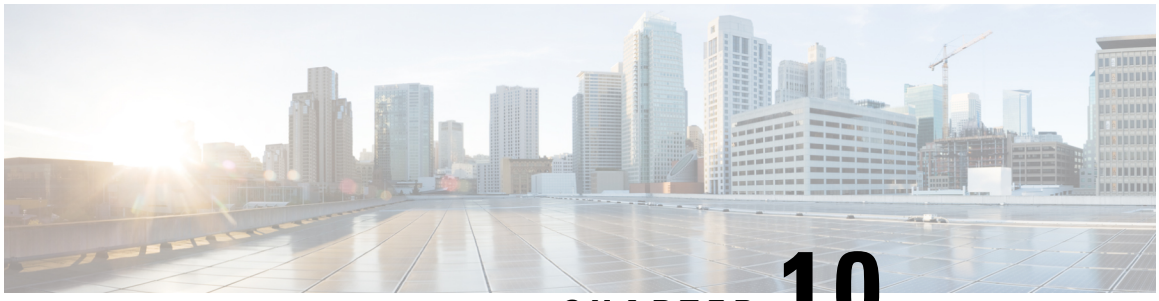
The script creates a backup of the MongoDB before the upgrade. It then copies the upgrade image to each node and executes the upgrade scripts.

It may take several minutes for the upgrade to complete. After the upgrade is complete, you can verify that the upgrade was successful and the Cisco ACI Multi-Site Orchestrator cluster is ready for use by accessing the Orchestrator GUI.

Step 8 If you upgraded from a release prior to Release 2.1(1), log in to your Orchestrator GUI and reset the password.

Due to password requirements change in Release 2.1(1), when you first log in to the Orchestrator GUI after upgrading to Release 2.1(1) or later, you will be prompted to update your password. The new password requirements are:

- At least 12 characters
- At least 1 letter
- At least 1 number
- At least 1 special character (`*` and `space` are not allowed



CHAPTER 10

Downgrading Orchestrator Deployments in VMware ESX

This chapter contains the following sections:

Downgrading Guidelines and Limitations

Note This chapter describes how to downgrade Multi-Site Orchestrator that was deployed without using Cisco Application Service Engine. If you deployed the Orchestrator inside Application Service Engine, follow the downgrade instructions described in Upgrading or Downgrading Orchestrator Deployments in Application Service Engine, on page 63 instead.

The following list describes the guidelines and limitations for downgrading the Cisco ACI Multi-Site Orchestrator:

- If you plan to downgrade the Cisco APIC as well, you must downgrade Cisco ACI Multi-Site Orchestrator first.
- This release of Cisco ACI Multi-Site Orchestrator, can be downgraded to any Release 1.2(1) or later. If you plan to downgrade to an earlier release, you must first downgrade to a 1.2(x) release, then follow the instructions described in Downgrading Cisco ACI Multi-Site, Release 1.2(x) to downgrade further.
- When downgrading to a release prior to Release 2.1(1), you must remove any Cisco Cloud APIC sites you may have added to your Cisco ACI Multi-Site Orchestrator. Failing to remove the cloud sites will cause the downgrade to terminate.
- If you have configured any read-only user roles and are downgrading to a release prior to Release 2.1(2), the read-only roles will be removed from all users. This means that any user that has **only** read-only roles will have no roles assigned to them and a Power User or User Manager will need to re-assign them new read-write roles.

  In addition, if you used an external authentication server to configure the read-only user roles, you must reconfigure the authentication servers and remove those read-only user roles. The read-only user roles

use a different format attribute-value (AV) string to specify read-write and read-only permissions and failing to update the configuration will cause those users to not authenticate correctly.

Additional details about external authentication servers configuration steps are described in the *Cisco ACI Multi-Site Configuration Guide*, but in short, you must update any user configuration strings from:

`cisco-av-pair=shell:msc-roles=writeRole1|writeRole2/readRole1|readRole2`

to:

`cisco-av-pair=shell:msc-roles=role1,role2`

- If you are downgrading to a release prior to Release 2.1(2), ensure that all users have the `Phone Number` field filled out. The field was required in earlier releases and any user created in Release 2.1(2) or later without a phone number provided will be unable to log into the GUI if the Orchestrator is downgraded to Release 2.1(1) or earlier. A Power User or User Manager can also update the field for any user after the downgrade.
- If you are downgrading to a release prior to Release 2.1(1), you will need to update all passwords stored by the Orchestrator, such as the passwords for all sites and authentication providers.
- Before you downgrade the Cisco ACI Multi-Site Orchestrator, remove the configuration of all features that are not supported in the release to which you are downgrading.

Downgrading Multi-Site Orchestrator

This section describes how to downgrade the Cisco ACI Multi-Site Orchestrator.

Before you begin

You must complete all the prerequisites detailed in Downgrading Guidelines and Limitations, on page 77.

Note When downgrading to a release prior to Release 2.1(1), you must remove any Cisco Cloud APIC sites you may have added to your Cisco ACI Multi-Site Orchestrator. Failing to remove the cloud sites will cause the downgrade to terminate.

Step 1 Download the Cisco ACI Multi-Site Orchestrator downgrade (target) image.

a) Go to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Upgrade Image* file (`msc-<version>.tar.gz`) for the release.

Step 2 Copy the downgrade image to each node.

Copy the `msc-<version>.tar.gz` file you downloaded to the `/opt/cisco/msc/builds/` directory on each node. You can use SCP or SFTP to transfer the file.

Example:

SFTP:

```
# sftp root@<node-ip>sftp> cd /opt/cisco/msc/builds/sftp> put msc-<version>.tar.gzsftp> quit
```

Example:

SCP:

```
# scp ./msc-<version>.tar.gz  root@<node-ip>:/opt/cisco/msc/builds/
```

Step 3 On each node, extract the file.

Example:

```
# cd /opt/cisco/msc/builds/# tar -xvzf msc-<version>.tar.gz
```

Step 4 On `node2` and `node3`, load the downgrade image.

On `node2` and `node3` only, run the following commands, replacing:

- <*current-version*> with the currently installed Cisco ACI Multi-Site Orchestrator release, for example *msc_2.2.1c*
- <*downgrade-version*> with the target downgrade version you downloaded and extracted in previous steps, for example *msc_1.2.1h*

Example:

```
# cd /opt/cisco/msc/builds/<current-version>/downgrade/# ./downgrade.sh <downgrade-version>
```

Step 5 From `node1`, downgrade Cisco ACI Multi-Site Orchestrator cluster.

On `node1` only, run the following commands, replacing:

- <*current-version*> with the currently installed Cisco ACI Multi-Site Orchestrator release
- <*node2-ip*> with the IP address of node2
- <*node2-password*> with the root user password for node2
- <*node3-ip*> with the IP address of node3
- <*node3-password*> with the root user password for node3
- <*downgrade-version*> with the version you are downgrading to

Note If you leave the IP and password arguments out, the script will prompt you to enter them.

Example:

```
# cd /opt/cisco/msc/builds/<current-version>/downgrade/# ./downgrade.sh -1 <node2-ip> -2
<node2-password> -3 <node3-ip> -4 <node3-password> <downgrade-version>
```

It may take several minutes for the downgrade to complete. After the downgrade is complete, you can verify that it was successful and the Cisco ACI Multi-Site Orchestrator cluster is ready for use by accessing the Orchestrator GUI.

Step 6 If necessary, update stored passwords.

Starting with Release 2.1(1), Multi-Site Orchestrator encrypts all stored passwords, such as each site's APIC passwords and the external authentication provider passwords. As a result, when downgrading to a release prior to Release 2.1(1), you must re-enter all the password after the Orchestrator downgrade is completed.

To update APIC passwords:

a) Log in to the Orchestrator after the downgrade.
b) From the main navigation menu, select **Sites**.

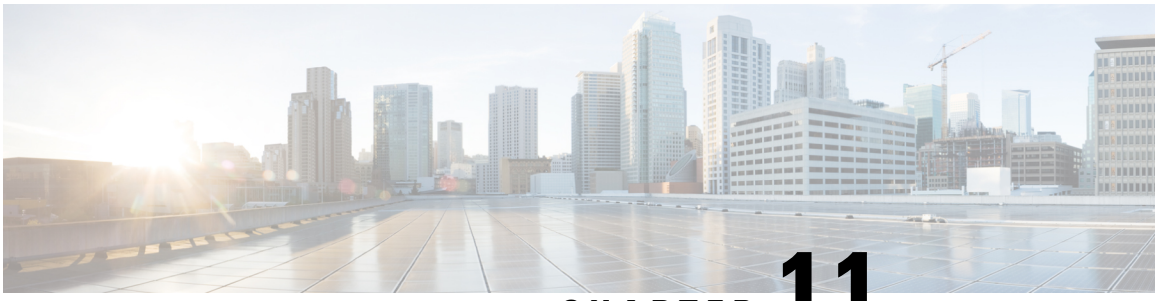
c) For each site, edit its properties and re-enter its APIC password.

To update external authentication passwords

a) Login into the Orchestrator after the downgrade.
b) From the navigation menu, select **Admin** > **Providers**.
c) For each authentication provider, edit its properties and re-enter its password.

PART IV

Single Node Deployments



CHAPTER 11

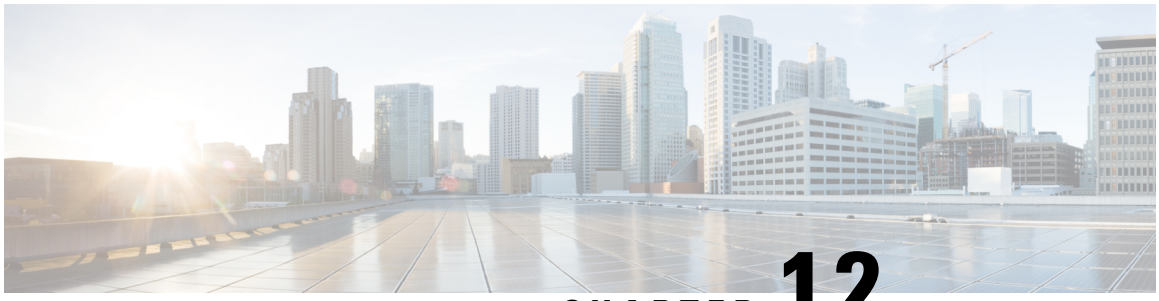
Single Node Overview

This chapter contains the following sections:

Overview

The following sections describe installation and upgrade procedures for single node installations. Single node is supported for lab and testing purposes only. Production deployments require 3-node high availability (HA) Orchestrator clusters and are described in other chapters in this book.

The basic requirements and workflows for single node installations and upgrades are similar to production deployments, so we encourage you to read through the Deployment Overview, on page 5 and the basic requirements of the *Cluster Deployments* section. However, certain steps may be skipped when installing a single node Orchestrator, so when you are ready, proceed with the installation or upgrade described in one of the following sections.



CHAPTER 12

Installing Single Node Orchestrator

This chapter contains the following sections:

Installing Single Node Orchestrator in VMware ESX

This section describes how to deploy a single node Cisco ACI Multi-Site Orchestrator in an ESX VM. Single node installations are supported for testing purposes only. Production Multi-Site deployments require a 3-node Orchestrator cluster, which is described in Deployment Overview, on page 5.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type

b) Click **ACI Multi-Site Software**.

c) Choose the Cisco ACI Multi-Site Orchestrator release version.

d) Download the *ACI Multi-Site Image* file (`msc-<version>.ova`) for the release.

Step 2 Deploy the OVA using the vCenter either the WebGUI or the vSphere Client.

Note The OVA cannot be deployed directly in ESX, it must be deployed using vCenter.

Step 3 Configure the OVA properties.

In the **Properties** dialog box, enter the appropriate information for each VM:

- In the **Enter password** field, enter the root password for the VM.
- In the **Confirm password** field, enter the password again.
- In the **Hostname** field, enter the hostnames for each Cisco ACI Multi-Site Orchestrator node. You can use any valid Linux hostname.
- In the **Management Address** (network address) field, enter the network address or leave the field blank to obtain it via DHCP.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- In the **Management Netmask** (network netmask) field, enter the netmask netmask or leave the field blank to obtain it via DHCP.
- In the **Management Gateway** (network gateway) field, enter the network gateway or leave the field blank to obtain it via DHCP.
- In the **Domain Name System Server** (DNS server) field, enter the DNS server or leave the field blank to obtain it via DHCP.
- In the **Time-zone string (Time-zone)** field, enter a valid time zone string.

  You can find the time zone string for your region in the IANA time zone database or using the `timedatectl list-timezones` Linux command. For example, *America/Los_Angeles* .
- In the **NTP-servers** field, enter Network Time Protocol servers separated by commas.
- In the **Application overlay** field, enter the default address pool to be used for Docker internal bridge networks.

  Application overlay must be a `/16` network. Docker then splits this network into two `/24` subnets used for the internal `bridge` and `docker_gwbridge` networks.

  For example, if you set the application overlay pool to `192.168.0.0/16`, Docker will use `192.168.0.0/24` for the `bridge` network and `192.168.1.0/24` for the `docker_gwbridge` network.

  You must ensure that the application overlay network is unique and does not overlap with any existing networks in the environment.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- In the **Service overlay** field, enter the default Docker overlay network IP.

  Service overlay must be a `/24` network and is used for the `msc_msc` Orchestrator Docker service network.

  You must ensure that the service overlay network is unique and does not overlap with any existing networks in the environment.

  Note The field is not validated prior to installation, providing an invalid value for this field will cause the deployment to fail.

- Click **Next**.
- In the **Deployment settings** pane, check all the information you provided is correct.
- Click **Power on after deployment**.
- Click **Finish**.

In addition to the above parameters, a 10GHz CPU cycle reservation is automatically applied to each Orchestrator VM when deploying the OVA.

Step 4 Log in to the VM using SSH.

Step 5 Change into the deployment scripts directory.

```
# cd /opt/cisco/msc/builds/<build_number>/prod-standalone
```

Step 6 Run the initialization script.

```
# ./msc_cfg_init.py
```

Step 7 Run the deployment script.

```
# ./msc_deploy.py
```

Step 8 Log in to the Cisco ACI Multi-Site Orchestrator GUI.

You can access the GUI using any of the 3 nodes' IP addresses.

The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

What to do next

For more information about Day-0 Operations, see Adding Tenants and Schemas, on page 57.

Installing Single Node Orchestrator in Service Engine

This section describes how to deploy a single node Cisco ACI Multi-Site Orchestrator in Cisco Application Service Engine. Single node installations are supported for testing purposes only. Production Multi-Site deployments require a 3-node Orchestrator cluster, which is described in Deployment Overview, on page 5.

Before you begin

- You must have Cisco Application Services Engine installed and the cluster configured as described in *Cisco Application Services Engine User Guide*.

  Note that if you are deploying Services Engine in AWS, by default only PEM-based login is enabled for each node. If you'd like to be able to SSH into the nodes using a password, you will need to explicitly enable password-based logins. You can do that by logging into each node separately using the PEM file the first time, then executing the following command:

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the ACI Multi-Site Orchestrator download page on Cisco DC App Center.

b) Click **Download** to download the image.

Step 2 Copy the Orchestrator image to the Application Services Engine.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), or you have enabled password-based logins for your AWS (`.ami`) deployment, use the following command to copy the Orchestrator image into the `tmp` directory on the Services Engine:

```
# scp <app-local-path> rescue-user@<service-engine-ip>:/tmp/
```

However, if your Service Engine is deployed in AWS and you have not enabled password-based login, you must use the certificate (`.pem`) file that you created during the Application Services Engine deployment:

```
# scp -i <pem-file-name>.pem <app-local-path>.aci rescue-user@<service-engine-ip>:/tmp/
```

For example, assuming you're running the `scp` command from the same directory where you saved the Orchestrator image:

- For password-based authentication:

```
# scp ./Cisco-MSO-2.2.3.aci rescue-user@10.30.11.147:/tmp/
```

- For PEM-based authentication:

```
# scp -i <pem-file-name>.pem ./Cisco-MSO-2.2.3.aci rescue-user@10.30.11.147:/tmp/
```

Step 3 Install the Orchestrator app in your Application Services Engine.

a) Log in to your Services Engine as `rescue-user`.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), simply SSH in using the following command:

```
# ssh rescue-user@<service-engine-ip>
```

However, if your Application Services Engine is deployed in AWS (`.ami`), you must login using the certificate (`.pem` file) that you created during the Application Services Engine deployment:

```
# ssh -i <pem-file-name>.pem rescue-user@<service-engine-ip>
```

b) Verify Services Engine health.

```
# acidiag health
All components are healthy
```

c) Install the Orchestrator.

In the following command, replace <*application-path*> with the full path to the application image you copied in the previous step.

```
# acidiag app install <application-path>
```

For example:

```
# acidiag app install /tmp/Cisco-MSO-2.2.3.aci
Image uploaded succesfully
check image status using: acidiag image show cisco-mso-2.2.3.aci
```

d) Verify that the application was loaded.

Use the following command to check the `operState` of the application.

While the application is loading and installing it will go through a number of operational states, which will be reflected in the `operState` field, for example `'operState': 'Initialize'`. This process can take up to 20 minutes and you must ensure that the state changes to `Disabled` before proceeding to the next step.

After the application's state changes to `Disabled`, make a note of the application's `id`, you will use it in the next step to enable the application.

```
# acidiag app show
[   {   'adminState': 'Disabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'PostInstall',
        'operState': 'Disabled',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

Step 4 Enable the Orchestrator app.

After installation is complete, the application will remain in the `Disabled` state by default and you must enable it.

In the following command, replace <*app-id*> with the application ID from the previous step:

```
# acidiag app enable <app-id>
```

For example:

```
# acidiag app enable cisco-mso:2.2.3
Application enabled succesfully
```

Step 5 Verify that the cluster was deployed successfully.

a) Verify that the application was enabled successfully.

While the application is being enabled, it will go through multiple operational states. You can use `acidiag app show` command to check the current state.

In the following output, ensure that the highlighted fields are `Enabled`, `Enable`, and `Running` respectively.

```
## acidiag app show
[   {   'adminState': 'Enabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'Enable',
        'operState': 'Running',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

b) Log in to the Cisco ACI Multi-Site Orchestrator GUI.

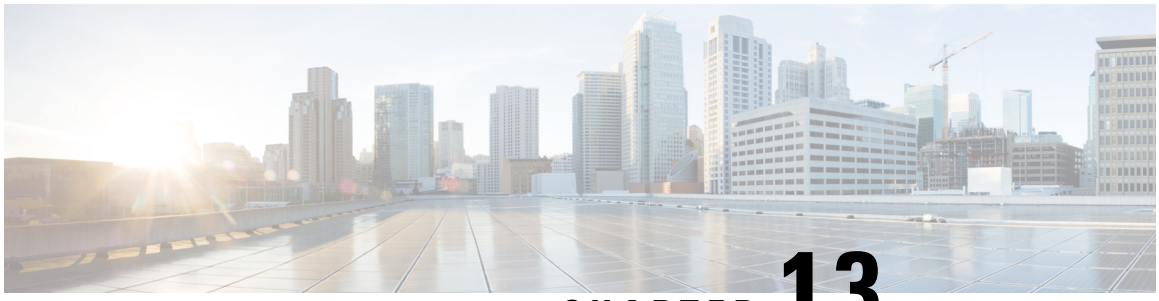
Note After the application is enabled as described in the previous step, it may take up to 20 additional minutes for all the Orchestrator services to start and the GUI to become available.

After the GUI becomes available, you can access it by browsing to any one of your Application Services Engine nodes' IP addresses. The default log in is **admin** and the default password is **We1come2msc!**.

When you first log in, you will be prompted to change the password.

What to do next

For more information about Day-0 Operations, see Adding Tenants and Schemas, on page 57.



CHAPTER 13

Upgrading Single Node Orchestrator

This chapter contains the following sections:

Upgrading Single Node ESX VM

This section describes how to upgrade single node Cisco ACI Multi-Site Orchestrator deployed in an ESX VM. If you are running a 3-node Orchestrator cluster, follow the upgrade procedure described in Upgrading Orchestrator Deployments in VMware ESX , on page 69 instead.

Step 1 If you are upgrading from a release prior to Release 2.1(1), configure at least 10GHz CPU cycle reservation for each Orchestrator VM.

This release of Multi-Site Orchestrator requires at least 10GHz CPU cycle reservation for each VM. New deployments of Release 2.1(1) or later apply CPU cycle reservation automatically, however if you're upgrading from an earlier release, you must manually update each Orchestrator VM's settings.

a) Log in to the vSphere client.
b) Navigate to the ESX host where your Orchestrator VMs are located.
c) Shut down one of the VMs.
d) Right click the VM and choose **`Edit Settings`**
e) In the **Virtual Hardware** tab, expand the **CPU** category.
f) In the **Reservation** field, enter `10 GHz`.
g) Click **OK** to save the changes.
h) Power on the VM and wait for the Orchestrator cluster to stabilize with all nodes healthy.
i) Repeat the steps for the other Orchestrator VMs.

Step 2 Download the Cisco ACI Multi-Site Orchestrator upgrade image.

a) Browse to the Software Download link:
https://software.cisco.com/download/home/285968390/type
b) Click **ACI Multi-Site Software**.
c) Choose the Cisco ACI Multi-Site Orchestrator release version.
d) Download the *ACI Multi-Site Upgrade Image* file (`msc-<version>.tar.gz`) for the release.

Step 3 Copy the image to your Orchestrator node.

The following command copies the image into the `/tmp` directory on the node.

```
# scp msc-<version>.tar.gz <mso-ip-address>:/tmp/
```

Step 4 Log in to your Orchestrator node and extract the `tools` directory from the Orchestrator image you copied.

Note In the following command, the image filename contains an `msc-` prefix with a dash, while the second argument has a `msc_` prefix with an underscore, because you are extracting a specific directory within the image file.

```
# cd /tmp
# tar xfz msc-<version>.tar.gz msc_<version>/tools
```

Step 5 Copy the upgrade script from the extracted directory into the Orchestrator `scripts` directory.

```
# cp msc_<version>/tools/msc_setup.py /opt/cisco/msc/scripts
```

Step 6 Change into the Orchestrator scripts directory.

```
# cd /opt/cisco/msc/scripts
```

Step 7 Run the upgrade script.

In the following command, provide the image filename you uploaded to the Orchestrator node.

```
# python3 msc_setup.py -u -f /tmp/msc-<version>.tar.gz -st
```

Note If the kernel needs to be upgraded, the scripts will perform the upgrade and reboot.

Step 8 If the system restarts due to a kernel upgrade, re-run the upgrade script.

When you re-run the script after a reboot, add the `--pass2` argument:

```
# python3 msc_setup.py -u -f /tmp/msc-<version>.tar.gz -st --pass2
```

Step 9 Verify upgrade was successful.

The installation can take up to 15 minutes. After it is completed, use the `docker service ls` command to verify that all docker `REPLICAS` are up:

```
# docker service ls
ID              NAME                        MODE            REPLICAS
yljvxfmjt3kb    msc_auditservice            replicated      1/1
kyvaqpehau15    msc_authyldapservice        replicated      1/1
y2fh16599hi5    msc_authytacacsservice      replicated      1/1
6pajp3kjktli    msc_backupservice           replicated      1/1
9a6tnu7wwb6j    msc_cloudsecservice         replicated      1/1
dmwkjl7het8i    msc_consistencyservice      replicated      1/1
l01mbez8j4sy    msc_endpointservice         replicated      1/1
qerrp08i6hsq    msc_executionengine         replicated      1/1
vsitso4b9xu6    msc_jobschedulerservice     replicated      1/1
l1sldx735iut    msc_kong                    replicated      1/1
zk6s5f9h6l93    msc_kongdb                  replicated      1/1
t4wbsstsps6r    msc_mongodb                 replicated      1/1
qi5aj3zygc2w    msc_pctagvnidservice        replicated      1/1
olxke4nk7me9    msc_platformservice         replicated      1/1
tlsjms2kwl64    msc_policyservice           replicated      1/1
9owa824s83a7    msc_schemaservice           replicated      1/1
zb3dy4d7j775    msc_siteservice             replicated      1/1
miubr6yw135n    msc_syncengine              replicated      1/1
wxle65d6ag1g    msc_ui                      replicated      1/1
jr01hfpmrcbw    msc_userservice             replicated      1/1
```

Step 10 (Optional) Free up disk space by deleting old images.

Use the following command to display all docker images in the system:

```
# docker images
```

You can then delete the old Orchestrator images using the following command:

```
# docker system prune -a
```

Step 11 If you upgraded from a release prior to Release 2.1(1), log in to your Orchestrator GUI and reset the password.

Due to password requirements change in Release 2.1(1), when you first log in to the Orchestrator GUI after upgrading to Release 2.1(1) or later, you will be prompted to update your password. The new password requirements are:

- At least 12 characters
- At least 1 letter
- At least 1 number
- At least 1 special character (`*` and `space` are not allowed

Upgrading Single Node Service Engine VM

This section describes how to upgrade single node Cisco ACI Multi-Site Orchestrator deployed in Cisco Application Service Engine. If you are running a 3-node Orchestrator cluster, follow the upgrade procedure described in Upgrading or Downgrading Orchestrator Deployments in Application Service Engine, on page 63 instead.

Step 1 Download the Cisco ACI Multi-Site Orchestrator Image.

a) Browse to the ACI Multi-Site Orchestrator download page on Cisco DC App Center.

b) Click **Download** to download the image.

Step 2 Make the image accessible by the Orchestrator.

Note This release supports GUI image upload from an HTTP or HTTPS server only, so you must either make the image available on a web server accessible by the Orchestrator or manually upload the image to the Application Server Engine where the Orchestrator is hosted.

If you have a web server running in your environment, simply host the `.aci` image you downloaded on that server and proceed to the next step.

Otherwise, to manually upload the image:

a) Copy the application to the Application Service Engine.

If your Cisco Application Services Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), or you have enabled password-based logins for your AWS (`.ami`) deployment, use the following command to copy the Orchestrator image into the `tmp` directory on the Services Engine:

```
# scp <app-local-path> rescue-user@<service-engine-ip>:/tmp/
```

However, if your Service Engine is deployed in AWS and you have not enabled password-based login, you must use the certificate (`.pem`) file that you created during the Application Services Engine deployment:

```
# scp <app-local-path>.aci -i <pem-file-name>.pem rescue-user@<service-engine-ip>:/tmp/
```

For example, assuming you're running the `scp` command from the same directory where you saved the Orchestrator image:

- For password-based authentication:

  ```
  # scp ./cisco-mso-2.2.3c.aci rescue-user@10.30.11.147:/tmp/
  ```

- For PEM-based authentication:

  ```
  # scp ./cisco-mso-2.2.3c.aci -i <pem-file-name>.pem rescue-user@10.30.11.147:/tmp/
  ```

b) Log in to your Service Engine as `rescue-user`.

If your Cisco Application Service Engine is deployed in VMware ESX (`.ova`), Linux KVM (`.qcow`), or as a physical appliance (`.iso`), simply SSH in using the following command:

```
# ssh rescue-user@<service-engine-ip>
```

However, if your Application Service Engine is deployed in AWS (`.ami`), you must login using the certificate (`.pem` file) that you created during the Application Service Engine deployment:

```
# ssh -i <pem-file-name>.pem rescue-user@<service-engine-ip>
```

c) Add the new image.

In the following command, replace <*application-path*> with the full path to the application image you copied in the previous step.

```
# acidiag app install <application-path>
```

For example:

```
# acidiag app install /tmp/cisco-mso-2.2.3c.aci
```

d) Verify that the application was loaded.

Use the following command to check the `operState` of the application.

While the application is loading and installing it will go through a number of operational states, which will be reflected in the `operState` field, for example `'operState': 'Initialize'`. This process can take up to 20 minutes and you must ensure that the state changes to `Disabled` before proceeding to the next step.

```
# acidiag app show
[   {   'adminState': 'Disabled',
        'apiEntrypoint': '/query',
        'appID': 'MSO',
        'creationTimestamp': '2020-02-10T20:30:36.195960295Z',
        'description': 'Multi-Site Orchestrator application',
        'displayName': 'ACI Multi-Site Orchestrator',
        'id': 'cisco-mso:2.2.3',
        'name': 'cisco-mso',
        'operStage': 'PostInstall',
        'operState': 'Disabled',
        'schemaversion': '',
        'uiEntrypoint': '/ui/app-start.html',
        'vendorID': 'Cisco',
        'version': '2.2.3'}]
```

Step 3 Log in to your Orchestrator.

Step 4 From the left navigation pane, select **Admin** > **Firmware Management**.

Step 5 Add the new image to the Application Service Engine cluster.

Note If you manually uploaded the image to the Service Node cluster, the image will be already available and you can skip this step.

a) In the main window, click **Add Image**.

An **Add Image** window opens.

b) In the **File Path** field, provide the URL to the new Orchestrator image.

For example, `https://www.my-web-server.com/mso/cisco-mso-2.2.3c.aci`.

c) Click **OK** to add the image.

The image will be uploaded to the Orchestrator's Service Engine nodes, unpacked, processed, and made available for the upgrade. The whole process may take several minutes and you will be able to see the status of the image.

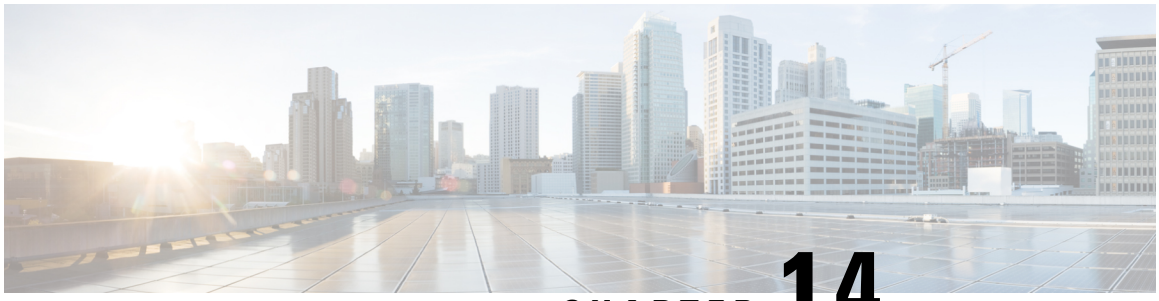
Wait for the status to change to `Available` before proceeding to the next step.

Step 6 Activate the new image.

Ensure that the new image's status is `Available`.

a) In the main window, click the actions menu next to the image you added.
b) Then click **Activate**.
c) In the **Activation Confirmation** window, click **Continue**.

Wait for the new image to be activated. The page automatically reloads when the process is completed.



CHAPTER 14

Converting to Production Cluster

This chapter contains the following sections:

Converting Single Node to Production Cluster

The easiest way to convert your single node Orchestrator installation into a full-fledged production cluster is to simply deploy a brand new cluster and then restore existing configuration database on it.

Step 1 Deploy a brand new Orchestrator cluster as described in *Cluster Deployments* section.

You can deploy the Multi-Site Orchestrator cluster in multiple different form factors. We recommend deploying a Service Engine Orchestrator cluster as described in Deploying in Cisco Application Services Engine, on page 9. Other available options are described in the Deployment Overview, on page 5.

Step 2 Backup existing deployment configuration.

a) Log in to your existing Cisco ACI Multi-Site Orchestrator.

b) From the left navigation pane, select **Admin** > **Backups**.

c) In the main window, click **New Backup**.

A **New Backup** window opens.

d) In the **Name** field, provide the name for the backup file.

The name can contain up to 10 alphanumeric characters, but no spaces or underscores (_).

e) Choose the **Backup Location**.

You can save the backup file locally on the Orchestrator nodes or export it to a remote location.

If you want to save the backup file locally, choose **Local**.

Otherwise, if you want to save the backup file to a remote location, choose **Remote** and provide the following:

- From the **Remote Location** dropdown menu, select the remote location.
- In the **Remote Path**, either leave the default target directory or you can choose to append additional subdirectories to the path. However, the directories must be under the default configured path and must have been already created on the remote server.

f) Click **Save** to create the backup.

Step 3 Copy the Backup file from the existing Orchestrator.

If you created the backup using a remote location, you can skip this step.

Otherwise, in the main window, click the actions ( ) icon next to the backup and select **Download**. This will download the backup file to your system.

Step 4 Bring down you single node Orchestrator instance.

Step 5 Import the backup file to your new Orchestrator cluster.

If you saved the backup locally, simply import the file:

a) Log in to your existing Cisco ACI Multi-Site Orchestrator.
b) From the left navigation menu, select **Admin** > **Backups**.
c) In the main window, click **Import**.
d) In the **Import from file** window that opens, click **Select File** and choose the backup file you want to import.

Importing a backup will add it to the list of the backups displayed the **Backups** page.

If you saved the backup to a remote location, add the remote location to the new Multi-Site Orchestrator:

a) Log in to your Cisco ACI Multi-Site Orchestrator.
b) From the left navigation pane, select **Admin** > **Remote Locations**.
c) In the top right of the main window, click **Add Remote Location**.

An **Add New Remote Location** screen appears.

d) Provide the same information for the remote location that you used in your old Orchestrator.
e) Click **Save** to add the remote server.

Step 6 Restore the configuration.

a) From the left navigation menu, select **Admin** > **Backups**.
b) In the main window, click the actions ( ) icon next to the backup you want to restore and select **Rollback to this backup**.

If the version of the selected backup is different from the running Multi-Site version, the rollback could cause a removal of the features that are not present in the backup version.

c) Click **Yes** to confirm that you want to restore the backup you selected.

If you click **Yes**, the system terminates the current session and the user is logged out.