Cisco Fog Director Reference Guide

Release 1.0

May 4, 2016

CONTENTS

Preface

Overview

This manual explains how to use Cisco Fog Director to manage, administer, monitor, and troubleshoot Cisco IOx apps and devices.

Organization

This manual is organized as follows:

Chapter 1, "Overview"	Provides an overview of Cisco IOx, Cisco Fog Director, and the life-cycle of a Cisco IOx app
Chapter 2, "Installing Cisco Fog Director"	Provides instructions for installing Cisco Fog Director
Chapter 3, "Cisco Fog Director General Operations"	Describes general operations that you perform with Cisco Fog Director
Chapter 4, "Managing Apps"	Describes the Cisco Fog Director Apps page, from which you manage app
Chapter 5, "Managing Devices"	Describes the Cisco Fog Director Devices page, from which you manage devices
Chapter 6, "Managing Cisco Fog Director Settings"	Describes the Cisco Fog Director Settings page, from which you view information about Cisco Fog Director and manage its debug logs
Chapter 7, "Managing Cartridges"	Describes the Cisco Fog Director Cartridges page, from which you manage cartridges

Obtaining Documentation and Support

For information about obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*. This document also lists new and revised Cisco technical documentation. It is available at:

http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.

Overview

This chapter provides an overview of Cisco IOx, Cisco Fog Director, and the lifecycle of a Cisco IOx app. It includes these sections:

About Cisco IOx

Cisco IOx is an application enablement platform that provides uniform and consistent hosting capabilities for various types of applications, or *apps*, across various Cisco platforms. This platform brings together Cisco IOS, the industry-leading networking operating system, and Linux, the leading open source platform. Linux-based applications can run on Cisco devices in the Cisco IOx framework, so using this platform, you can bring custom applications and interfaces to the network.

With Cisco IOx, developers can create a wide variety of IoT apps, such as data aggregation system and control systems.

About Cisco Fog Director

Cisco Fog Director allows administrators to manage, administer, monitor, and troubleshoot Cisco IOx apps and devices. It provides a web-based user interface from which you can perform activities that include the following:

- Install and uninstall apps
- Start and stop apps
- Upgrade apps
- View the status of apps
- Backup and restore app data
- Monitor apps and devices and collect statistics
- Create and obtain debug logs for troubleshooting

Hardware Platform Caveat

Cisco C800 series devices do not provide dedicated storage for apps. These devices have a single, soldered-on flash storage that is shared between Cisco IOS and apps. The flash storage is not field replaceable.

Flash has a finite number of P/E cycles. It is expected to last for the duration of the device lifecycle if the flash is used only for Cisco IOS configuration. If apps write to the flash frequently, flash wear out becomes a serious concern.

We recommend that developers and users monitor and throttle the frequency of writes to flash. If an app demands frequent writes or a large amount of data storage, we recommend that data be exported for off-device storage.

App Lifecycle

The following table provides the general operations that are involved in the lifecycle of a Cisco IOx app. Use this information as a guide as you deploy apps. There are many additional operations that you can perform as needed. Although those operations are not listed in this table, they are described in detail in this manual.

	Operation	**Reference**
Step 1	Add to Cisco Fog Director each device on which the app is to be installed.	See the "Adding Devices" section on page 5-8 or the "Importing Devices" section on page 5-9.
Step 2	Add to Cisco Fog Director cartridges that PAAS apps require.	See the "Adding a Cartridge" section on page 7-2
Step 3	Upload the app to Cisco Fog Director. The app is now an *unpublished app* and appears in the Unpublished Apps section on the Cisco Fog Director Apps View page. Although it is now in Cisco Fog Director but not yet ready to be installed on a device.	See the "Adding an App" section on page 4-8.
Step 4	Publish the unpublished app in Cisco Fog Director. The app is now an *available app* and appears in the Available Apps section on the Cisco Fog Director Apps View page. The app can now be installed on a device.	See the "Publishing an App" section on page 4-10.
Step 5	Use Cisco Fog director to update or add information for the app as needed. This information includes an icon, description, release notes, and external links.	See the "Editing an App Icon, Description, and Release Notes" section on page 4-21 and the "Configuring App Links" section on page 4-28.
Step 6	Use Cisco Fog Director to install the available app on one or more devices. The app is now an *installed app* and appears in the Installed Apps section on the Cisco Fog Director Apps View page.	See the "Installing an App" section on page 4-10.

	Operation	**Reference**
Step 7	Use Cisco Fog Director to reconfigure the app if needed.	See the "Reconfiguring App Parameters" section on page 4-22.
Step 8	To keep the app current, use Cisco Fog Director to upgrade the app when needed.	See the "Upgrading an App" section on page 4-19.

App Lifecycle

CHAPTER 2

Installing Cisco Fog Director

This chapter describes how to install Cisco Fog Director. It includes these sections:

Installation

The following sections describes how to install the Cisco Fog Director OVA file on a virtual machine (VM).

System Requirements

The VM host on which you install must meet the following minimum requirements:

- 4 core CPU
- 6 GB RAM
- 100 GB hard disk

Installation in VMware vSphere

To install Cisco Fog Director in VMware vSphere Hypervisor, perform the following steps.

Before You Begin

- Review the information in the "System Requirements" section on page 2-1.
- Make sure that you have a valid Cisco.com user ID and password, which are required to obtain the VM OVA image for installation.

Procedure

Step 1 From a client PC, take these actions to obtain the VM OVA image:

   a. Go to this URL:

     https://software.cisco.com/download/release.html?i=!y&mdfid=286290097&softwareid= 286306227&release=1.0.0&os=

   b. Click the **Download** button that corresponds to the .ova file that you want.

   c. Follow the on-screen instructions to download the file to your local drive.

Step 2 From a client PC, use the VMware vSphere Hypervisor client application to log in to your VMWare host.

Step 3 Choose **File > Deploy OVF Template**.

   The Deploy OVF Template Wizard starts.

Step 4 In the Deploy OVF Template Wizard, take these actions:

   a. In the Deploy OVF Template window, locate to and select the Fog Director OVF template that you downloaded in Step 1, and then click **Next**.

   b. In the OVF Template Details window, click **Next**.

   c. In the Name and Location window Inventory Location area, choose the VM host on which to install the OVA file, and then click **Next**.

   d. In the Datastore window, click the datastore in which to store the VM files, and then click **Next**.

   e. In the Host / Cluster window, click **Next**.

   f. In the Specify a Specific Host window, click **Next**.

   g. In the Disk Format window, click **Next**.

   h. In the Network Mapping window, click **Next**.

   i. (Optional) In the Ready to Complete window, if DCHP is configured in your environment and you want Cisco Fog Director to start automatically when the installation completes, check the **Power on after deployment** check box.

   j. In the Ready to Complete window, click **Finish**.

Step 5 When the Deployment Completed Successfully window appears, click **Close** in that window.

   The installation is completes. If needed, configure a static IP address as described in the "DHCP Configuration" section on page 2-4 before you start Cisco Fog Director.

Installation in VMware Player

To install Cisco Fog Director in VMware Player, perform the following steps.

Before You Begin

- Review the information in the "System Requirements" section on page 2-1.

- Make sure that you have a valid Cisco.com user ID and password, which are required to obtain the VM OVA image for installation.

Procedure

Step 1   From a client PC, take these actions to obtain the VM OVA image.:

    a.   Go to this URL:

       https://software.cisco.com/download/release.html?i=!y&mdfid=286290097&softwareid=286306227&release=1.0.0&os=

    b.   Click the **Download** button that corresponds to the .ova file that you want.

    c.   Follow the on-screen instructions to download the file to your local drive.

Step 2   From a client PC, use the VMware Player client application to log in to your VMWare host.

Step 3   In the right side of the Welcome window, click **Open a Virtual Machine**.

Step 4   Follow the on-screen prompts to locate and select the he Fog Director OVF template that you downloaded in Step 1.

Step 5   In the Import Virtual Machine dialog box, click the **Import** button.

    The installation completes. If needed, configure a static IP address as described in the "DHCP Configuration" section on page 2-4 before you start Cisco Fog Director.

Installation in VMWare Fusion

To install Cisco Fog Director in VMware Fusion, perform the following steps.

Before You Begin

- Review the information in the "System Requirements" section on page 2-1.
- Make sure that you have a valid Cisco.com user ID and password, which are required to obtain the VM OVA image for installation.

Procedure

Step 1   From a client PC, take these actions to obtain the VM OVA image.:

    a.   Go to this URL:

       https://software.cisco.com/download/release.html?i=!y&mdfid=286290097&softwareid=286306227&release=1.0.0&os=

    b.   Click the **Download** button that corresponds to the .ova file that you want.

Step 2   Follow the on-screen instructions to download the file to your local drive.

Step 3   From the File menu, choose **Import**.

Step 4   In the Choose an Existing Virtual Machine dialog box, click **Choose File** and follow the on-screen prompts to locate and select the he Fog Director OVF template that you downloaded in Step 1.

Step 5   In the Choose an Existing Virtual Machine dialog box, click **Choose File** button.

    The installation completes. If needed, configure a static IP address as described in the "DHCP Configuration" section on page 2-4 before you start Cisco Fog Director.

DHCP Configuration

By default, Cisco Fog Director fetches an IP address from your DHCP server when it starts. If your environment does not support DHCP, you can configure a static IP address for Cisco Fog Director.

To configure a static IP address, follow these steps:

Procedure

Step 1 From a VMware console, to log in to the VM on which you installed Cisco Fog Director.

Use the following log in credentials:

- Username—**fogdir**
- Password—**fogdir**

Step 2 Use the **sudo vi** command to open the /etc/network/interfaces file.

Step 3 In the interfaces file, update the following fields as needed:

- address
- netmask
- gateway
- dns-nameservers

The following shows an example of the interfaces file:

```
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet static
address <ip address>
netmask <subnet mask>
gateway <gateway ip address>
dns-nameservers <name server add 1> <name server add 2> <name server add 3> //optional
```

Step 4 Save the interfaces file and reboot the VM.

CHAPTER **3**

Cisco Fog Director General Operations

This chapter describes general operations that you perform with Cisco Fog Director.

This chapter includes these sections:

Browser Guidelines

When you access Cisco Fog Director by using a supported browser, be aware if the following guidelines that this section describes.

- You can access the Cisco Fog Director user interface by using Mozilla Firefox release 44 and above or Google Chrome release 48 and above.
- For increased system security, Cisco Fog Director times out after a 30 minute period of no use
- To ensure that a Cisco Fog Director page shows the most current information, use your browser Refresh feature to periodically update the page

Accessing Cisco Fog Director

After you install Cisco Fog Director, you can access it from any supported computer that has IP connectivity to the Cisco Fog Director server.

To access Cisco Fog Director, follow these steps:

Procedure

Step 1 Start a supported browser, and in the Address field, enter the fully-qualified host name or the IP address of the server on which Cisco Fog Director is running.

If you are logging in for the first time, the End User License Agreement (EULA) dialog box displays. Otherwise, the Log In page displays.

Step 2 If the End User License Agreement dialog box displays, review the EULA and click the **Accept** button to continue.

Step 3 Enter your Cisco Fog Director ID in the **LOGIN ID** field, and enter your Cisco Fog Director Password in the **PASSWORD** field.

IDs and passwords are case-sensitive, so make sure to enter them exactly as they are configured.

The default Fog Director ID is **admin** and the default password is **admin**.

Step 4 Click **Login**.

If you entered the default password (admin), the system prompts you to change your password. Otherwise, the Cisco Fog Director Apps page appears.

Step 5 If the system prompts you to change your password, take these actions:

  a. Enter your new password in the **NEW PASSWORD** and **CONFIRM PASSWORD** fields.

  The password is case-sensitive and can include any number of alphanumeric and special characters, but no spaces.

  b. Click **CHANGE PASSWORD**.

  c. Enter your new password in the **PASSWORD** field.

  d. Click **Login**.

Exiting Cisco Fog Director

To exit Cisco Fog Director, click the **Logout** button from any Cisco Fog Director page.

The Log In page displays.

Changing Your Cisco Fog Director Password

To change your Cisco Fog Director password, follow these steps:

Procedure

Step 1 Take either of these actions:

  • If you are logged in to Cisco Fog Director, click the **Logout** button .

  • If you are not logged in to Cisco Fog Director, start a supported browser, and in the Address field, enter the fully-qualified host name or the IP address of the server on which Cisco Fog Director is running.

The Log In page displays.

Step 2 Enter your Cisco Fog Director ID in the **LOGIN ID** field, and enter your Cisco Fog Director Password in the **PASSWORD** field.

IDs and passwords are case-sensitive, so make sure to enter them exactly as they are configured.

Step 3   Enter your new password in the **NEW PASSWORD** and in the **CONFIRM NEW PASSWORD** fields.

The password is case-sensitive and can include any number of alphanumeric and special characters, but no spaces.

Step 4   Click **CHANGE PASSWORD**.

To cancel a password change operation, click **Login** instead of **CHANGE PASSWORD**.

Understanding Managed and Unmanaged States for Apps

A Cisco IOx app is considered to be in *managed state* when the you can manage it on a device by using Cisco Fog Director. A device is considered to be in *unmanaged state* when it has been added to Cisco Fog Director but cannot be managed on a device.

In general, a Cisco IOx app is in managed state when it has been installed on a device through Cisco Fog Director. However, in some scenarios in which an app already is installed on a device using a method other than Cisco Fog Director, the app does not go to managed state when device is then added to Cisco Fog Director.

This section provides an overview of the general steps to take in these scenarios to ensure that an app is in managed state.

Scenario 1

If an app is in unmanaged state on a device, follow these steps to change it to managed state:

	Procedure	Reference
Step 1	Take either of these actions: • Uninstall the app from the device using Cisco IOx Client or Cisco IOx Local Manager • Delete the device from Cisco Fog Director	See your Cisco IOx Client or Cisco IOx Local Manager documentation, or see the "Deleting a Device" section on page 5-11.
Step 2	If you uninstalled the app from the device, remove the app from the Installed App area on the Cisco Fog Director App View page by clicking the Remove button in this area for the app.	See the "Managing Installed Apps" section on page 4-2
Step 3	Add or import the device to Cisco Fog Director.	See the "Adding Devices" section on page 5-8 or the "Importing Devices" section on page 5-9.
Step 4	Add the app to Cisco Fog Director.	See the "Adding an App" section on page 4-8.
Step 5	Install the app on the device using Cisco Fog Director.	See the "Installing an App" section on page 4-10.

Scenario 2

If you have a device on which an app is installed using a method other than Cisco Fog Director, follow these steps to ensure that the app does not go to unmanaged state with you add the device to Cisco Fog Director:

	Procedure	Reference
Step 1	Uninstall the app from the device using Cisco IOx Client or Cisco IOx Local Manager.	See your Cisco IOx documentation.
Step 2	Add the app to Cisco Fog Director.	See the "Adding an App" section on page 4-8.
Step 3	Add or import the device to Cisco Fog Director.	See the "Adding Devices" section on page 5-8 or the "Importing Devices" section on page 5-9.
Step 4	Install the app on the device using Cisco Fog Director.	See the "Installing an App" section on page 4-10.

Scenario 3

An will go to unmanaged state in this situation:

1. You add a device to Cisco Fog Director.
2. You install an app on the device by using Cisco Fog Director.
3. You delete the device from Cisco Fog Director (with the app still installed on the device).
4. You delete the app from Cisco Fog Director.
5. You add the device again to Cisco Fog Director.

To prevent the app from going to unmanaged state, follow these steps before you add the device again to Cisco Fog Director:

	Procedure	Reference
Step 1	Add the app to Cisco Fog Director.	See the "Adding an App" section on page 4-8.
Step 2	Add or import the device to Cisco Fog Director.	See the "Adding Devices" section on page 5-8 or the "Importing Devices" section on page 5-9.

Troubleshooting

The following sections provide information that can be useful for troubleshooting Cisco Fog Director.

- Cisco Fog Director Logs, page 3-4
- Cisco Fog Director Processes, page 3-5

Cisco Fog Director Logs

Cisco Fog Director provides several options for viewing or obtaining logs for apps, devices, and the system. You can use these logs to monitor operations or troubleshoot issues that occur.

Logs are stored in the /opt/cisco/fogdirector/logs folder on the server on which Cisco Fog Director is running.

Table 3-1 describes the logs and provides references to sections that provide more detailed information.

Table 3-1   Logs for Troubleshooting

Log	Description	Reference
App log	Log information that is generated by an app on a device.	See the description of the **View App Log** button in the "Viewing Detailed Monitoring Information" section on page 4-33. Also see the description of the App Log tab and View all App Logs in the "Apps Area" section on page 5-6
Device log	Log information that is generated by the device.	See the description of Collect Debug Logs, the **VIEW DEVICE LOGS** button, and the **DOWNLOAD TECH SUPPORT LOGS** button in the "Device Details Area" section on page 5-5. Also see the "Obtaining Device Logs" section on page 5-15
Cisco Fog Director debug log	Information about actions performed by users, and errors or exceptions generated by a device or persistent store.	See the "Managing Cisco Fog Director Debug Logs" section on page 6-1.

Cisco Fog Director Processes

To operate properly, Cisco Fog Director requires that its processes be running on the server on which it is installed. If you experience problems with Cisco Fog Director, such as its web-based user interface becoming unresponsive, you can check the status of the processes and stop and restart them if needed.

To manage Cisco Fog Director processes, use an SSH client to access the server on which Cisco Fog Director is installed, log in using your Cisco Fog Director user name and password, and then use the commands that Table 3-2 describes.

Table 3-2   Managing Cisco Fog Director Processes

Activity	Command	Remarks
Display the status of Cisco Fog Director processes.	# **sudo service fogd status**	If Cisco Fog Director is not operating properly, use this command to ensure that all processes are running.
Stop Cisco Fog Director processes.	# **sudo service fogd stop**	If the Cisco Fog Director web-based user interface becomes unresponsive, use these commands to stop and then start the Cisco Fog Director processes. Restarting processes in this way may resolve the issue.
Start Cisco Fog Director processes.	# **sudo service fogd start**	

CHAPTER 4

Managing Apps

The Cisco Fog Director Apps pages provides information about Cisco IOx apps and provides access to features for managing these apps.

When you log in to Cisco Fog Director, the Apps View page appears, If no apps have yet been added to Cisco Fog Director, this page displays "Welcome to Cisco Fog Director" and displays the **ADD NEW APP** button and the **IMPORT APPS** button.

If at least one app has been added, this page includes these areas:

*   Installed Apps area—Lists apps that have been installed, or are in the process of being installed, through Cisco Fog Director on at least one device. Also provide information about these apps and devices, and access to other features and information for managing these apps. (An app that has been installed and then removed from a device appear in this area until you manually remove it from this area.)

*   Available Apps area—Lists apps that have been published are so are available to be installed on one or more devices. Also provide information about these apps and devices, and access to other features and information for managing these apps.

*   Unpublished Apps area—Lists apps that have been uploaded to Cisco Fog Director but that have not been published.

To access the Apps pages, log in to Cisco Fog Director as described in the "Accessing Cisco Fog Director" section on page 3-1, and then click the **APPS** tab. The Apps View page displays.

This chapter includes these sections:

Managing Installed Apps

The Installed Apps area on the Apps View page lists each app that is installed through Cisco Fog Director on at least one device, provides information about these apps, and provides access to related features.

For each installed app, area includes the items that Table 4-1 describes.

Table 4-1   Installed Apps Area Items

Item	Description
App name and icon	Displays the name and version of the app and an app for the app. Click an app icon to display more detailed information about the app and to access features for managing the app, as described in the "Viewing Detailed Information about an Installed or Available App" section on page 4-6.
App Status	Displays text and a chart that provide information about the states of an app. App states can include the following: • Running—App is running on a device • In Progress—App is in the process of installing on a device • Stopped—An app that was running has been stopped on a device • Failed—A start, stop, install, uninstall, upgrade, or configuration action that was performed on an app did not execute properly The text that describes each state shows the number of devices on which the app in that state and the total number of devices on which the app is installed For example, "8/12 Running" means that the app is installed on 12 devices and is running on 8 of them. The donut chart provides a visual representation of each state of an app as a percentage of the number of devices on which the app is installed. Hover your mouse pointer over any section of a chart to see what state that section represents and the percentage of devices on which the app is in that state. Click a chart to display monitoring information for the app, as described in the "Monitoring an App" section on page 4-31.

Table 4-1   Installed Apps Area Items (continued)

Item	Description
Top 5 CPU Consumer	Host name of up to five devices on which the app has consumed the most CPU resources during the past 24 hours.
	The percentage value next to a host name indicates the average amount of CPU resources the app consumed on the device during the past 24 hours.
	Click a host name to display device detailed information about the device. See the "Viewing Detailed Information about a Device" section on page 5-4 for more information.
Top 5 Memory Consumer	Host name of up to five devices on which the app has consumed the most RAM resources during the past 24 hours, and the amount of memory, in MG, consumed on each device.
	The percentage value next to a host name indicates the average amount of RAM resources the app consumed on the device during the past 24 hours.
	Click a host name to display device details information about the device. See the See the "Viewing Detailed Information about a Device" section on page 5-4 for more information.
REMOVE button	Appears if an app is not currently installed on any device. Click to remove the app from the Installed Apps area.

Managing Available Apps

The Available Apps area on the Apps View page lists each app that has been published, provides information about these apps, and provides access to related features. An available app is ready to be installed on one or more devices.

You can display this area in either of these views:

- App Install view—Lists available apps and provide access to detailed information and related features for each app
- APP EDIT view—Lists available apps, provides options for unpublishing an app or removing it from a device, and provides access to related information and features for each app

The following sections provide more detailed information:

- Available Apps Area: App Install View, page 4-3
- Available Apps Area: App Edit View, page 4-4

Available Apps Area: App Install View

The Available Apps area appears in App Install view by default when you access the Apps View page. When this area is in the App Edit view, you can change to the App Install view by clicking the **SWITCH TO APP INSTALL VIEW** button or by clicking the **APPS** tab.

In App Install view, the Available Apps area includes the items that Table 4-2 describes.

Table 4-2   Available Apps Area, App Install View Items

Item	Description
App name and icon	Displays the name, version, and icon of each available app. Click an app icon to display more detailed information about the app and to access features for managing the app, as described in the "Viewing Detailed Information about an Installed or Available App" section on page 4-6.
SWITCH TO APP EDIT VIEW button	Click to change the Available Apps area to App Edit view.

Available Apps Area: App Edit View

The Available Apps area appears in App Edit view when this area is in App Install view and you click the **SWITCH TO APP EDIT VIEW** button.

In App Edit view, the Available Apps area includes the items that Table 4-3 describes.

Table 4-3   Available Apps Area, App Edit View Items

Item	Description
App name and icon	Displays the name. version, and icon of each available app. Click an app icon to display more detailed information about the app and to access features for administering the app.
IMPORT APPS button	See the "Backing Up and Restoring Apps" section on page 4-30.
EXPORT APPS button	See the "Backing Up and Restoring Apps" section on page 4-30.
SWITCH TO APP INSTALL VIEW button	Click to change the Available Apps area to App Install view. See the "Available Apps Area: App Install View" section on page 4-3.
Unpublish button ⬇ for each app	See the "Unpublishing an App" section on page 4-10.
Remove button ✖ for each app	See the "Removing an App" section on page 4-20.

When the Available Apps area is in App Edit view and you click an app icon, a configuration page displays. The items that this page displays vary depending on the type of the app, and can include the items that Table 4-4 describes.

Table 4-4   Available Apps Area > Configuration Page Items

Item	Description
App icon	The icon that appears in Cisco Fog Director for the app. This icon comes from an image file that you specify. You can click **Edit Icon** to select an image file as described in the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
Author	Entity that authored the app, as specified in the app metadata.

Table 4-4   Available Apps Area > Configuration Page Items (continued)

Item	Description
Resource Profile	Resource profile of the app, which specifies the amount of host system CPU and memory (RAM) resources that the app requires on a device. For information about assigning resource profiles to an app, see *Cisco IOx Local Manager Reference Guide*.
CPU	Number of CPU units that the app requires on a device.
Memory	Amount of RAM, in KB, that the app requires on a device.
Disk	Amount of disk space, in MB, that the app requires on a device.
App Type	Type of the app (for example, **PaaS** or **VM**)
Runtime	Runtime environment that the app requires on a device.
CPU Architecture	Type of device on which the app is supported.
App Links	Appears if you configured links for an app. Click a link to go to the configured resource. See the "Configuring App Links" section on page 4-28.
UPGRADE PKG button	Lets you upload a newer version of an app to Cisco Fog Director. See the "Upgrading an App" section on page 4-19.
PUBLISH button	Click to publish the app, which makes the app available for installation on devices. See the "Publishing an App" section on page 4-10.
SAVE button	Click to save updates that you make to the description or release notes for the app. See the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
Description	Brief description of the app that appears when you view detailed information for the app. You can click **Edit** next to "Description" to enter description text as described in the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
Release Notes	Notes for the app that appears when you view detailed information for the app. For example, notes might include a list and descriptions of features added in an updated app. You can click **Edit** next to "Release Notes" to enter release note text as described in the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
App Links button	Let you configure external links for an app. See the "Configuring App Links" section on page 4-28.

Managing Unpublished Apps

The Unpublished Apps area on the Apps View page on the Apps View page lists each app that has been uploaded to Cisco Fog Director and is not yet published. An unpublished app must be published before it can be installed on one or more devices.

The Unpublished Apps area includes the items that Table 4-5 describes.

Table 4-5   Unpublished Apps Area Items

Item	Description
ADD NEW APP button	Lets you upload an app to Cisco Fog Director. See the "Adding an App" section on page 4-8.
App name and icon	Displays the name, version, and icon of each unpublished app. Click an icon to display additional information for the app. The page that appears is the same page that the "Available Apps Area: App Edit View" section on page 4-4 describes.
Publish button ⬆ for each app	Lets you publish an app, which makes it available for installation on a device. See the "Publishing an App" section on page 4-10.
Remove button ✖ for each app	Removes this version of the app from Cisco Fog Director.

Viewing Detailed Information about an Installed or Available App

To view detailed information about an installed app or available, click its icon in the Installed Apps area or in the Available Apps area on the Apps View page. The App Configuration page displays.

This page includes information and features that apply to the app. The items that this page displays vary depending on the state of the app, and can include the items that Table 4-6 describes.

Table 4-6   Detailed Information about an Installed or Available App Items

Item	Description
General information	The name of the app, its version, and the date and time it was last updated.
INSTALL button	Lets you install an app on one or more devices. See the "Installing an App" section on page 4-10.
MONITOR APP button	Displays information about the operation of the app and its resource consumption on devices See the "Monitoring an App" section on page 4-31.
UNINSTALL button	Lets you uninstall an app from one or more devices. See the "Uninstalling an App" section on page 4-16.
Author	Entity that authored the app, as specified in the app metadata.
CPU	Number of CPU units that the app requires on a device.
Memory	Amount of RAM, in KB, that the app requires on a device.
Disk	Amount of disk space, in MB, that the app requires on a device.
App Type	Type of the app (**PaaS** or **VM**)
Runtime	Runtime environment that the app requires on a device.
CPU Architecture	Type of device on which the app is supported.
App Links	Appears if you configured links for an app. Click a link to go to the configured resource. See the "Configuring App Links" section on page 4-28.

Table 4-6   Detailed Information about an Installed or Available App Items (continued)

Item	Description
Installation Successful display	Shows the number of devices on which the app has been successfully installed. The **EDIT CONFIGURATION** button under this display lets you update configuration parameters that apply to an app, These items may include configuration information, resource profile, networking, and port information. See the "Reconfiguring App Parameters" section on page 4-22 for more information.
Actions Failed on display	Shows the number of devices on which an installation, update, uninstall, or reconfiguration action failed for the app. Hover your mouse pointer over this area to see more detailed information about specific action failure types. You can click the **RETRY NOW** button retry an action. See the "Retrying a Failed Action for an App" section on page 4-29 for more information.
Upgrade Required On	After you add and publish a newer version of an already-published app, this field displays the number of devices on which the app should be upgraded. You can click the **UPGRADE** button to perform the upgrade. See the "Upgrading an App" section on page 4-19 for more information.
Installing Display	Displays information about the devices on which the app is installing. This information includes: • One or more *device squares*. Each one represents a device on which you are installing the app and shows the status of the install operation on that device. You can hover your mouse pointer over a device square to display the Edit Resource Profile dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the resource profile that has been assigned for the app on the device You can click the hostname and IP address in the dialog box to exit the installation and display the Device Details page for the device. • The host name of the device on which the app is installing and the status and progress of the installation operation on that device. Click the host name to display detailed information about the device, as described in the "Viewing Detailed Information about a Device" section on page 5-4. • A search device field, which you can display by clicking the expand icon ⊙ next to Search Device. Enter the IP address or host name of a device to see the status of the app installation process on that device.

Table 4-6   Detailed Information about an Installed or Available App Items (continued)

Item	Description
App State on installed devices display	Includes a chart that provides a visual representation of the number of devices on which the app in a particular state.
	Hover your mouse pointer over any section of a chart to see what state that section represents and the number of devices on which the app is in that state.
	Click any section of the chart to display a table with detailed information about each device on which the app is in the state. This table includes the following:
	• App state and percentage—Name of the state, and the percentage of devices on which the app is installed that the app is in that state.
	• Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
	• Host Name—Host name of the device on which the app is in the state. Click a host name to display detailed information about the device. See the See the "Viewing Detailed Information about a Device" section on page 5-4 for more information.
	• IP address—IP address of the device on which the app is in the state. Click an IP address to display detailed information for the device. See the "Viewing Detailed Information about a Device" section on page 5-4 for more information.
	• Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.
	• Last Heard—How long ago Cisco Fog Director last communicated with the device.
	• Error Summary—For an app that is in the Failed state, provides information about the cause of the action that failed.
	• Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
Description	Brief description of the app. See the "Editing an App Icon, Description, and Release Notes" section on page 4-21 for related information.
Release Notes	Release notes for the app. See the "Editing an App Icon, Description, and Release Notes" section on page 4-21 for related information.

Adding an App

Adding a Cisco IOx app uploads the app to Cisco Fog Director. When you add an app, it appears in the Unpublished area on the Apps View page and becomes available to be published.

To add an app, follow these steps:

Procedure

Step 1 On the Apps View page, click the **ADD NEW APP** button.

If other apps have already been added, this button appears In the Unpublished Apps area,

Step 2 In the dialog box that appears, Click the **Select App Package** button.

Step 3 Follow the on-screen prompts to locate and select the app that you want to add.

The app is added to Cisco Fog Director and a page with the items that Table 4-7 displays. The items in this page depend on the type of app that you added.

Table 4-7   Added App Page Items

Item	Description
Edit Icon	Click to add an icon for the app. See the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
App Information	Includes the following information • Name of the app • Latest version—Version of the app that you added • Last updated—Date and time that the app was last updated
Author	Entity that authored the app, as specified in the app metadata.
Resource Profile	Resource profile of the app, which specifies the amount of host system CPU and memory (RAM) resources that the app requires on a device. For information about assigning resource profiles to an app, see *Cisco IOx Local Manager Reference Guide*.
App Type	Type of the app (**PaaS** or **VM**)
Runtime	Runtime environment that the app requires on a device.
App Links button	Let you configure external links for an app. See the "Configuring App Links" section on page 4-28.
UPGRADE PKG button	Lets you upload a newer version of an app to Cisco Fog Director. See the "Upgrading an App" section on page 4-19.
PUBLISH button	Click to publish the app, which makes the app available for installation on devices. See the "Publishing an App" section on page 4-10.
SAVE button	Click to save updates that you make to the description or release notes for the app. See the "Editing an App Icon, Description, and Release Notes" section on page 4-21.
Description	Brief description of the app that appears when you view detailed information for the app. You can click **Edit** next to "Description" to enter description text as described in the "Editing an App Icon, Description, and Release Notes" section on page 4-21.

Table 4-7   Added App Page Items (continued)

Item	Description
Release Notes	Notes for the app that appears when you view detailed information for the app. For example, notes might include a list and descriptions of features added in an updated app. You can click **Edit** next to "Release Notes" to enter release note text as described in the "Editing an App Icon, Description, and Release Notes" section on page 4-21.

Publishing an App

You can publish an app after it has been added to Cisco Fog Director. A published app becomes available to install on devices.

To publish an app, take any of these actions:

*   In the Unpublished Apps area on the Apps View page, click the **Publish** button ⬆ that appears under the app that you want to publish

*   In the page that displays when you add an app, click the **PUBLISH** button.

*   In the Available Apps area, go to App Edit view, click the icon for the app that you want to publish, and then click the **PUBLISH** button in the page that displays

After you perform the Publish action, the app moves from the Unpublished Apps area to the Available Apps area on the Apps View page.

Unpublishing an App

Unpublishing an app moves the app to the unpublished area and makes it unavailable for installation on any device. Unpublishing an app does not remove it from devices on which it is installed already.

To unpublish an app, follow these steps:

Procedure

Step 1 In the Available Apps area on the Apps View page, click **SWITCH TO APP EDIT VIEW**.

Step 2 Click the **Unpublish** button ⬇ under the icon for the app.

Installing an App

You can install a published app on a device that has been added or imported to Cisco Fog Director.

The following sections provide additional information:

*   Install App Options, page 4-11

*   Install App Procedure, page 4-12

Install App Options

To view options for installing an app, click the **INSTALL** button on the Apps Configuration page for the app.

The Filter Devices page displays. This page includes the items that Table 4-8 describes.

Table 4-8   Filter Devices Page Items

Item	Description
Installed Devices table	Provides information about each device that has been added to Cisco Fog Director, and includes the following items:
	• Search Hostname, IP address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
	• Show field—Enter the name of a tag end then press the **Enter** key to display information for devices with a matching tag. You can choose a tag from a drop-down list of available tags by typing the first few letters of the tag and then clicking the tag that you want.
	• Check box—Check the check box for each device on which you want to install the app. You can click the check box in the title row of the table to quickly check all boxes in the table.
	• Host Name—Host name of the device on which the app is to be installed.
	• IP Address—IP address of the device on which the app is to be installed.
	• Tags—Tags that are assigned to a device.
	• Installed Apps—Apps that are installed on the device
	• Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
ADD SELECTED DEVICES button	Click to add devices with checked check boxes to the Selected Devices table.

Table 4-8   Filter Devices Page Items (continued)

Item	Description
Selected Devices table	Provides information about each device on which you want to install the app. Devices appear in this table after you check their check boxes in the Installed Devices table and then click **ADD SELECTED DEVICES**. This table includes the following items:
	• Selected Devices—Number of devices on which you want to install the app.
	• Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
	• Host Name—Host name of the device on which you want to install the app.
	• IP Address—IP address of the device on which you want to install the app.
	• Tags—Tags that are assigned to the device on which you want to install the app.
	• Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.
	• Last Heard—How long ago Cisco Fog Director last communicated with the device.
	• Action—Click the x icon ✖ to remove a device from the selected device table. Clicking this icon does not affect the device.
	• Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
Next button	Available if there is at least one device in the Selected Devices table. Click to continue an app install procedure.

Install App Procedure

To install an app on one or more devices, perform the following steps.

If you are installing an app on multiple devices and want to stop the installation procedure at any time, unpublish the app as described in the "Unpublishing an App" section on page 4-10.

Before You Begin

- Add or import each device on which you are installing the app to Cisco. Fog Director. See the "Adding Devices" section on page 5-8 or the "Importing Devices" section on page 5-9.

- Add the app to Cisco Fog Director. See the "Adding an App" section on page 4-8.

- Publish the app. See the "Publishing an App" section on page 4-10.

Procedure

Step 1   Take either of these actions:

- If the device is installed on at least one device, in the Installed Apps area on the Apps View page, click the icon for the app that you want to install, and then click the **INSTALL** button.

- If the device is not installed on any device, in the Available Apps area on the Apps View page, make sure that you are in App Install view, click the icon for the app that you want to install, and then click the **INSTALL** button.

Step 2   In the Installed Devices table, check the check box for each device on which you want to install the app.

For detailed information about this table and locating devices, see the "Install App Options" section on page 4-11.

Step 3   Click the **ADD SELECTED DEVICES** button.

The devices that you selected and on which the app can be installed are added to the Selected Devices table. The app will be installed on the devices that this table lists. For detailed information about this table and about removing devices from this table, see the "Install App Options" section on page 4-11.

Step 4   Click the **Next** button near the bottom of the page.

The Installation Summary page appears. This page lets you review and configure operations that are performed by Cisco Fog Director on the devices on which you are installing the app.

Step 5   (Optional) In the Installation Summary page, expand **Selected Devices** (if it is not expanded already) to review the following information for each device that you selected:

- Host Name—Host name of the device.

- IP Address—IP address of the device.

- Tags—Tags that are assigned to the device.

- Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.

- Last Heard—How long ago Cisco Fog Director last communicated with the device.

- Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.

Step 6   In the Installation Summary page, take the following actions as needed:

- (Optional) To change the list of devices that you selected, click the **Back** button, update information in the Selected Devices table as described earlier in this procedure, and then click the **Next** button again.

- (Optional) To change the default tag that will be added to each device, type another tag name in the **Tag Selected Devices as** field.

  By default, the system adds a tag with the app name to each device. You can change this name, or, if you do not want a tag to be added, delete all text in this field. See the "Managing Tags for a Device" section on page 5-12 for related information.

- (Optional) To cause the app to start automatically after it installs, check the **Start app after installation** check box. Starting an app initiates its operation on a host device and puts the app in Running state. CPU and memory (RAM) resources that were reserved for the app become in use.

- (Optional) Click the **VIEW INCOMPATIBLE DEVICES** button (if this button is not dimmed) to see a table that provides information about devices that you selected but on which the app cannot be installed. This table includes the following items:

  – Host Name—Host name of the device.

  – IP Address—IP address of the device.

  – Tags—Tags that are assigned to the device.

  – Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.

  – Incompatibility Cause—A brief description of why the app cannot be installed on the device.

  – Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table, and to designate the maximum number of devices that can appear on each page.

Step 7   (Optional) In the Installation Summary page, expand **Customize Configuration** to view and update configuration information for this app.

The configuration items that display are defined in the package_config.ini file for the app. The value that each field displays is the default value for that item as defined by the app. You can make updates in these fields as needed.

Step 8   (Optional) In the Installation Summary page, expand **Configure Resource Profile** to view and update the resource profiles that have been assigned for the app on each device.

You can update the resource profile for a specific device, some devices, or all devices.

The *device squares* in the box in the middle of the Configure Resource Profile area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Resource Profile dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the resource profile that has been assigned for the app on the device. You can click the hostname and IP address in the dialog box to exit the installation and display the Device Details page for the device.

To update a resource profile on one or more devices, take these actions:

a.   If you want to limit the device squares displays to one or more specific devices, take either of these actions:

  – To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

  – To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

b.   Take the desired action:

  – To change the resource profile for a specific device, hover your mouse pointer over the device square for that device, and in the Edit Resource Profile dialog box, choose a resource profile from the **Select Profile** drop-down list.

  – To change the resource profile for all devices for which a device square displayed, click the desired profile radio button and then click the **REASSIGN PROFILE** button:

  - **Exact matching profile**—Assigns the resource profile that is defined for the app in its metadata, if the resources are available on a device

  - **Largest available profile**—Assigns the largest resource profile that is currently available on each device on which you are installing

Step 9   (Optional) In the Installation Summary page, expand **Configure Networking** to view and update the network from which the app obtains its IP address or addresses on each device.

The Configure Networking area is available only if its options apply to this installation.

You can update the network for a specific device, some of devices, or all devices.

The *device squares* in the box in the middle of the Configure Networking area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Network Details dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the network that has been assigned for the app on the device.

To update the network for an app on one or more devices, take these actions:

a. If you want to limit the device squares to one or more specific devices, take either of these actions:

– To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

– To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

b. Take the desired action:

– To change the network for a specific device, hover your mouse pointer over the device square for that device, and in the Edit Network Details dialog box. choose a network from the **Select Network** drop-down list. Network options are:

  - **iox-bridge0**—App obtains its IP address from a DCHP pool that is configured in Cisco IOS

  - iox-nat0—App obtains its IP address from an internal network address translator

– To change the network for all devices for which a device square displayed, click either of the following radio buttons and then click the **REASSIGN NETWORKS** button:

  - Bridged—App obtains its IP address from a DCHP pool that is configured in Cisco IOS

  - NATed—App obtains its IP address from an internal network address translator

Step 10   (Optional) In the Installation Summary page, expand **Configure Device Resource Ports** to view and update the serial port that an app uses on a device.

The Configure Device Resource Ports area is available only if the app requests a serial port.

The *device squares* in the box in the middle of the Configure Device Resource Ports area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Serial Details dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the serial port that has been assigned for the app on the device.

To update a serial port for an app on one or more devices, take these actions:

a. If you want to limit the device squares to one or more specific devices, take either of these actions:

– To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

– To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

b. Hover your mouse pointer over the device square for the device that you want to update, and in the Edit Serial Details dialog box, choose a port from the **Select Serial Port** drop-down list.

Step 11   (Optional) In the Installation Summary page, expand **Network Status** to view network, resource, and related information for apps and devices.

The Network Status area displays the following information:

- How many of the devices that you selected for installation of the app are reachable. ("Reachable" means that Cisco Fog Director can communicate with the device.) Hover your mouse pointer over a graph to see more detailed information.

- The *device squares* in the box in the middle of the area. Each box represents a device on which you are installing the app. You can hover your mouse pointer over a device square to display the following information:

  - **Cartridges**—Cisco cartridges that a PAAS app requires to run. These cartridges must already be uploaded to Cisco Fog Director (see Chapter 7, "Managing Cartridges") and are installed automatically on the device as part of the app installation process.

  - **CPU Availability**—Number of free CPU units on the device.

  - **Memory Availability**—Amount of free RAM, in MB, on the device.

- How many of the devices that you selected for installation of the app are reachable. ("Reachable" means that Cisco Fog Director can communicate with the device.) Hover your mouse pointer over a graph to see more detailed information.

- How often the Cisco Fog Director updates the information in this area. You can choose a value from the **Collect resource usage at least every** drop-down list. Options are **Every 15 mins**, **Every 1 hour**, **Every 4 hour**, **Every 8 hour**, **Every 16 hour**, and **Never ever**.

Step 12   When you are satisfied with the information on the Installation Summary page, click the **DONE, LET'S GO** button.

The App Configuration page appears, as described in the "Viewing Detailed Information about an Installed or Available App" section on page 4-6.

While the app is installing on a device, the status of the installation displays for that device. Click the device to see the progress of the installation.

If the Actions Failed display on this page indicates that the installation failed on any device, you can click the **RETRY NOW** button to try the installation on these devices again. See the "Retrying a Failed Action for an App" section on page 4-29.

Uninstalling an App

You can uninstall an app from any device on which it is running. Uninstalling an app removes it from the device and releases device CPU and memory (RAM) resources that were reserved for it.

You can uninstall an app that is in any state.

The following sections provide additional information:

- Uninstall App Options, page 4-17
- Uninstall App Procedure, page 4-18

Uninstall App Options

To view options for uninstalling an app, click the **UNINSTALL APP** button on the Apps Configuration page for the app.

A page displays that includes the items that Table 4-9 describes.

Table 4-9   **Uninstall App Items**

Item	Description
Installed Devices table	Provides information about each device on which the app is installed, and includes the following items:
	• Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
	• Show field—Enter the name of a tag end then press the **Enter** key to display information for devices with a matching tag. You can choose a tag from a drop-down list of available tags by typing the first few letters of the tag and then clicking the tag that you want.
	• Check box—Check the check box for each device from which you want to uninstall the app. You can click the check box in the title row of the table to quickly check all boxes in the table.
	• Host Name—Host name of the device on which the app is installed.
	• IP Address—IP address of the device on which the app is installed.
	• Tags—Tags that are assigned to the device.
	• Installed Apps—Apps that are installed on the device.
	• Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
ADD SELECTED DEVICES button	Click to add devices with checked check boxes to the Selected Devices table.

Table 4-9   Uninstall App Items (continued)

Item	Description
Selected Devices table	Provides information about each device from which you want to uninstall the app. Devices appear in this table after you check their check boxes in the Installed Devices table and then click **ADD SELECTED DEVICES**. This table includes the following items: • Selected Devices—Number of devices from which you want to remove the app. • Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type. • Host Name—Host name of the device from which you want to uninstall the app. • IP Address—IP address of the device from which you want to uninstall the app. • Tags—Tags that are assigned to the device from which you want to uninstall the app. • Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information. • Last Heard—How long ago Cisco Fog Director last communicated with the device. • Action—Click the x icon ✖ to remove a device from the selected device table. Clicking this icon does not affect the device and does not remove the app from the device. • Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
DONE, LET'S GO button	Executes an uninstall operation.

Uninstall App Procedure

To remove an installed app from one or more devices, follow these steps:

Procedure

Step 1 Take either of these actions:

• In the Installed Apps area on the Apps View page, click the icon for the app that you want to uninstall, and then click the **UNINSTALL** button.

• In the Available Apps area on the Apps View page, make sure that you are in App Install view, click the icon for the app that you want to uninstall, and then click the **UNINSTALL** button.

Step 2   In the Installed Devices table, check the check box for each device from which you want to uninstall the app.

For detailed information about this table and locating devices, see the "Uninstall App Options" section on page 4-17.

Step 3   Click the **ADD SELECTED DEVICES** button.

The devices with checked check boxes are added to the Selected Devices table. The app will be uninstalled from devices that this table lists. For detailed information about this table and about removing devices from this table, see the "Uninstall App Options" section on page 4-17.

Step 4   Click the **DONE, LET'S GO** button.

Upgrading an App

When an new version of an installed app becomes available, you can upgrade the app. This process includes uploading the app for Cisco Fog Director and then upgrading devices with the new app version.

To upgrade an app, follow these steps:

Procedure

Step 1   f you are not viewing the page that displays when you add an app, take these actions:

  a.   In the Available Apps area on the Apps View page, make sure that you are in App Edit view.

  b.   In this area, click the icon for the app for the app to upgrade.

Step 2   Take these actions to upload the new version of the app to Cisco Fog Director:

  c.   Click the **UPGRADE PKG** button.

  d.   In the dialog box that displays, click the **Select New App Package** button, and then follow the on-screen prompts to locate and select the app file that you want.

The app file that you select uploads to Cisco Fog Director.

Step 3   Click the **Publish** button on the Configuration page.

The app is published, which makes it available for upgrading, and the Apps View page displays.

Step 4   Take these actions to upgrade devices with the app that you uploaded:

  a.   In the Installed Apps area on the Apps View page, click the icon for the app to upgrade.

  b.   Click the **UPGRADE** button, which appears under the "Upgrade Required on" displays.

The Filter Devices page appears. This page includes the items that Table 4-8 on page 4-11 describes.

  c.   In the table, check the check box for each device on which you want to upgrade the app, and then click the **ADD SELECTED DEVICES** button.

  d.   Click the **DONE, LET'S GO** button.

The App Configuration page appears, as described in the "Viewing Detailed Information about an Installed or Available App" section on page 4-6.

While the app is upgrading on a device, the status of the upgrade displays for that device. Click the device to see the progress of the upgrade.

If the Actions Failed display on this page indicates that the upgrade failed on any device, you can click the **RETRY NOW** button to try the upgrade on these devices again. See the "Retrying a Failed Action for an App" section on page 4-29.

Reverting to the Previous Version of an App

After you upgrade an app, you can revert to the most recent previously installed version of that app, if needed.

The following sections provide additional information:

- Reverting to the Previous Version of a Published App, page 4-20
- Reverting to the Previous Version of an Unpublished App, page 4-20

Reverting to the Previous Version of a Published App

If you have upgraded an app and then published the upgraded version, you can revert to the previous version of the app.

To revert to the previous version of a published app, follow these steps:

Procedure

Step 1   Uninstall the app from each device on which it is installed, as described in the "Uninstalling an App" section on page 4-16.

Step 2   Unpublish the app, as described in the "Unpublishing an App" section on page 4-10.

The previous version of the app appears in the Published area on the Apps View page.

Reverting to the Previous Version of an Unpublished App

If you have upgraded an app but not published the upgraded version, you can revert to the previous version of the app.

To revert to the previous version of an unpublished app, remove the app as described in the "Removing an App" section on page 4-20. The previous version of the app appears in the Unpublished area on the Apps View page.

Removing an App

Removing an app removes it from Cisco Fog Director.

To remove an app, follow these steps:

Procedure

Step 1   Uninstall the app as described in the "Uninstalling an App" section on page 4-16.

The app moves to the Available Apps area on the Apps View page.

Step 2   In the Available Apps area, click **SWITCH TO APP EDIT VIEW**.

Step 3   Click the **Remove** button ⊗ under the icon for the app.

The app moves to the Unpublished Apps area on the Apps View page.

Step 4   In the Unpublished Apps area, click the **Remove** button ⊗ under the icon for the app.

Editing an App Icon, Description, and Release Notes

You can add or update the following items for an app:

- Icon—The icon that appears in Cisco Fog Director for the app.

  This icon comes from an image file that you specify. The image size should be 250 x 250 pixels. The system accepts images that are other sizes, but those images are scaled and may not appear as desired. The image file can in any of these formats: ai, bmp, drw, gif, ico, jpe, jpeg, jpg, pct, png, psd, psp, raw, scf, svg, svgz, tif, or tiff.

- Description—Brief description of the app that appears when you view detailed information for the app.

- Release Notes (optional)—Notes for the app that appears when you view detailed information for the app. For example, notes might include a list and descriptions of features added in an updated app.

To add or update an icon, description, or release notes for an app, follow these steps:

Procedure

Step 1   If you are not viewing the page that displays when you add an app, take these actions:

  a.   In the Available Apps area on the Apps View page, make sure that you are in App Edit view.

  b.   In this area, click the icon for the app for which you want to add or update the icon, description, or release notes.

Step 2   To add or update an icon, take these actions:

  a.   Click **Edit Icon**.

  b.   Follow the on-screen prompts to locate and select the image file for the icon that you want.

Step 3   To add or update a description, take these actions:

  a.   Click **Edit** next to "Description."

  b.   In the edit area that appears, type the description. You can use the formatting tools at the top of the Edit area to format the text and perform related operations.

  c.   Click **Apply**.

  d.   Click the **SAVE** button.

Step 4 To add or update release notes, take these actions:

a. Click **Edit next to** "Release Notes."

b. In the edit area that appears, type the notes. You can use the formatting tools at the top of the Edit area to format the text and perform related operations.

c. Click **Apply**.

d. Click the **SAVE** button.

Reconfiguring App Parameters

You can reconfigure a variety of items that apply to an app. Depending on the app, items that you can reconfigure include:

- Configuration information—Configuration items that are defined in the package_config.ini file for the app

- Resource profile—Amount of host system CPU and memory (RAM) resources that the app requires on a device.

- Networking—Network from which the app obtains its IP address or addresses

- Resource Port—Serial port that the app uses on a device

The following sections provide additional information:

Reconfigure App Options

To view options for reconfiguring an app, take either of these actions:

- Click the **EDIT CONFIGURATION** button on the Apps Configuration page for the app

- From the Devices tab, choose a device, and then click **EDIT CONFIGURATION** near the bottom of the page that displays for the device

If you clicked **Edit Configuration** from the Apps Configuration page, the Reconfigure App page appears, which displays that includes the items that Table 4-10 describes.

Table 4-10   Reconfigure App Page Items

Item	Description
Installed Devices table	Provides information about each device on which the app is installed, and includes the following items: • Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type. • Show field—Enter the name of a tag end then press the **Enter** key to display information for devices with a matching tag. You can choose a tag from a drop-down list of available tags by typing the first few letters of the tag and then clicking the tag that you want. • Check box—Check the check box for each device on which you want to reconfigure the app. You can click the check box in the title row of the table to quickly check all boxes in the table. • Host Name—Host name of the device on which the app is installed. • IP Address—IP address of the device on which the app is installed. • Tags—Tags that are assigned to the device on which the app is installed. • Installed Apps—Apps that are installed on the device. • Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
ADD SELECTED DEVICES button	Click to add devices with checked check boxes to the Selected Devices table.

Table 4-10   Reconfigure App Page Items (continued)

Item	Description
Selected Devices table	Provides information about each device on which you want to reconfigure the app. Devices appear in this table after you check their check boxes in the Installed Devices table and then click **ADD SELECTED DEVICES**. This table includes the following items:
	• Selected Devices—Number of devices on which you want to reconfigure the app.
	• Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
	• Host Name—Host name of the device on which you want to reconfigure the app.
	• IP Address—IP address of the device on which you want to reconfigure the app.
	• Tags—Tags that are assigned to the device on which you want to reconfigure the app.
	• Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.
	• Last Heard—How long ago Cisco Fog Director last communicated with the device.
	• Action—Click the x icon ✖ to remove a device from the selected device table. Clicking this icon does not affect the device and does not remove the app from the device.
	• Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
Customize Resources	Expand this area to access the items that you can reconfigure.

Reconfigure App Procedure

You can reconfigure an app from the Apps View page or the Devices View page, as described in the following sections:

Reconfiguring an App from the Apps View Page

Reconfiguring an app from the Apps View page is useful if you want to apply the reconfiguration to multiple devices.

To reconfigure an app from the Apps View page, perform the following steps. The items that you can reconfigure depend on the app, so some configuration options that the following procedure includes may not be available for some apps.

Before You Begin

Make sure that the app is installed as described in the "Installing an App" section on page 4-10.

Procedure

Step 1   Take one of these actions:

- In the Installed Apps area on the Apps View page, click the icon for the app that you want to reconfigure, and then click the **EDIT CONFIGURATION** button on the App Configuration page.

- In the Available Apps area on the Apps View page, make sure that you are in App Install view, click the icon for the app that you want to reconfigure, and then click the **EDIT CONFIGURATION** button on the App Configuration page.

Step 2   In the Installed Devices table, check the check box for each device on which you want to reconfigure the app.

For detailed information about this table and locating devices, see the "Reconfigure App Options" section on page 4-22.

Step 3   Click the **ADD SELECTED DEVICES** button.

The devices with checked check boxes are added to the Selected Devices table. The app can be reconfigured on devices that this table list. For detailed information about this table and about removing devices from this table, see the "Reconfigure App Options" section on page 4-22.

Step 4   To to change configuration information for this app, take these actions:

a.   Click the Expand icon ⊙ next to **Customize Configuration**.

The configuration items that display are defined in the package_config.ini file for the app.

b.   Make updates as needed in the fields that appear.

The value that each field displays is the default value for that item as defined by the app. To see the current value of an item on a particular device, from the Devices tab, choose a device, and then click **EDIT CONFIGURATION** near the bottom of the page that displays for the device.

c.   (Optional) **Check the Restart app** after configuration check box if you want the app to restart after you save the configuration updates. Some apps require a restart after a configuration change.

d.   Click the **DONE, LET'S GO** button to complete the changes to configuration information.

Step 5   To reconfigure resource profiles that have been assigned for the app, take these actions:

a.   Click the Expand icon ⊙ next to **Customize Resources**, if this area is not expanded already.

b.   Click the Expand icon ⊙ next to **Configure Resource Profiles**.

You can update the resource profile for a specific device, some devices, or all devices.

The *device squares* in the box in the middle of the Configure Resource Profile area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Resource Profile dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the resource profile that has been assigned for the app on the device. You can click the hostname and IP address in the dialog box to exit the reconfigure procedure and display the Device Details page for the device.

    c. If you want to limit the device squares displays to one or more specific devices, take either of these actions:

      – To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

      – To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

    d. Take the desired action:

      – To change the resource profile for a specific device, hover your mouse pointer over the device square for that device, and in the Edit Resource Profile dialog box. choose a resource profile from the **Select Profile** drop-down list.

      – To change the resource profile for all devices for which a device square displayed, click the desired profile radio button and then click the **Reassign Profile** button:

        - **Exact matching profile**—Assigns the resource profile that is defined for the app in its metadata, if the resources are available on a device

        - **Largest available profile**—Assigns the largest resource profile that is currently available on a device

    e. If you are finished reconfiguring the app, click the **EDIT RESOURCES** button. Otherwise, continue to the following step.

Step 6 To reconfigure the network from which the app obtains its IP address or addresses, take these actions:

    a. Click the Expand icon ⊙ next to **Customize Resources**, if this area is not expanded already.

    b. Click the Expand icon ⊙ next to **Configure Networking**.

    You can update the network for a specific device, some devices, or all devices.

    The *device squares* in the box in the middle of the Configure Networking area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Network Details dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the network that has been assigned for the app on the device.

    c. If you want to limit the device squares to one or more specific devices, take either of these actions:

      – To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

      – To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

    d. Take the desired action:

      – To change the network for a specific device, Hover your mouse pointer over the device square for that device, and in the Edit Network Details dialog box, choose a network from the **Select Network** drop-down list. Network options are:

        - **iox-bridge0**—App obtains its IP address from a DCHP pool that is configured in Cisco IOS

        - **iox-nat0**—App obtains its IP address from an internal network address translator

      – To change the network for all devices for which a device square displayed, click either of these radio buttons and then click the **REASSIGN NETWORKS** button:

        - **Bridged**—App obtains its IP address from a DCHP pool that is configured in Cisco IOS

        - **NATed**—App obtains its IP address from an internal network address translator

    e. If you are finished reconfiguring the app, click the **EDIT RESOURCES** button. Otherwise, continue to the following step.

Step 7   To reconfigure the serial port that the app uses on a device, take these actions:

    a.   Click the Expand icon ⌄ next to **Customize Resources**, if this area is not expanded already.

    b.   Click the Expand icon ⌄ next to **Configure Device Resource Ports**.

        The *device squares* in the box in the middle of the Configure Device Resource Ports area represent devices on which you are installing the app. You can hover your mouse pointer over a device square to display the Edit Serial Details dialog box. This dialog box shows the host name and IP address of the device, tags assigned to the device, and the serial port that has been assigned for the app on the device.

    a.   If you want to limit the device squares to one or more specific devices, take either of these actions:

        –   To limit the device display to a specific device based on its hostname or IP address, enter all or part of the hostname or IP address in the **Search Hostname, IP Address** field.

        –   To limit the device display to specific devices based a tag, choose a tag from the **Show** drop-down list.

    b.   Hover your mouse pointer over the device square for the device that you want to update, and in the Edit Serial Details dialog box, choose a port from the **Select Serial Port** drop-down list.

    c.   When you are finished reconfiguring resources, click the **EDIT RESOURCES** button.

Reconfiguring an App from the Devices View Page

Reconfiguring an app from the Devices View page applies the reconfiguration to a specified device.

To reconfigure an app from the Devices View page, follow these steps:

Before You Begin

Make sure that the app is installed as described in the "Installing an App" section on page 4-10.

Procedure

Step 1   On the Devices page, choose the device on which you want to reconfigure the app.

Step 2   Click **Edit Configuration** under the app that you want to reconfigure.

    The configuration items that display are defined in the package_config.ini file for the app.

Step 3   Make updates as needed in the fields that appear.

    The value that each field displays is the value for that item on the device that you chose.

Step 4   (Optional) **Check the Restart app** after configuration check box if you want the app to restart after you save the configuration updates. Some apps require a restart after a configuration change.

Step 5   Click the **RECONFIGURE APP** button.

Configuring App Links

You can use app link to associate links to external resources with an app. For example, you could include a link to a web site or document that provides information about an app, or you could include a link to a reference guide or configuration guide for an app. You can associate as many links as needed with an app.

After you configure a link for an app, the link appears in the under App Links on the App Configuration page, and in the Apps area on the Device Details page. Click a link to go to the configured resource.

The following sections describe how add, update, or delete app links.

Adding an App Link

To configure and app link, follow these steps:

Procedure

Step 1 If you are not viewing the page that displays when you add an app, take these actions:

    a. In the Available Apps area on the Apps View page, make sure that you are in App Edit view.

    b. In this area, click the icon for the app for which you want to add links.

Step 2 Click the **App Links** button [+].

Three fields appear.

Step 3 In the first field, enter a name for the link.

For example, enter the name of the web page or a document that the link references.

Step 4 In the second field, enter the URL of the link.

Step 5 In the third field, enter a brief description of the linked resource.

Step 6 Take either of these actions:

- To save your changes, click the Check icon [✓].
- To close the fields without saving your changes, click the X icon [✗].

Updating or Deleting an App Link

To update or delete an app link, follow these steps:

Procedure

Step 1 If you are not viewing the page that displays when you add an app, take these actions:

    a. In the Available Apps area on the Apps View page, make sure that you are in App Edit view.

    b. In this area, click the icon for the app for which you want to add links.

Step 2   Take either of these actions

- To delete the link, click the Delete icon .

- To update the link, click the Delete icon and continue to Step 3.

Step 3   In the fields that display, update the name a name of the link, the URL of the link, or the description of the link as needed.

Step 4   Take either of these actions:

- To save your changes, click the Check icon .

- To close the fields without saving your changes, click the X icon .

Retrying a Failed Action for an App

If any of the following actions fails on one or more devices, you can use the **RETRY NOW** button on the App Configuration page to retry the action:

- Installing an app

- Upgrading an app

- Uninstalling an app

- Reconfiguring app parameters (including configuration, resource profile, networking, and resource port information)

To retry a failed action, follow these steps:

Procedure

Step 1   From the App Configuration page for the app, click the **RETRY NOW** button.

This button is available only if an action failed.

The Select Retry Actions page appears. This page includes the following information for each device on which the action failed:

- Host Name—Host name of the device

- IP Address—IP address of the device

- Tags—Tags that are assigned to the device

- Installed Apps—Apps that have been installed on the device

- Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.

Step 2   In the device table, check the check box for each device to which you want to apply the retry or remove action.

Step 3   Take either of these actions:

- Click the **REDEPLOY** button to retry the action on the devices that you selected.

- Click the **REMOVE FOREVER** button to delete information about the error that failed and clear the error from the system

Backing Up and Restoring Apps

The Cisco Fog Director export and import features let you back up and restore apps. This feature can be useful for creating an archive of apps or for importing apps to another Cisco Fog Director.

The export feature saves all apps that appear in the Available and the Unpublished areas on the Apps View page to a zip file outside of Cisco Fog Director. The import feature restores apps that have been exported to a zip file.

The following sections describe these features in detail:

Exporting Apps

Exporting apps lets you save apps in an export file, which is a zip file named exportedApps.zip that is stored outside of Cisco Fog Director. This action affects all apps that appear in the Available and the Unpublished areas on the Apps View.

`To export an app, follow these steps:

Procedure

Step 1   In the Available Apps area on the Apps View page, make sure that you are in App Edit view, and then click the **EXPORT APPS** button.

Step 2   Follow the on-screen prompts to save the app in the location of your choice.

The file is named exportedApps.zip.

Importing Apps

When you import apps that you exported as described in the , the apps are added to Cisco Fog Director. If an app already exists in the Cisco Fog Director to which you are importing, the app is not restored.

To import an app, follow these steps:

Procedure

Step 1   On the Apps View page, take either of these actions:

*   If no apps have yet been added, click the **IMPORT APPS** button
*   If other apps have already been added, in the Available Apps area, make sure that you are in App Edit view, and then click the **IMPORT APPS** button

Step 2   In the Import Apps dialog box that displays, click the **Select Apps Archive** button.

Step 3   Follow the on-screen prompts to locate and select the exportedApps.zip export file that you want to import.

When the import process completes, the Import Apps Dialog box confirms the completion. It also provides information about any apps that could not be imported (you might need to scroll down in the dialog box to see this information).

Monitoring an App

Monitoring an app provides information about the operation of an app across all devices on which it is installed. This information can be useful for evaluating the operation of the app or for troubleshooting. The following sections describe the app monitoring features:

- Viewing General Monitoring Information, page 4-31
- Viewing Detailed Monitoring Information, page 4-33

Viewing General Monitoring Information

To view general monitoring information about an installed app, take any of these actions:

- In the Installed Apps area on the Apps View page, click the App Status donut chart for the app
- In the Available Apps area on the Apps View page, make sure that you are in App Install view, click the icon for the app that you want to monitor, and then click the **MONITOR APP** button
- Click the **MONITOR APP** button when you are viewing detailed information about the app

The App Monitoring page displays. This page includes information and features that apply to the app, and includes some or all of the items that Table 4-11 describes.

Table 4-11   App Monitoring Page Items

Item	Description
Installed-on information	Shows the number of devices on which the app has been successfully installed.
Configuration View link	Click to display detailed information about the app, as described in the "Viewing Detailed Information about an Installed or Available App" section on page 4-6.
APP DOWNTIME	Shows the number of devices on which the app has been in Running state or in Stopped state during the designated time period.
	Hover your mouse pointer over any part of the chart to see detailed information about a data point.
	You can click **Day**, **Week**, or **Month** above this graph to designate the time period for the information.

Table 4-11   *App Monitoring Page Items (continued)*

Item	Description
Status charts	Show information about devices on which an app is running and on which an app is stopped. For each state, a chart shows the name of the state, and the number of devices on which the app is in that state, and the percentage of devices on which the app is installed that the app is in that state.
	You can click the following buttons under a status chart:
	• **STOP**—Appears under the Running chart. Click to stop the app, which shuts down its operation on the host devices on which it is running and puts it in Stopped state on these devices.
	• **START**—Appears under the Stopped chart. Click to start the app, which initiates its operation on the host devices on which it is stopped and puts it in Running state on these devices.
	• **VIEW DETAIL**—Appears under each chart and provides access to information that can be useful for troubleshooting. See the "Viewing Detailed Monitoring Information" section on page 4-33.

Table 4-11 *App Monitoring Page Items (continued)*

Item	Description
App Consumption	Displays the following charts, which provide information about device resources that the app consumes: • Mean CPU Consumption—Average (mean) CPU resources that the app used on devices on which it ran during the designated time period. • Mean Disk Consumption—Average (mean) hard disk space that the app used on devices on which it ran during the designated time period. • Mean Memory Consumption—Average (mean) RAM resources that the app used on devices on which it ran during the designated time period. • Mean Network Consumption—Average (mean) network bandwidth that the devices on which the app ran used for the app during the designated time period. You can click **Day**, **Week**, or **Month** above these charts to designate the time period for the information that the charts display. Hover your mouse pointer over any part of a chart to see detailed information about a data point. Click a chart to display a table with detailed information about the corresponding resource consumption for individual devices. The tables include the following items: • Host Name—The host name of the device on which the resource is consumed. Click a host name to display device details information for the device. See the "Viewing Detailed Information about a Device" section on page 5-4. • IP Address—The IP Address of the device on which the resource is consumed. Click an IP address to display device details information for the device. See the "Viewing Detailed Information about a Device" section on page 5-4. • Tags—Tags that have been assigned to the device. See the "Managing Tags for a Device" section on page 5-12. • CPU Consumption, Disk Consumption, Memory Consumption, or Network Consumption (depending on the chart that you clicked)—Shows the average (mean) resource consumption of the app on the device during the designated time period.

Viewing Detailed Monitoring Information

To view general monitoring information about an installed app, click either of these buttons on the App Monitoring page:

- **VIEW DETAIL** under the Running Devices chart—Displays a table for the devices on which the app is in Running state. This table includes the **Running Devices** tab and the **Error** tab.

    This button is dimmed if the app is not in the Running state on at least one device.

- **VIEW DETAIL** under the Stopped Devices chart—Displays a table for the devices on which the app is in Stopped state. This table includes the **Stopped Devices** tab and the **Error** tab.

  This button is dimmed if the app is not in the Stopped state on at least one device.

The **Running Devices** or **Stopped devices** tab in the table provide information for devices on which the app is in the corresponding state. The **Error** tab provides information about devices on which the app is in an error state of some kind.

This table includes the items that Table 4-5 describes.

Table 4-12   Detailed Monitoring Information for an App

Item	Description
Search Hostname, IP Address field	Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type.
Host Name	Host name of the device on which the app is in the state. Click a host name to display device details information for the device. See the "Viewing Detailed Information about a Device" section on page 5-4.
IP Address	IP Address of the device on which the app is in the state. Click an IP address to display device details information for the device. See the "Viewing Detailed Information about a Device" section on page 5-4.
Tags (on **Running Devices** or **Stopped Devices** tab only)	Tags that have been assigned to the device. See the "Managing Tags for a Device" section on page 5-12.
Health	Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information.
View App Log button (on **Running Devices** or **Stopped Devices** tab only)	Click to display log information that is generated by the app on a device.
Error Summary (on **Error** tab only)	Brief description of the error that occurred.
Pagination controls	Click a control to go to the first, next, last, previous, or specific page in the table.

Managing Devices

A *device* is a Cisco IOS device that supports Cisco IOx. You can install Cisco IOx apps on these devices only.

The Cisco Fog Director Device pages provide information about devices and provides access to features for monitoring and troubleshooting devices, and for administering apps on devices.

To access the Devices pages, log in to Cisco Fog Director as described in the "Accessing Cisco Fog Director" section on page 3-1, and then click the **DEVICES** tab. The Devices View page displays.

This chapter includes these sections:

Viewing General Information about Devices

The Devices View page, which displays when you choose the **DEVICES** tab in Cisco Fog Manager, provides general information about devices that have been added or uploaded to Cisco Fog Manager.

This page includes the items that Table 5-1 describes.

Table 5-1   Devices View Page Items

Item	Description
Last Heard chart	Number of devices with which Cisco Fog Director successfully interacted over the past month. The chart can include sections for day, week, month, and never. Hover your mouse pointer over a section of the cart to see the percentage of devices that correspond to that section.
Reachability chart	Number of devices with which Cisco Fog Director can communicate. Hover your mouse pointer over a section of the cart to see the percentage of devices that correspond to that section.
Top 5 Consumers	Includes the following charts, which provide information about resources that IOx apps consumed on devices during the past 24 hours. Hover your mouse pointer over any circle in a chart to see the host name of the device for which that circle provides information. Double-click any circle in a chart to display detailed information about the device for which that circle provides information, as described in the "Viewing Detailed Information about a Device" section on page 5-4. • CPU—Shows the percentage of CPU resources consumed by apps for the five devices on which the apps consumed the most resources • Memory—Shows the memory, in KB, consumed by apps for the five devices on which the apps consumed the most memory • Disk—Shows the disk space, in MB, consumed by apps for the five devices on which the apps consumed the most disk space • Network—Shows the network bandwidth, in KB, consumed by the five devices that consumed the most bandwidth when running apps
ADD button	Displays the Adds New Device window, which you use to add a device to Cisco Fog Director. See the "Adding Devices" section on page 5-8.
IMPORT button	Lets you add devices to Cisco Fog Director by importing a CSV file in which information for the devices is defined. See the "Importing Devices" section on page 5-9.

Table 5-1   Devices View Page Items (continued)

Item	Description
Device table	Provides information about each device that has been added to Cisco Fog Director. This table includes the following: • Search Hostname, IP Address field—Type all or part of a host name or IP address of a device to display information for devices with matching information. The table display updates as you type. • Show field—Enter the name of a tag end then press the **Enter** key to display information for devices with a matching tag. You can display a drop-down of tags that you can choose typing the first few letters of the tag. • Host Name—Host name of the device. Click a host name to display detailed information about the device. See the "Viewing Detailed Information about a Device" section on page 5-4. • IP Address—IP address of the device. Click a host name to display device detailed information about the device. See the "Viewing Detailed Information about a Device" section on page 5-4. • Tags—Tags for the device. See the "Managing Tags for a Device" section on page 5-12. • Health—Icons that represent information about CPU use or memory use on the device. Hover your mouse pointer over an icon to see more detailed information. • Last Heard—How long ago Cisco Fog Director last communicated with the device. • Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table. To see additional information about a device or access various functions for a device, click the Expand icon ▸ to the left of the device host name in the Device table. The following row in this table describes the items that appear.

Table 5-1 **Devices View Page Items (continued)**

Item	Description
Expanded device information and functions	The following items appear when you click the Expand icon ▸ to the left of the device host name in the Device table:
	• **Edit Device**—Click to edit various attributes for the device. See the "Editing Attributes for a Device" section on page 5-11.
	• **Delete Device**—Click to remove the device from Cisco Fog Director. See the "Deleting a Device" section on page 5-11.
	• **Refresh** button ⟳ —Click to cause Cisco Fog Director to rediscover the device and update information that displays.
	• App information and controls—Provides the following for each app that is installed on the device
	– App—Name of the app.
	– Downtime - today—Amount of time during the past 24 hours that the app was in Stopped state.
	– CPU - mean %age today—Average (mean) percentage of CPU resources that the app used on the device during the past 24 hours.
	– Memory - mean Kb today—Average (mean) memory (RAM) in KB, that the app consumed on the device during the past 24 hours.
	– Status—State of the app.
	– Action—**Stop App** button ▪, **Start App** button ▶, **Remove App** button ✖, depending on the state of the app. See the "Starting or Stopping an App on a Device" section on page 5-12 or the "Removing an App from a Device" section on page 5-13.

Viewing Detailed Information about a Device

To view detailed information about a device, take any of these actions:

• On the Devices View page, double-click a circle in a Top 5 Consumers chart. Detailed information displays for the device for which that circle provides information.

• On the Apps View page or the Devices View page, click the host name of the IP address of a device anywhere that either of these items appears as a link.

The Device Details page displays. This page includes information and features that apply to the app, as the following sections describe:

• Device Details Area, page 5-5

• Apps Area, page 5-6

Device Details Area

The Device Details area on the Device Details page provides detailed information about a device, and includes the items that Table 5-1 describes.

Table 5-2   Host Information Area Items

Item	Description
Up Time	Amount of time that the device has been operating since it last started.
Last Heard	How long ago Cisco Fog Director last communicated with the device.
Device Details tab	Displays the following information: • Serial number—Serial number of the device. • IP Address—IP address of the device. • Port—Port on which Cisco IOx runs on the device. • Description—Description of the device that was entered when the device was added to Cisco Fog Director. • Resources charts—Shows the amount of CPU (in units), memory (in KB), and disk (in MB) resources that are in use and available for apps on the device. Hover your mouse pointer over a chart to see more detailed information.
Cartridges tab	Includes the following (see Chapter 7, "Managing Cartridges," for more information about cartridges): • Unused Cartridges—Number of cartridges that are installed on the device but that are not used by any app. • NAME—Name of each unused cartridge. Hover your mouse pointer over a cartridge name to see detailed information about the cartridge. • SIZE—Size, in MB, of each unused cartridge. • **DELETE UNUSED CARTRIDGES** button—Removes all unused cartridges from the device. See the "Deleting Unused Cartridges" section on page 5-14.
Launch Local Manager link	Opens the Cisco IOx Local Manager application in a new browser tab or window. This application is installed on a device as part of the installation of the Cisco IOx framework on that device. It provides a web-based user interface that you can use to manage, administer, monitor, and troubleshoot apps on the host system, and to perform a variety of related activities. For detailed information about this application, see *Cisco IOx Local Manager Reference Guide*.
Collect Debug Logs	Turns Cisco IOx debug log collection on or off for the device. See the "Obtaining Device Logs" section on page 5-15.

Table 5-2   Host Information Area Items (continued)

Item	Description
VIEW DEVICE LOGS button	Click to display log information that is generated by the device. If the Collect Debug Logs option is set to **Yes** on this Device Details page, the device log also includes debug information. See the "Obtaining Device Logs" section on page 5-15.
DOWNLOAD TECH SUPPORT LOGS button	Click to obtain a log file that contains log information that was generated by the device. If the Collect Debug Logs option is set to **Yes** on this Device Details page, the log file also includes debug information. See the "Obtaining Device Logs" section on page 5-15.

Apps Area

The Apps area on the Device Details page includes the items that Table 5-3 describes for each Cisco IOx app that is installed on the device. Some items might not appear depending on your deployment.

Table 5-3   Apps Area Items

Item	Description
App Info	Includes the following information: • App Status—Status of the app (for example, RUNNING). • App Type—Type of the app. • Installed on—Date and time that the app was installed on the device. • Last Upgrade—Date and time that the app was upgraded on the device. • Version—Version number of the app. • App Links—Available if you configured links for an app. Click a link to go to the configured resource. See the "Configuring App Links" section on page 4-28. • **Start App** button ▶ —Start the app, which initiates its operation on the device and puts the app in Running state. • **Stop App** button ■ —Stops the app, which shuts down its operation on he device and puts the app in Stopped state. • **Remove App** button ✖ —Removes the app from the device. See the "Removing an App from a Device" section on page 5-13.

Table 5-3   Apps Area Items (continued)

Item	Description
App Details	Includes the following information: • **Refresh** button ⟳ —Click to cause Cisco Fog Director to rediscover the device and update information that displays in the Apps area. • Resource Profile—Resource profile that is configured for the app. Hover your mouse pointer over the resource profile name to see system CPU and memory (RAM) resources that the app requires on the device. • App IP—IP address that is assigned to the app on the device. • Ports—Hover your mouse pointer over **Ports** to see port asked and port mapping information for TCP ports and UDP ports. **Port Asked** is the port that the app requests in its package_config.ini file. **Mapped Port** is the port that is used for external communication with the app. Port mapping is handled by Cisco IOx. • App mac—MAC address that is assigned to the app on the device • Network Mode—Network mode in that is assigned to the app • Serial Port—Serial port that is assigned to the app • Cartridges Used—Cisco cartridges that the app requires to run, if any
App Downtime	Shows the states that the app was in on the device over the past month. Hover your mouse pointer over any section of a chart to see the name of the state, the date and time that the app entered the state, and the amount of time the app was in the state.
App Consumption	Displays the following charts, which provide information about device resources that the app consumes: • CPU Consumption—Percentage of CPU resources that the app used on the device during the designated time period. • Memory Consumption—RAM resources, in KB, that the app used on the device during the designated time period. • Disk Consumption—Hard disk space, in MB, that the app used on the device during the designated time period. • Network Consumption—Network bandwidth, in bytes, that the device used for the app during the designated time period. You can click **Day**, **Week**, or **Month** above these charts to designate the time period for the information that the charts display. Hover your mouse pointer over any part of a chart to see detailed information about a data point.
App Log tab	Displays log information that was generated by the app on the device. Click **Refresh** to update the display with current information.

Table 5-3   Apps Area Items (continued)

Item	Description
Edit Configuration tab	Lets you update configuration for the app. The items that display are defined in the package_config.ini file for the app.
Edit App Settings tab	Lets you change the following settings for an app by choosing the desired value from a drop-down list: • Resource Profiles—Resource profile for the app • Network Configuration—Network from which the app obtains its IP address or addresses • Serial Configuration—Device serial port that the app uses If you make changes in this tab, click the **RECONFIGURE SETTINGS** button to send the updated information to the device.
View all App Logs	Displays all logs that the app generates on the device Click **Refresh** to update the display with current information.

Adding Devices

Adding a device makes it manageable by Cisco Fog Director and available for the installation and running of IOx apps.

All devices that you add to Cisco Fog Director should be configured to synchronize their time from same NTP server. In this way, Cisco Fog Director can accurately aggregate data from the servers.

To add a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   On the Devices View page, click the **ADD** button.

The Add New Device window displays.

Step 3   In the Add New Device window, enter information for the device to add, as described in the following table:

Field	Description
IP Address	Required. IP address of the device to be added.
Port	Required. HPPTS port on which Cisco IOx runs on the device. Valid values are 0 through 65535. The default port is 844.
Username	Required. Cisco IOS user name that is configured on the device.
Password	Required. Cisco IOS password that is configured on the device.
Tags	Optional. One or more tags for the device. (See the "Managing Tags for a Device" section on page 5-12 for an explanation of tags.) To enter more than one tag, separate each tag by pressing the **Tab** key.

Field	Description
Contact Details	Optional. Contact information of the person who is responsible for the device.
Description	Optional. Brief description of the device.

Step 4 In the Add New Device window, take one of these actions:

- To save the information you entered, add the device, and exit the window, click the **SAVE & CLOSE** button.

- To save the information you entered, add the device, and clear the fields in the window, click the **SAVE & AND ADD MORE** button. Now you can enter information for another device to add.

- To clear the fields in the window and exit the window without adding the device, click the **CANCEL** button.

Importing Devices

Importing devices provides you with a convenient way to add several devices to Cisco Fog Director at once. The import process involves creating a comma-separated value (CSV) file that includes information about each device to be added, and then importing that file to Cisco Fog Director.

The following sections provide detailed information:

- Creating an Import File, page 5-9
- Importing an Import File, page 5-10

Creating an Import File

To import devices to Cisco Fog Director, you begin by creating a CSV import file. This file includes one record for each device that is to be added Cisco Fog Director.

Cisco Fog Director provides a sample CSV file that you can use to create your own file.

Cisco recommends that you use Microsoft Excel to edit the sample CSV file, then use the Save As command in Excel to save the file as a **CSV (Comma delimited)** type.

An import file must adhere to these guidelines:

- The file must be comma delimited.
- Lines preceded with a pound sign (#) are comment lines and are ignored by the import process.
- Each record must include each field that the following procedure describes. The fields must be in the order shown. A field that is indicated as "Optional" can be blank.

To use the sample CSV file to create an import file, follow these steps:

Procedure

Step 1 In Cisco Fog Director, click the **DEVICES** tab.

Step 2   On the Devices View page, click the **IMPORT** button.

The Import window displays.

Step 3   Click **Download Sample CSV** and follow the on-screen prompts to open a sample CSV file or save it in to the location of your choice.

Step 4   If you saved the sample CSV file, open it with Microsoft Excel or another editor that can open a CSV file.

Step 5   For each device to be added, create a record for it that includes the following information:

Field	Description
ipv4_address	Required. IP address of the device.
https_port	Required. HTTPS port on which Cisco IOx runs on the device. Valid values are 0 through 65535. The default port is 844.
https_username	Required. Cisco IOS user name that is configured on the device.
https_password	Required. Cisco IOS password that is configured on the device.
tags	Optional. One or more tags for the device. (See the "Managing Tags for a Device" section on page 5-12 for an explanation of tags.) If you include more than one tag, separate each tag with a comma. Enclose the tag or tag string of tags with double quotation marks (").
contact_details	Optional. Contact information of the person who is responsible for the device.
description	Optional. Brief description of the device.

Step 6   Save the import file as a **CSV (Comma delimited)** type in the location of your choice.

You can give this file any valid Windows file name.

Importing an Import File

After you create an import file as described in the "Creating an Import File" section on page 5-9, you can import the file to Cisco Fog Director. Doing so adds the devices that the file defines to Cisco Fog Director.

If the import file includes a record for a device that already exists in Cisco Fog Director, the information for that device is updated with the information in the record.

To use the sample CSV file to create an import file, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   On the Devices View page, click the **IMPORT** button.

The Import window displays.

Step 3   Click the **Select devices csv** button and follow the on-screen prompts to locate and select the CSV file that you want to import.

Cisco Fog Director discovers the devices that the import file includes and the devices appear in the Devices table.

Editing Attributes for a Device

Editing attributes for a device lets you update various information for the device.

To edit device information, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   In the Device table, click the **Expand** icon ▶ to the left of the device host name of the device for which you want to edit attributes.

Step 3   Click **Edit Device**.

The Edit Device dialog box displays. This dialog box shows the IP address of the device and provides fields in which you can enter or update information.

Step 4   In the Edit Device dialog box, enter information in the following fields as needed:

- **Port**—HTTPS port on which Cisco IOx runs on the device.

  Valid values are 0 through 65535. The default port is 844.

- **Username**—Cisco IOS user name that is configured on the device.

- **Password**—Cisco IOS password that is configured on the device.

- **Contact Details**—Contact information of the person who is responsible for the device.

- **Description**—Brief description of the device.

Step 5   In the Edit Device dialog box, take either of these actions:

- Click the **SAVE & CLOSE** button to save your changes and exit the dialog box

- Click the **CLOSE** button to exit the dialog box without saving your changes

Deleting a Device

Deleting a device removes it from Cisco Fog Director.

To delete a device from Cisco Fog Director, perform the following steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   In the Device table, click the **Expand** icon ▸ to the left of the device host name of the device that you want to delete.

Step 3   Click **Delete Device**.

The Delete dialog box displays.

Step 4   Click **OK** in the delete dialog box.

Managing Tags for a Device

A tag is a brief descriptive label that you assign to a device. For example, a tag could be the name of an administrator, the name of an app, or the purpose of an app. Tags are useful for categorizing devices. In some areas on the Apps pages, you can display devices with matching tags.

The following guidelines apply to tags:

- There is no limit to the number of tags that can be assigned to a device
- A tag can include alphanumeric characters, special characters, and spaces
- Tags are case sensitive

You manage tags for a device in the Device table on the Devices View page.

To assign a tag to device, click the **Enter new tag** field in the Tags column that corresponds to the device, enter the tag that you want, and then press the **Enter** key or the **Tab** key.

To remove a tag from a device, click the **X** next to the tag.

Starting or Stopping an App on a Device

Starting an app initiates its operation on a host device and puts the app in Running state. CPU and memory (RAM) resources that were reserved for the app become in use.

Stopping an app shuts down its operation on a host device and puts the app in Stopped state. CPU and memory (RAM) resources that were used by the app remain reserved for it but stop being used.

The following sections describe how to start and stop an app from the DEVICES tab:

-
-

You also can start or stop an app from the App Monitoring page by clicking the **START** or **STOP** button under a status chart. See the for more information.

Starting an App

Starting an app initiates its operation on a host device and puts the app in Running state.

To start an app on a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   Take either of these actions:

- In the Device table on the Devices View page, click the IP address or the host name of the device on which you want to start the app.

- In the Device table, click the **Expand** icon ▸ to the left of the device host name of the device of the device on which you want to start the app.

Step 3   If the app is running, take either of these actions:

- If you clicked the IP address or the host name of the device in Step 2, click the **Start App** button ▶ that appears under the icon of the app that you want to start.

- If you clicked the **Expand** icon in Step 2, click the **Start App** button ▶ that corresponds to the app that you want to start.

Stopping an App

Stopping an app shuts down its operation on a host device and puts the app in Stopped state.

To stop an app on a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   Take either of these actions:

- In the Device table on the Devices View page, click the IP address or the host name of the device on which you want to stop the app.

- In the Device table, click the **Expand** icon ▸ to the left of the device host name of the device of the device on which you want to stop the app.

Step 3   If the app is running, take either of these actions:

- If you clicked the IP address or the host name of the device in Step 2, click the **Stop App** button ■ that appears under the icon of the app that you want to stop.

- If you clicked the **Expand** icon in Step 2, click the **Stop App** button ■ that corresponds to the app that you want to stop

Removing an App from a Device

Removing an app from a device removes it from the host device and releases CPU and memory (RAM) resources that were reserved for the app.

To remove an app from a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   Take either of these actions:

- In the Device table on the Devices View page, click the IP address or the host name of the device from which you want to remove the app.

- In the Device table, click the **Expand** icon ▶ to the left of the device host name of the device from which you want to remove the app.

Step 3   If the app is running, take either of these actions:

- If you clicked the IP address or the host name of the device in Step 2, click the **Stop App** button ■ that appears under the icon of the app that you want to remove from the device.

- If you clicked the **Expand** icon in Step 2, click the **Stop App** button ■ that corresponds to the app that you want to remove from the device,

Step 4   Take either of these actions:

- If you clicked the IP address or the host name of the device in Step 2, click the **Remove App** button ✖ that appears under the icon of the app that you want to remove from the device, then click the **YES** button in the confirmation dialog box that displays.

- If you clicked the **Expand** icon in Step 2, click the **Remove App** button ✖ that corresponds to the app that you want to remove from the device,

Deleting Unused Cartridges

For system maintenance and to free disk space on a device, you can delete cartridges that have been installed on the device but that are not used by any apps. Deleting cartridges removes them and their metadata from a device.

To delete unused cartridges from a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   In the Device table on the Devices View page, click the IP address or the host name of the device for which you want to delete unused cartridges.

Step 3   In the Unused Cartridges area on the page that displays, click the **DELETE UNUSED CARTRIDGES** button.

Obtaining Device Logs

To troubleshoot a device, you can view and download a device log file that you can review or provide to Cisco for assistance. The file contains log information that was generated by the device. If the Collect Debug Logs option on the Device Details page is set to **Yes**, the log file also includes debug information.

To create a log file for a device, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **DEVICES** tab.

Step 2   In the Device table on the Devices View page, click the IP address or the host name of the device for which you want to create a log file.

Step 3   Click the **Yes** button next to Collect Debug Logs near the top right of the screen.

Step 4   Try to reproduce the issue that you are troubleshooting.

Step 5   Take either of these actions:

- To review log information, click the **VIEW DEVICE LOGS** button. Then use the tabs in the window that appears to review the information that you want.

- To save a log file, click the **DOWNLOAD TECH SUPPORT LOGS** button and then follow the on-screen prompts to save the log file in the location of your choice.

Step 6   (Optional) To stop collecting log information, click the **No** button next to Collect Debug Logs.

CHAPTER 6

Managing Cisco Fog Director Settings

The Cisco Fog Director Settings page provides information about Cisco Fog Director and lets you manage Cisco Fog Director debug logs.

To access the Settings page, log in to Cisco Fog Director as described in the "Accessing Cisco Fog Director" section on page 3-1, and then click the **SETTINGS** tab.

This chapter includes these sections:

Viewing Information about Cisco Fog Director

The About Fog Director area on the Settings page provides the information that Table 6-1 describes.

Table 6-1   About Fog Director Items

Item	Description
API Version	Version of the Cisco Fog Director API
Release Version	Click to change the Available Apps area to App Edit view
Release Version	Cisco Fog Director version that you are using
Built On	Date and time that the Cisco Fog Director version that you are using was built

Managing Cisco Fog Director Debug Logs

Cisco Fog Director can create and collect information about your Cisco Fog Director session. This information includes actions performed by users, and errors or exceptions generated by the device or persistent store. You can configure Cisco Fog Director to store this information in a debug log file, which you can provide to your Cisco representative for assistance with troubleshooting, if needed.

To create a debug log file for Cisco Fog Director, follow these steps:

Procedure

Step 1   Click the Cisco Fog Director **SETTINGS** tab.

Step 2   In the Logging Configuration area, click the **Yes** button.

Step 3   Try to reproduce the issue that you are troubleshooting.

Step 4   Click the **DOWNLOAD LOGS** button and then follow the on-screen prompts to save the log file in the location of your choice.

Step 5   (Optional) To stop collecting log information, click the **No** button in the Logging Configuration area.

CHAPTER 7

Managing Cartridges

Packages for PAAS apps include only the app logic (such as Python or Java files), but not the Linux operating files or the root file system that the app requires. Cartridges provide the root file system and Python or Java files that an app requires to run.

Before you can install a PAAS through Cisco Fog Director, you must add the cartridges that the app requires. Cisco Fog Director prevents installing a PAAS app that requires cartridges if the cartridges have not been added.

Cartridges are not used by KVM apps.

The Cisco Fog Director Cartridges page provides information about cartridges and provides access to features for managing cartridges on devices.

To access the Cartridges page, log in to Cisco Fog Director as described in the "Accessing Cisco Fog Director" section on page 3-1, and then click the **CARTRIDGES** tab. The Devices View page displays.

This chapter includes these sections:

- Viewing General Information about Cartridges, page 7-1
- Adding a Cartridge, page 7-2
- Deleting a Cartridge, page 7-2

Viewing General Information about Cartridges

The Cartridges page, which displays when you choose the **CARTRIDGES** tab in Cisco Fog Manager, provides general information about cartridges that have uploaded to Cisco Fog Manager, and lets you import additional cartridges.

This page includes the items that Table 7-1 describes.

Table 7-1   *Cartridges Page Items*

Item	Description
Cartridges table	Provides information about each cartridge that has been imported to Cisco Fog Manager. This table includes the following items: • NAME—Cisco-assigned name of the cartridge. • VERSION—Version of the cartridge. • CPU ARCH—CPU architecture that is required for the cartridge to operate. • DESCRIPTION—Cisco-assigned description of the cartridge. • ACTION—Click the **Delete** icon ✖ to delete the corresponding cartridge and its metadata from Cisco Fog Director. See the "Deleting a Cartridge" section on page 7-2. • Pagination controls—Click a control to go to the first, next, last, previous, or specific page in the table.
Search box	Type all or part of a cartridge name, CPU architecture, or description to display information for cartridges with matching information. The table display updates as you type.
ADD NEW CARTRIDGE button	Click to import a cartridge to Cisco Fog Director. See the "Adding a Cartridge" section on page 7-2.

Adding a Cartridge

Adding a cartridge uploads it to Cisco Fog Director. The app is then available for installation when you install an app that requires it.

To add a cartridge, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **CARTRIDGES** tab.

Step 2   On the Cartridges page, click the **ADD NEW CARTRIDGE** button.

The Add New Cartridge window displays.

Step 3   In the Add New Cartridge window, click the **Select Cartridge Package** button.

Step 4   Locate and select the cartridge that you want to import.

Deleting a Cartridge

Deleting a cartridge removes the cartridge and its metadata from Cisco Fog Director.

For information about deleting unused cartridges from a device, see the "Deleting Unused Cartridges" section on page 5-14.

To delete a cartridge, follow these steps:

Procedure

Step 1   In Cisco Fog Director, click the **CARTRIDGES** tab.

Step 2   On the Cartridges page, click the **Delete** icon ✖ in the ACTION column for the cartridge that you want to delete.

INDEX

U

uninstalling app

    options   **4-17**

    procedure   **4-18**

unmanaged state, of app   **3-3**

Unpublished Apps area, on Apps View page   **4-1, 4-5**

unpublishing app   **4-10**

updating app link   **4-28**

upgrading app   **4-19**

uploading app   **4-8**

V

VMware

    Fusion, installing Cisco Fog Director in   **2-3**

    Player, installing Cisco Fog Director in   **2-2**

    vSphere, installing Cisco Fog Director in   **2-1**