HDLC Support for SCATS

This chapter contains the following sections:

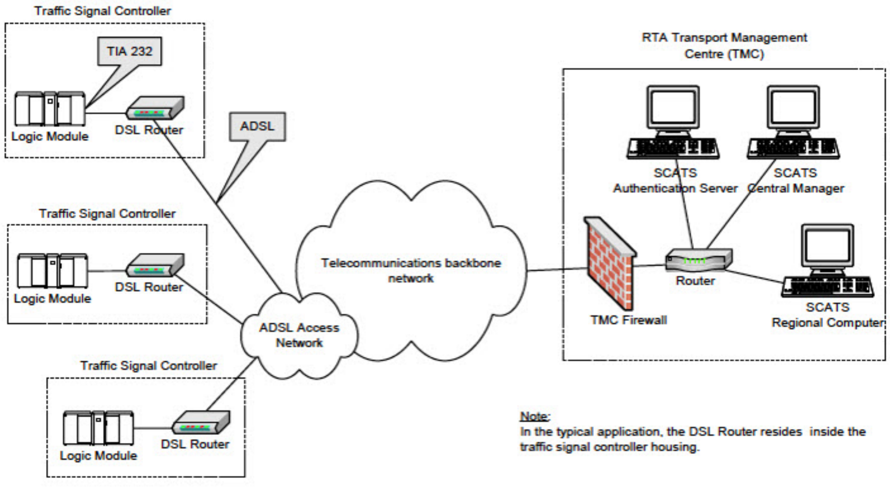
HDLC Support for SCATS Overview

The Sydney Coordinated Adaptive Traffic System (SCATS), is an intelligent transportation system that manages the dynamic (on-line, real-time) timing of signal phases at traffic signals, meaning that it tries to find the best phasing (i.e. cycle times, phase splits and offsets) for a traffic situation (for individual intersections as well as for the whole network). SCATS is based on the automatic plan selection from a library in response to the data derived from loop detectors or other road traffic sensors. SCATS uses sensors at each traffic signal to detect vehicle presence in each lane and pedestrians waiting to cross at the local site. The vehicle sensors are generally inductive loops installed within the road pavement. The pedestrian sensors are usually push buttons. Various other types of sensors can be used for vehicle presence detection, provided that a similar and consistent output is achieved. Information collected from the vehicle sensors allows SCATS to calculate and adapt the timing of traffic signals in the network.

High-Level Data Link Control (HDLC) is a group of data link (Layer 2) protocols used to transmit synchronous data packets between point-to-point nodes. Data is organized into addressable frames. This format has been used for other multipoint-to-multipoint protocols, and inspired the HDLC-like framing protocol described in RFC 1662. HDLC uses a zero-insertion/deletion process (bit stuffing) to ensure that the bit pattern of the delimiter flag does not occur in the fields between flags. The HDLC frame is synchronous and therefore relies on the physical layer (Layer 1) to clock and synchronize frame transmission and reception.

This feature is being developed as an IOx app which integrates with the existing virtualization layers available in IOS XE based IoT routers. The intended application is to have a SCATS controller connected to the router via serial cable. The SCATs protocol the app will follow is documented in specification TSI-SP-068.

The following figure is an example of a typical SCATS traffic control network application:


Traffic Signal Controller
TIA 232
Logic Module
DSL Router
ADSL
Traffic Signal Controller
Logic Module
DSL Router
Traffic Signal Controller
Logic Module
DSL Router
ADSL Access Network
Telecommunications backbone network
RTA Transport Management Centre (TMC)
SCATS Authentication Server
SCATS Central Manager
TMC Firewall
Router
SCATS Regional Computer

Note:
In the typical application, the DSL Router resides inside the traffic signal controller housing.

In the above figure, an IR1101 plays the role of the DSL Router to which the Traffic Signal Controller (TSC) is connected via a serial interface. Upon connection to the TSC, the router obtains a Site ID from the controller, which it will then forward to the SCATs Authentication Server. The authentication servers will be provided to the IOx app through a JSON file including IP and port and there can be up to three authentication servers that the IOx app can cycle through.

Once the Authentication Server has received the Site ID, it will reply to the router with the corresponding SCATs regional computer IP and port that matches that Site ID. All further communication is then done transparently from TSC to Regional Computer.

The router will use two modes to communicate with the TSC (HDLC and non-HDLC). There are four available serial configurations, and the user can select which configurations will be used by enabling or disabling them through a second JSON file provided to the app.

Since this is an IOx app, the feature can be disabled by stopping, deactivating, or uninstalling the app. The application will mainly be deployed using Local Manager. App size is about 50 MB, CPU is 400 units and memory is 128 MB.

Configure IOx Application

Perform this task to enable access to the IOx Local Manager. The IOx Local Manager 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.

Important The SCATs IOX application does not configure and enable a VPN for the connections. If a VPN is necessary for operations, please configure the VPN through IOS XE on the IR1101 outside of the application.

Note In the steps that follow, IP HTTP commands do not enable IOx, but allow the user to access the WebUI to connect the IOx Local Manager.

Enable IOx

Perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>`**`enable`**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device#`**`configure terminal`**	Enters global configuration mode.
Step 3	**iox** **Example:** `Device(config)#`**`iox`**	Enables IOx
Step 4	**ip http server** **Example:** `Device(config)#`**`ip http server`**	Enables the HTTP server on your IP or IPv6 system.
Step 5	**ip http secure-server** **Example:** `Device(config)#`**`ip http secure-server`**	Enables a secure HTTP (HTTPS) server.
Step 6	**username** name **privilege** level **password** {**0** | **7** | *user-password* }*encrypted-password* **Example:** **`username admin privilege 15 password 0 admin`**	Establishes a username-based authentication system and privilege level for the user. The username privilege level must be configured as 15.

Step 7	**end**
	Example:
	`Device(config-if)#`**`end`**
		Exits interface configuration mode and returns to privileged EXEC mode.

Configure a VirtualPortGroup to a Layer 3 Data Port

Multiple Layer 3 data ports can be routed to one or more VirtualPortGroups or containers. VirutalPortGroups and Layer 3 data ports must be on different subnets.

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device>`**`enable`**	Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device#`**`configure terminal`**	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)#`**`interface virtualportgroup 0`**	Configures an interface and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* **Example:** `Device(config-if)#`**`ip address 192.168.0.1 255.255.255.0`**	Configures an IP address for the interface.

Step 5	**end**
	Example:
	`Device(config-if)#`**`end`**
		Exits interface configuration mode and returns to privileged EXEC mode.

Configure Serial Port for IOx Communication

Use the following steps to configure the serial port.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>`**`enable`**	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device#`**`configure terminal`**	Enters global configuration mode.
Step 3	**interface async** *number* **Example:** `Device(config)#`**`interface async 0/3/0`**	Configures an async interface and enters interface configuration mode.
Step 4	**encapsulation relay-line** **Example:** `Device(config-if)#`**`encapsulation relay-line`**	Configure the async interface as a relay-line.

	Command or Action	Purpose

Step 5	**end**
	Example:
	`Device(config-if)#end`
		Exits interface configuration mode and returns to privileged EXEC mode.

Step 6	**relay-line** *slot/subslot/port for modems* **Example:** `Device(config)#relay-line 0/0/1 0/3/0`	Configure the relay line between async interface and IOx app.

Step 7	**end**
	Example:
	`Device(config)#end`
		Exits interface configuration mode and returns to privileged EXEC mode.

Deploy SCATs Application

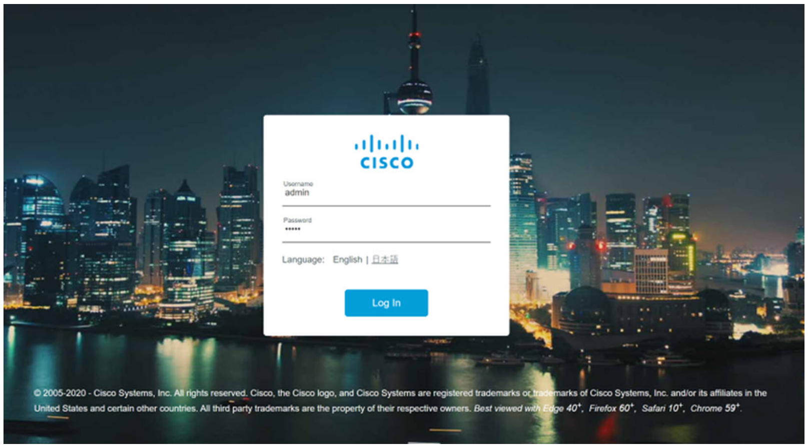
There are two methods to deploy the SCATs application on the IR1101. Either through the Local Manager (Graphical UI) or through IOS-XE (On-device CLI).

Deploy SCATs Application via Local Manager

If you have gone through the procedure to enable the webserver and to add a user, you should be able to access the IR1101 web interface using the SVI IP-address. using https://<svi ip>/ (eg: https://192.168.0.30/) and then log in using the user created earlier.

Step 1 **https://**<*svi ip*>/

The WebUI login appears:



Username: admin

Password: •••••

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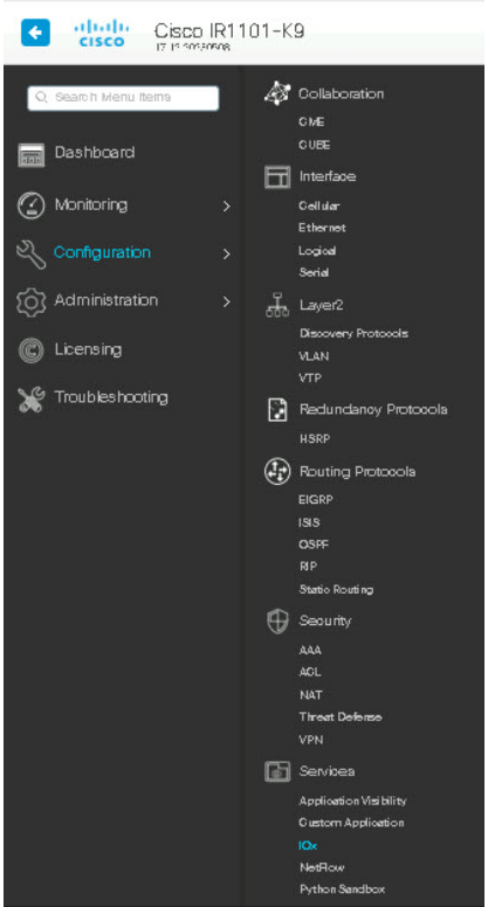
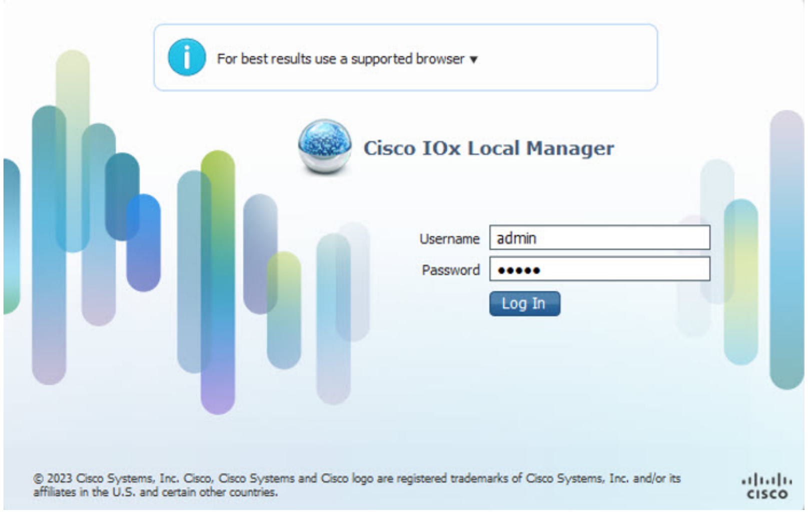
Step 2 Navigate to the IOx page through **Configuration** > **Services** > **IOx**. See the following image:



Step 3 Use the same user credentials to enter Cisco IOx Local Manager. (For direct access, use the following URL: https://<svi ip>/iox/login)


For best results use a supported browser ▾

Cisco IOx Local Manager

Username admin

Password •••••

Log In

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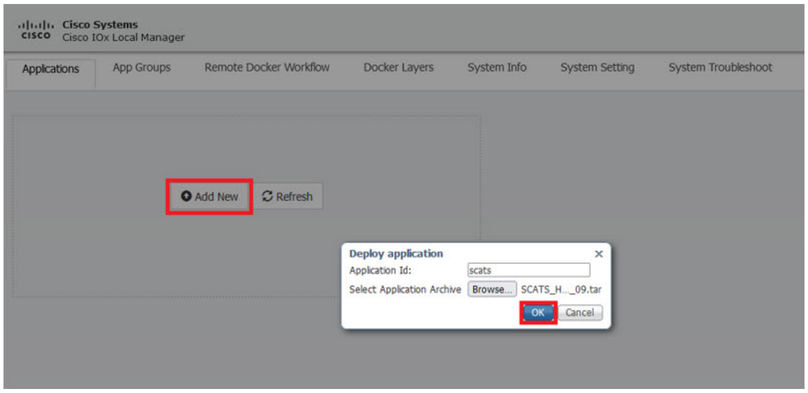
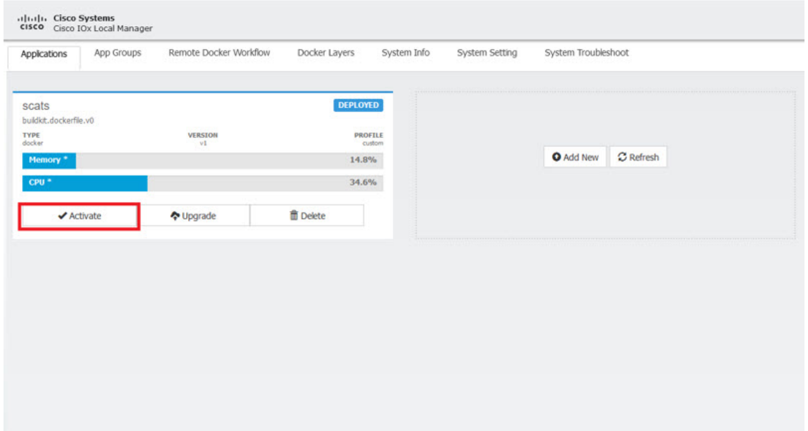
Step 4 Deploy the application by clicking **Add New**. Assign a name to the Application Id, and select the SCATs application package for the Application Archive.



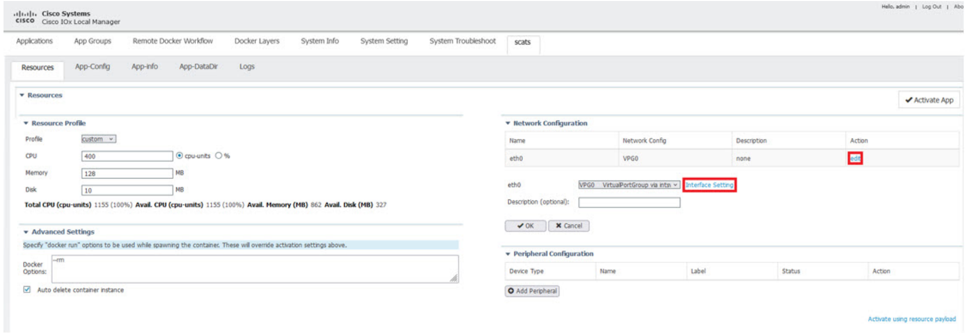
Application Id: scats
Select Application Archive Browse... SCATS_H..._09.tar

Step 5 After selecting **OK**, the application will be uploaded and installed into the IR1101.

Step 6 Click on **Activate**.



Step 7 Under the **Network Configuration** section, the VirtualPortGroup0 configuration from above can be seen. Click on **edit** and then click **Interface Setting**.



Profile: custom
CPU: 400 ● cpu-units ○ %
Memory: 128 MB
Disk: 10 MB
Total CPU (cpu-units) 1155 (100%) Avail. CPU (cpu-units) 1155 (100%) Avail. Memory (MB) 862 Avail. Disk (MB) 327

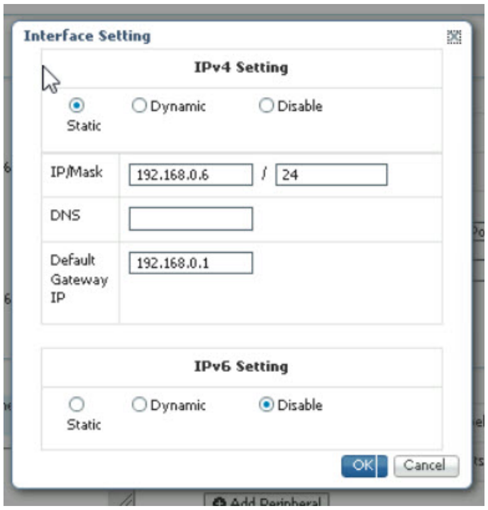
Specify "docker run" options to be used while spawning the container. These will override activation settings above.
Docker Options: --rm
☑ Auto delete container instance

Name	Network Config	Description	Action
eth0	VPG0	none	edit

eth0: VPG0 VirtualPortGroup via ints
Description (optional):

Device Type	Name	Label	Status	Action

Step 8 Configure the IP addresses for the interface.



IPv4 Setting

● Static ○ Dynamic ○ Disable

IP/Mask: 192.168.0.6 / 24

DNS:

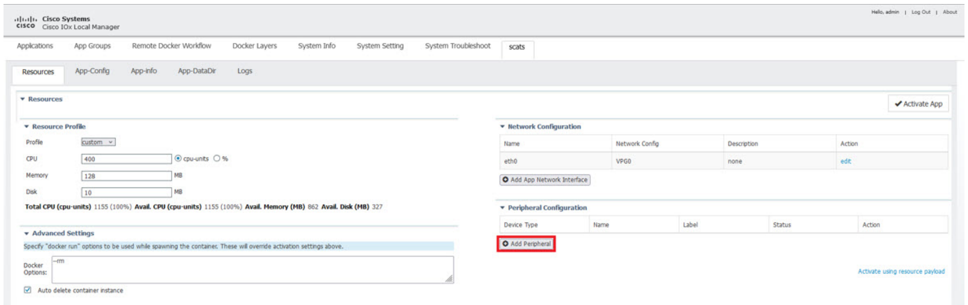
Default Gateway IP: 192.168.0.1

IPv6 Setting

○ Static ○ Dynamic ● Disable

Step 9 Click **OK** on both windows to finalize the network configuration.

Step 10 Under the **Peripheral Configuration** section, select **serial** for the Device Type.



Resources

Resource Profile

Profile: custom

CPU: 400 ● cpu-units ○ %

Memory: 128 MB

Disk: 10 MB

Total CPU (cpu-units) 1155 (100%) **Avail. CPU (cpu-units)** 1155 (100%) **Avail. Memory (MB)** 862 **Avail. Disk (MB)** 327

Advanced Settings

Specify "docker run" options to be used while spawning the container. These will override activation settings above.

Docker Options: --rm

☑ Auto delete container instance

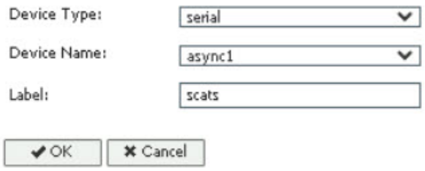
Network Configuration

Name	Network Config	Description	Action
eth0	VPG0	none	edit

Peripheral Configuration

Device Type	Name	Label	Status	Action

Step 11 For Device Name, select the **async** interface the serial relay line was mapped to. Label the peripheral and click **OK**

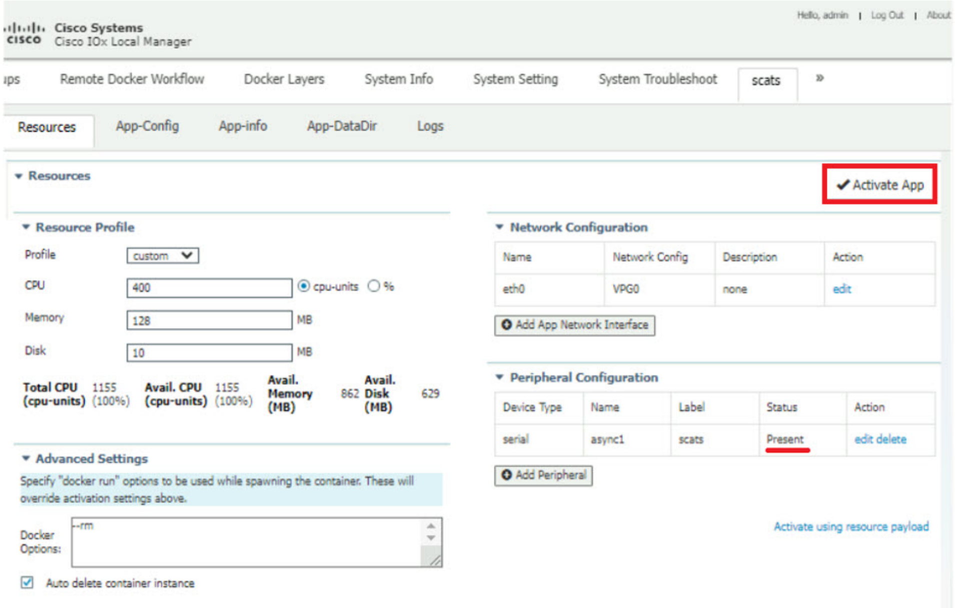


Device Type: serial

Device Name: async1

Label: scats

Step 12 The **Status** should say **Present** for the peripheral. Click on **Activate App** in the top right corner, and then select **Applications** in the top bar to return to the main page.



Resource Profile

Profile: custom

CPU: 400 ● cpu-units ○ %

Memory: 128 MB

Disk: 10 MB

Total CPU (cpu-units)	1155 (100%)	Avail. CPU (cpu-units)	1155 (100%)	Avail. Memory (MB)	862	Avail. Disk (MB)	629

Advanced Settings

Specify "docker run" options to be used while spawning the container. These will override activation settings above.

Docker Options: --rm

☑ Auto delete container instance

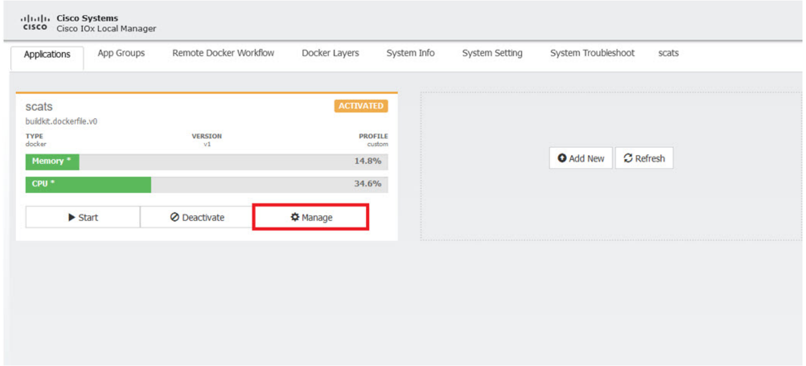
Network Configuration

Name	Network Config	Description	Action
eth0	VPG0	none	edit

Peripheral Configuration

Device Type	Name	Label	Status	Action
serial	async1	scats	Present	edit delete

Step 13 The application will now be activated. Click **Manage** to be brought back to the Resources Page.



scats ACTIVATED

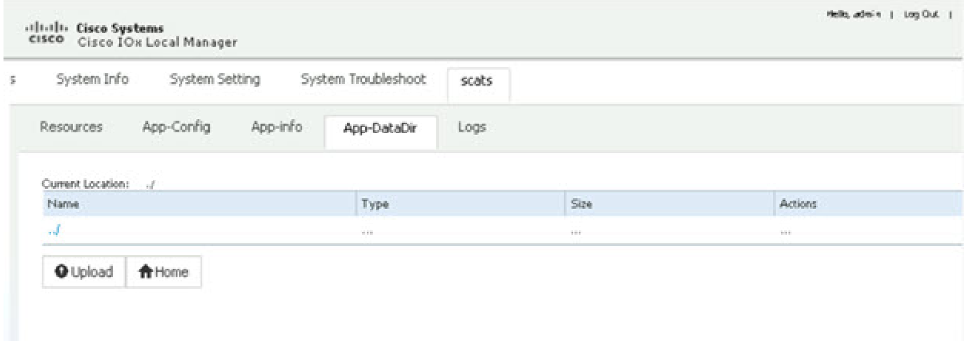
buildkt.dockerfile.v0

TYPE	VERSION	PROFILE
docker	v1	custom

Memory * 14.8%

CPU * 34.6%

Step 14 From the **Resources** tab, click **App-DataDir**.



Current Location: ./

Name	Type	Size	Actions
../	...	...	...

SCATs requires two files to operate, authserver.json and serialconfig.json, to notify the application of the available authentication servers and which of the four serial configurations for SCATs to enable.

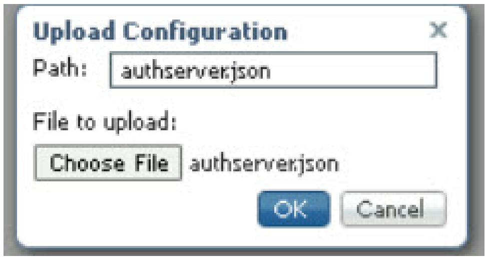
```
Example of authserver.json file (1-3 auth servers allowed)
{
    "auth_servers":[
        {"ip":"10.0.1.13", "port":2012},
        {"ip":"10.0.1.1", "port":2012}
    ]
}

Example of serialconfig.json file
{
    "serial_configurations":[
        {"serial_config":"enabled"},
        {"serial_config":"disabled"},
        {"serial_config":"disabled"},
        {"serial_config":"disabled"}
    ]
}
```

Step 15 Click on **Upload** and choose the files to be uploaded into the App-DataDir.

Note The paths must be authserver.json and serialconfig.json.

Step 16 Click **OK** to select.

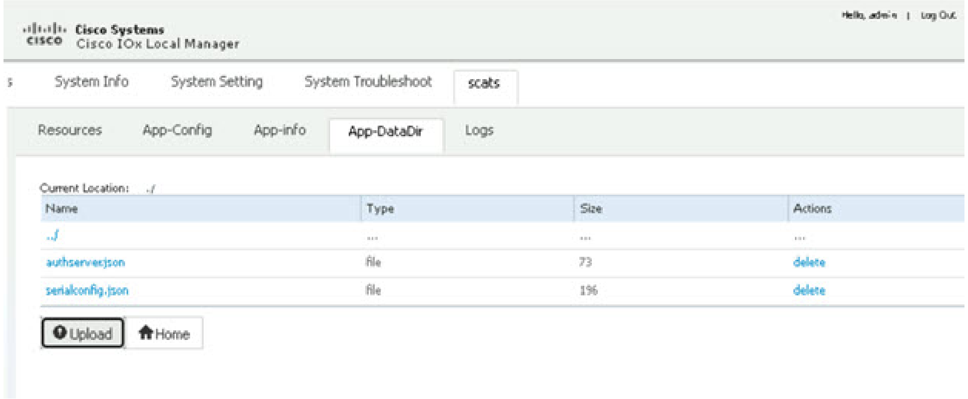


Upload Configuration

Path: authserver.json

File to upload:

Step 17 Verify the two json files are present and then click **Upload**.

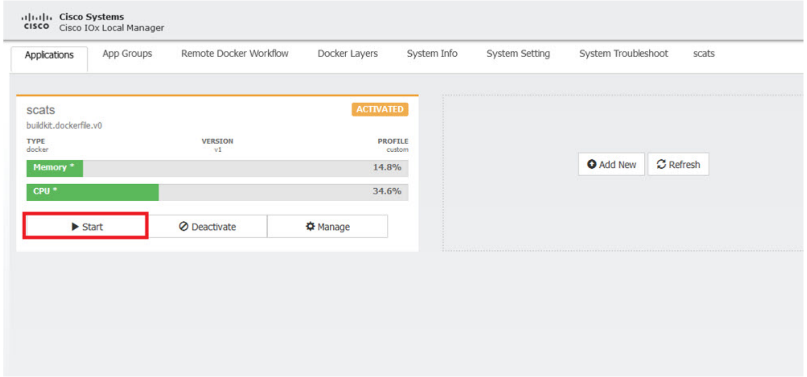


Current Location: ./

Name	Type	Size	Actions
../	...	...	...
authserver.json	file	73	delete
serialconfig.json	file	196	delete

Step 18 Select **Applications** to return to the main application page. Click on **Start** to start the application. It will show as running now.

Step 19 Click on **Start** to start the application.



scats
buildkit.dockerfile.v0

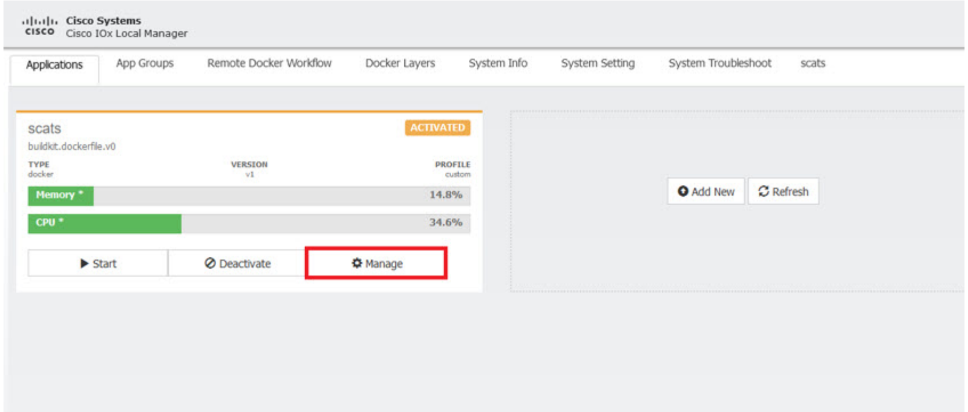
TYPE	VERSION	PROFILE
docker	v1	custom

Memory * 14.8%

CPU * 34.6%

The status shows the application is activated, and you should see Memory and CPU details.

Step 20 To troubleshoot any issues, click on **Manage** and then click on the **Logs** tab.



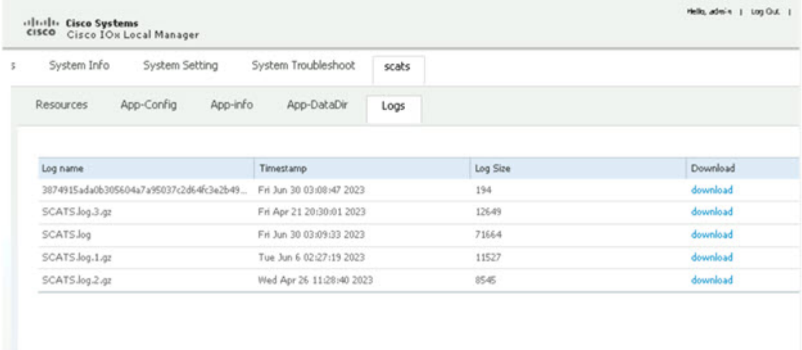
scats
buildkit.dockerfile.v0

TYPE	VERSION	PROFILE
docker	v1	custom

Memory * 14.8%

CPU * 34.6%

Step 21 Logs from the application will be stored under SCATS.log* and can be downloaded from the Local Manager.



Log name	Timestamp	Log Size	Download
3874915ada0b305604a7a95037c2d64fc3e2b49...	Fri Jun 30 03:08:47 2023	194	download
SCATS.log.3.gz	Fri Apr 21 20:30:01 2023	12649	download
SCATS.log	Fri Jun 30 03:09:33 2023	71664	download
SCATS.log.1.gz	Tue Jun 6 02:27:19 2023	11527	download
SCATS.log.2.gz	Wed Apr 26 11:28:40 2023	8545	download

To stop and delete the app, click **Stop**, then **Deactivate** and **Delete**.

Deploy SCATs Application Using the IOS-XE CLI

Use the following steps:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device>enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device#configure terminal`	Enters global configuration mode.
Step 3	**app-hosting appid** *app-name* **Example:** `Device(config)#app-hosting appid scats`	Configures the SCATS application and enters the application configuration mode.
Step 4	**app-vnic** *gateway-number* **virtualportgroup** *number* **guest-interface** *number* **Example:** `Device(config-app-hosting)#app-vnic gateway0 virtualportgroup 0 guest-interface 0`	Configures the application interface and the gateway of the application.
Step 5	**guest-ipaddress** *ip-address* **netmask** *mask* **Example:** `Device(config-app-hosting-gateway0)#guest-ipaddress 192.168.0.6 netmask 255.255.255.0`	Configures the application Ethernet interface ip address.
Step 6	**app-default-gateway** *ip-address* **guest-interface** *number* **Example:** `Device(config-app-hosting-gateway0)#app-default-gateway 192.168.0.1 guest-interface 0`	Configures the application default gateway ip address.
Step 7	**app-hosting docker** **Example:** `Device(config-app-hosting)#app-hosting docker`	Enter the configuration mode for docker options.
Step 8	**run-opts** *option-number* "-- *device host-serial:container-serial* **Example:** `Device (config-app-hosting-docker)#run-opts 1 "--device /dev/ttySerial1:/dev/ttySerial1"`	Match the async interface to the container interface. **Note** The serial port must match what the relay line was set to. In the example, async 0/3/0 was set to async 1, so the corresponding serial is /dev/ttySerial1.

Step 9	**end**
	Example:
	`Device(config-app-hosting-docker)#end`
		Exits docker options configuration mode and returns to privileged EXEC configuration mode.

Step 10	**app-hosting install appid** *application-name* **package** *package-path*	Installs the SCATS app from the specified location.

	Command or Action	Purpose
	Example: `Device#app-hosting install appid scats package flash:SCATS_HDLC_signed_05_09.tar`	The app can be installed from any local storage location such as, flash, bootflash, and usbflash0.
Step 11	**app-hosting activate appid** *application-name* **Example:** `Device#app-hosting activate appid scats`	Activates the SCATS application. Activates the SCATS application. This command validates all application resource requests, and if all resources are available the application is activated; if not, the activation fails.
Step 12	**app-hosting data appid** *application-name* **copy** *authserver.json-path* **Example:** `Device#app-hosting data appid scats copy flash:authserver.json`	Copy the authserver.json file into the IOx App-Data dir.
Step 13	**app-hosting data appid** *application-name* **copy** *serialconfig.json-path* **Example:** `Device# app-hosting data appid scats copy flash:serialconfig.json`	Copy the serialconfig.json file into the IOx App-Data dir.
Step 14	**app-hosting start appid** *application-name* **Example:** `Device#app-hosting start appid scats`	Starts the SCATs application. Application start-up scripts are activated.

Troubleshooting

To troubleshoot the app, perform the following:

Start a session within the IOx app, for example:

```
app-hosting connect appid application-name session
```

For example:

```
Device#app-hosting connect appid scats session
```

Logs can be viewed in /iox_data/logs under SCATS.log*.

Stop and Delete the Application

To stop and delete the app, do the following steps:

Step	Command	Purpose
1	**app-hosting stop appid** *application-name* `Device#app-hosting stop appid scats`	Stops the application.

Step	Command	Purpose
2	**app-hosting deactivate appid** *application-name* `Device#`**`app-hosting deactivate appid scats`**	Deactivates all resources allocated for the application.
3	**app-hosting uninstall appid** *application-name* `Device#`**`app-hosting uninstall appid scats`**	Uninstalls the application. Uninstalls all packaging and images stored. All changes and updates to the application are also removed.