



The bridge to possible

Network Transformation by Utilising Application Hosting Capabilities at the Edge

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Agenda

- Introduction
- App Hosting Basics
- Hosting on Catalyst Switches
- Hosting on Wireless AP's
- Hosting on IOT routers

App Hosting Basics



Why App Hosting ?

- Adding monitoring or configuration capabilities to devices at the edge
- Having analytics to make a variety of business decisions
- Sensing the threat closer to source and preventing the threat from propagating into the network
- Distributed processing for IOT, bringing the cloud closer to edge

Application Deployment Types

- Bare-Metal Servers



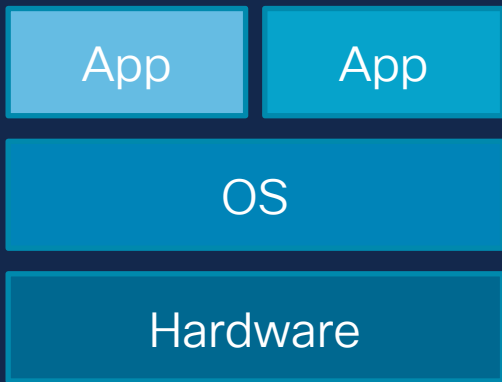
- Virtual Machines



- Containers



Bare-Metal Servers

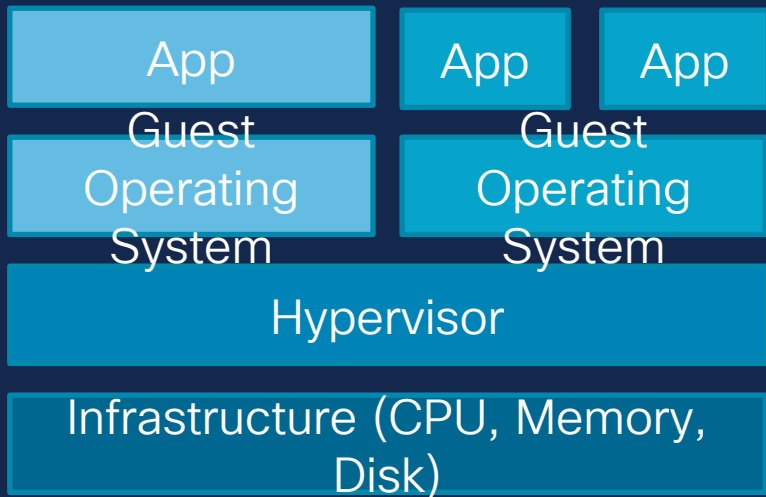


- A bare-metal server is a physical server that is dedicated to a single tenant.
- It can run multiple applications, but the resources are not shared with other tenants.

Bare-metal servers have these advantages:

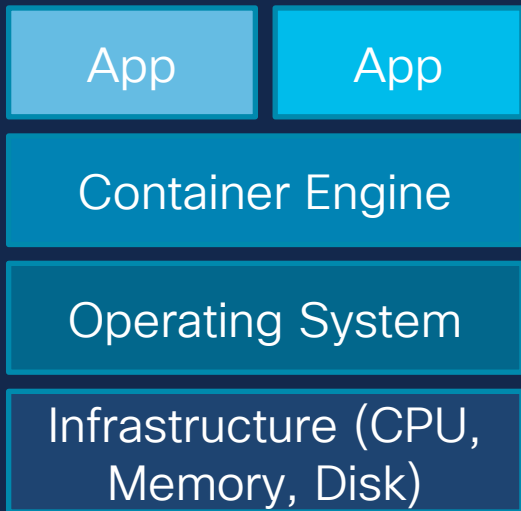
- Performance: Physical server resources can be optimized for a specific workload.
- Security: Data, applications, and other resources are physically isolated.
- Reliability: Physical resources are dedicated to a specific workload

Virtual Machine



- A virtual machine is an emulation of a computer system running on a shared host.
- Each virtual machine consists of its own environment (including operating system, libraries, and applications) and is not aware of other virtual machines running on the same physical host.
- Communication between applications inside a virtual machine and physical resources is through an abstraction layer called a hypervisor.
- This abstraction layer is responsible both for resource allocation and isolation.

Containers



- Container technology uses host operating system features to provide an isolated environment for multiple applications to run on the same server.

The most widely used container solution used today is Docker. Docker enables users to package containers so that they can be moved between environments.

Docker

Portable deployments

- Docker to create a single object (image) containing all your bundled applications. The image can then be installed on any other Docker-enabled host

Versioning

- Docker can track versions of containers, inspect differences between versions, and commit new versions.

Component reuse

- Docker allows building and stacking of already created packages.

Shared images

- Anyone can upload new images to a public registry of Docker images

Edge Computing

- Today, more applications are moving to the cloud, and multiple clouds are being deployed.
- The increased number of endpoints dramatically increases the volumes of data that need to be processed and transporting the data to central locations for processing becomes expensive.
- To solve these issues, a new service architecture is being introduced: edge computing, which is based on distributing computing capacity to the edge of the network.
- Brings computing resources as close to the source of data as possible to reduce latency and bandwidth use.

Edge Computing



Better Performance

Lowering the latency between the end user device and a processing and storage unit to get better performance



Network Efficiency

Implementing edge offloading for greater network efficiency

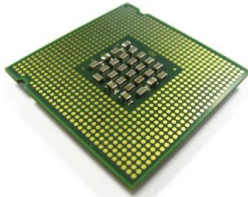
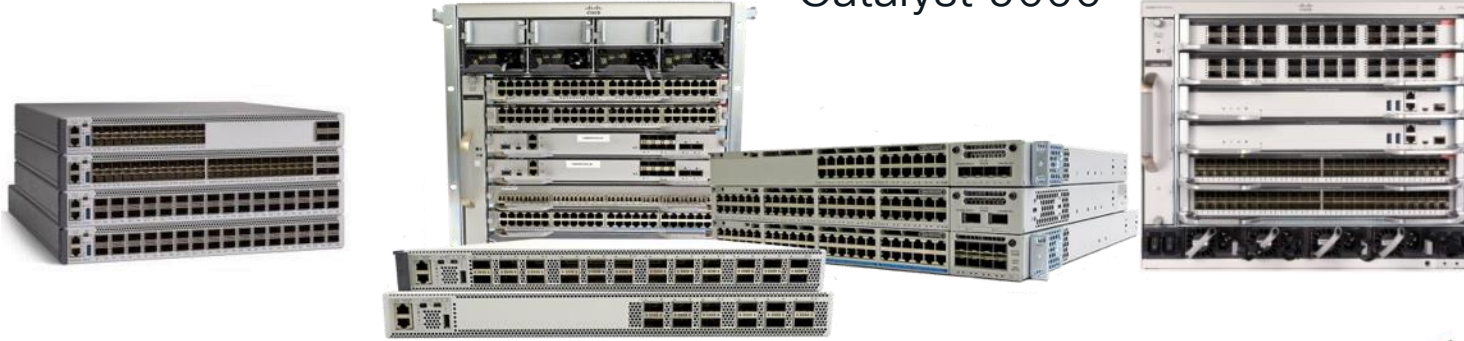


Reducing Transport Costs

Performing computations and reducing transport costs

Networking Today !!!

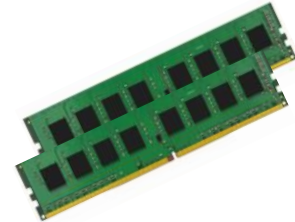
Catalyst 9000



x86 CPU



Linux-based OS



Memory/Storage

Enables hosting docker containers and 3rd party apps

New strategic capabilities with App Hosting on C9K Switches

Existing Hardware

Managed via CLI
or DNA-C

Real Time Processing

Lower Latency

Save Bandwidth



IT Operations and
Monitoring Tools

**Consolidate
Physical
Infrastructure**



Security Agents
and Functions

Enhance Visibility &
Security
Enforcement



Cloud Gateways with
Serverless Edge Compute

**Reduce App Latency
& Optimize App
Traffic**

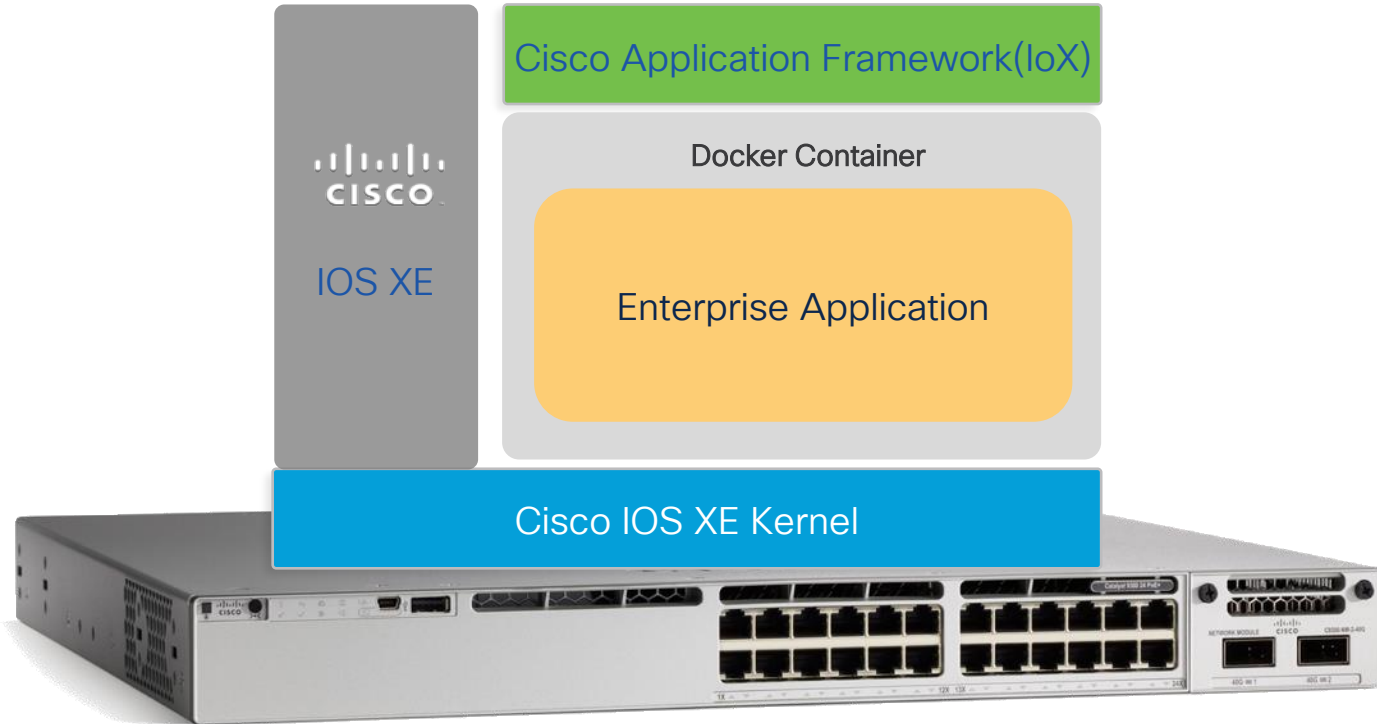


Customer Specific
Applications

3rd Party App
Hosting

Rich ecosystem
partnership with 25+
certified apps and
200+ active
customer

Catalyst 9000 App Hosting Architecture



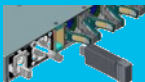
HW resources for App Hosting

	Resource type	Catalyst 9300	Catalyst 9300-X	Catalyst 9400	Catalyst 9400-X	Catalyst 9500	Catalyst 9500-X	Catalyst 9600	Catalyst 9600-X
Networking	AppGig Port	1x1G	2x10G	1x1G	2x10G	Mgmt Port*	2x10G	Mgmt Port*	Mgmt Port* (2x10G CPU ports)
Resources	Memory	2GB	8GB	8GB	8GB	8GB	8GB	8GB	8GB
	CPU	1 core	2 core	1 core	1 core	1 core	1 core	1 core	1 core
	Storage	240GB (USB3.0/SSD)	240GB (USB3.0/SSD)	480-960GB (SATA)	480-960GB (SATA)	480-960GB (SATA)	480-960GB (SATA)	480-960GB (SATA)	480-960GB (SATA)

* Using loopback with any external ports

Catalyst 9300-X

USB 3.0
240GB




Back panel



Catalyst 9400-X

M2 SATA
480/960GB




Plug into removable SUP



Catalyst 9500-X

M2 SATA
480/960GB




Back panel



Catalyst 9600-X

M2 SATA
480/960GB



Plug into removable SUP

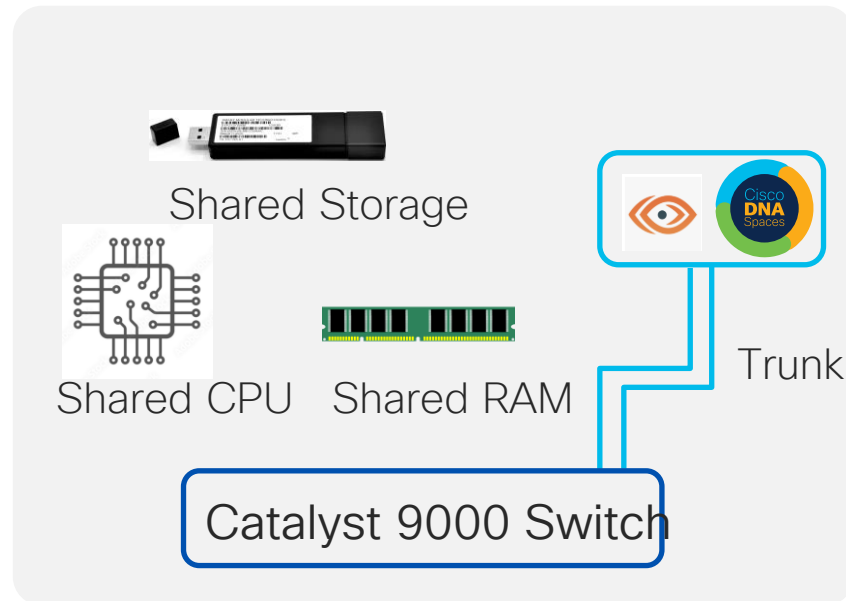


Multiple Applications Support on Catalyst 9K

17.5.1

Requirements :

- Cisco Signed Applications Only
(ex. ThousandEyes, IoT Gateway)
- Must use SSD Storage
- Enough HW resources should be available to run all applications
- AppGigabitEthernet ports config must not create a conflict between the apps



HW resource can be customized via DNA-C and CLI

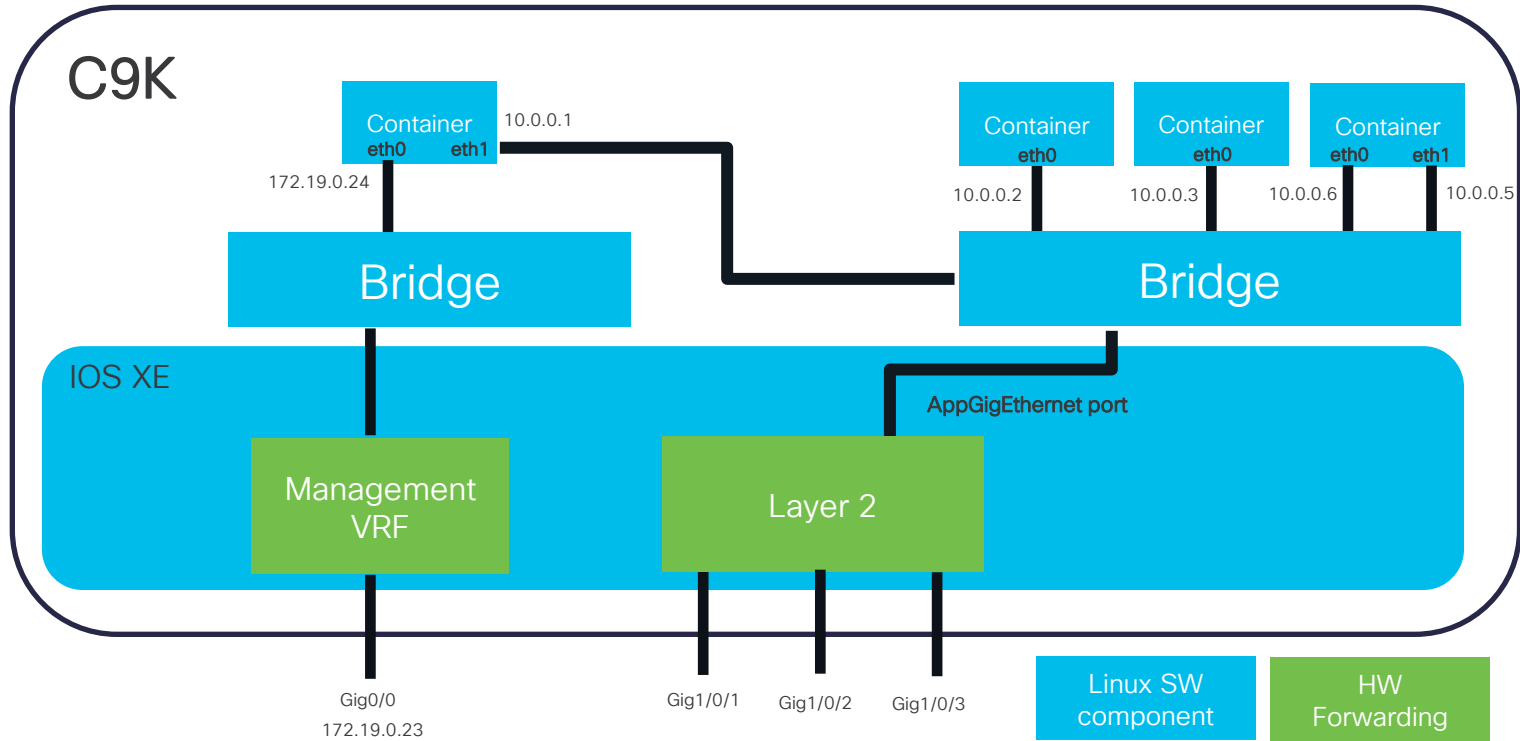
IOS XE performance and security protection

- Memory and CPU usage for Apps are bounded using Control groups (cgroups).
- Process and files access for Apps are isolated and restricted (using user namespace)
- Disk usage is isolated using separate storage.



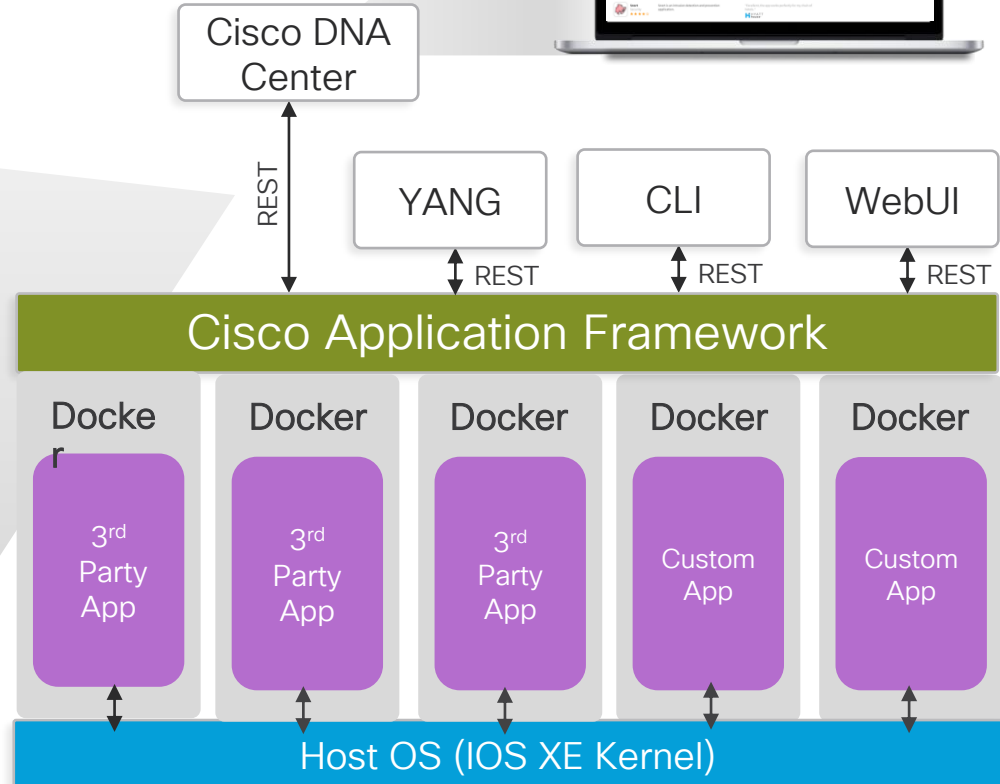
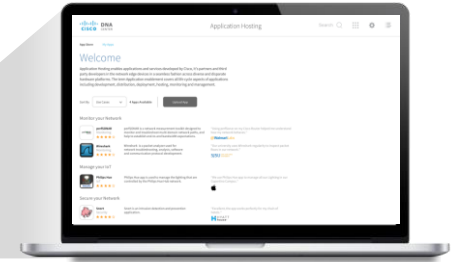
Catalyst 9000 Containers Networking

Catalyst 9000 Containers Networking



App Lifecycle Management

Application Management



Application Management using Cisco DNA

Cisco DNA Center

Enable Apps on Switches

Select Switches

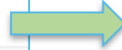
Select switches where you want to enable **thousandeyes/enterprise-agent**.

Switches (2) 0 Selected

Q Search Table

<input type="checkbox"/>	Device Name	Site	IP Address	Serial Number
<input type="checkbox"/>	197-CAT-DOG.cisco.com	.../BLR-18/FLR-1	10.78.106.197	FCW2221G0HJ
<input type="checkbox"/>	198-CAT.cisco.com	.../BLR-18/FLR-1	10.78.106.198	FOC2221Z072

2 Records



Cisco DNA Center

Enable Apps on Switches

Configure App

Configure app specific settings to bootstrap **thousandeyes/enterprise-agent**.

Add Application Vlan

Network Settings

Interface Name: eth0 VLAN: VLAN0299 Address Type: Dynamic

> App Resources

> App Data

> Docker Runtime Options

If the app requires docker runtime options add/edit them here.

Add Account Token from ThousandEyes Account

```
-e TEAGENT_ACCOUNT_TOKEN=ADD_DATA --hostname=$(SYSTEM_NAME) --cap-add=NET_ADMIN --mount type=tmpfs,destination=/var/log/agent,tmpfs-size=140M --mount type=tmpfs,destination=/var/lib/te-agent/data,tmpfs-size=200M --v $(APP_DATA)/data:/var/lib/te-agent -e TEAGENT_PROXY_TYPE=DIRECT -e TEAGENT_PROXY_LOCATION= -e
```

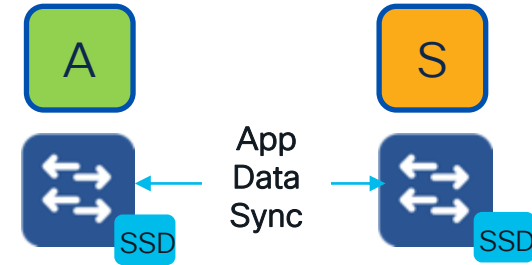
The app will be started by default. Deselect this option only if you do not want the app to be started after installation.

☒ Start app on installation

Application HA

App Hosting High Availability with Auto-Restart

- Provides cold restartability of application and the underlying app hosting framework
- Retain the last configured operational state of app in the event of system switchover or restart
- 1+1 redundancy mode
- Same storage type (Flash* or SSD) required on both Active and Standby
- Enabled by default

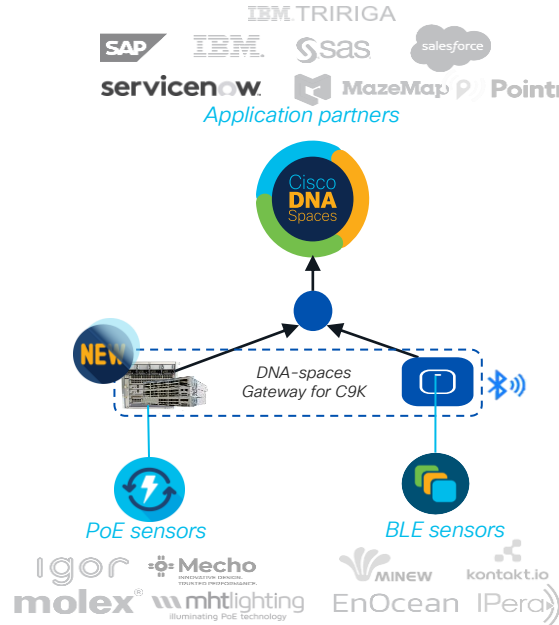


Supported Platforms	Release
9300 StackWise (1+1 mode only)	17.2.1
9400 Dual Sup (Single Chassis & StackWise Virtual)	17.5.1
9500H StackWise Virtual	17.5.1
9600 Dual Sup (Single Chassis & StackWise Virtual)	17.5.1

* Flash is only for Cisco Singed app

Catalyst 9K expands value for Smart buildings

Next: DNA-spaces gateway for Catalyst 9K will expand outcomes



New use cases

- Sustainable buildings
- Employee health & Safety
- Productivity Improvement
- Building Analytics

Unified Marketplace

- Largest choice of IoT devices
- Unmatched solution scale
- Cisco validated

Lower TCO

- Automated workflows
- No vendor lock-ins
- Cloud based as-a-service

*Source: Cisco Smart building TCO calculator

Use Cases

User Experience

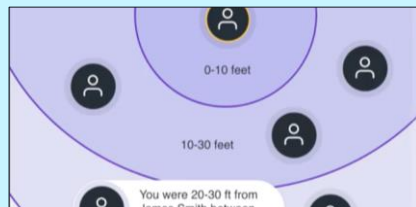
Conference Room Booking

GA



Safety & Compliance

Density Triggers



Real Estate Utilization

Device/People Counting



Automation & Optimization

Environmental Monitoring & Asset location



Cisco Catalyst 9K



Cisco DNA Spaces



PoE lights & Sensors



Cisco Catalyst
Wireless
LAN Controller



Cisco Catalyst
Wireless
LAN Controller



POE sensors / HVAC

Validated Apps- DevNet Eco System Exchange

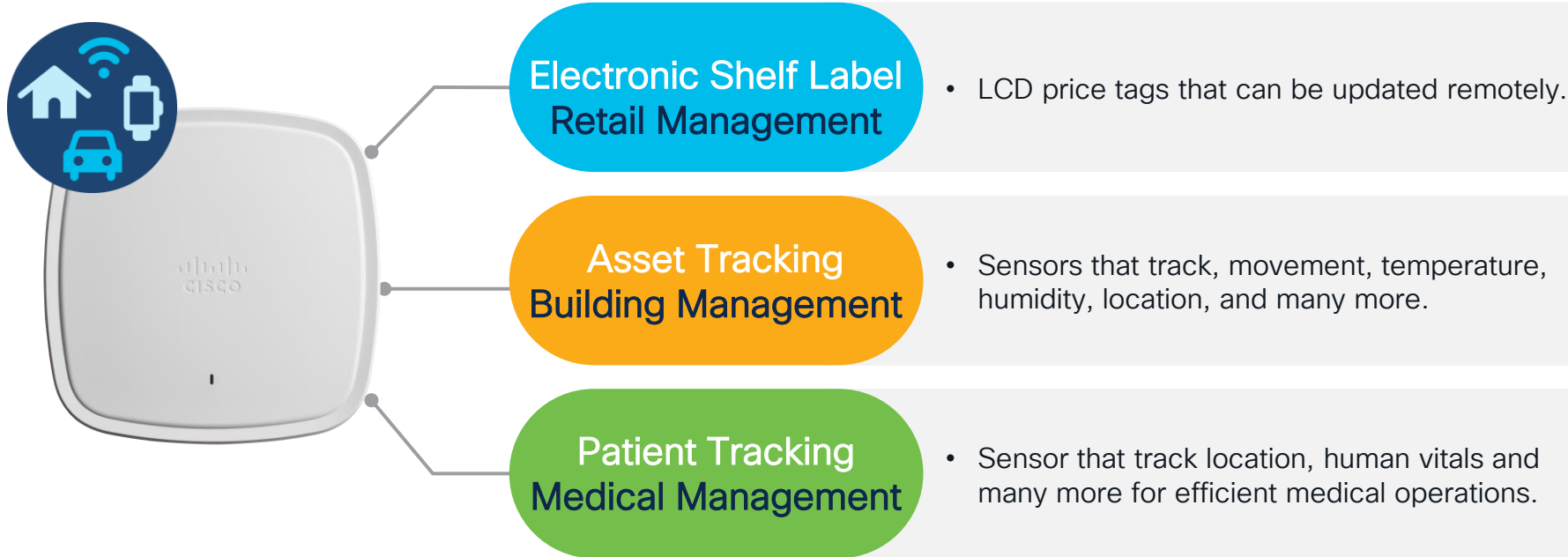
DevNet Eco System Exchange



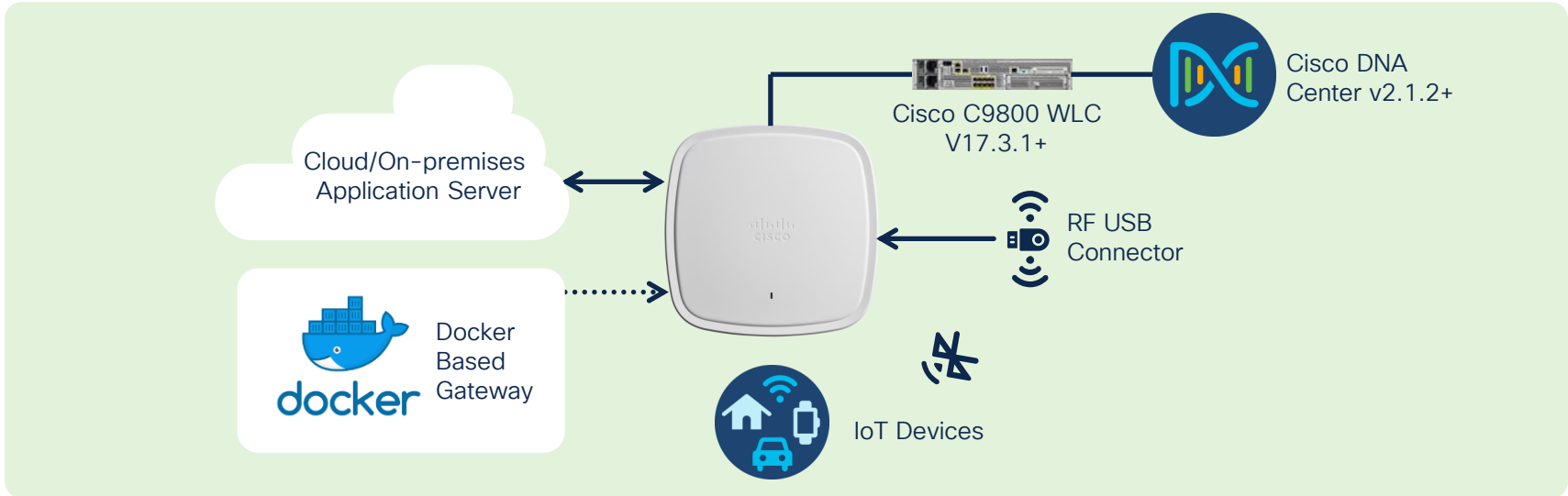
- Cisco will not provide any support to third-party apps and open source apps unless specifically called out.
- Such apps, however, will be validated for compatibility on Cisco® Catalyst® 9000 switches.
- DevNet ecosystem will indicate the partners who have worked on Cisco Catalyst 9000 switches.

Application Hosting in Catalyst Access Points

Partner Solution Use Case Segments



IOx Application Hosting Topology

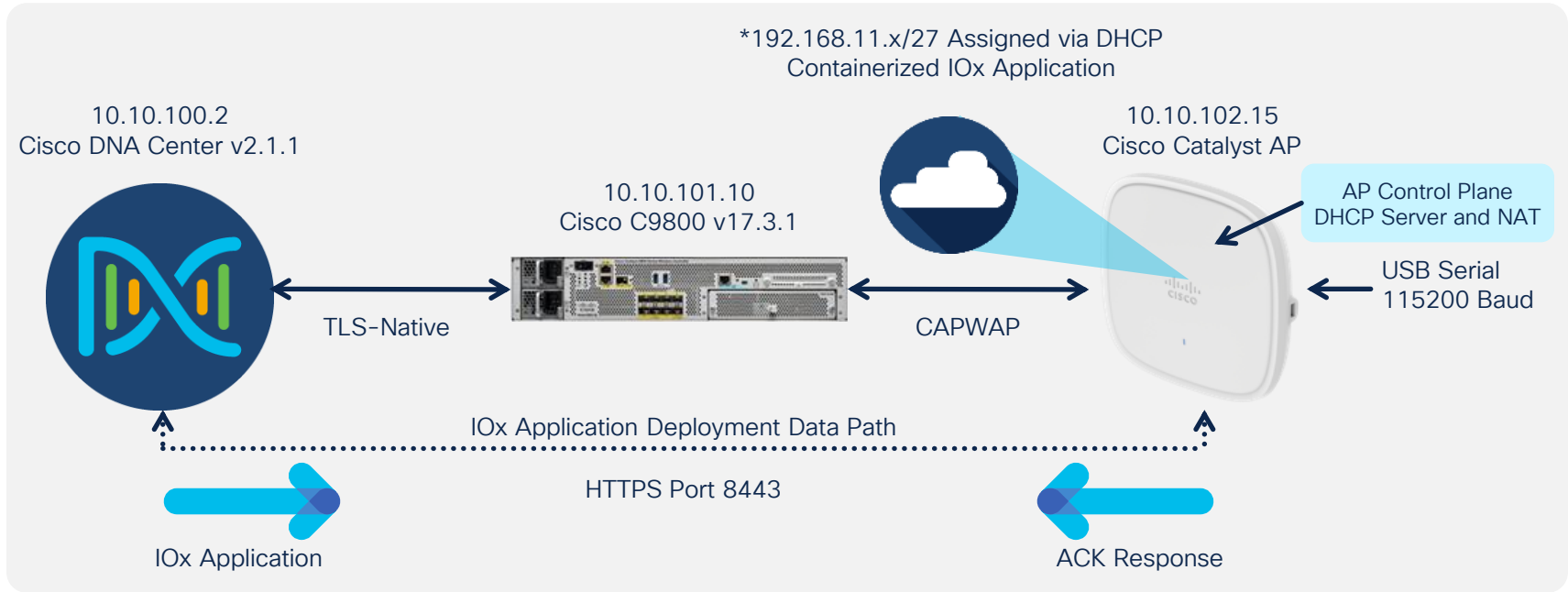


Cisco DNA Center deploys the app

RF USB Connector can be any RF

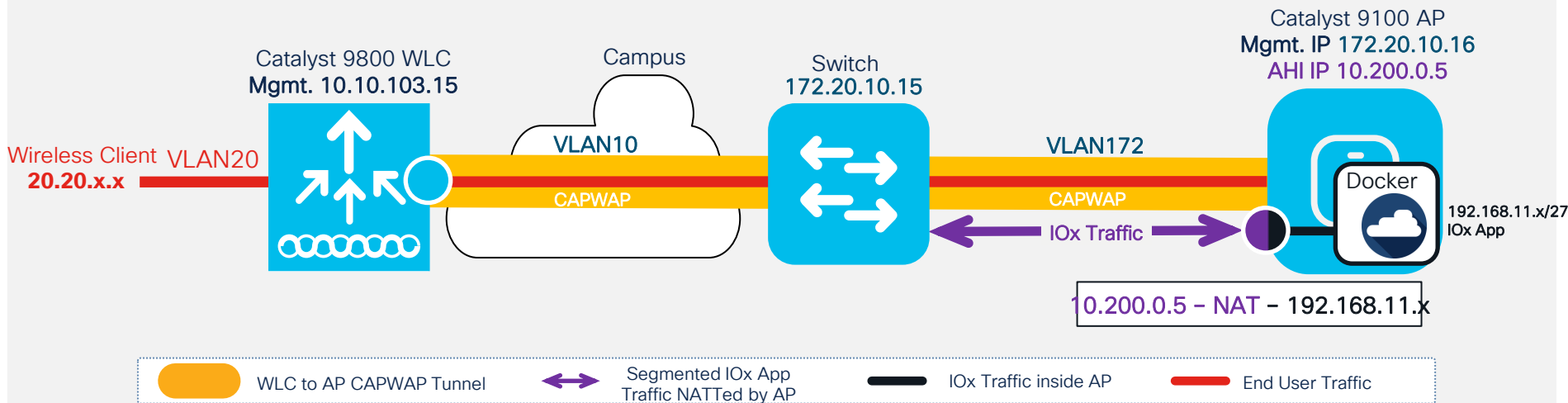
Catalyst AP acts as an IoT gateway

Application Hosting Network topology



*The IOx Application's traffic is locally switched and communicates to external sources through NATting the AP's IP

IOx Traffic Segmentation with AHI on Local Mode AP

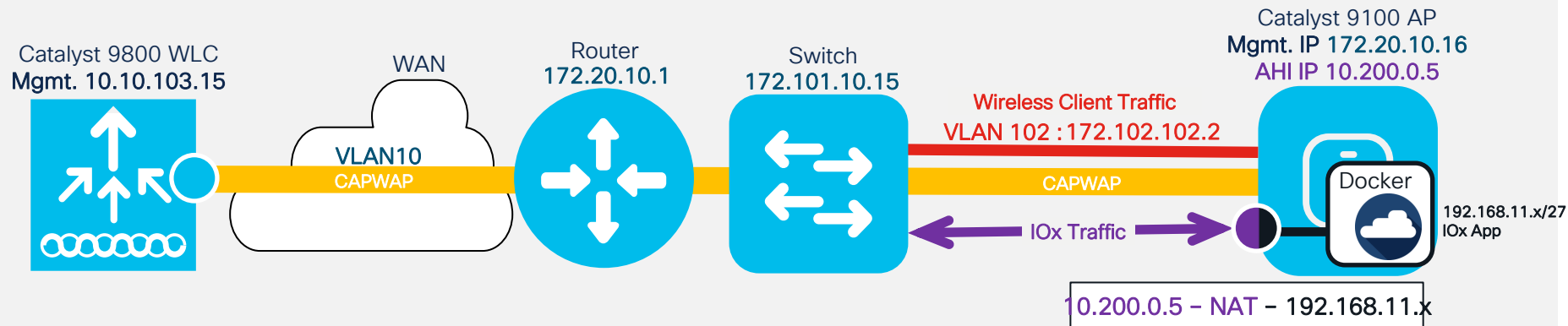


The IOX App cannot access AP data or management traffic with Auxiliary-Client Interface (AHI) enabled

The IOX App uses the AP's AHI IP address to communicate externally

The IOX App's traffic is always locally switched regardless of AP mode

IOx Traffic Segmentation with AHI on FlexConnect AP mode

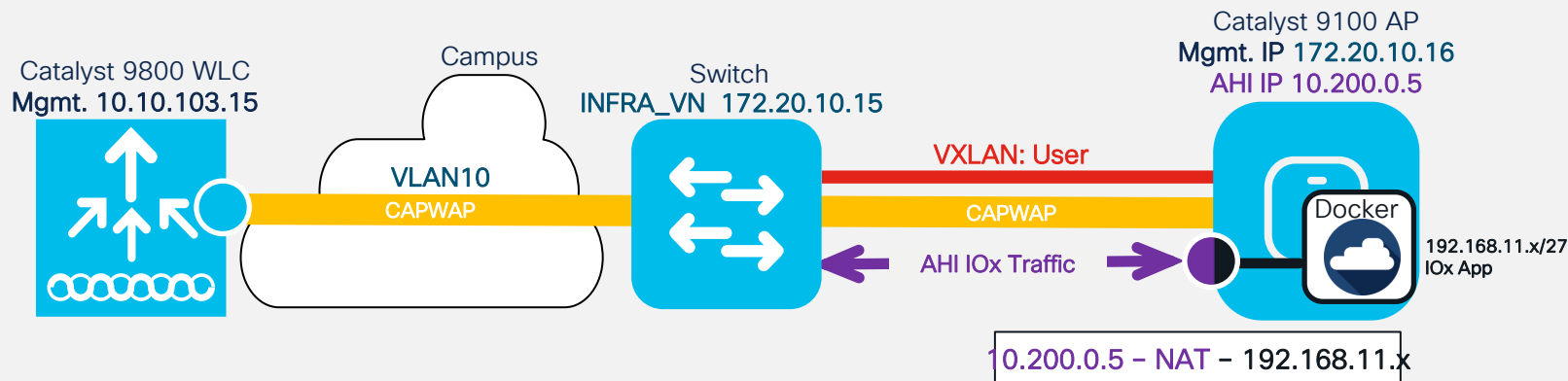


The IOX App cannot access AP data or management traffic with Auxiliary-Client Interface (AHI) enabled

The IOx App uses the AP's AHI IP address to communicate externally

The IOx App's traffic is always locally switched regardless of AP mode

IOx Traffic Segmentation with AHI on Fabric Wireless mode



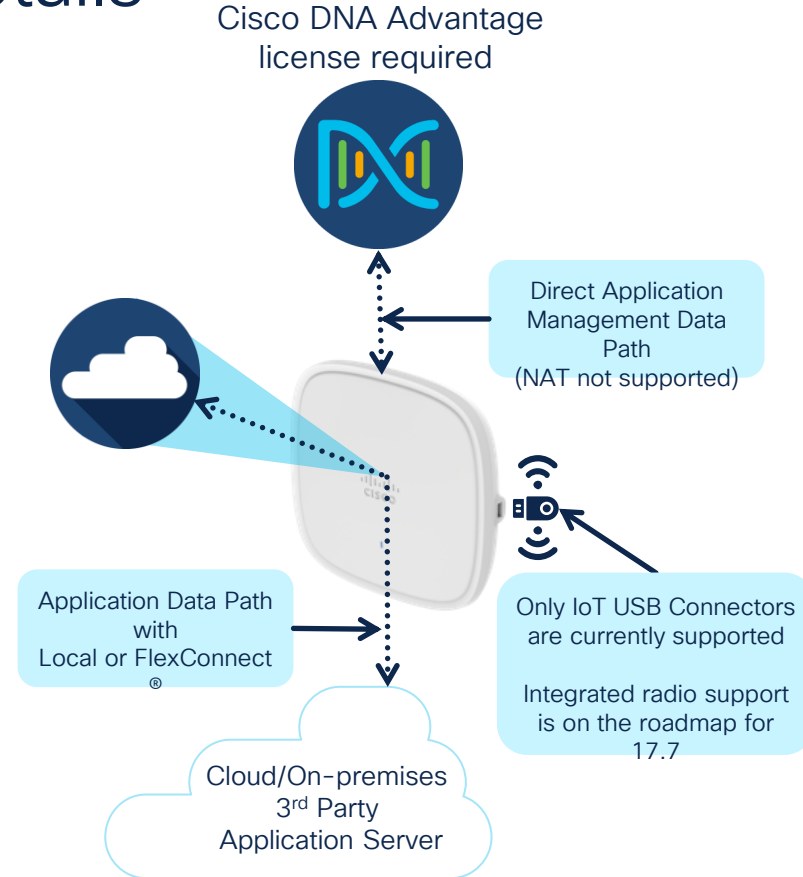
The IOx App cannot access AP data or management traffic with Auxiliary-Client Interface (AHI) enabled

The IOx App uses the AP's AHI IP address to communicate externally

The IOx App's traffic is always locally switched regardless of AP mode

IOx Application Deployment Details

- Cisco DNA Advantage license required
- Supports up to 2 applications.
- Dedicated resources given to the application.
- Application security is dependent on the application developer.



Application Hosting deployment workflow

Day 0 – Cisco DNA Center configurations

- Create a network hierarchy site
- Discover WLC and access points
- Assign WLC and access points to the network hierarchy

Day 1 – Upload and deploy IOx applications

- Upload IOx application to Cisco DNA Center
- Deploy uploaded application to specific access points

Day 2 – Manage and monitor IOx applications

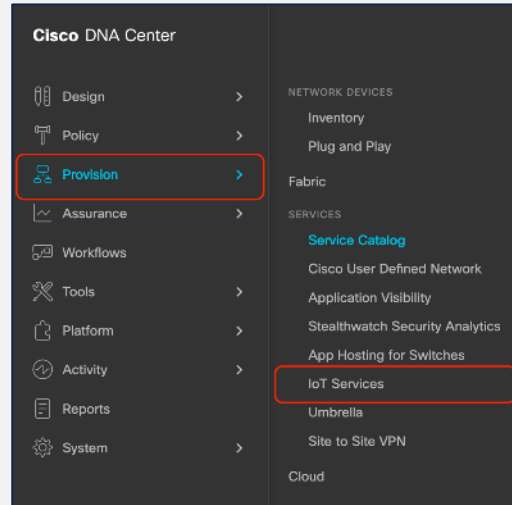
- Establish communication between IOx application and the application server
- Manage and monitor IOx application through the application server

Upload IOx Application



Step 1: Navigate to IoT Services

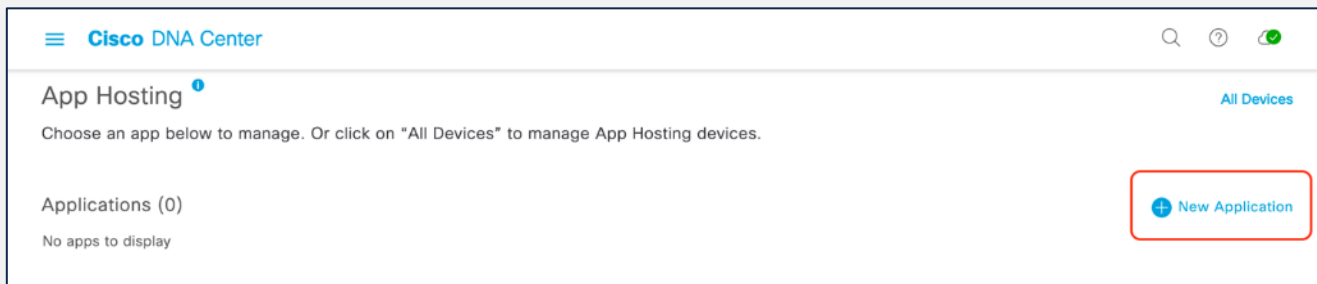
- 1 Open the menu, click on **Provision**, then **IoT Services** to enter the App Hosting page.



Cisco DNA Center's IoT Services page provides an intuitive graphical user interface for users to upload and manage a third-party application they would like to deploy onto their access points.

Step 2: Upload the IOx application to Cisco DNAC

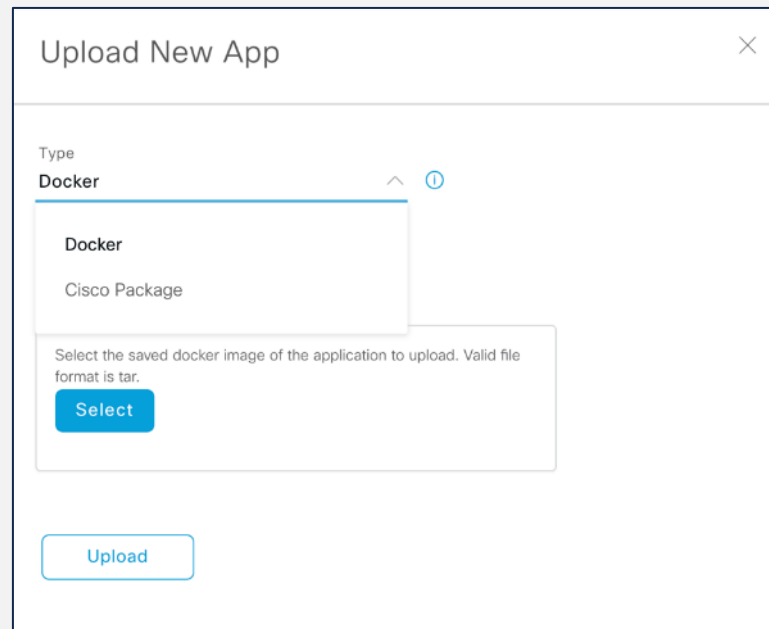
- 1 Click on **New Application** on the right side of the screen.



Step 2: Upload the IOx application to Cisco DNAC

2 Click on the **Type** drop-down menu and select an application type:

- Option 1 – Docker
 - Choose this option if the app you are uploading is a Docker app saved as a tar file using the Docker save command.
- Option 2 – Cisco Package
 - Choose this option if the app you are uploading has been packaged using the Cisco app packaging toolchain.
- For more information regarding both package types, visit: <https://developer.cisco.com/docs/iox/>



Upload New App

Type
Docker

Docker
Cisco Package

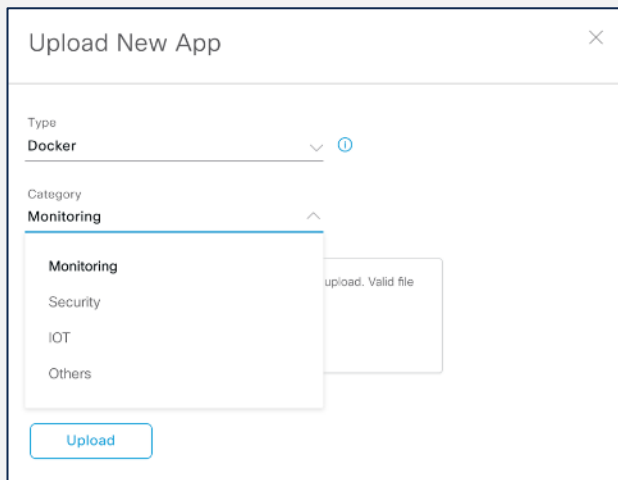
Select the saved docker image of the application to upload. Valid file format is tar.

Select

Upload

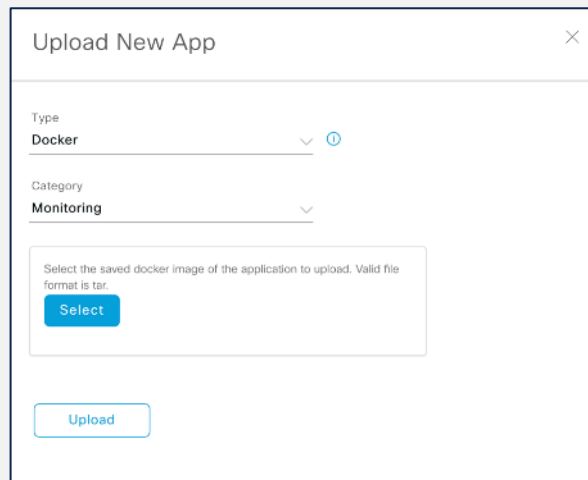
Step 2: Upload the IOx application to Cisco DNAC

- 3 Click the **Category** drop-down menu and select an application category: Monitoring, Security, IoT, etc.



The screenshot shows the 'Upload New App' dialog box. The 'Type' dropdown is set to 'Docker'. The 'Category' dropdown is open, showing a list of options: 'Monitoring', 'Security', 'IOT', and 'Others'. 'Monitoring' is highlighted. An 'Upload' button is at the bottom.

- 4 Click the **Select** button to select a file to upload, then click **Upload** to upload the file.

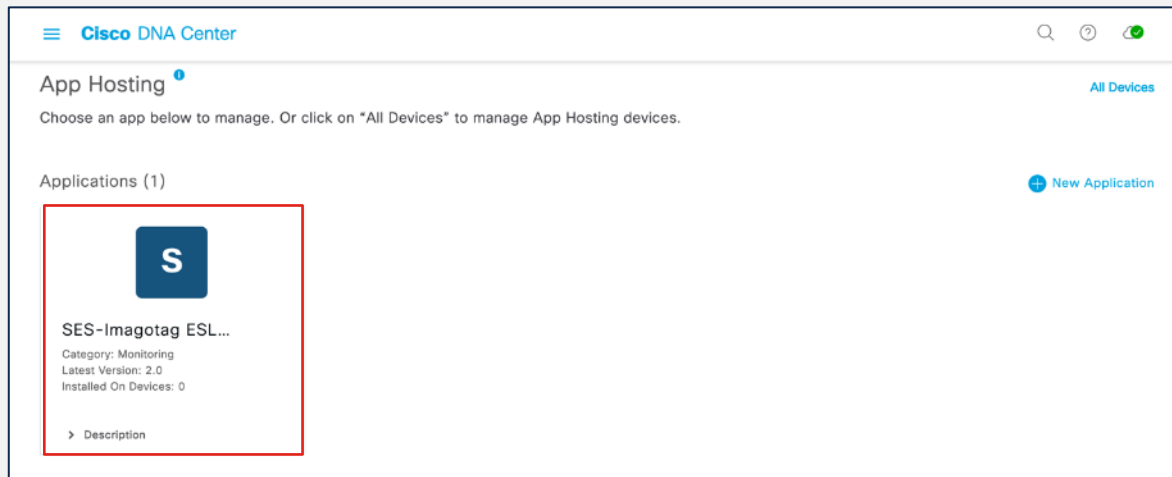


The screenshot shows the 'Upload New App' dialog box. The 'Type' dropdown is set to 'Docker' and the 'Category' dropdown is set to 'Monitoring'. A text box contains the instruction: 'Select the saved docker image of the application to upload. Valid file format is tar.' Below this is a blue 'Select' button. At the bottom is an 'Upload' button.

Step 2: Upload the IOx application to Cisco DNAC

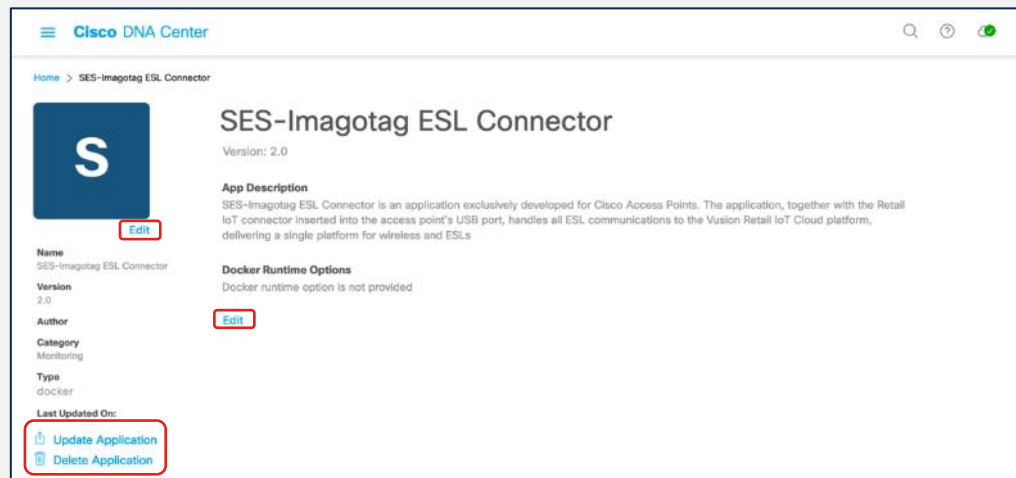
5 Ensure the application you've uploaded now appears within the App Hosting page.

6 Optional: If you would like to manage the application, click on the application to enter the application's management page.



Step 2: Upload the IOx Application to Cisco DNAC

- 7 (1) To update the application, click on the **Update Application** button; (2) To delete the application, click on the **Delete Application** button; (3) To edit the application's description, click on the **Edit** button.

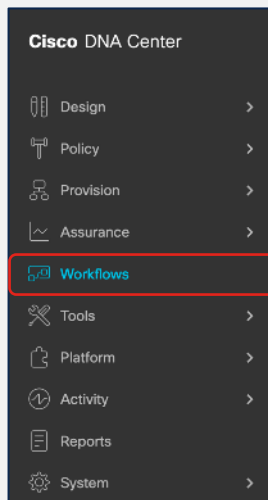


Deploy IOx Application



Step 1: Navigate to “Enable IoT Services Workflow”

1 Open the menu, then click on **Workflows**.

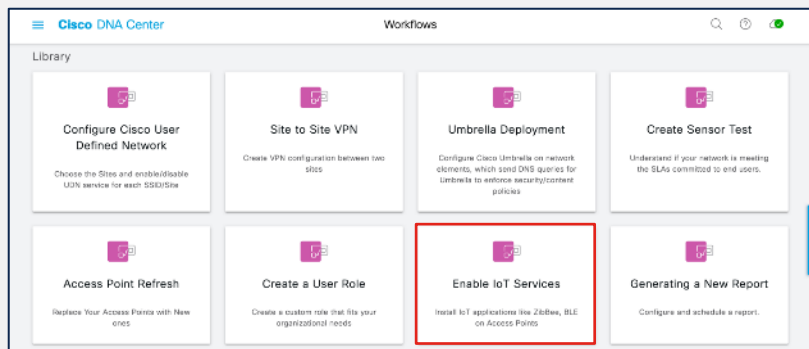


Cisco DNA Center’s “Enable IoT Services Workflow” function allows you to easily deploy your application to either a location or specific access point.

Step 1: Navigate to “Enable IoT Services Workflow”

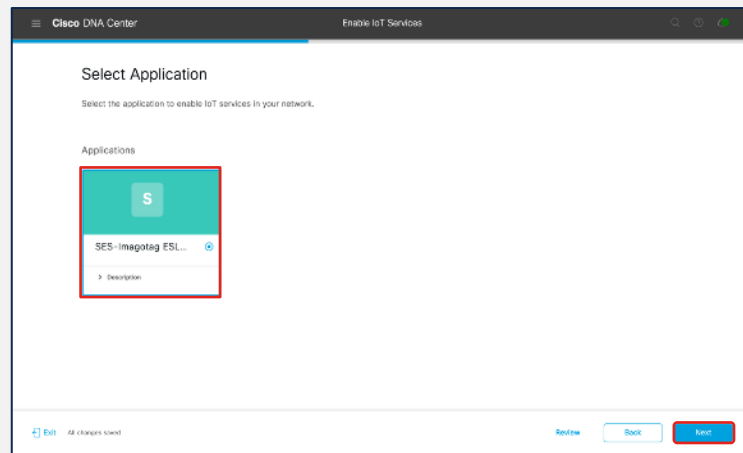
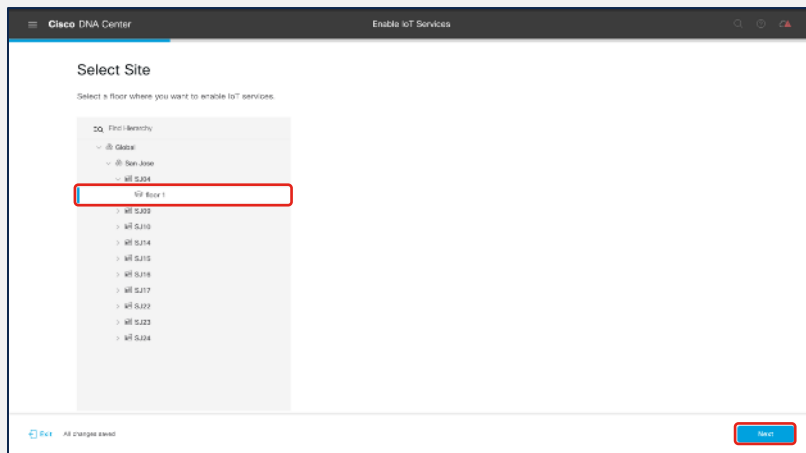
2 Click on **Enable IoT Services** to begin the deployment workflow.

3 Click on the **Let's Do it** button on the modal box that appears.



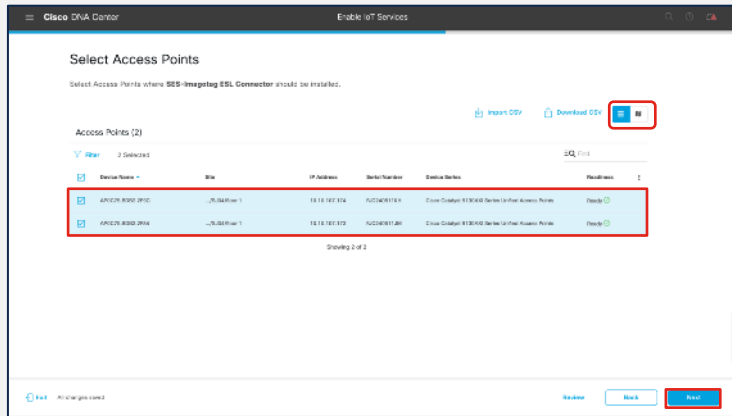
Step 2: Deploy the application to access points on a floor

- 1 Select a floor within the network hierarchy where you'd like to deploy the application, then hit **Next**.
- 2 Select the image that you would like to deploy the device on that floor, then hit **Next**.

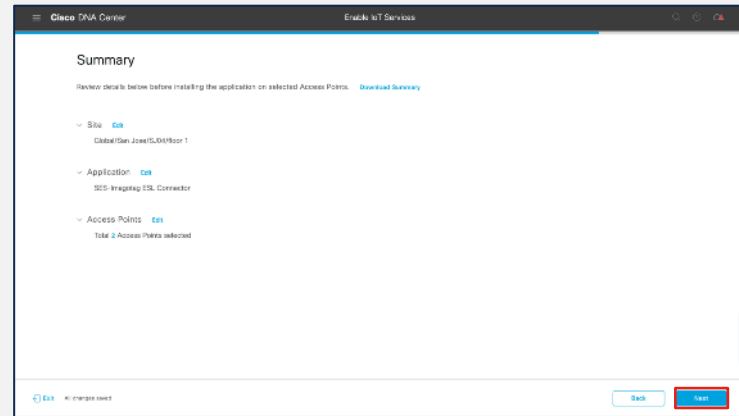


Step 2: Deploy application to access points on a floor

- 3 Select the AP(s) on this floor where you would like to deploy the image, then click **Next**.



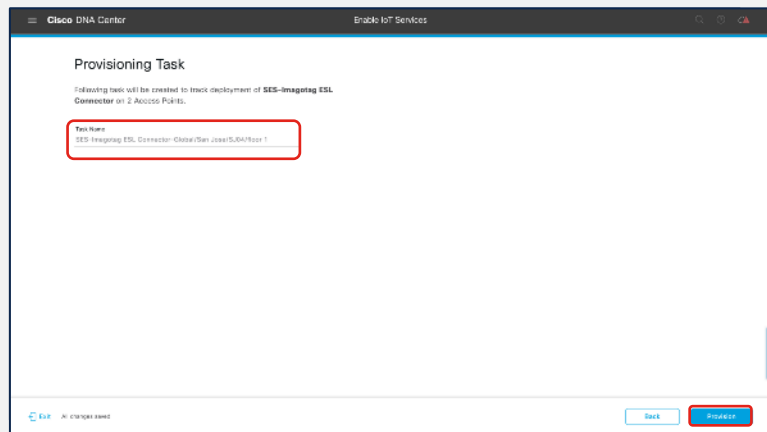
- 4 Review that the application is being deployed to the intended site and access point(s), then click **Next**.



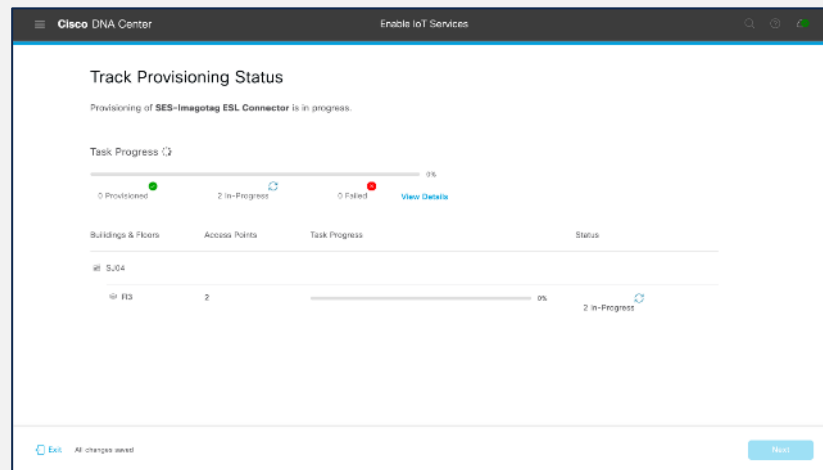
- Ensure the Readiness column says **Ready**
- By default, this page shows an AP list view; however, it can be toggled to a maps view via the map icon at the top right-side corner of the table.

Step 2: Deploy application to access points on a floor

5 Note the **Task Name** for reference, then hit **Provision**.



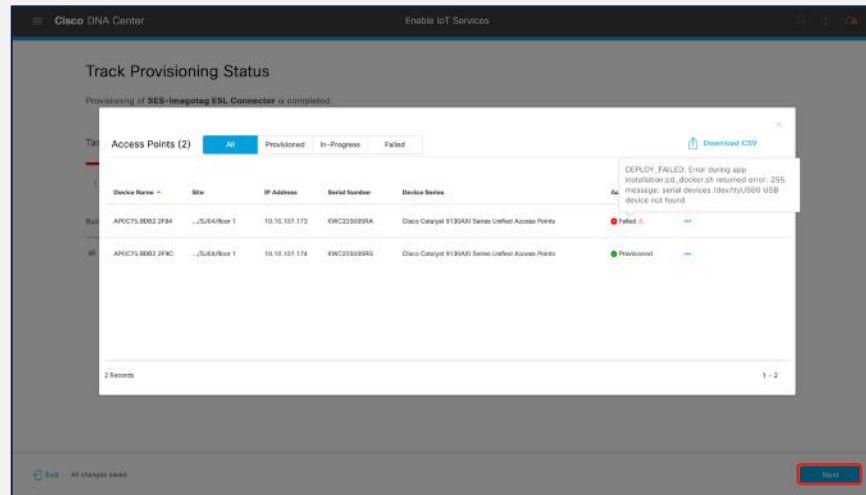
6 Observe that the application deployment process will begin.



Step 2: Deploy application to access points on a floor

7 If all previous steps were followed, you will observe a **Provisioned** message.

8 After reading through the provisioning status of your application deployment, hit **Next**.

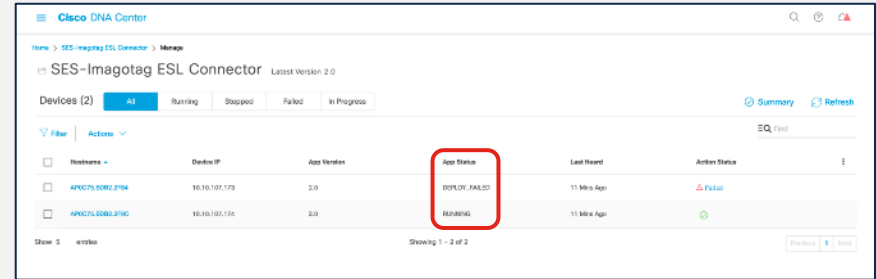
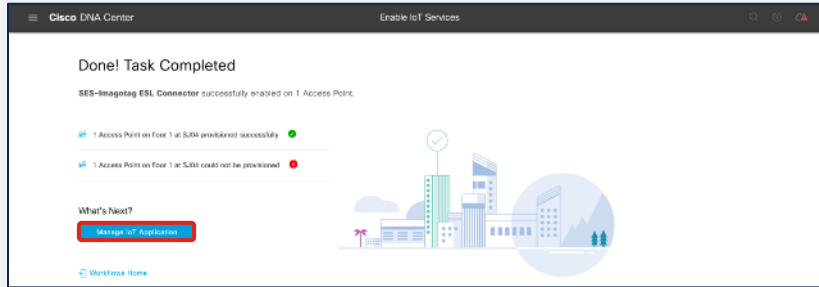


Warning: If you attempt to deploy an application with a dependency on a USB attachment, and the attachment is not detected, you will receive a Failed message.

Step 2: Deploy application to access points on a floor

9 Click on the **Manage IoT Application** button to continue to the application's management page.

10 On this Application Management page, you're able to manage the status of the deployed applications.

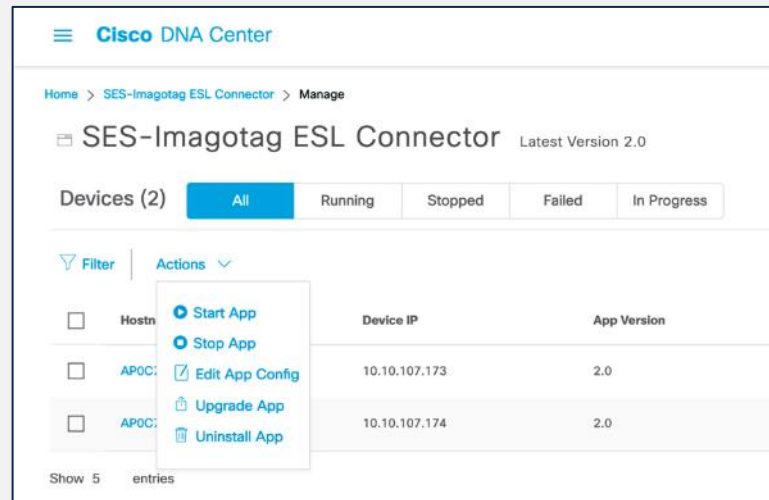


Observe beneath the **App Status** column that you can monitor the status of your application.

Step 2: Deploy application to access points on a floor

11 In order to manage the application deployed to the access point, click on the **Actions** drop-down menu

1. **Start App** – If you stopped your app via the **Stop App** button, you could start it again via this button
2. **Stop App** – You can stop the loaded application from running. (Stopping an application does not delete or uninstall it.)
3. **Edit App Config** – If your application requires additional configurations, you can edit it via this button
4. **Upgrade App** – If you've uploaded a newer version of your use through the initial IoT Services Workflow, you can click on the **Upgrade App** button to upgrade the application running on the AP to the new version
5. **Uninstall App** – Click this button to remove the application from your access point entirely



Step 2: Deploy application to access points on a floor

- 12 At this point, your application should be deployed successfully to your access point(s) and if desired, you can verify this via the following AP CLI command:

```
AP0C75.BDB2.2F9C#show iox applications
Total Number of Apps : 1
-----
App Name                : SES_Imagotag_ESL_Connector
App Ip                  : 192.168.11.2
App State               : RUNNING
App Token               : 576fdae5-81a0-4e93-8093-afb050872c12
App Protocol            : usb
Number of Disconnects   : 0
App Grpc Connection     : Down
Rx Pkts From App        : 0
Tx Pkts To App          : 0
Tx Pkts To Wlc          : 0
Rx Pkts From WLC        : 0
Tx Data Pkts To DNASpaces : 0
Tx Cfg Resp To DNASpaces : 0
Rx KeepAlive from App   : 0
Dropped Pkts            : 0
App keepAlive Received On : NA
```

Your application will, by default, receive an IP address from the 192.168.11.x/27 through DHCP, and can communicate externally from the AP through NAT. This means that the IOx app will, by default, have the same IP address as the AP from the perspective of external applications.

Useful CLI Commands



Catalyst Access Points CLI commands

1 Statistics of the loaded application:

Nolan_AP#show iox applications

Total Number of Apps : 1

App Name : communication_daemon

App Ip : 192.168.11.2

App State : RUNNING

App Token : 0f690ed5-c341-4342

App Protocol : usb

App Grpc Connection : Down

Rx Pkts From App : 0

Tx Pkts To App : 0

Tx Pkts To Wlc : 0

Tx Data Pkts To DNASpaces : 0

Tx Cfg Resp To DNASpaces : 0

Rx KeepAlive from App : 0

Dropped Pkts : 0

App keepAlive Received On : NA

2 AP and connected USB device info:

Nolan_AP#show inventory

NAME: C9130AX, DESCR: Cisco Catalyst 9130AX

Series Access Point

PID: C9130AXI-B , VID: V01, SN: FJC240511KH

Entity Name	: USB Module
Detected	: Yes
Status	: Enabled
Product ID	: ea60
Vendor ID	: 10c4
Manufacturer	: Silicon Labs
Description	: CP2102N USB to UART Bridge
Controller	
Serial Number	: 0cd351d9f35
Max Power	: 100 mA

Catalyst Access Points CLI commands (continued)

3 Loaded IOx application status:

```
Nolan_AP#show iox status
```

```
IOx Status      : Enabled
CAF Status      : Up
CAF Token       : 9e054a32-d1ff-464e-aadd-6c5934959310
CAF Port        : 8443
```


Cisco IOS XE WLC CLI commands

- 1 Status of the USB modules connected to all joined access points:

```
Nolan_eWLC#show ap module summary
```

Output of show ap module summary:

AP Name	External Module	External Module PID	External Module Description
Nolan_AP1	Enable	10c4/ea60/100	CP2102N USB to UART Bridge C
Nolan_AP2	Enable	10c4/ea60/100	CP2102N USB to UART Bridge C

- 2 State of the USB modules connected to all joined access points:

```
Nolan_eWLC #show ap config general
```

USB Module Type	: USB Module
USB Module State	: Enabled
USB Operational State	: Enabled
USB Override	: Disabled

Cisco IOS XE WLC CLI commands

3 Application Hosting status of each joined access point:

Nolan_eWLC#show ap apphost summary

<i>AP Name</i>	<i>AP Mac</i>	<i>Apphost Status</i>	<i>CAF Port</i>	<i>Apphost HW capable</i>

<i>SS-2027</i>	<i>00ee.ab18.b620</i>	<i>Up</i>	<i>8443</i>	<i>Yes</i>
<i>Axel-2036</i>	<i>04eb.409f.a000</i>	<i>Up</i>	<i>8443</i>	<i>Yes</i>

4 Configuring Auxiliary-Client Interface (AHI) for IOx app traffic segmentation:

Nolan_eWLC#config terminal

Nolan_eWLC(config)# <AP Join Profile Name>

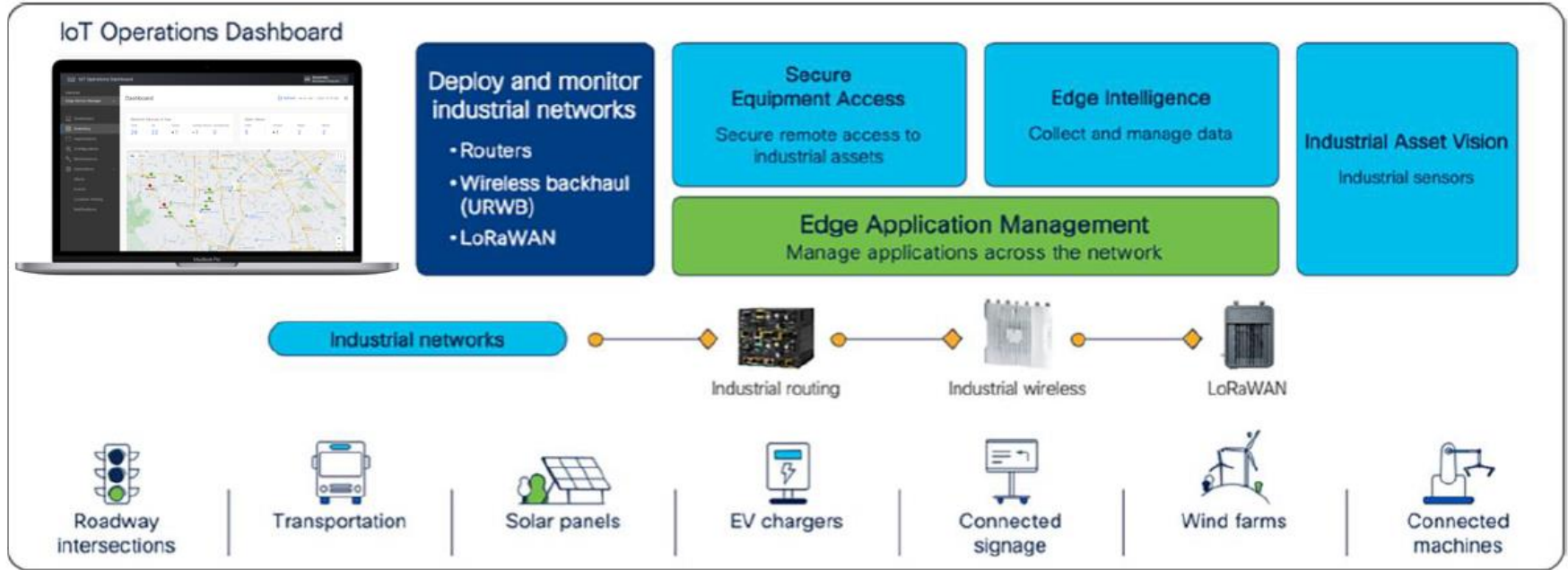
Nolan_eWLC(config-ap-profile)# auxiliary-client interface vlan-id <VLAN ID>

Note: Ensure that this VLAN exists within your 9800 controller

App hosting on Cisco IoT routers



What is IoT-OD



APP installation via IOT OD

IoT Operations Dashboard

SERVICES

Edge Device Manager

Dashboard

Inventory

Applications

Configuration

Software

Operations

Application Inventory

Filter

Add Application

Refresh

As of: Mar 20, 2023 4:21 PM

Application Name	Version	Instances	Managed by IOD	Added Date	Actions
nginx_iox_arm	1.0	1	Yes	Mar 20, 2023 03:42 PM	...
SEA-agent-IOSXE	0.66	0	Yes	Mar 20, 2023 03:47 PM	...

APP installation via IOT OD

The screenshot displays the Cisco IoT Operations Dashboard. The left sidebar contains a navigation menu with the following items: SERVICES, Edge Device Manager (expanded), Dashboard, Inventory, Applications (selected), Configuration, Software, and Operations. The main content area is titled 'SEA-agent-IOSEX' and includes a breadcrumb 'Application Inventory / SEA-agent-IOSEX'. Below the title are two links: 'Install Application' and 'View Instances (0)'. The 'Application Details' section contains a table with the following information:

Application Name	SEA-agent-IOSEX	Versions	0.66
Application Type	Docker	CPU Architecture	aarch64
Author Name	Cisco Systems	Author Link	http://www.cisco.com
Application Size	8.7 MB (19.9 MB uncompressed)	Application Description	Secure Equipment Access Agent for IOSEX

Below the application details is a 'Recommended Resources' section with a table:

CPU	128 Units	Disk Space	128 MB
RAM	24 MB		

App Installation via IoT OD

The screenshot displays the Cisco IoT Operations Dashboard. The left sidebar contains a navigation menu with the following items: SERVICES, Edge Device Manager (expanded), Dashboard, Inventory, Applications (selected), Configuration, Software, and Operations. The main content area shows the 'SEA-agent-IOSXE' application page. At the top, there's a breadcrumb trail: 'Application Inventory / SEA-agent-IOSXE / Instances'. Below this, the title 'SEA-agent-IOSXE' is displayed. The 'Instances' section features a table with columns: Network Device Name, App Version, Status, Transitional Status, Health, Data Fetched at, and Actions. A single instance is listed: IR1101-CL-Vinay, with App Version 0.66, Status Deploying, and Health Unavailable. The table is filtered by 'App Version is 0.66'. The bottom of the page shows '1 Records' and a pagination control set to 'Show Records: 10'.

IoT Operations Dashboard

SERVICES

- Edge Device Manager
- Dashboard
- Inventory
- Applications**
- Configuration
- Software
- Operations

SEA-agent-IOSXE

Instances

Filter 0 Selected Start Stop Uninstall Change Version Refresh As of: Mar 20, 2023 4:22 PM

App Version is 0.66

Network Device Name	App Version	Status	Transitional Status	Health	Data Fetched at	Actions
IR1101-CL-Vinay	Unavailable	Deploying	Unavailable	Unavailable	an hour ago	...

1 Records Show Records: 10 1 - 1

APP installation via IOT OD

Install Application: SEA-agent-IOSXE

- 1 Select Devices 2 **Configure Application** 3 Review

Application Resources

Resource Profile

Recommended

Recommended

Tiny

Default

Custom

RAM (MB)*

24

Disk Space (MB)*

128

Network Configuration

Network Interface	Device Network	Port Map Mode	Actions
eth0	VPG0	Not Applicable ⓘ	

APP installation via IOT OD

Install Application: SEA-agent-IOSXE



- 1 Select Devices
- 2 Configure Application
- 3 Review

Select Devices

The Application can be installed on individual devices, or on all Devices in a selected Group. Only Devices that are Online will have the Application installed.

- ☐ Group: Install on all devices in a group
- ☒ **Devices: Install on individual devices**

Available Devices

1 Selected

[Refresh](#) As of: Mar 20, 2023 4:21 PM

<input checked="" type="checkbox"/>	Network Device Name	Group	Model	Serial Number	IP Address	Install Readiness Status
<input checked="" type="checkbox"/>	IR1101-CL-Vinay	DEMO	IR1101-K9	FCW2513P40Z	10.11.39.33	Discovered with error. Device unreachable : null Refresh device status

1 Records

Show Records: 10 1 - 1

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The bridge to possible

Thank you

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The background of the slide is a vibrant, abstract graphic. It features a series of overlapping, wavy bands of color in shades of red, orange, yellow, green, and blue, creating a sense of movement and energy. On the right side, there is a bright, multi-colored sunburst or starburst effect, with rays of light radiating outwards in various colors including blue, green, yellow, and orange. The overall composition is dynamic and visually appealing.

cisco *Live!*

Let's go

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