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You make possible

IOx 2.0 - Docker all the way

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Agenda

- Edge Compute and IOx
- IOx application packages
- Demo
- Docker on IOx
  - Native Docker support
  - Docker remote workflow
- Demo
- Wrap up

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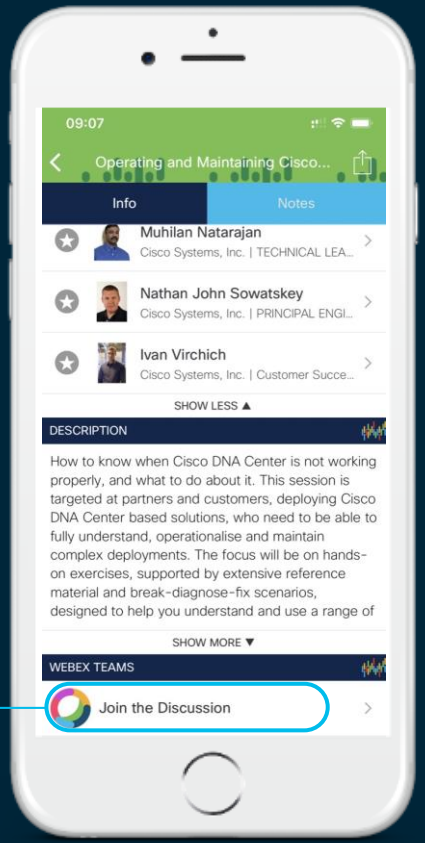


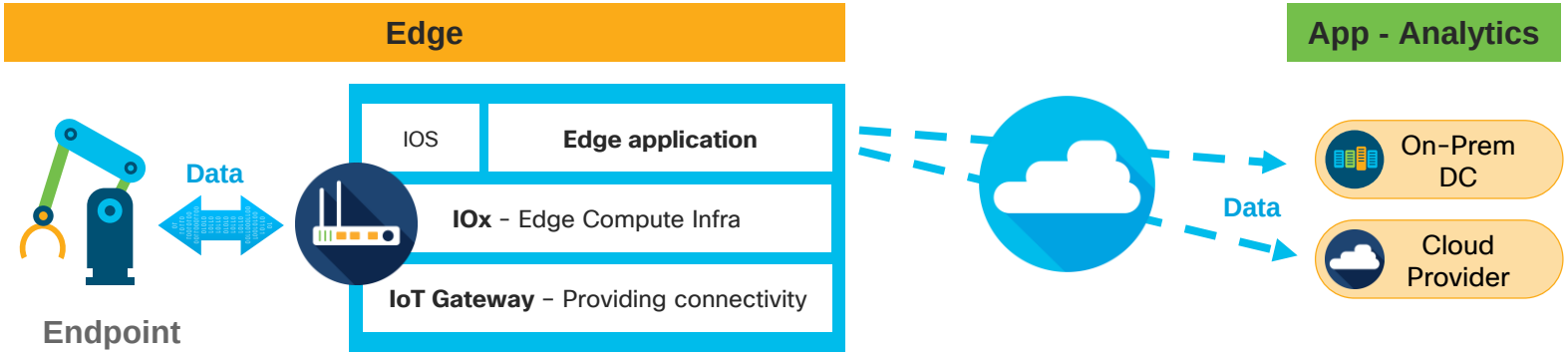
Edge compute and IOx

A distributed computing paradigm which brings computation and data storage closer to the location where it is needed

Wikipedia

Edge Computing

Near-edge, decentralized processing of data



Take processing to the data to improve latency and reduce bandwidth requirement

Why compute at the edge?

There may not be enough network bandwidth	 Data reduction
Most of the data is not interesting	 Filtering
The use of data may be at the edge	 Latency optimization
Computation can be optimized for some purposes	 Partitioning
Data normalization	 Application simplification
Data redirection based on the content of the data	 Dynamic changes

Edge computing – use case examples

Traffic control and driver safety

Collect data from vehicle and weather sensors to control traffic lights and display warning dashboard

IC3000

Reduce machine downtime

Collect machine data and perform analytics to eliminate machine down time

IR829

Fleet management

Real-time Telemetry for operational efficiency and driver analysis

IR829

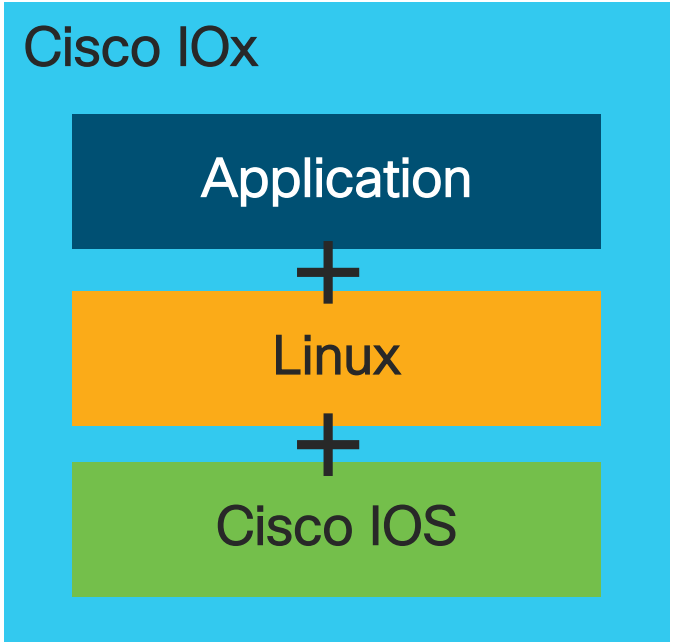
Secondary substation automation

Remotely configure and operate Virtual SCADA for telemetry and automation

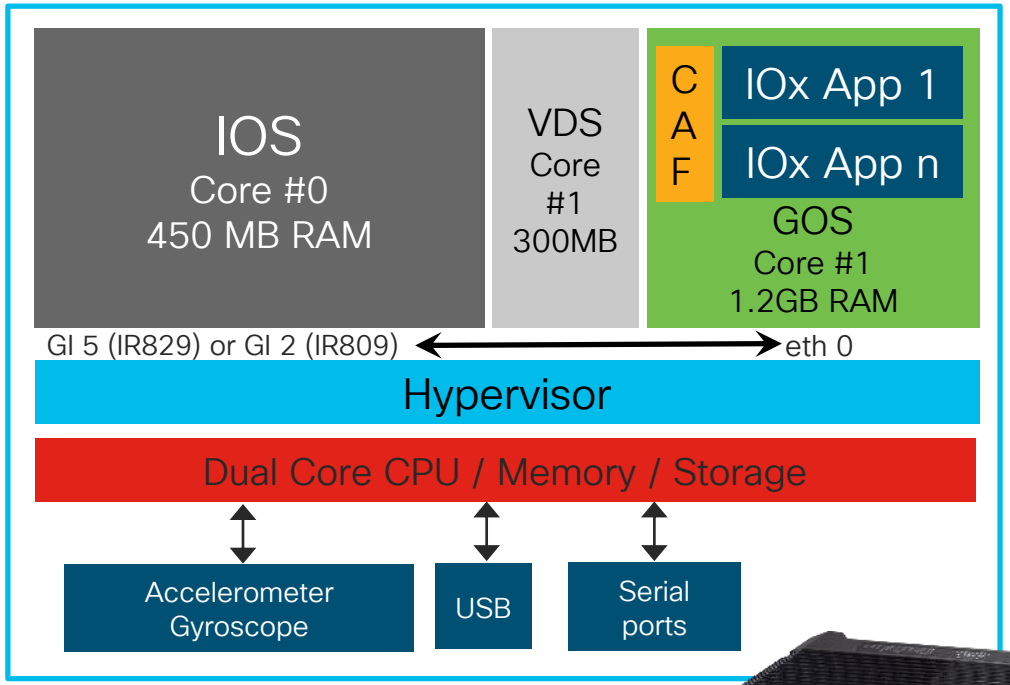
IR1101

Cisco IOx

- Enables hosting applications and services at network edge
- Available on different Cisco hardware platforms
- Full application life cycle:
  - Development
  - Distribution and Deployment
  - Hosting
  - Monitoring and Management
- Leverage secure connectivity of Cisco IOS
- On-prem or cloud-based management

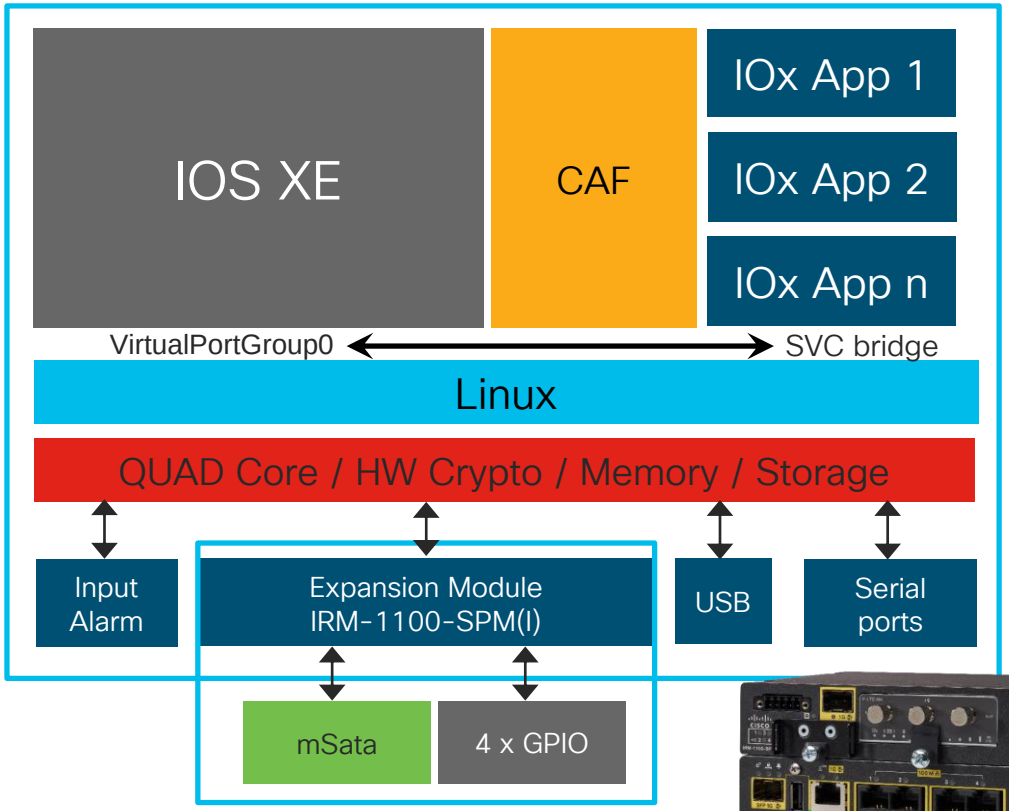


Cisco IOx – Architecture example (IR829)



- Type 1 Hypervisor running directly on the IR800 hardware
- Virtual Device Server (VDS) – handles device's sharing, eg. Console, USB,…
- Guest-OS (GOS) hosts IOx applications
- Full isolation between IOS and GOS
- Communication through internal virtual Ethernet connection

Cisco IOx – Architecture example (IR1101)



- IOS running on Linux
- CAF (Cisco Application Framework) running as a process
- CAF controls IOx applications and resources
- L3 IOS communication through internal VirtualPortGroup
- vNIC per application/container
- CPU Architecture: ARM 64v8

Cisco IOx – Portfolio

Compute Gateway

Dedicated compute gateway designed to be fully secure and remotely managed

IC3000

Network with Edge compute

Lower TCO with integrated network and edge-compute functionalities. Extensive coverage of connectivity options (cellular, WiFi, Ethernet, Low power Mesh etc.)

IR809

IR1101

CGR 1120, 1240 & compute module

IR829

Catalyst IE3x00

Purpose-build for Industrial environments

Ruggedized | Built for IoT | Industries Certified

Proven Cisco Technology

Intent-based Networking to the IoT Edge

Cisco IOx – IoT platform hardware overview



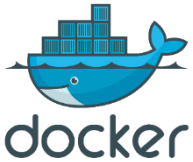



	IE4000	IR8x9	IR1100	CGR 1000	IE3400	IC3000
Ruggedized HW	IP30 -40° C to +70° C	IR809: IP30 IR829: IP40 -40° C to +60° C	IP30 -40° C to +60° C	CGR1120: IP30 CGR1240: IP67 -40° C to +70° C	IP30 -40° C to +75° C	IP30 -40° C to +60° C
Architecture	PPC32	X86_64	ARMv8	X86_64	ARMv8	X86_64
CPU	PowerPC ~600 MHz 1 dedicated core for IOx	Intel Rangeley 1.25GHz 2-core with 50% of one core to IOX	Marvell 4-core ARMv8 Cortex-A72 CPU, 1.2GHz	4-Core 800Mhz AMD Gx-410VC on Compute module	4-core Zynq UltraScale+ ARMv8 Cortex-A53 - 1.2GHz	Intel Rangeley 1.25GHz 4-core
Memory	512 MB	2GB with 760MB for IOX	4GB with 2GB for IOX	4GB	4GB with 2GB for IOX	8GB
Storage mSATA for R/W longevity	256 MB flash storage	512MB-1.5GB storage, 50-100GB (mSATA SKU)	4 GB with 2 GB reserved for IOx	64 (50)- 128 (100) GB mSATA	2 GB + SD	64 -128 GB mSATA

IOx Application Packages

IOx Application Packages

- Compressed packages of code or binaries that can be deployed to the Cisco Application Hosting Framework (CAF)
- Different types of applications depending on your needs
  - Docker container based
  - Platform as a Service (PaaS)
  - Linux Container (LXC)
  - Kernel Virtual Machine (KVM)
- IOx application package :
  - Package Descriptor
  - Package Configuration
  - Binaries, code, libs, virtual disks, root FS, images
- Different architectures: x86, ARM, PowerPC



IOx Application Packages

- Lifecycle: Deployed – Activated – Running
- Package descriptor: package.yaml
  - Required resources
  - Required devices
  - Network configuration
  - Command to run
  - …
- config.ini: Configuration bootstrapping
- activate.json: Set activation options

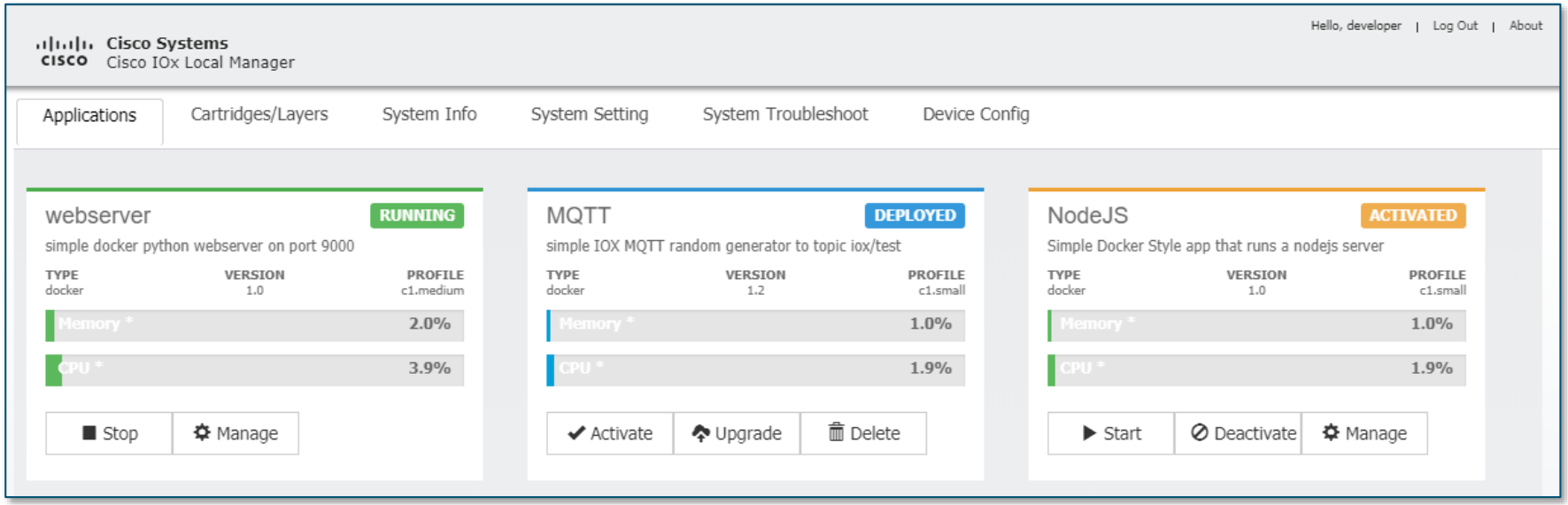
Example package.yaml

```
descriptor-schema-version: "2.2"

info:
  name: "iox_docker_pythonweb"
  description: "simple Python Webserver"
  version: "1.0"
  author-link: "http://www.cisco.com"
  author-name: "Jens Depuydt"

app:
  cpuarch: "x86_64"
  type: docker
  resources:
    profile: c1.small
    network:
      -
        interface-name: eth0
        ports:
            tcp: [9000]

  startup:
    rootfs: rootfs.tar
    target: ["python","/webserv.py","9000"]
```

IOx Application Packages – Local Manager

Local IOx application management with GUI

Deploy, activate, start and troubleshoot IOx application packages for a single device



IOx Application Packages – ioxclient

- CLI tool to manage IOx on devices
- Can be used to package apps
- OS X, Windows, Linux

```
[jedepuyd@cen7 ~]$ ioxclient app list
Currently active profile :  lab
Command Name:  application-list
Saving current configuration
List of installed App :
 1. webserver  --->    RUNNING
 2. MQTT       --->   DEPLOYED
 3. NodeJS     --->  ACTIVATED
[jedepuyd@cen7 ~]$ ioxclient app stop webserver
Currently active profile :  lab
Command Name:  application-stop
App webserver is Stopped
```


IOx Application Packages – Steps

1. Build: Container (LXC or Docker), VM or PaaS app (Python or Java)
2. Prepare for deployment (for example: export root FS)
3. Create package.yaml
4. Create IOx package using ioxclient
5. Deploy
6. Activate
7. Start
8. *Profit*

DEMO – IOx Application Packages

Docker on IOx platforms

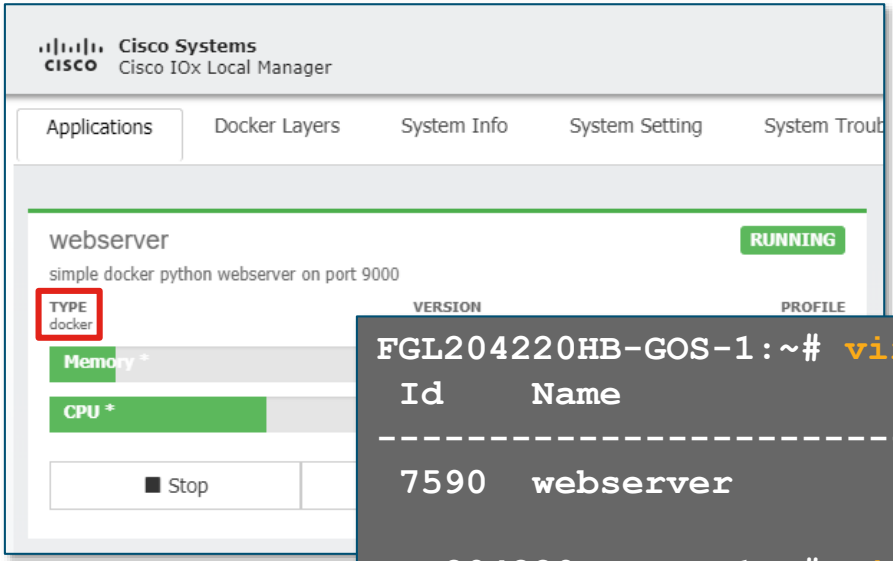
Docker on IOx – Before native Docker

IOx supports running Docker containers since IOx AC3 (version 1.2)

Steps when deploying a Docker containers with IOx <AC9

1. CAF parses the docker image format
2. Understands the dependencies and ordering from the image layers.
3. Uses AUFS to union mount the layers in the appropriate order
4. Puts a READ/WRITE layer as the top most layer
5. Applies SMACK labels to the entire rootfs similar to LXC
6. Creates LXC container and runs with libvirt lxc driver

Docker on IOx – Before native Docker



```
FGL204220HB-GOS-1:~# virsh -c lxc:/// list
 Id    Name                           State
----------------------------------------------------
 7590  webserver                      running

FGL204220HB-GOS-1:~# virsh lxc-enter-namespace webserver /bin/sh
FGL204220HB-GOS-1:/# cat /proc/1/cgroup
10:debug:/
9:perf_event:/apphosting.partition/lxc-7590-webserver.libvirt-lxc
8:net_cls:/apphosting.partition/lxc-7590-webserver.libvirt-lxc
...
```

Docker on IOx – Native Docker

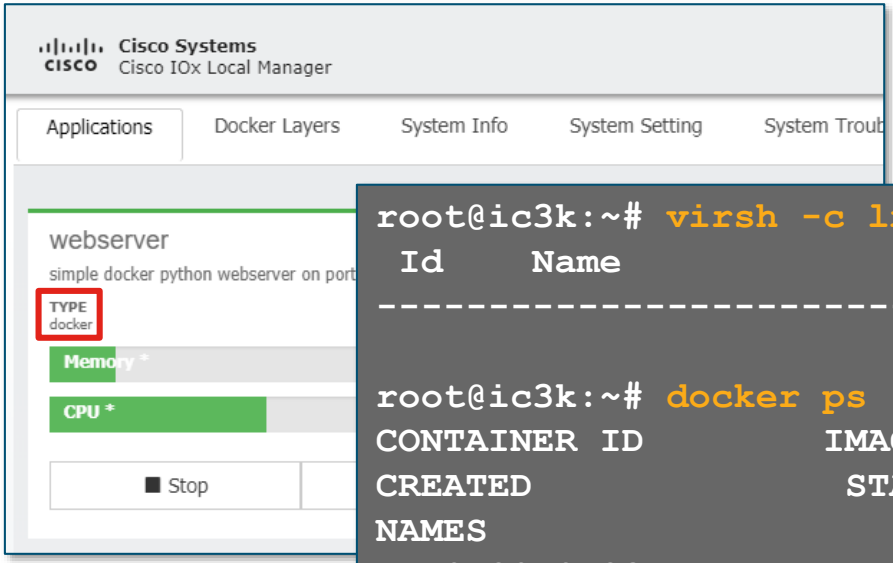
Non-native Docker causes difficulties with porting existing Docker based containers to IOx due to lack of compatibility.

Any Docker image that runs on my PC should run 'as-is' on IOx platforms (keeping in mind architecture/resource constraints)

IOx AC9 introduced native Docker for a limited set of IOx platforms

- Full life cycle management of native docker apps through ioxclient/LM/FND/...
- Backwards compatibility
- Support for limited list of docker-runtime options .
- Shared volumes between containers, tmpfs mount, --net/-network and bind mount
- Layer by layer installation support for docker type apps.
- Bridge, Nat, Container and None type network support for native docker containers

Docker on IOx – Native Docker



```
root@ic3k:~# virsh -c lxc:/// list
 Id    Name                           State
----------------------------------------------------

root@ic3k:~# docker ps
CONTAINER ID        IMAGE                  COMMAND
CREATED             STATUS              PORTS
NAMES
c5b0a20b0a23        ioxpythonweb:1.0       "python /webserver.p…"
About a minute ago   Up About a minute
webserver
43322c999d72        cisco_sleep:latest     "/bin/sleep 10000000…"
About a minute ago   Up About a minute   0.0.0.0:40000->9000/tcp
webserver_sleep
```

Docker on IOx – Remote Docker workflow

IOx AC10 introduced remote Docker workflow:

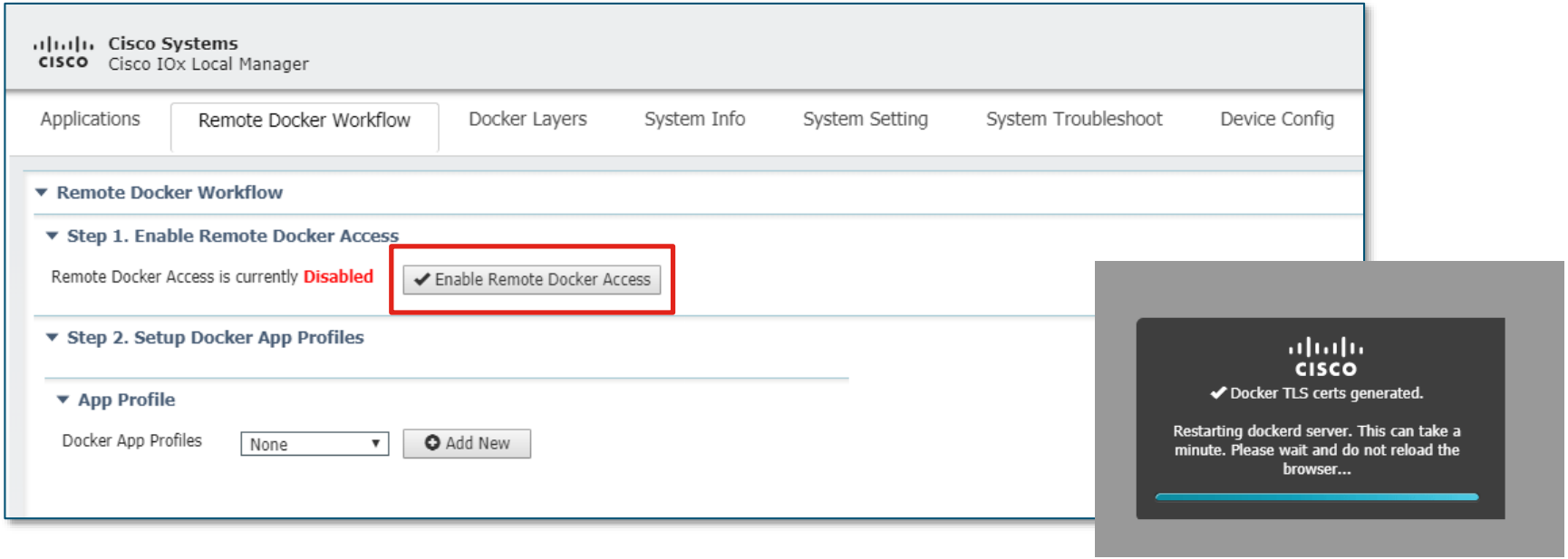
- Directly deploy containers without going through the full packaging cycle
- Containers installed through remote docker workflow are not manageable via ioxclient/LM/FD/GMM
- Use docker cli for end-to-end app development
- No ioxclient packaging
- Minimal Cisco/IOx-specific knowledge required for app development
- Quick on-boarding of new developers
- Easy for expert developers to quickly iterate through app development process

Remote Docker workflow – Get started

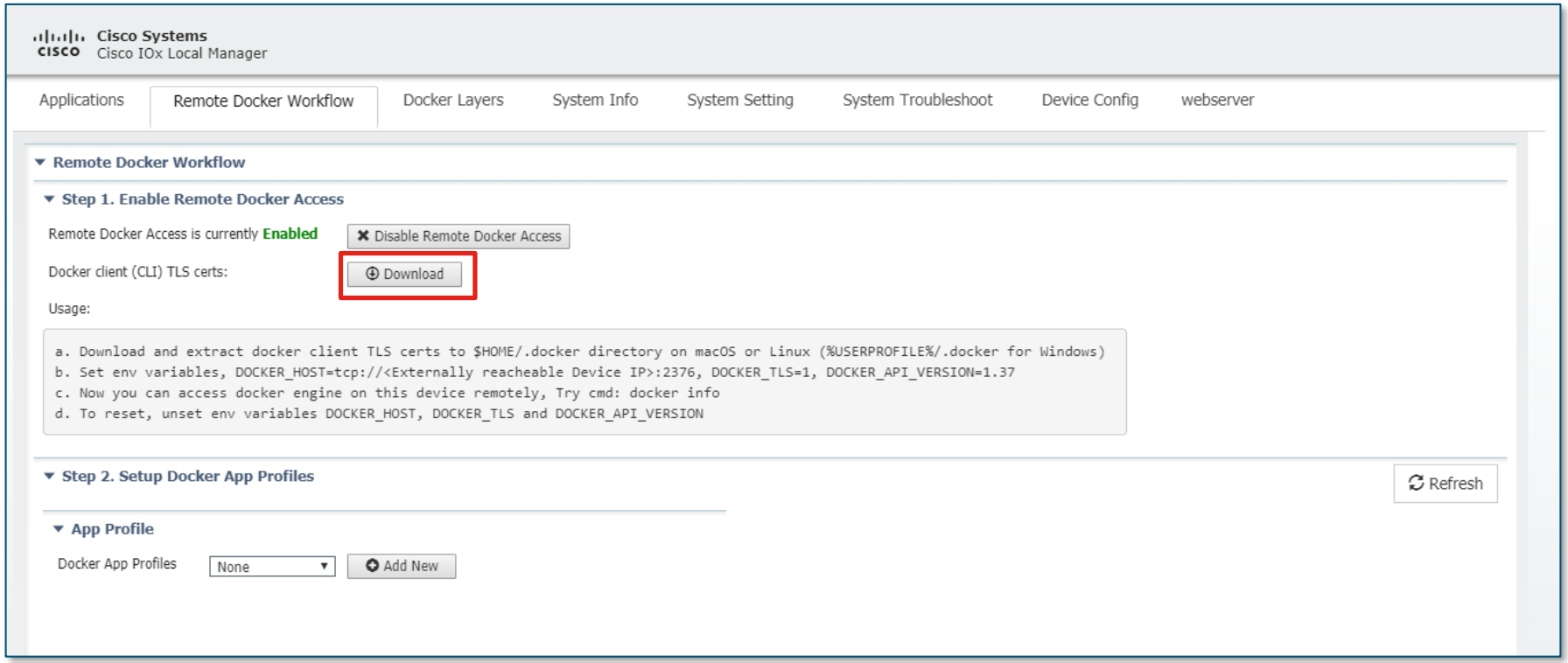
1. Enable remote docker engine access via Local Manager
2. Create docker app profile with required resources: cpu, memory, disk, network interfaces and peripherals via Local Manager
3. App profile creation will generate associated docker runtime options for usage from docker run command
4. Setup remote docker engine access environment in development machine
5. Use the generated docker run options and desired docker image for app development

Remote Docker workflow – Enable

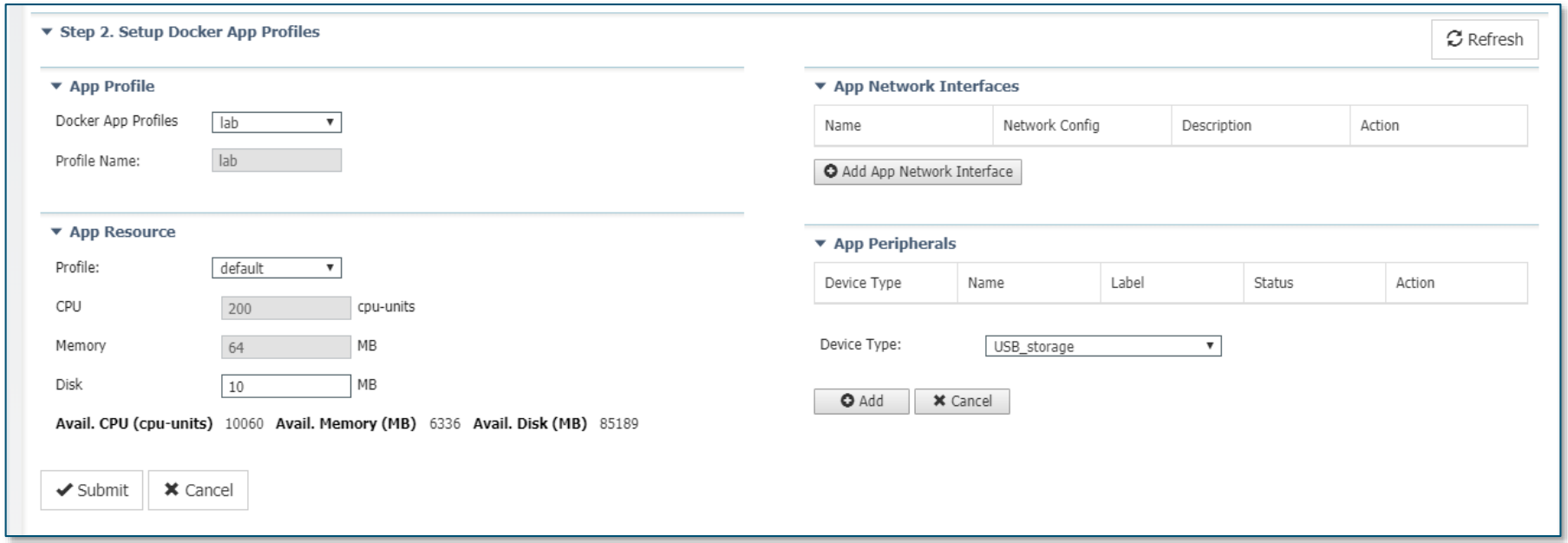
By default, Docker engine web server on Cisco platform is disabled



Remote Docker workflow – Download TLS certs



Remote Docker workflow – Create app profiles



Remote Docker workflow – Use

1. Build
2. Docker save/export
3. Remote docker load/import
4. Remote docker run
5. *Profit*

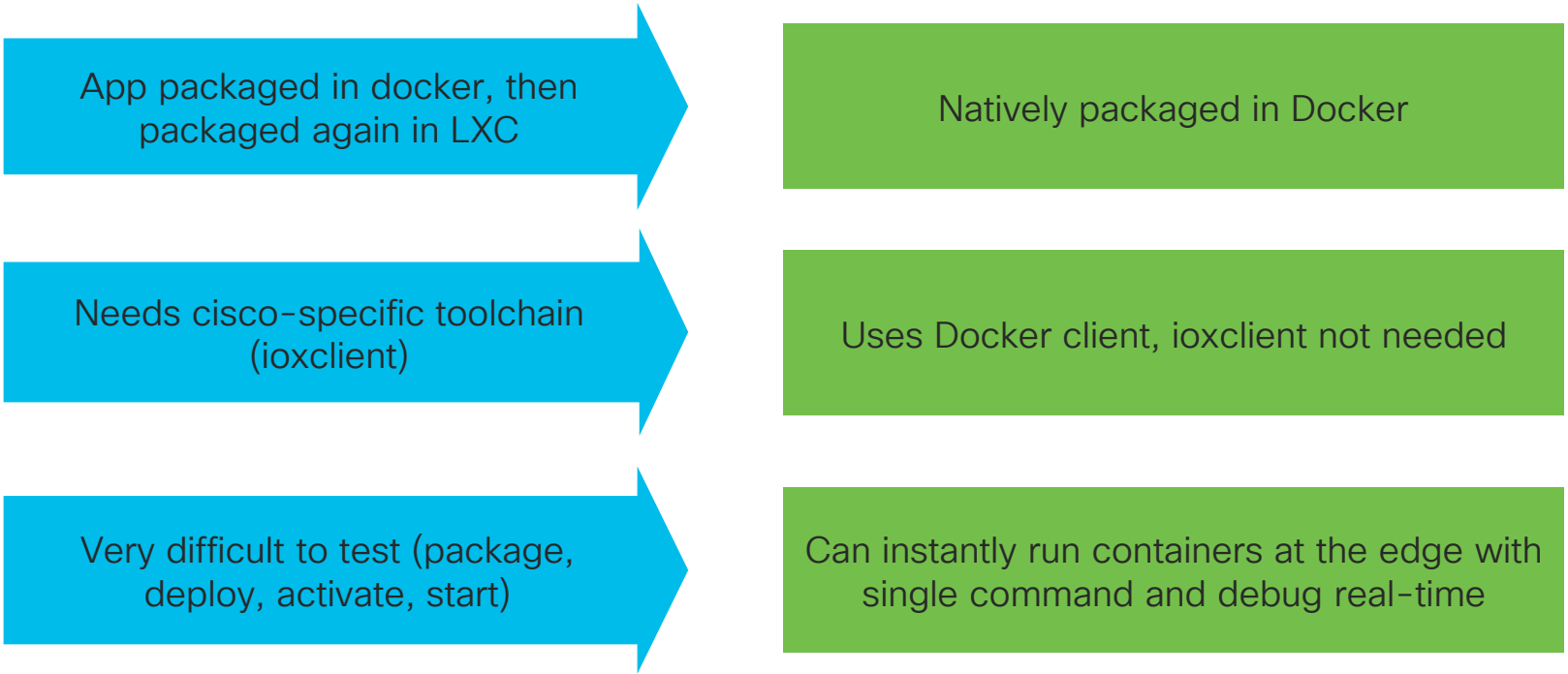
Or

1. Remote docker build
2. Remote docker run
3. *Profit*

DEMO – Remote Docker workflow

Wrap up

Docker on IOx after AC10



Cisco IOx – Development vs. Deployment

Developer

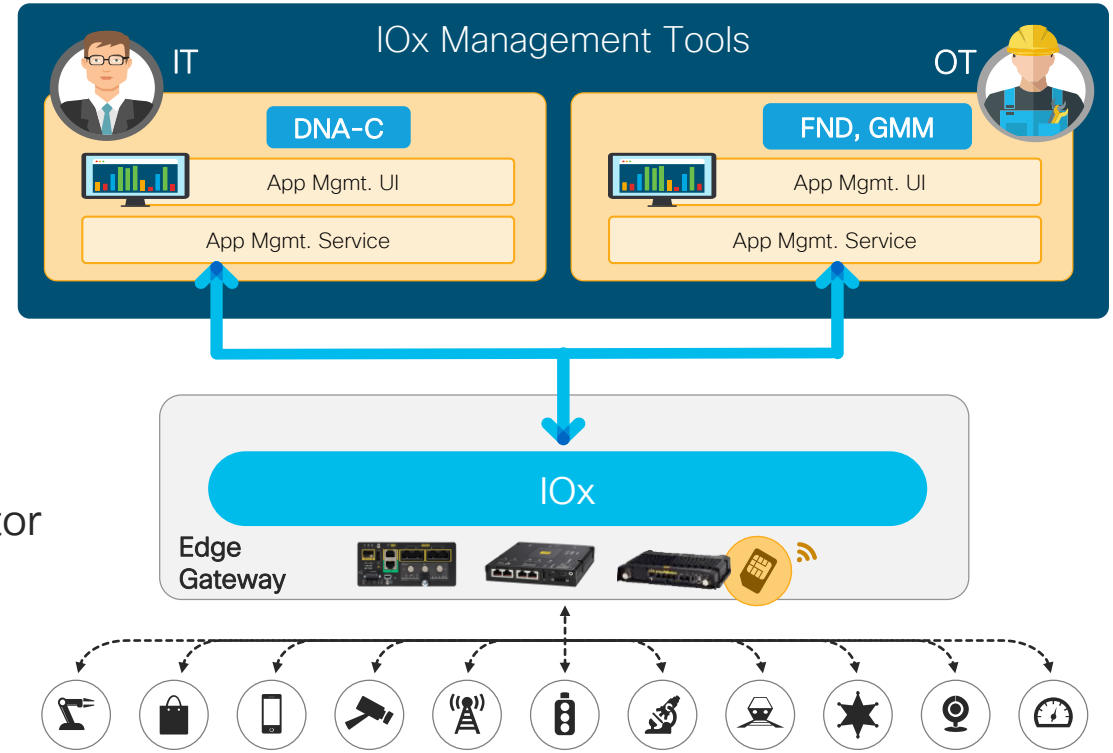
Single:

- Local Manager
- Ioxclient
- Docker

Operator

Mass:

- Field Network Director
- Kinetic GMM
- DNA-C



Learn & Explore About IOx On DevNet

Discover & Explore IOx

Learn about IOx on DevNet

https://developer.cisco.com/docs/iox/#!introduction-to-iox

Experiment With IOx

IOx Learning Labs & Sandbox

https://devnetsandbox.cisco.com/RM/Topology

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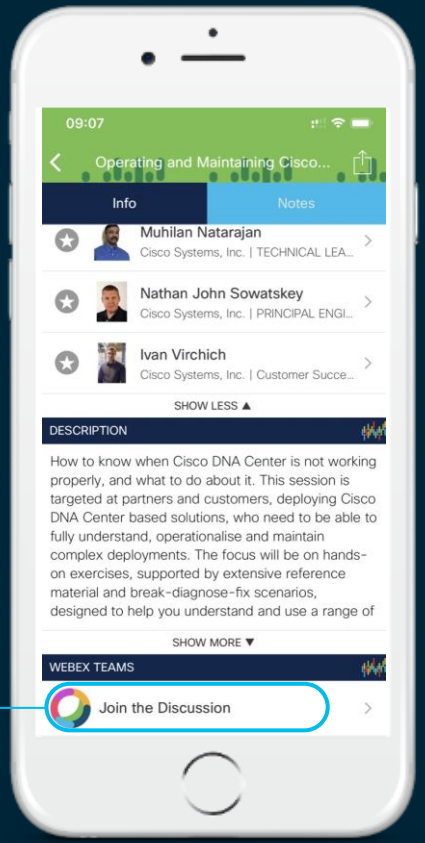

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