IOx Components Installation Guide

Kinetic - Edge & Fog Processing Module (EFM) 1.5.0

Revised: May 15, 2018

Contents

Introduction

The provided EFM IOx application images include the EFM C Broker so that they can be deployed on a Cisco IOx platform with an x86 architecture (such as the Cisco IR809 or IR829) or the PowerPC architecture (such as the IE4000).

For the IR809/IR829, the image is provided with application development languages (DART, java) that the microservices may need to execute (eg. dart-system, java-snmp, etc.). Other components, such as the filesystem, have been added to the images to allow storage of data during operation.

IOx allows each application to have its own lifecycle management, to enable upgrading and restarting these applications independently. In the EFM system, the EFM Link Manager provides lifecycle management to EFM microservices in the same application container. Using this facility, life cycle management of EFM microservices can be consistent with the management of other nodes throughout the EFM system using the EFM System Administrator.

Due to the memory and disk space constraints of the IOx target platforms, care has been taken to minimize the installation of too many application language support (such as Java, DART, python, etc.) as well as microservice links.

Deployment on the Cisco IOx EFM applications can be performed by the “ioxclient”, Local Manager or the graphical tool Fog Director.

Once an application is deployed into an IOx host and the application is running it is possible to use the EFM System Administrator tool, currently only supported on a Linux environment, to configure the new message broker and links by creating a new uplink connection to the router’s outside address of the application (see NAT statements below).

The following packages are provided in the EFM-IOx-1-2-0.zip package. The subfolders are the following:

For the Cisco IE4K platform:

- efm_ppc: LXC Package suitable for installation onto an ie4k router running an iox environment.
  Components running on the ie4k device:
  - IOT-DSA broker (C-based)
  - Life cycle manager

For the Cisco IR8x9 platform:

- efm_x86_64: LXC Package suitable for installation onto an ir809/ir829 router running an iox environment.
  - IOT-DSA broker (C-based)
  - Life cycle manager
  - DART runtime environment
  - JAVA runtime environment
  - dslink-dart-system link
  - dslink-dart-dql link
  - dslink-dart-dataflow engine

More information about IOx can be found at Cisco's DevNet site:
https://developer.cisco.com/site/iox/index.gsp .

IOx supported version

The current version supported for the IR809/IR829 is IOx version 1.4. For the CGR1K it is IOx version 1.2.3. On IE4000 it is IOx version 1.5.1.

Upward compatibility to newer IOx versions was not tested with EFM 1.5.0.

EFM IOx Application Profile

Activate.json file

The EFM Application profile file activate.json defines the resources and names that are used to the IOx guest OS environment. This file can be used for the default activation phase of the IOx deployment, after the installation of the corresponding package.tar.gz.

The default activation profile will be “large”. This is defined as:

CPU (cpu-units):	60
Memory (MB):	256
Disk (MB):	default

In many cases, the most memory is recommended and will require a manual definition of the following custom profile.

Custom Profile Definition and Activation

Due to changes in the IOx version 1.4, it may be best to deploy with a custom profile rather than the “activate.json” profile. This will allow reserving all the available application memory beyond the default value when not installing and running other IOx applications in parallel.

For example, on the IR809/829 running IOx version 1.4, a custom profile can reserve the maximum values for the EFM:

CPU (cpu-units):	732
Memory (MB):	767
Disk (MB):	256

Disabling IOx Application package signature verification for installation

IOx 1.4 introduces the concept of package signature verification. The EFM IOx application is not self-signed and does not install with the default verification enable[1]. Installation will require using the ioxclient to disable the verification. Type the following:

```
ioxclient platform signedpackages disable
```

[1] See https://developer.cisco.com/site/iox/docs/#manage-package-signature-validation for more details.

Access to IR8x9 Serial ports and Gyroscope

The EFM 8x9 IOx package allows for the reservation and communication with 3 serial interfaces. On the IR829 this can correspond to the 2 serial interfaces on the router and the gyroscope/accelerometer. For the case of the IR809, the additional serial interface is redundant.

The activate.json profile file maps **does not** map the serial interfaces in a predefined manner.

In order to map the serial interfaces to the logical Serial Adaptors the Local Manager tool must be used.

Using IOx-NAT or IOx-Bridging for the EFM application

The EFM application is installed the IOx Guest OS. For the purposes of networking outside the router or switch, it is necessary to understand how the EFM Application obtains its IP address and exposes to the rest of the network.

For IPv4, the EFM application obtains its address using a DHCP request. There are 2 different manners that the application obtains its address, depending on the mode of configuration of eth0 and/or eth1.

Network Configuration of eth0/eth1	Source of IP Address	Notes:
IOx-nat	The IPv4 DHCP address is obtained from an INTERNAL pool inside the IOx GuestOS.	- All connectivity from the application is NATted via the GuestOS IP address on the router or switch. - All start and restart events do not affect the router NAT statements to reach the GuestOS - The application internal TCP port is mapped to a free GuestOS TCP port (for example, the efm ports 8080 and 8484 are custom mapped to the IOx GuestOS 8080 and 8484)
IOx-bridge	The IPv4 DHCP address is obtained from an EXTERNAL pool outsie the IOx GuestOS. All communications flow around the GuestOS, directly to the application	- No TCP port mapping occurs and the application TCP ports are exposed according to the application profile. For the EFM, TCP ports 8080 for http and 8484 for https - Every start and restart of the application requests a new IPv4 address. In many cases

	this can affect the NAT statements on the router - The router or switch may not have visibility into the IP address assigned and may causes challenges in obtaining the address for connecting to the device

While either mode can be used, this document we will guide through the use of iox-nat because it is simpler to determine the IPv4 address that is needed to connect the upstream broker.

EFM Application TCP port mapping

The EFM application package has defined a custom mapping of the TCP Ports 8080 and 8484. These TCP ports will be exposed either using iox-nat or iox-bridge. If these values overlap with another application, the Custom port mapping values can be modified via the Local Manager deployment interface.

While port 8484 is exposed, the broker does not listen to https connections until the server certificate and key file are installed and the broker.json file is properly updated.

Deploying with the IOx Client

Ioxclient is supported on Windows, Mac and Linux. To obtain the latest version of ioxclient 1.4, see https://developer.cisco.com/site/iox/docs/#none-downloads.

Using the IOx client to install the EFM application on the IOx platform:

```
cd <EFM package name folder>
ioxclient app install <IOx app name> package.tar
```

Example:

```
#ioxclient app install EFM package.tar
Currently active profile :  default
Command Name: application-install
Installation Successful. App is available at :
https://192.168.25.201:8443/iox/api/v2/hosting/apps/EFM_Broker
Successfully deployed
```

Starting the application with IOx client

```
ioxclient app activate <IOx app name> --payload activate.json
```

Example:

```
#ioxclient app activate EFM --payload activate.json
Currently active profile :  default
Command Name: application-activate
Payload file : activate.json. Will pass it as application/json in request body..
App EFM_Broker is Activated
```

```
ioxclient app start <IOx app name>
```

Example:

```
#ioxclient app start EFM
Currently active profile :  default
Command Name: application-start
App EFM_Broker is Started
```

Verify that the application is running with IOx client

```
ioxclient app list
```

```
#ioxclient app list
Currently active profile :  default
Command Name: application-list
List of installed App :
 1. EFM        --->    RUNNING
```

What is the GuestOS IP Address on the IR809/IR829?

To determine the application container IP address for the NAT mapping on the router:
`show iox host list detail`

```
ir829#show iox host list detail

IOX Server is running. Process ID: 331
Count of hosts registered: 1

Host registered:
===============
    IOX Server Address: FE80::235:1AFF:FE91:FA8C; Port: 22222

    Link Local Address of Host: FE80::1FF:FE90:8B05
    IPV4 Address of Host:       192.168.101.6
    IPV6 Address of Host:       fe80::1ff:fe90:8b05
    Client Version:             0.4
    Session ID:                 1
    OS Nodename:                ir829-GOS-1
    Host Hardware Vendor:       Cisco Systems, Inc.
    Host Hardware Version:      1.0
    Host Card Type:             not implemented
    Host OS Version:            1.5.5.1
    OS status:                  RUNNING

    Interface Hardware Vendor:  None
    Interface Hardware Version: None
    Interface Card Type:        None
```

In the example above the GuestOS is 192.168.101.6.

Applying NAT to IR809/IR829 router configuration (if needed)

If global routing reachability is not available for the subnet belonging to the GuestOS, then inserting a IP Network Address Translation (NAT) can allow other brokers to reach the GuestOS hosted EFM broker.

Note: This NAT function is independent of the GuestOS internal NAT operation for applications, this NAT function is performed on the IOS Router to allow for global networking reachability beyond the IOx host.

For example, Assuming Vlan1 is the external address as shown below for the example above. The GuestOS exposes the ports 8080 and 8484 for http and https. They are going to be mapped externally to ports 8080 and 8484:

```
interface Vlan1
 ip address 192.168.25.201 255.255.254.0
 ip nat outside

interface GigabitEthernet5
 ip address 192.168.101.1 255.255.255.0
```

```
 ip nat inside


ip nat inside source static tcp 192.168.101.6 8080 interface Vlan1 8080
ip nat inside source static tcp 192.168.101.6 8484 interface Vlan1 8484
```

What is the GuestOS IP Address on the IE4000

On the GuestOS IP address is defined in the switch configuration under “iox”.

For example:

```
iox
 host ip address 10.228.219.200 255.255.255.128 vlan 1
 host ip default-gateway 10.228.219.129
```

Obtaining the Application TCP Port mapping with IOx client on the IE4000

```
ioxclient app info <IOx app name>
```

The last step will help determine which IOx guest operating TCP ports have been assigned to the EFM Broker.

For example, using the ioxclient app info <app> to obtain the application information:

```
# ioxclient app info EFM
Currently active profile :  default
Command Name: application-info
Details of App : EFM
------------------------------
{
 "appCustomOptions": "",
 "appType": "lxc",
 "author": "femasche",
 "authorLink": "mailto://femasche@cisco.com",
 "dependsOn": {},
 "description": "EFM ",
 "env": {
  "CAF_APP_APPDATA_DIR": "/data/appdata",
  "CAF_APP_CONFIG_DIR": "/data",
  "CAF_APP_CORE_DIR": "/local/local1/core_dir",
  "CAF_APP_CPU_SHARES": 5797,
  "CAF_APP_ID": "efm",
  "CAF_APP_LOG_DIR": "/data/logs",
  "CAF_APP_MEMORY_SIZE_KB": 262144,
  "CAF_APP_PERSISTENT_DIR": "/data",
  "CAF_APP_PERSISTENT_DISK_SIZE_KB": 10240,
  "CAF_APP_USERNAME": "root",
  "CAF_SYSTEM_UUID": "e91e78ba-4065-43ff-a9a7-86339fe0eb20"
 },
 "id": "efm",
 "is_autoinstalled": false,
 "is_service": false,
 "name": "efm",
 "networkInfo": {},
```

```
 "resources": {
  "cpu": 600,
  "disk": 10,
  "memory": 256,
  "network": [
   {
    "interface-name": "eth0",
    "network-name": "iox-nat0",
    "port_map": null,
    "ports": {
     "tcp": [
      8080,
      8484
     ]
    }
   }
  ],
  "profile": "c1.large",
  "vcpu": 1
 },
 "state": "RUNNING",
 "toolkitServicesUsed": null,
 "version": "1.20"
}
```


In the example above the section “ports” shows the application defined TCP Port 8080 and TCP port 8484 are available. In the EFM instance, port 8080 is for http and port 8484 for https connections.

Configuring the CGR1000 Network Interfaces

For CGR1K devices, we need to use the bridge mode for the containers' interfaces (iox-bridge). In bridge mode, the EFM application container might receive different IP addresses on every start. We need to define a specific IP address for the **IOS** interface to provide the application container with a static DHCP address and a forwarding rule for the EFM ports to the container. On the CGR1000 the following configuration defines static client-identifier.

```
ip dhcp pool iox-efm-eth0-static
 host 192.168.4.2 255.255.255.0
 client-identifier 6566.6d
 default-router 192.168.4.1

ip dhcp pool iox-efm-eth1-static
 host 192.168.4.3 255.255.255.0
 client-identifier 6566.6d32
 default-router 192.168.4.1

ip nat inside source static tcp 192.168.4.2 8080 interface GigabitEthernet2/2 8080
```

The client identifiers are patched into the EFM application container. If you change the client identifiers in the IOS rules, you have to change the addresses provided to the udhcpc_opts commands inside the EFM application container in /etc/network/interfaces accordingly.

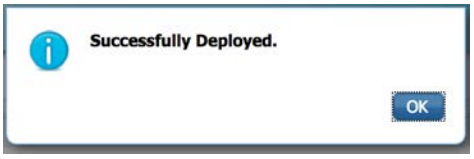
Deploying with Cisco IOx Local Manager

Caveat: When working with the IOx Local Manager, the browser language must be set to English. To the contrary, a blank page will appear.

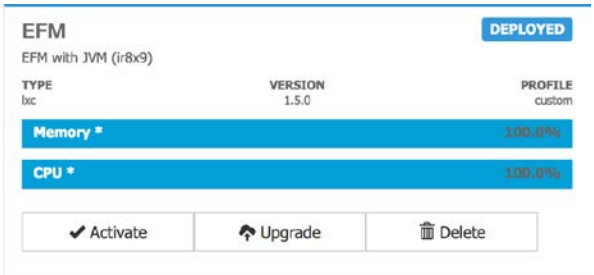
Connect via a web browser to the IOx router to the defined port for the Cisco IOx Local Manager. For example: https://192.168.25.201:8443/. Login with the router credentials.

Select “Add New” to install the EFM application package.

Apply any name for the application on the host, for example “EFM”. Locate the package.tar you are installing specific for the platform on your local disk. Then Select OK. Upload will take a few minutes.



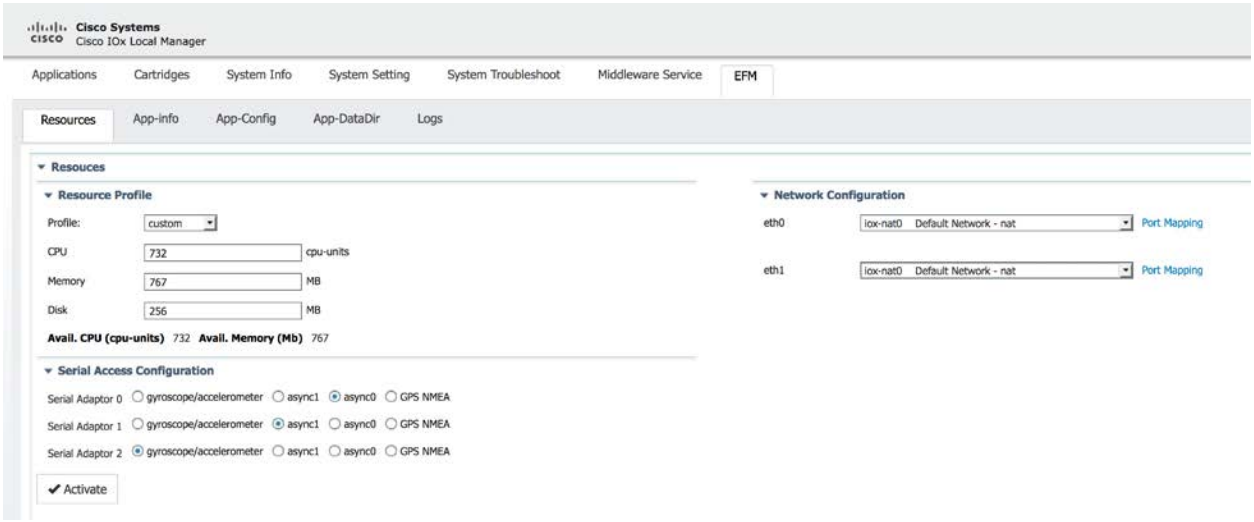
The following application status should appear:



Select “Activate” and the following page will appear to activate the EFM application.

Under the “Resources” tab and the Resources Profile the default values are shown.

The maximum available CPU and memory are show at the bottom of the page. If needed, the values can be adjusted higher or lower as CPU and memory may vary if other applications are deployed.



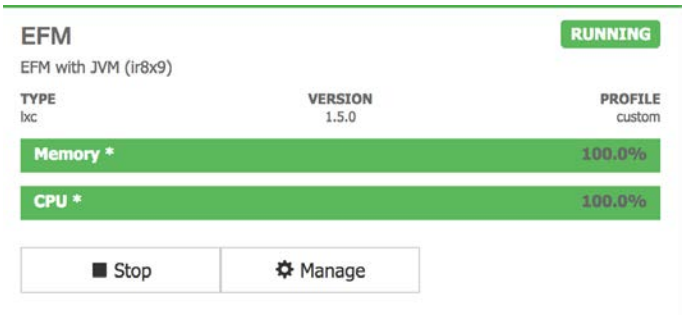
Serial ports need to be defined to proceed with the activation, even if the application will not communicate with any serial devices. There are no default selections.

Ensure that the Network Configuration to “iox-nat0 Default Network - nat” if using NAT. Port Mapping should be left as is for auto.

Select “Activate”.

Return to the Applications tab.

Now that application has been activated, it must be started. Select “Start”.



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Host registered:
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```
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Link Local Address of Host: FE80::1FF:FE90:8B05
IPV4 Address of Host:       192.168.101.6
IPV6 Address of Host:       fe80::1ff:fe90:8b05
Client Version:             0.4
Session ID:                 1
OS Nodename:                ir829-GOS-1
Host Hardware Vendor:       Cisco Systems, Inc.
Host Hardware Version:      1.0
Host Card Type:             not implemented
Host OS Version:            1.4.2.3
OS status:                  RUNNING

Interface Hardware Vendor:  None
Interface Hardware Version: None
Interface Card Type:        None
```

In the example above the GuestOS is 192.168.101.6.

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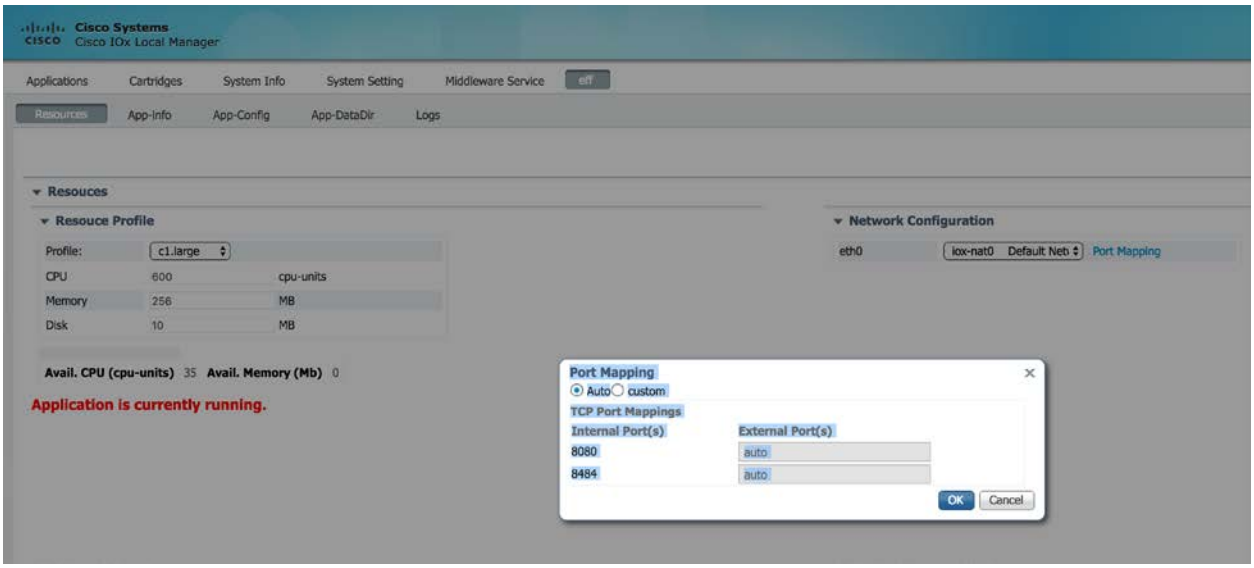
```

Obtaining the Application TCP Port mapping with IOx client on the IE4000

The port mapping shown in the Local Manager for the application under Resources.



In the example above the section “ports” shows the application defined TCP Port 8080 and TCP port 8484 are available. These are automatically mapped externally to the IOx GuestOS address. In most cases they are the same.

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 default-router 192.168.4.1

ip dhcp pool iox-efm-eth1-static
```

```
 host 192.168.4.3 255.255.255.0
 client-identifier 6566.6d32
 default-router 192.168.4.1

ip nat inside source static tcp 192.168.4.2 8080 interface GigabitEthernet2/2 8080
```

The client identifiers are patched into the EFM application container. If you change the client identifiers in the IOS rules, you have to change the addresses provided to the udhcpc_opts commands inside the EFM application container in /etc/network/interfaces accordingly.

Caveats

Restarting the EFM application usually causes the application to request a new DHCP address. This will affect the NAT address statement and needs to be updated.

The DSLinks are stopped by default and need to be started if required.

On CGR1K devices, files cannot be uploaded using the Local Manager due to a file permission problem. If you need to add an upstream to a CGR1K device, you have to copy the file into the application container using scp or add the CGR to a broker as upstream and define everything remotely using the EFM System Administrator tool.

Obtaining documentation and submitting a service request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

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

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