CHAPTER 8

INTEGRATED INDUSTRIAL ROUTERS

Kup książkę

8 Integrated Industrial Routers

8.1 DESCRIPTION OF INTEGRATED ROUTERS

Industrial integrated routers, in addition to supporting Wi-Fi, wired networks, also have support for fourth-generation integrated wireless WANs (4G LTE) and also support Machine-to-Machine (M2M) applications.

Part 1. A brief description of the Cisco IOx environment.

The Cisco IOx application environment is a combination of Cisco IOS and Linux OS to provide higher network security.

Figure 8.1 Cisco IOx application environment - source (Cisco.live, 2019) [5]

Part 2. A brief description of fog computing.

Fog computing is a decentralized computing framework placed between the cloud and end devices. It allows users to place resources, including applications and the data they generate, in physical locations to increase performance.

[5] Presentation Cisco.live. Las Vegas. 2019.

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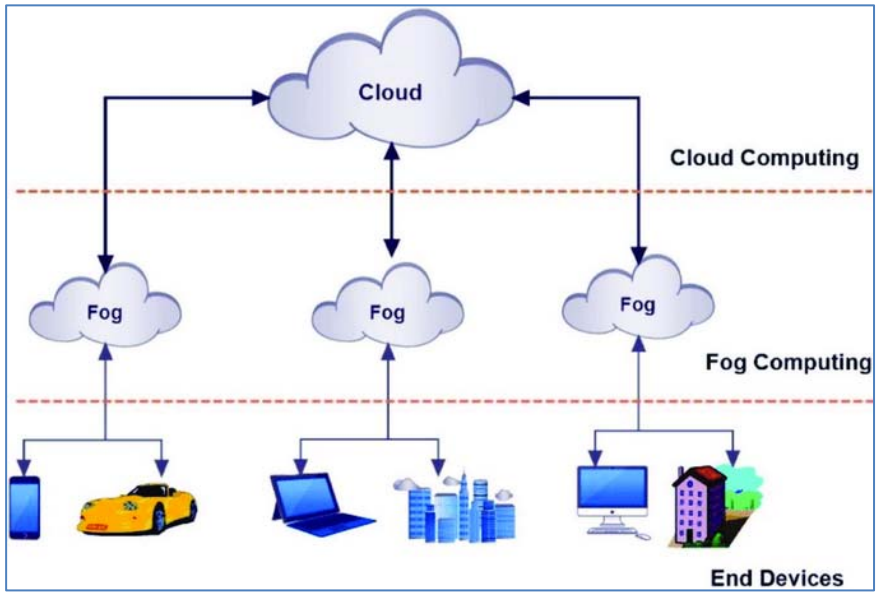

Figure 8.2 Fog computing IOx - source (Cisco.live, 2019) [6]

Part 3. A brief description of the 819 routers software.

In the 819 series routers, individual software components run in two CPU cores:

- in core 0 (Core 0) runs IOS,
- Core 1 runs the so-called Host OS, the so-called hypervisor, and applications.

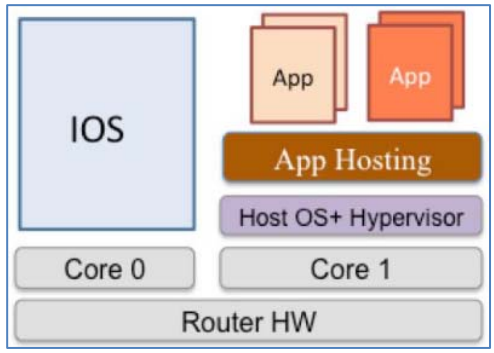

Figure 8.3 Placement of systems and applications in the 819 IOx series router - source (Cisco.live, 2019) [7]

[6] Presentation Cisco.live. Las Vegas.2019.
[7] Presentation Cisco.live. Las Vegas.2019.

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The industrial integrated router models implemented in Packet Tracer are:

- Router 819HG-4G-IOX
- Router 819HGW

Part 4. A brief description of the 819HG-4G-IOX router.

The **819HG-4G-IOX** router supports Machine-to-Machine (M2M) applications and cellular network services.

Figure 8.4 View of 819HG-4G-IOX

The **819IOX** router comes standard with two antennas and non-replaceable MODULES:

- one **GigabitEthernet0** interface,
- four (**FastEthernet0 – FastEthernet3**) interfaces,
- one **Serial0** serial communication interface,
- one **Ethernet1** interface,
- one **VirtualPortGroup0**,
- one **Cellular0 interface**.

Part 5. Brief description of the 819HGW router.

The **Cisco 819HGW** (Integrated Services Router), is a variation of the **819** router model that supports Machine-to-Machine (M2M) applications and cellular network services.

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Figure 8.5 View of 819HGW

The **819HGW** router comes standard with five antennas and non-replaceable:

- one **GigabitEthernet0** interface,
- four (**FastEthernet0 – FastEthernet3**) interfaces,
- one **Serial0** serial communication interface,
- one **Ethernet1** interface,
- one **Wlan-Gigabitethernet0** wireless interface,
- one **Cellular0** interface,
- one internal module acting as **wlan-ap0** access point.

Part 6. Main commands of the IOX service configuration mode.

To enter **IOX** mode, follow the commands:

```
enable
conf t
iox
```

Command	Brief description
host ip address	IP address and mask for Ethernet interface1
host ip default-gateway	IP address of the default gateway for the Ethernet interface1
exit	Exit from IOX mode

Table 8.1 IOx commands

Source: (Cisco800, 2022), (IOx-Application-Hosting, 2022) [8]

[8] Cisco 800 Series Integrated Services Routers Software Configuration Guide.

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Part 7. Initial configuration setup commands.

Note: addresses are examples.

NAT settings on the inside.

```
enable
conf  t
interface  Ethernet1
ip  address  192.168.3.1  255.255.255.0
ip  nat  inside
no  shutdown
exit
```

IOx host addressing settings

```
enable
conf  t
iox
host  ip  address  192.168.3.2  255.255.255.0
host  ip  default-gateway  192.168.3.1
exit
```

NAT settings on the external side

```
enable
conf  t
interface  GigabitEthernet0
ip  address  1.100.30.113  255.255.255.0
ip  nat  outside
no  shutdown
exit
```

Settings of address ranges, subject to translation by NAT

```
enable
conf  t
ip  access-list  standard NAT_ACL
permit  192.168.0.0  0.0.255.255
exit
```

Association of an external interface with a NAT_ACL list

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```
enable
conf  t
ip nat inside source list NAT_ACL interface GigabitEthernet0
overload
exit
```

Association of external interface with IOx TCP port 8443

```
enable
conf  t
ip nat inside source static tcp 192.168.3.2 8443 interface
GigabitEthernet0 8443
exit
```

Part 8. Local management interface components.

The **Local Management UI** consists of the following components, shown in the figure.

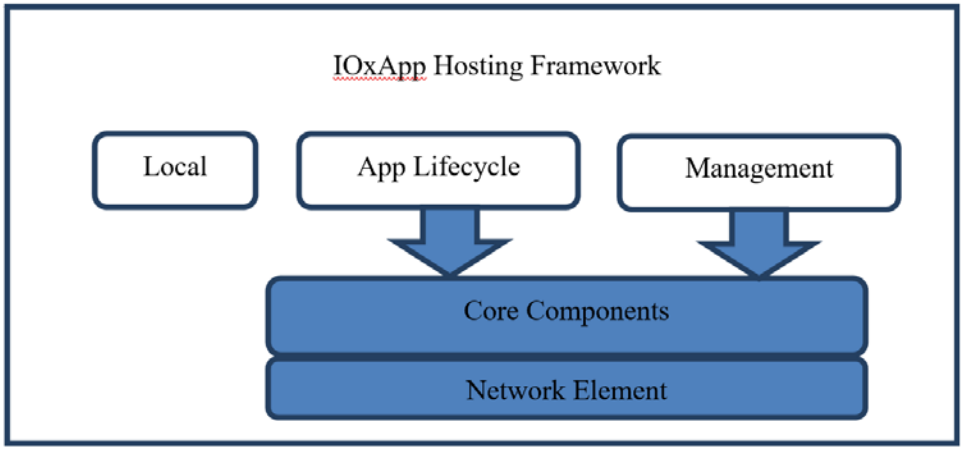

Fig. 8.6 Local Management UI components

Local Management UI is available via **8332** port.

8.2 Basic configuration for 819HG-4G-IOX (Exercise 21)

Part 1.Network topology.

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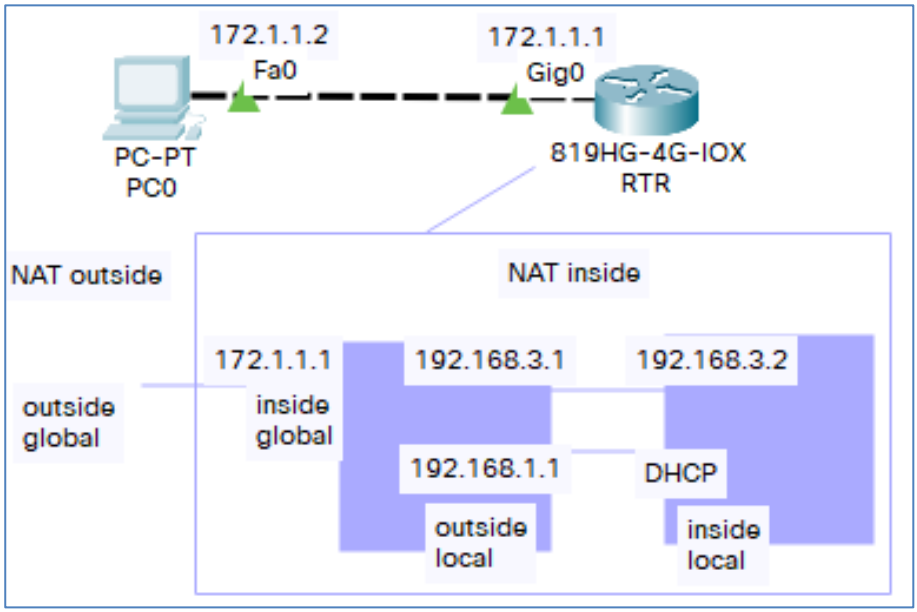

Figure 8.7 Network topology

Part 2. Required equipment.

- PC-PT – 1 pcs
- 819HG-4G-IOX router – 1 pcs

Device	Model	Interface	IP/Mask	Default gateway
PC0	PC-PT	Fa0	172.1.1.2/24	172.1.1.1
RTR	819HG-4G-IOX	Gi0	172.1.1.1/24	-

Table 8.2 Network addressing

Part 3. Plan of the exercise.

Configure the RTR router according to the following steps:

Step 1. Create a password-protected account

Commands:

```
username cisco privilege 15
password 0 cisco
```

Step 2. Configure DHCP.

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Commands:

```
enable
conf  t
hostname  RTR
ip dhcp excluded-address 192.168.1.0 192.168.1.1

ip dhcp pool iox-apps
network 192.168.1.0 255.255.255.0
default-router 192.168.1.1
```

Step 3. Configure NAT and host IOx addressing.

Commands:

```
interface GigabitEthernet0
ip address 172.1.1.1 255.255.255.0
ip nat outside

interface Ethernet1
ip address 192.168.3.1 255.255.255.0
ip nat inside

interface VirtualPortGroup0
ip address 192.168.1.1 255.255.255.0
ip nat inside

iox
host ip address 192.168.3.2 255.255.255.0
host ip default-gateway 192.168.3.1

ip nat inside source list NAT_ACL inteface  Gi0  overload
ip nat inside source static  tcp  192.168.3.2  8443
172.1.1.1  8443

ip access-list standard NAT_ACL
permit 192.168.0.0   0.0.255.255
```

Step 4. Check NAT addressing.

Commands:

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```
show ip  nat  translations
```

```
RTR#show  ip  nat  translations
Pro  Inside global     Inside local       Outside local      Outside global
tcp 172.1.1.1:8443     192.168.3.2:8443   ---                ---
```

Figure 8.8 NAT addressing in RTR router

Step 5. Check access to the site https://172.1.1.1:8443 and log in.

In PC0, open the page https://172.1.1.1:8443 (log into Cisco Application Management. User: **cisco** Password: **cisco**).

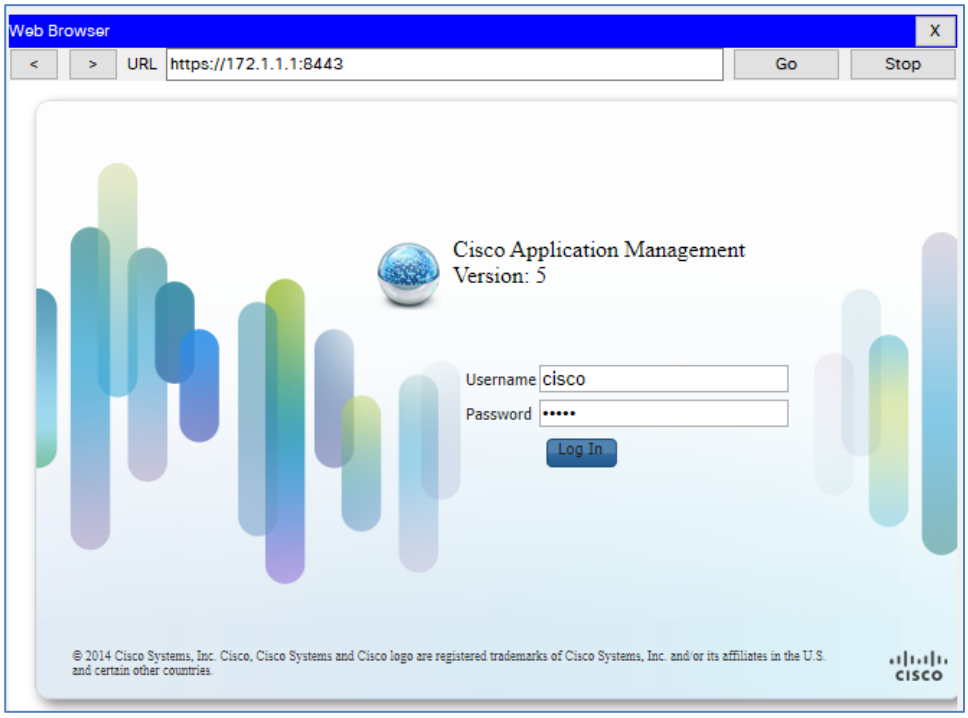

Figure 8.9 https://172.1.1.1:8443

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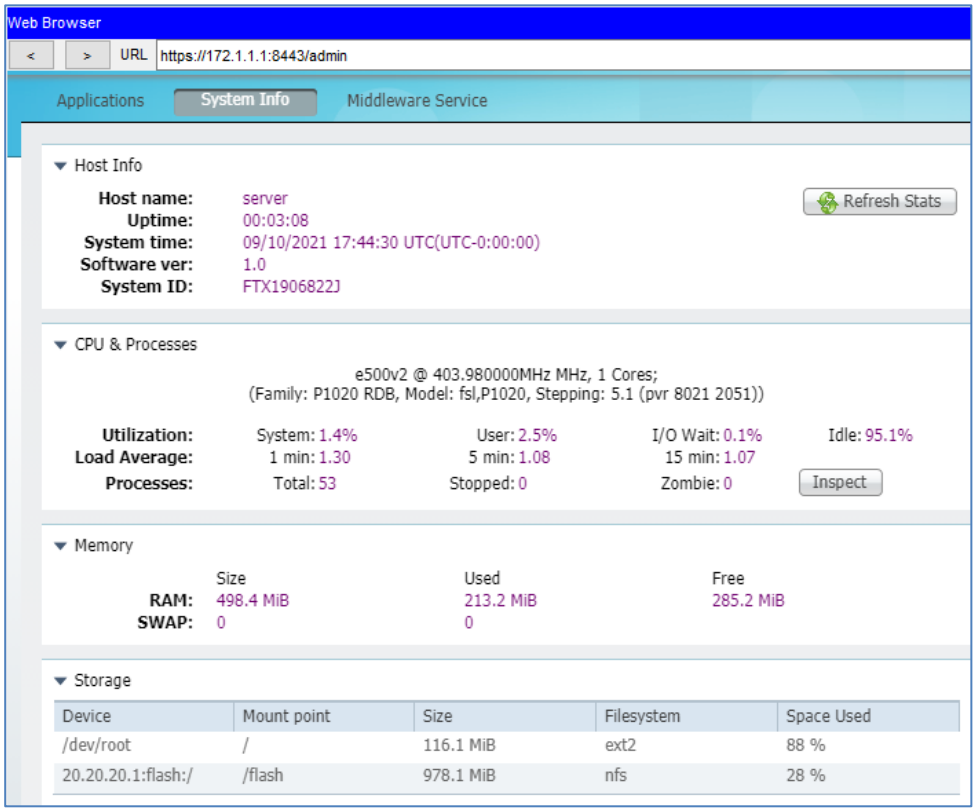

Figure 8.10 https://172.1.1.1:8443/admin

8.3 Running a virtual machine in 819HG-4G-IOX (Exercise 22)

Part 1. Network topology.

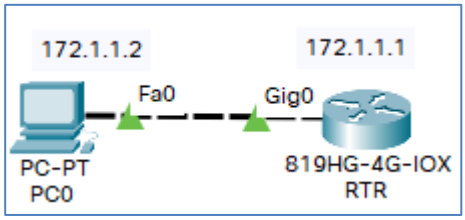

Figure 8.11 Network topology

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Part 2. Required equipment:

- PC-PT – 1 pcs
- 819HG-4G-IOX – 1 pcs

Part 3. **Assumptions:**

The RTR router has configured addressing, NAT, and:

- Cisco Application Management listening on port 8443,
- access to Cisco Application Management is configured (login: cisco, password: cisco).
- The virtual machine is located on PC0 in the vm1 directory.

Part 3. Plan of the exercise – method 1 – using GUI.

Configure RTR router according to the given steps:

Step 1. Log into Cisco Application Management

From PC0 log into Cisco Application Management (address https://172.1.1.1:8443).

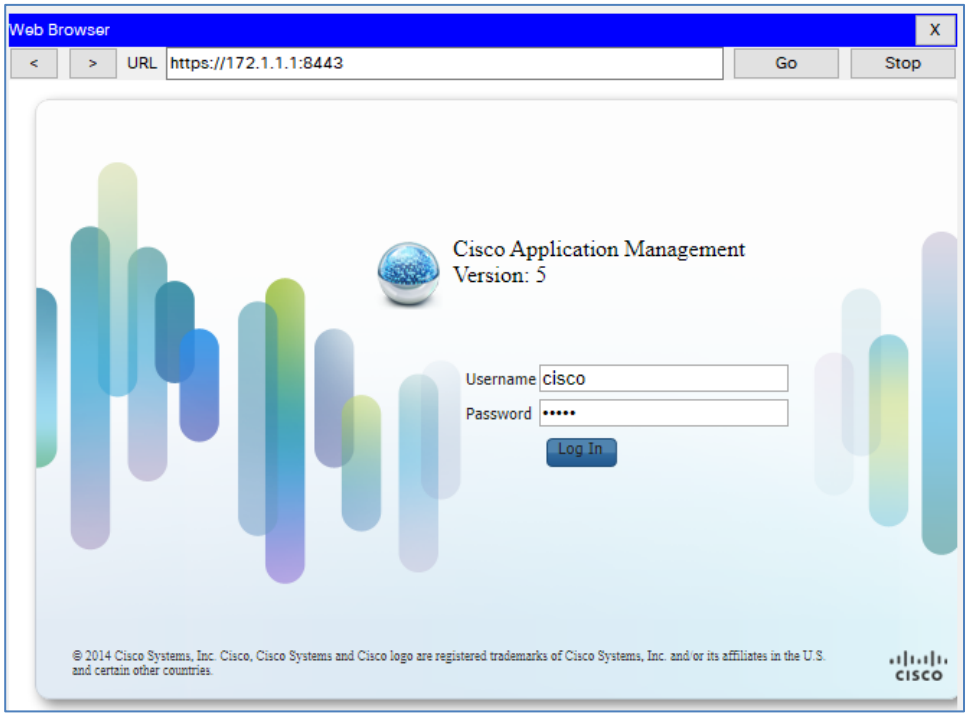

Figure 8.12 Cisco Application Management login page

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Step 2. Add new virtual machine.

Using [**Add/Deploy**] button add virtual machine.

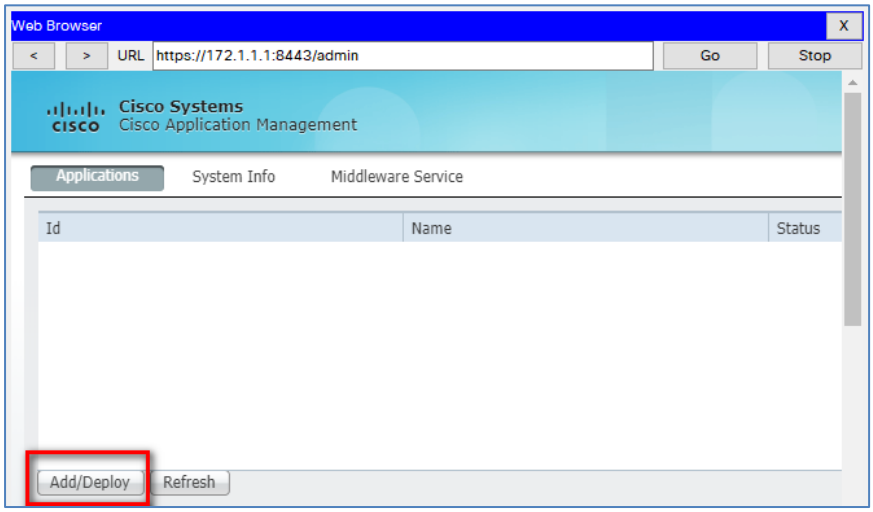

Figure 8.13 Adding a virtual machine

In **Application Id** field type 1.

Select the file (**Project Name**) **vm1**.

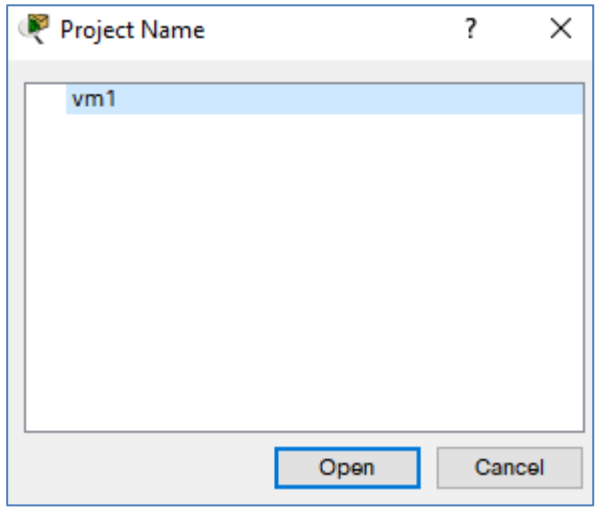

Figure 8.14 Selecting a virtual machine

Step 3. Start and stop the virtual machine.

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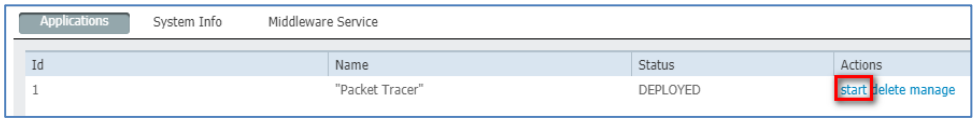

Figure 8.15 Running a virtual machine

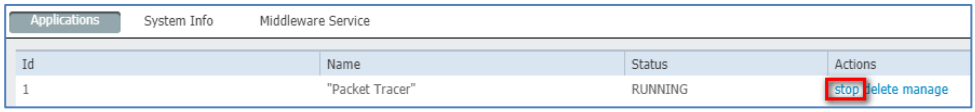

Figure 8.16 Stopping the virtual machine

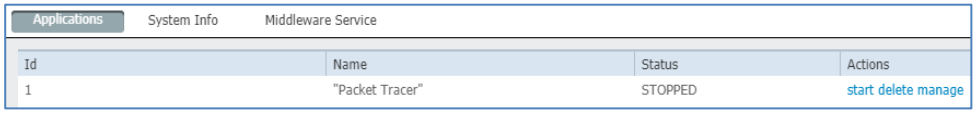

Figure 8.17 Status of the virtual machine

Part 4. Course of the exercise – method 2 – using CLI.

Step 1. On your computer, go to the **vm1** directory and check its contents.

Use the commands : **`cd, dir.`**

```
C:\>
C:\>cd vml
C:\vml>dir

 Volume in drive C has no label.
 Volume Serial Number is 5E12-4AF3
 Directory of C:\vml

5/13/2015   14:11 PM           205       app_manifest.yaml
5/13/2015   14:11 PM           0         e500v2-linux-guest.uImage
5/13/2015   14:11 PM           554       imgb_cb_script.sh
5/13/2015   14:11 PM           148       vml.js
5/13/2015   14:12 PM           240       vml.ova
5/13/2015   14:11 PM           3         vml.ver
5/13/2015   14:11 PM           406       vml.xml
               1556 bytes          7 File(s)
C:\vml>
```

Figure 8.18 Checking the contents of the C:\vlm directory

Step 2. On the router RTR and transfer the **vml.ova** file from PC0 to the flash memory on the router.

Use the commands: **`enable, copy`**

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```
RTR#
RTR#copy tftp flash
Address or name of remote host []? 172.1.1.2
Source filename []? vml.ova
Destination filename [vml.ova]?

Accessing tftp://172.1.1.2/vml.ova...
Loading vml.ova from 172.1.1.2: !
[OK - 240 bytes]

240 bytes copied in 0 secs
```

Figure 8.19 Uploading the vml.ova file to flash memory on the router

Step 3. On the router, check the contents of the flash memory.

Use the command : **`dir`**

```
RTR#dir
Directory of flash:/

    4  -rw-    33591768          <no date>  c800-universalk9_iox-mz.SPA.155-1.T.bin
    2  -rw-       28282          <no date>  sigdef-category.xml
    1  -rw-      227537          <no date>  sigdef-default.xml
    5  -rw-         240          <no date>  vml.ova

255744000 bytes total (221896173 bytes free)
```

Figure 8.20 Checking the contents of flash memory:/

Step 4. Install a virtual machine on the router.

Use the commands :

`enable, virtual-service install name vm1 package flash:/vm1.ova`

```
RTR#
RTR#virtual-service install name vml package flash:/vml.ova
Installing package 'flash:/vml.ova' for virtual service 'vml'. Once the install has
finished, the VM may be activated. Use 'show virtual-service list' for progress.
*mar 1 00:42:23.657: %VIRT_SERVICE-5-INSTALL_STATE: Successfully installed virtual
service vml
RTR#
```

Figure 8.21 Installing the virtual machine

Step 5. On the router, go to global configuration mode and start vm1.

Use the commands :

`conf t, virtual-service vm1, activate`

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```
RTR#
RTR#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
RTR(config)#virtual-service vm1
RTR(config-virt-serv)#activate
% Activating virtual-service 'vm1', this might take a few minutes. Use 'show virtual-
service list' for progress.
*mar 1 00:46:47.249%VIRT_SERVICE-5-ACTIVATION_STATE: Successfully activate virtual
service vm1
RTR(config-virt-serv)#
```

Figure 8.22 Running the virtual machine

Step 6. On the router, stop vm1

Use the commands :

`conf t, virtual-service vm1, no activate`

```
RTR(config-virt-serv)#
RTR(config-virt-serv)#no activate
*mar 1 00:48:48.652%VIRT_SERVICE-5-ACTIVATION_STATE: Successfully deactivate virtual
service vm1
RTR(config-virt-serv)#
```

Figure 8.23 Stopping the virtual machine

8.4 List of auxiliary files

- exercise21-isr819hg-4g-iox-basic-configuration.pkt
- exercise22-isr819hg-4g-iox-running-virtual-machine.pkt

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