

Introduction to IBM Edge Application Manager - IEAM

Introduction to IBM Edge Application Manager - Think Academy Online 2022 Lab #1133 lab guide workbook

Successfully deploy models to the edge using IBM Edge Application Manager workload orchestration

Introduction

Gain hands-on experience with the IBM Edge Application Manager web management console. Install the Horizon agent, then deploy and manage a Horizon edge service on your edge device.

This Think Academy lab session is available for [IBM Think Academy Online 2022](#) attendees (Virtual Sign up for Free!)

Prerequisites

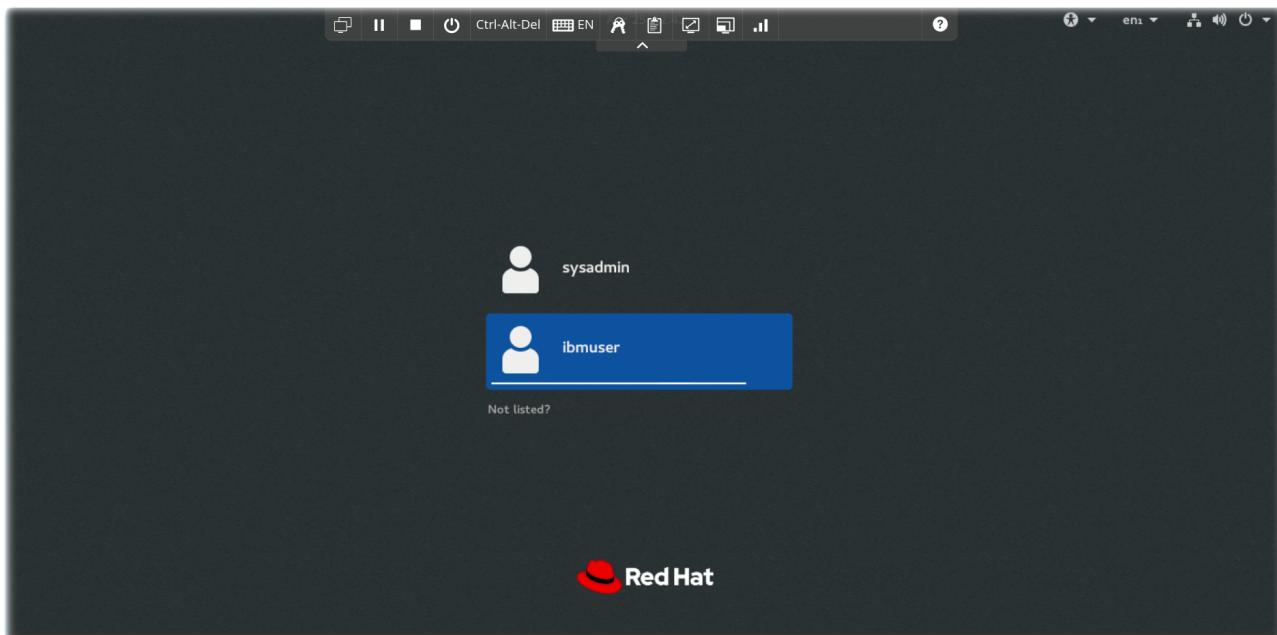
- Create a free [IBM Cloud account](#)
- Register for the [IBM Think Academy Online 2022](#) lab session #1133

Lab Objectives

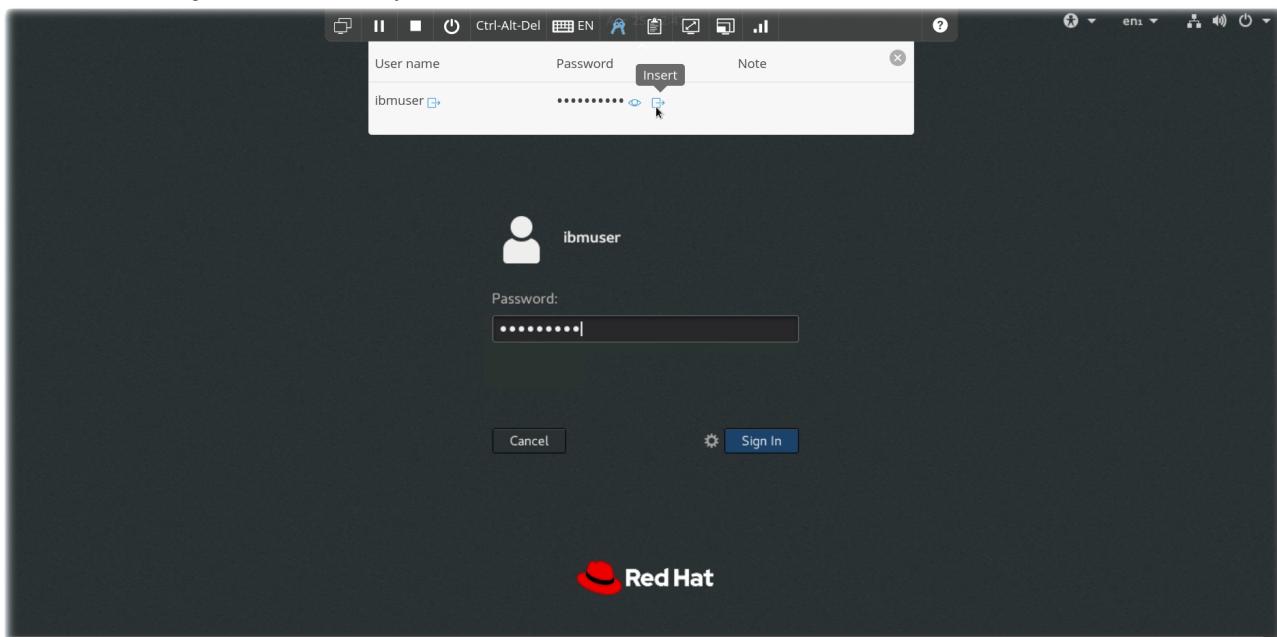
- Access the IBM Edge Application Manager Lab virtual machine environment
- Learn about IEAM components
- Explore the IEAM web console
- Register an Edge node
- Experiment with the hzn command line interface
- Configure IEAM Services and Policies
- Deploy containerized workloads to your edge device

Access to the Think Academy Online 2022 Lab Environment

- Select **ibmuser**



- Login Credentials for the virtual machine are stored in the toolbar
- Click on the **Keys** icon in the top toolbar

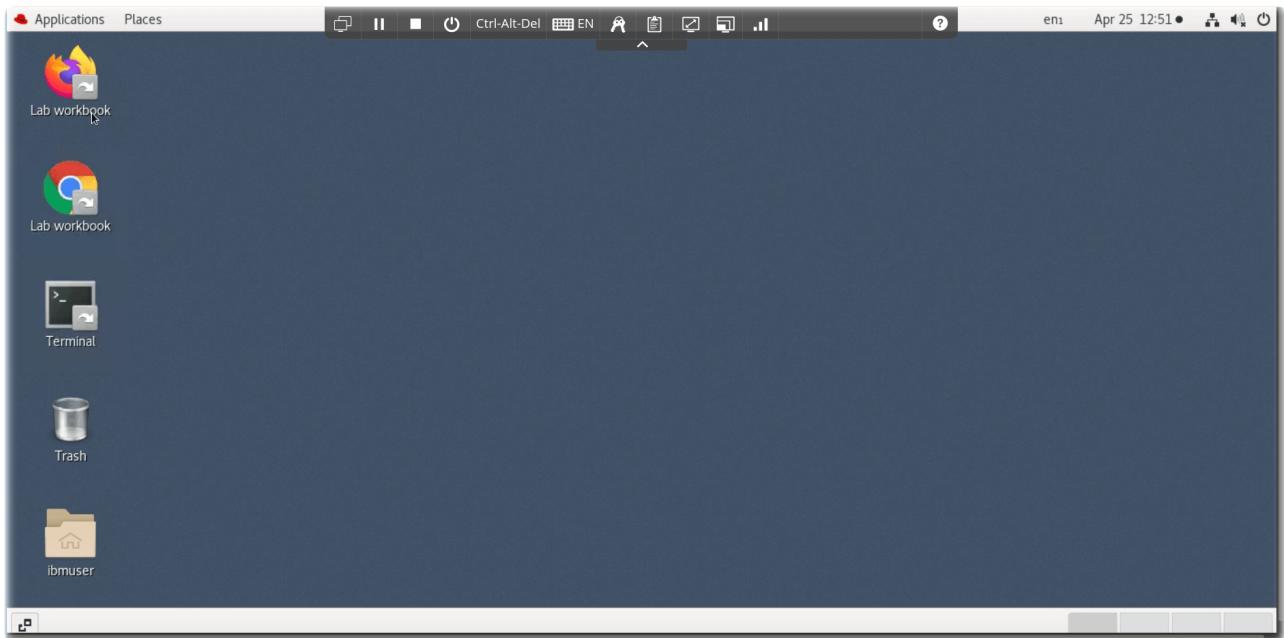


- A drop down dialog will appear with various credentials used in this lab
- Click on the **Insert** button for the ibmuser password
- Click on the **Sign In** button

Navigating the Virtual Machine

This lab will use several components within the RHEL Gnome desktop environment:

- Review the desktop



- a terminal window to execute `hn` Horizon edge agent commands
- a browser window with access to the IBM Edge Application Manager web console
- this GitHub repository / PDF which provides exercises to learn about IEAM, the Horizon agent, and containerized edge workloads
- a **Lab workbook** Firefox or Chrome icon link
- the browser will open to the [Introduction to IBM Edge Application Manager - IEAM](#) github repo
- additional browser Bookmark bar resources

IEAM Component Definitions

Before proceeding to the lab instructions, let's review some IEAM component definitions.

- *IEAM Management Hub* - The web UI used by IEAM administrators to view and manage the other components of IBM Edge Application Manager.
- *Node* - Typically, **edge devices** have a prescriptive purpose, provide (often limited) compute capabilities, and are located near or at the data source. Currently [supported IEAM edge device OS and architectures](#):
 - `x86_64`
 - Linux `x86_64` devices or virtual machines that run Ubuntu 20.x (focal), Ubuntu 18.x (bionic), Debian 10 (buster), Debian 9 (stretch)
 - Red Hat Enterprise Linux® 8.1, 8.2, and 8.3
 - Fedora Workstation 32
 - CentOS 8.1, 8.2, and 8.3
 - SuSE 15 SP2
 - `ppc64le`
 - Linux `ppc64le` devices or virtual machines that run Ubuntu 20.x (focal) or Ubuntu 18.x (bionic)

- Red Hat Enterprise Linux® 7.6, 7.9, 8.1, 8.2, and 8.3
 - ARM (32-bit)
 - Linux on ARM (32-bit), for example Raspberry Pi, running Raspberry Pi OS buster or stretch
 - ARM (64-bit)
 - Linux on ARM (64-bit), for example NVIDIA Jetson Nano, TX1, or TX2, running Ubuntu 18.x (bionic)
 - Mac
 - macOS
- *Containerized Workload* - Any Docker/OCI containerized service, microservice, or piece of software that does meaningful work when it runs on an edge node.
 - *Service* - A service that is designed specifically to be deployed on an edge cluster, edge gateway, or edge device. Visual recognition, acoustic insights, and speech recognition are all examples of potential edge services.
 - *properties* - name/value pairs, often used to describe attributes of nodes (like model, serial number, role, capabilities, attached hardware. etc.) or attributes of a service or deployment (see "policy").
 - *constraints* - logical expressions in terms of "properties". Constraints are used to control and manage software deployment to edge nodes.
 - *policy* - a collection of zero or more properties and zero or more constraints, sometimes with additional data fields (see "node policy", "service policy", and "deployment policy")
 - *node policy* - a set of properties and constraints related to an edge node (either a stand-alone Linux edge node or a Kubernetes cluster node)
 - *service policy* - a set of properties and constraints related to a specific deployable service
 - *business policy* - (deprecated) the former name for "deployment policy"
 - *deployment policy* - a set of properties and constraints related to the deployment of a specific service together with an identifier for the service version to deploy, and other information such as how rollbacks should be handled when failures occur.
 - *pattern* - another name for "deployment pattern"
 - *deployment pattern* - a list of specific deployable services. Patterns are a simplification of the more general, and more capable, "policy" mechanism. Edge nodes can register with a deployment pattern to cause the pattern's set of services to be deployed.
 - *IEAM Edge Cluster* - IBM Edge Application Manager (IEAM) [edge cluster capability](#) helps you manage and deploy workloads from a management hub cluster to remote instances of OpenShift® Container Platform or other Kubernetes-based clusters. Edge clusters are IEAM edge nodes that are Kubernetes clusters. An edge cluster enables use cases at the edge, which require colocation of compute with business operations, or that require more scalability, availability, and compute capability than what can be supported by an edge device. IEAM edge cluster configuration is outside the scope of this introduction lab.

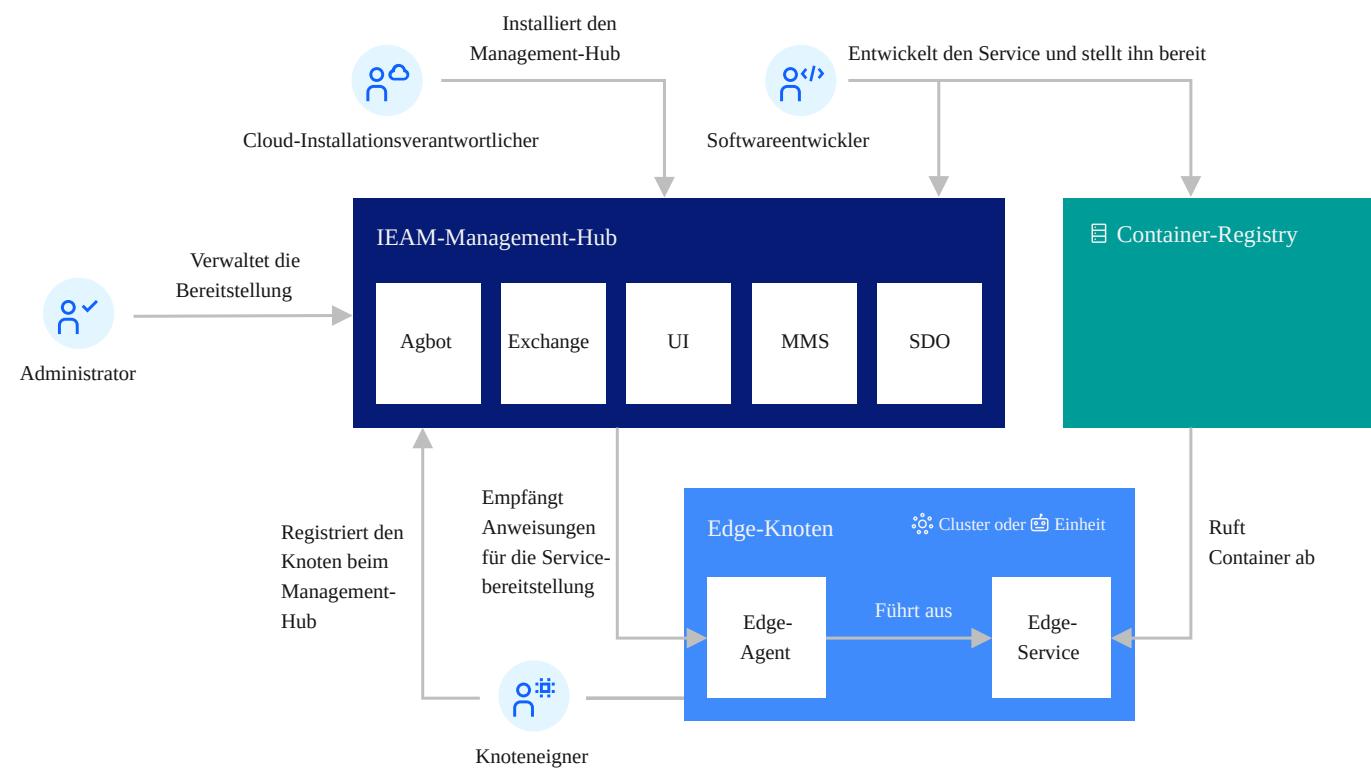
Architecture

The goal of edge computing is to harness the disciplines that have been created for hybrid cloud computing to support remote operations of edge computing facilities. IEAM is designed for that purpose.

The deployment of IEAM includes the management hub that runs in an instance of OpenShift Container Platform installed in your data center. The management hub is where the management of all of your remote edge nodes (edge devices and edge clusters) occurs.

These edge nodes can be installed in remote on-premises locations to make your application workloads local to where your critical business operations physically occur, such as at your factories, warehouses, retail outlets, distribution centers, and more.

The following diagram depicts the high-level topology for a typical edge computing setup:

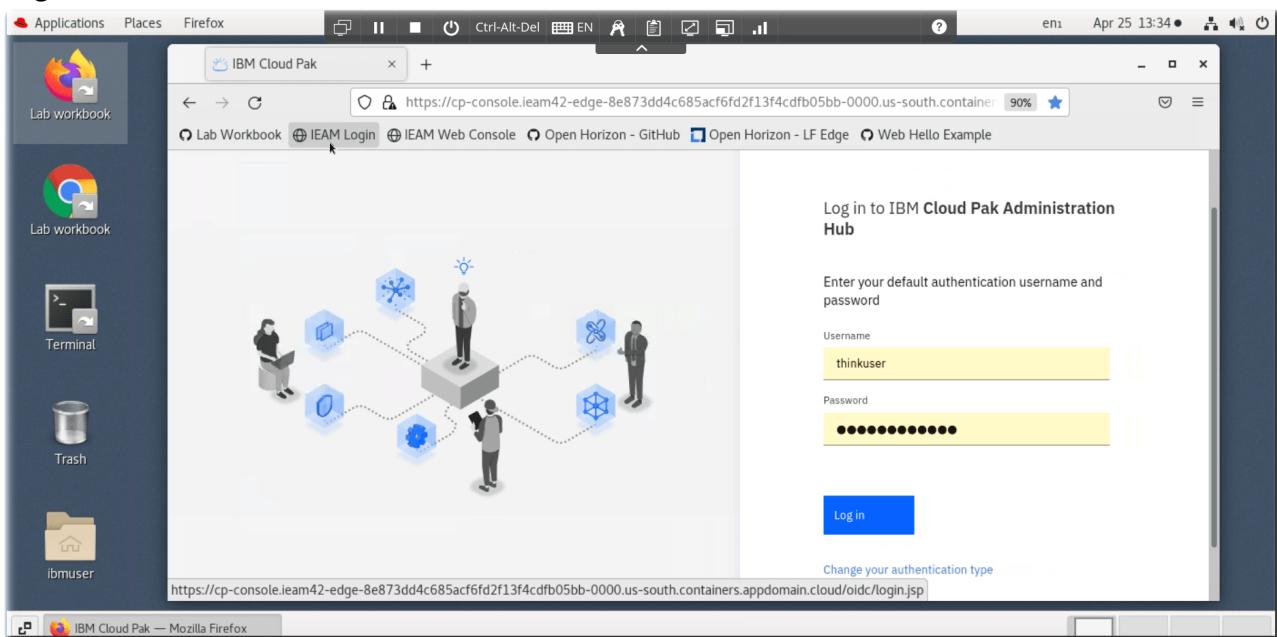


Let's Get Started

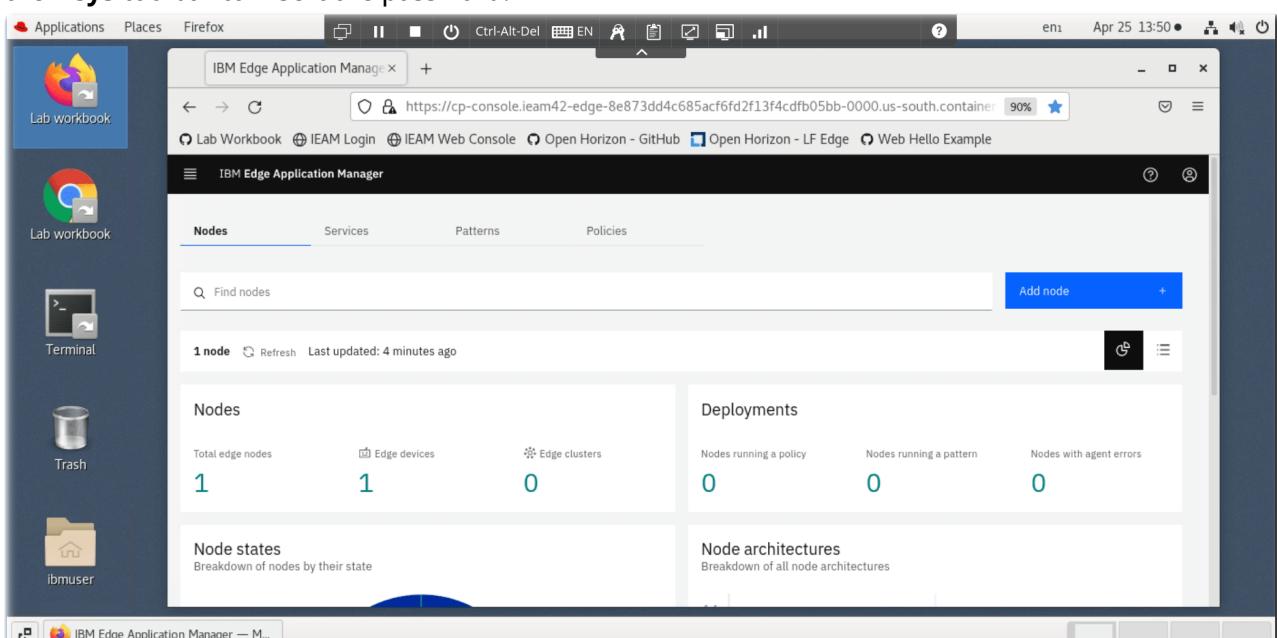
Explore the IEAM web console

In this section, explore the IEAM mgmt web console.

- Click either the Firefox or Chrome browser icon on your desktop
 - Note:** Launch IBM Edge Application Manager by selecting **IEAM Login** from the browser toolbar.
 - You may also need to click on the Advanced button and proceed to the self-signed certificate.
 - Choose **Default Authentication**.
- Login into the IEAM console



- The **thinkuser** userid / password are already saved in your browser keystore but if you need to, use the **Keys** toolbar to insert the password.



- Note:** If you receive a **403** error, modify the browser URL in the address bar, remove the **common-nav/403** and replace it with **edge**. Or click on the **IEAM Web Console** link in the browser Bookmark bar.

- Nodes

- Manage the node properties and constraints
- Note:** there are only a few edge nodes registered. In a subsequent section of the lab, your edge node will appear here.

The screenshot shows the IBM Edge Application Manager interface running in a Firefox browser window. The title bar indicates the URL is <https://cp-console.iam42-edge-8e873dd4c685acf6fd2f13f4cdfb05bb-0000.us-south.container.appdomain.cloud/>. The main content area is titled "IBM Edge Application Manager" and has tabs for "Nodes", "Services", "Patterns", and "Policies". The "Nodes" tab is selected. A search bar at the top says "Find nodes". Below it, a table titled "Node states" shows one node: "think-edge-instructor". The table includes columns for Name, Owner, Architecture, Node Type, State, and Last updated. The node details are: Name: think-edge-instructor, Owner: think, Architecture: amd64, Node Type: Device, State: Registered, Last updated: a few seconds ago. The bottom of the table shows pagination: Items per page: 25, 1 - 1 of 1 items, 1 of 1 pages. On the left side of the interface, there is a sidebar with icons for "Lab workbook", "Terminal", "Trash", and "ibmuser".

- Services

The screenshot shows the IBM Edge Application Manager interface running in a Firefox browser window. The title bar indicates the URL is <https://cp-console.iam42-edge-8e873dd4c685acf6fd2f13f4cdfb05bb-0000.us-south.container.appdomain.cloud/>. The main content area is titled "IBM Edge Application Manager" and has tabs for "Nodes", "Services", "Patterns", and "Policies". The "Services" tab is selected. A search bar at the top says "Find services". Below it, a table titled "31 services" shows four service entries: (3) ibm.cpu2evtstreams, (3) ibm.hello-secret, (3) ibm.hello-mmss, and (4) ibm.helloworld. Each entry includes a "Devices" section with architecture, version, and nodes information. The bottom of the table shows sorting: Sort by: Last Updated. On the left side of the interface, there is a sidebar with icons for "Lab workbook", "Terminal", "Trash", and "ibmuser".

- Patterns

IBM Edge Application Manager

Patterns

| Pattern ID | Owner | Services | Architectures | Last updated |
|-------------------------------------|--------------------|----------|-------------------|----------------------------|
| pattern-web-hello-python-instructor | thinkuser think | 1 ⓘ | amd64 | a few seconds ago |
| pattern-ibm.cpu2evtstreams | root root | 3 ⓘ | amd64, arm, arm64 | Friday, September 24, 2021 |
| pattern-nginx-operator-amd64 | root root | 1 ⓘ | amd64 | Friday, September 24, 2021 |

- Policies

IBM Edge Application Manager

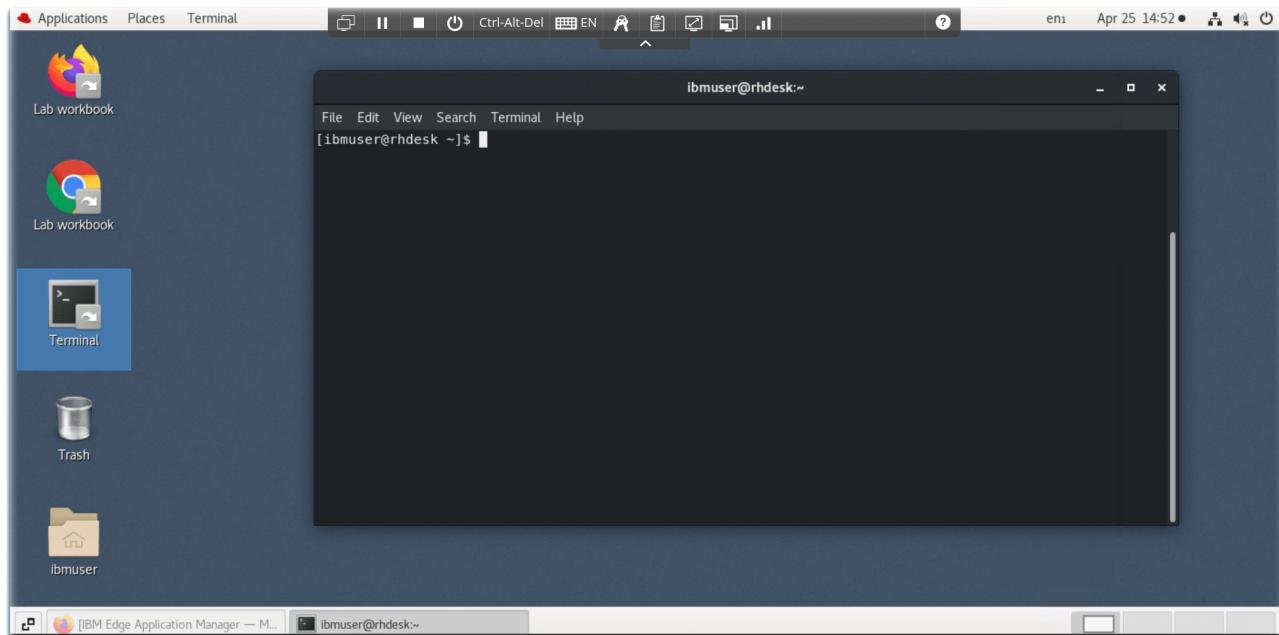
Policies

| Policy ID | Owner | Label | Last Updated |
|--|--------------------|---|--------------|
| think/policy-cpu-mqtt-example-instructor_amd64_1.0.0 | thinkuser think | cpu-mqtt-example-instructor Deployment Policy | 2 days ago |

Explore the "Edge" Device

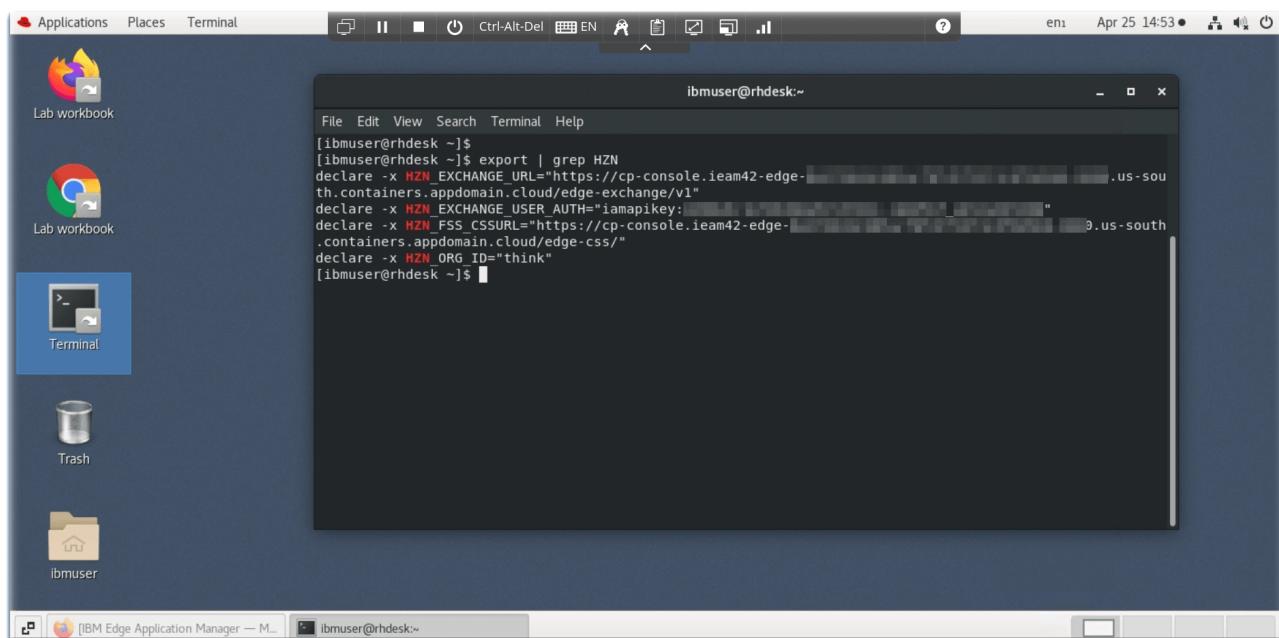
The virtual machine lab environment provided during the Think 2022 lab will be your "edge device" today. Normally, your edge device might be an industrial computer, small board computer, etc.

- Click on the **Terminal** icon and launch a console window.



- To simplify the edge lab setup, the HZN environment variables have been pre-configured in the `~/.bashrc` profile
- Inspect the HZN environment variables by entering this shell pipeline

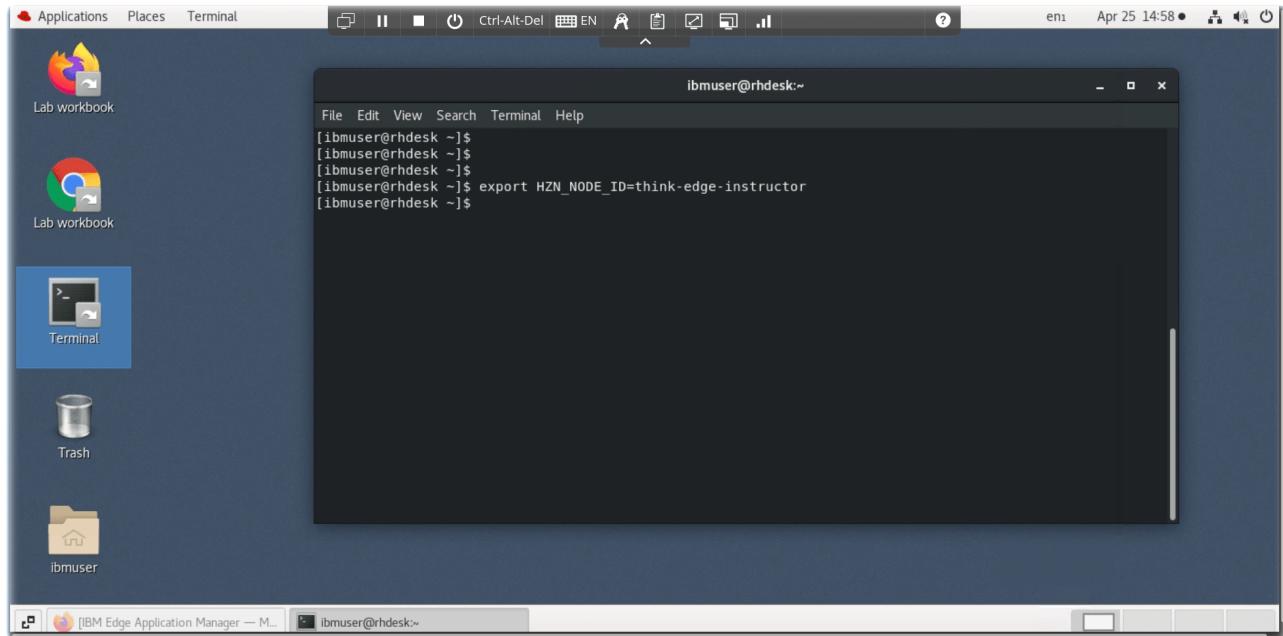
```
export | grep HZN
```



Note: (the urls and iamapikey have been blurred in the public screenshots)

- Set your HZN_NODE_ID environment variable to something unique which will allow you to find your "edge" device in the IEAM management console. eg `think-edge-<yourname>`

```
export HZN_NODE_ID=think-edge-<yourname>
```

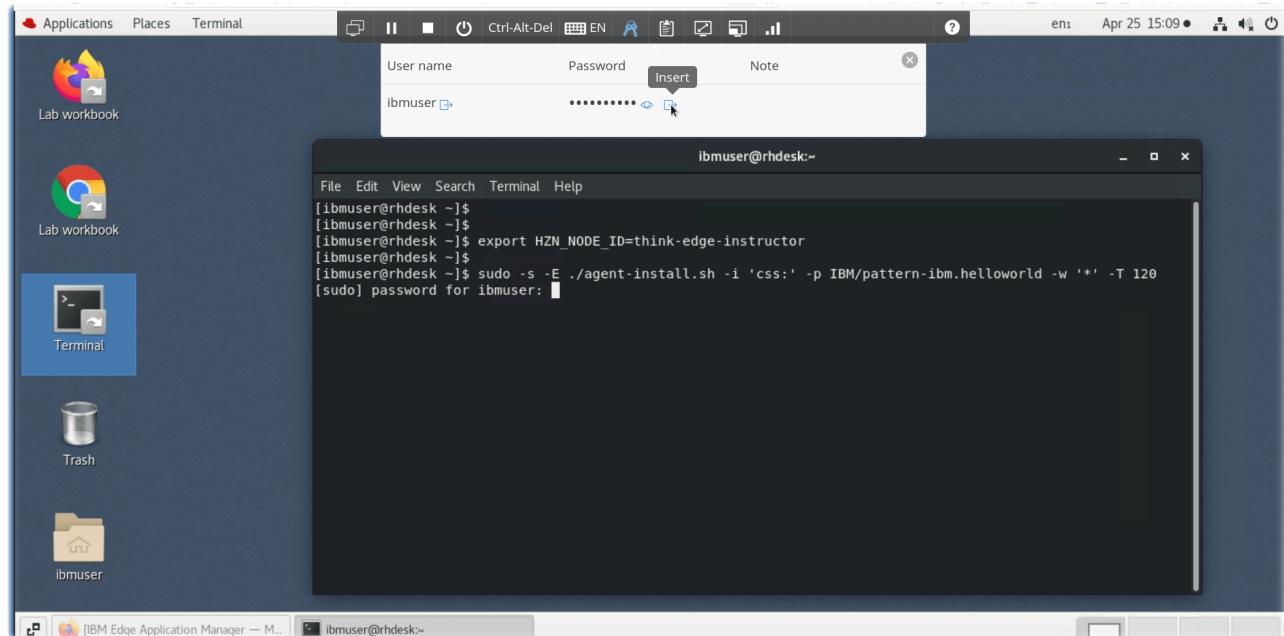


- **Stop :** Did you `export HZN_NODE_ID=think-edge-<yourname>` as required in the above step? You won't be able to find your device in the IEAM mgmt console if you don't set a node name.

Install / Register your edge node

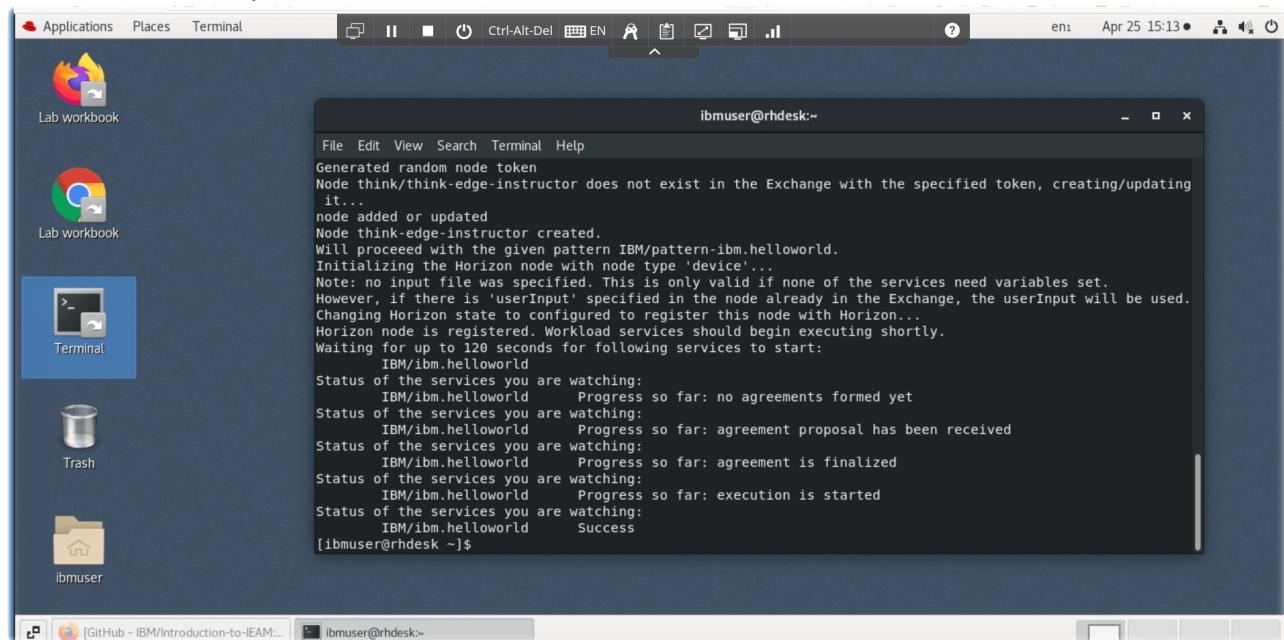
- Enter the following command in the Terminal window to install and register the agent into the IEAM management hub.

```
sudo -s -E ./agent-install.sh -i 'css:' -p IBM/pattern-ibm.helloworld
-w '*' -T 120
```



Use the **Keys** toolbar to insert the `ibmuser` password at the `sudo` prompt

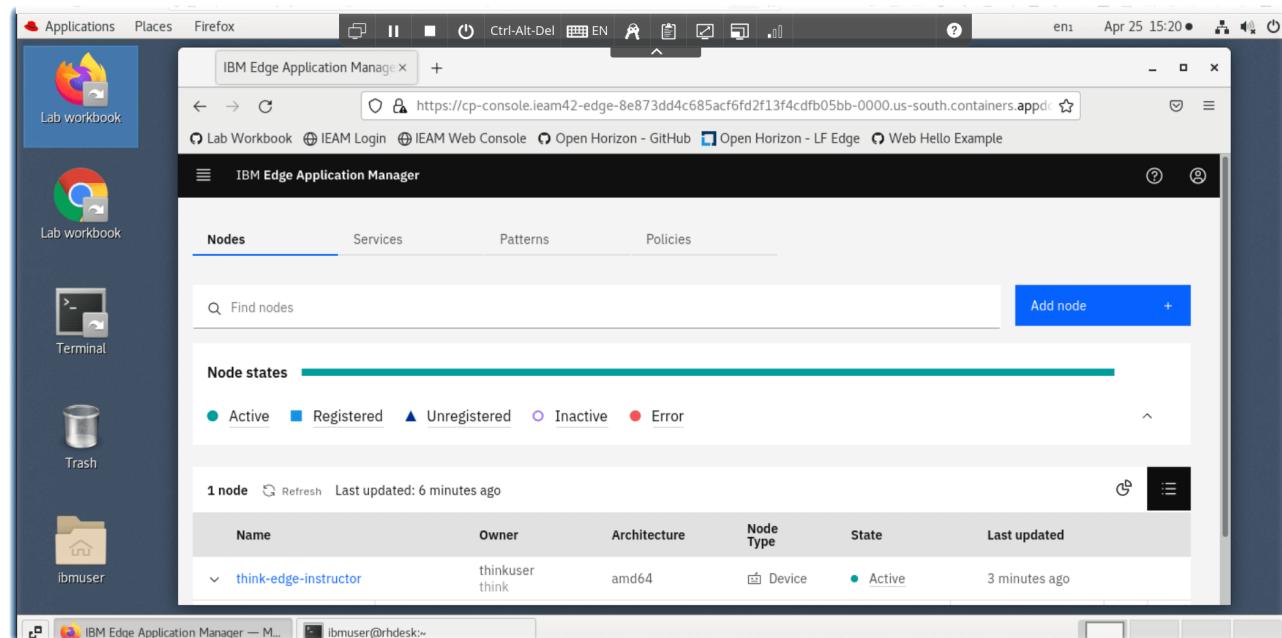
- When the node registration completes, it will have also configured an `IBM/pattern-ibm.helloworld` pattern to execute on this node.



- Query the Horizon agent version that was installed

```
hzn version
Horizon CLI version: 2.29.0-595
Horizon Agent version: 2.29.0-595
```

- Return to the IEAM web console. Switch to the **Nodes** section, Click on the **Refresh** button and find your device.



- **Warning:** If you don't see your node, or you skipped the step which sets the name of your edge node, **export HZN_NODE_ID=think-edge-<yourname>**, you can unregister the node and try again.

```
sudo hzn unregister -vrfD
export HZN_NODE_ID=think-edge-<yourname>
sudo -s -E ./agent-install.sh -i 'css:' -p IBM/pattern-
ibm.helloworld -w '*' -T 120
```

- Return to the Terminal window. See what agreements are running.

```
watch hzn agreement list
```

```
[ibmuser@rhdesk ~]$ hzn agreement list
[
  {
    "name": "pattern-ibm.helloworld_IBM_amd64 merged with pattern-ibm.helloworld_IBM_amd64",
    "current_agreement_id": "deae0f07ca0b16e9b35b324e2a601b8f7307359bfc9d0095233cd7b01ac663cf",
    "consumer_id": "IBM/agbot",
    "agreement_creation_time": "2022-04-25 15:12:04 -0500 CDT",
    "agreement_accepted_time": "2022-04-25 15:12:13 -0500 CDT",
    "agreement_finalized_time": "2022-04-25 15:12:13 -0500 CDT",
    "agreement_execution_start_time": "2022-04-25 15:12:15 -0500 CDT",
    "agreement_data_received_time": "",
    "agreement_protocol": "Basic",
    "workload_to_run": [
      {
        "url": "ibm.helloworld",
        "org": "IBM",
        "version": "1.0.0",
        "arch": "amd64"
      }
    ]
}
[ibmuser@rhdesk ~]$
```

- Query details about your node

```
hzn node list
```

```
[ibmuser@rhdesk ~]$ hzn node list
{
  "id": "think-edge-instructor",
  "organization": "think",
  "pattern": "IBM/pattern-ibm.helloworld",
  "name": "rhdesk",
  "node_type": "device",
  "token_last_valid_time": "2022-04-25 15:11:41 -0500 CDT",
  "token_valid": true,
  "ha": false,
  "configstate": {
    "state": "configured",
    "last_update_time": "2022-04-25 15:11:42 -0500 CDT"
  },
  "configuration": {
    "exchange_api": "https://cp-console.iam42-edge-8e873dd4c685acf6fd2f13f4cdfb05bb-0000.us-south.containe
rs.appdomain.cloud/edge-exchange/v1/",
    "exchange_version": "2.87.0",
    "required_minimum_exchange_version": "2.81.0",
    "preferred_exchange_version": "2.81.0",
    "mms_api": "https://cp-console.iam42-edge-8e873dd4c685acf6fd2f13f4cdfb05bb-0000.us-south.containers.ap
pdomain.cloud/edge-css",
    "architecture": "amd64",
    "horizon_version": "2.29.0-595"
  }
}
[ibmuser@rhdesk ~]$
```

Using the Horizon HZN command line

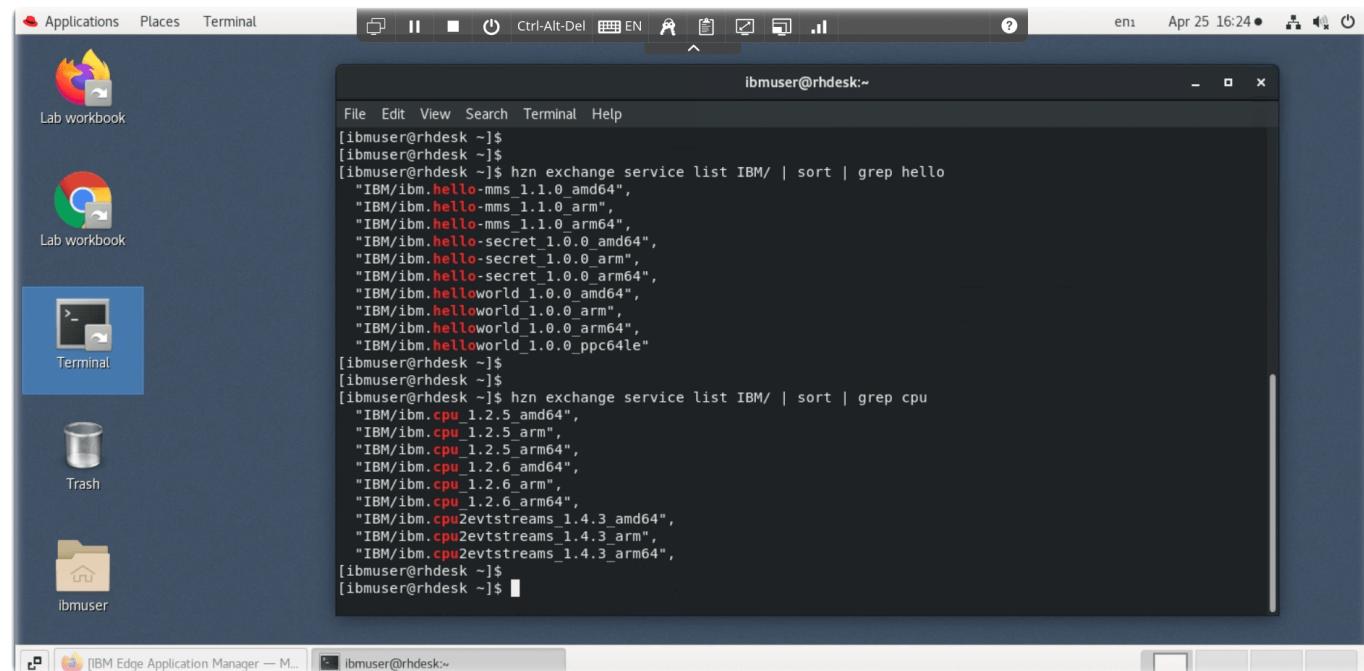
There are many horizon command line interface parameters. This section will explore some of them.

```
hzn help
```

The IEAM management hub installation includes several examples which have been published into the exchange automatically. These services, patterns and policies can target different CPU architectures and constraints. IEAM also supports rollback between service containers. The following commands will list the services, patterns, and deployment policies available in your exchange:

Note: The following commands assume you have the Horizon environment variables `HZN_ORG_ID` and `HZN_EXCHANGE_USER_AUTH` set

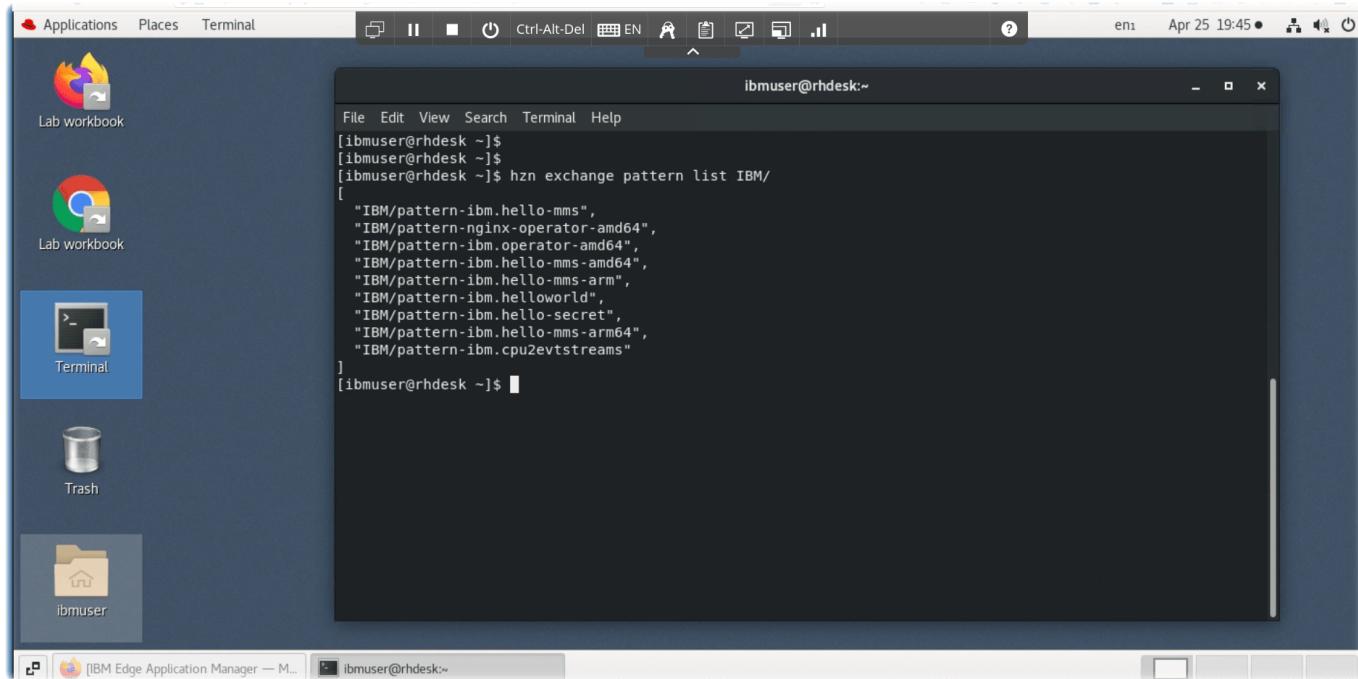
```
hzn exchange service list IBM/
```



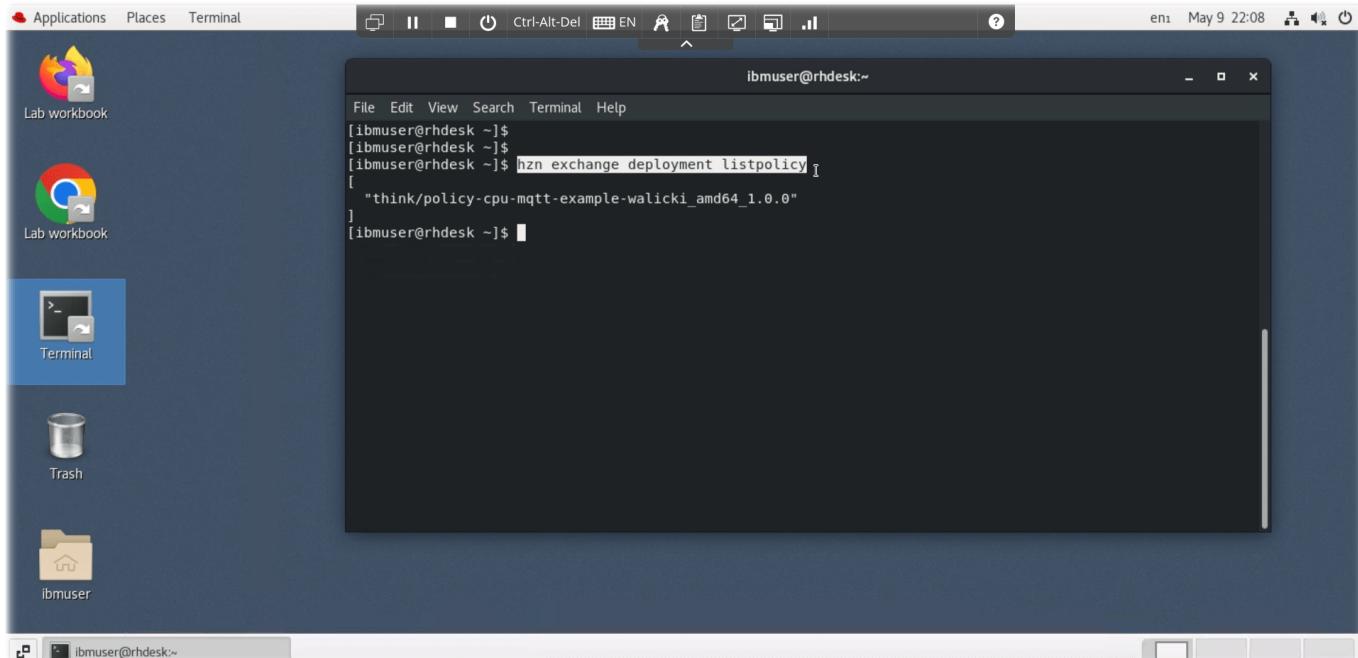
A screenshot of a Linux desktop environment. On the left is a dock with icons for 'Lab workbook' (twice), 'Terminal' (selected), 'Trash', and 'ibmuser'. The main window is a terminal window titled 'ibmuser@rhdesk:~'. It contains the following command and its output:

```
[ibmuser@rhdesk ~]$ hzn exchange service list IBM/ | sort | grep hello
"IBM/ibm.hello-mms_1.1.0_amd64",
"IBM/ibm.hello-mms_1.1.0_arm",
"IBM/ibm.hello-mms_1.1.0_arm64",
"IBM/ibm.hello-secret_1.0.0_amd64",
"IBM/ibm.hello-secret_1.0.0_arm",
"IBM/ibm.hello-secret_1.0.0_arm64",
"IBM/ibm.helloworld_1.0.0_amd64",
"IBM/ibm.helloworld_1.0.0_arm",
"IBM/ibm.helloworld_1.0.0_arm64",
"IBM/ibm.helloworld_1.0.0_ppc64le"
[ibmuser@rhdesk ~]$ hzn exchange service list IBM/ | sort | grep cpu
"IBM/ibm.cpu_1.2.5_amd64",
"IBM/ibm.cpu_1.2.5_arm",
"IBM/ibm.cpu_1.2.5_arm64",
"IBM/ibm.cpu_1.2.6_amd64",
"IBM/ibm.cpu_1.2.6_arm",
"IBM/ibm.cpu_1.2.6_arm64",
"IBM/ibm.cpu2evtstreams_1.4.3_amd64",
"IBM/ibm.cpu2evtstreams_1.4.3_arm",
"IBM/ibm.cpu2evtstreams_1.4.3_arm64",
[ibmuser@rhdesk ~]$
```

```
hzn exchange pattern list IBM/
```

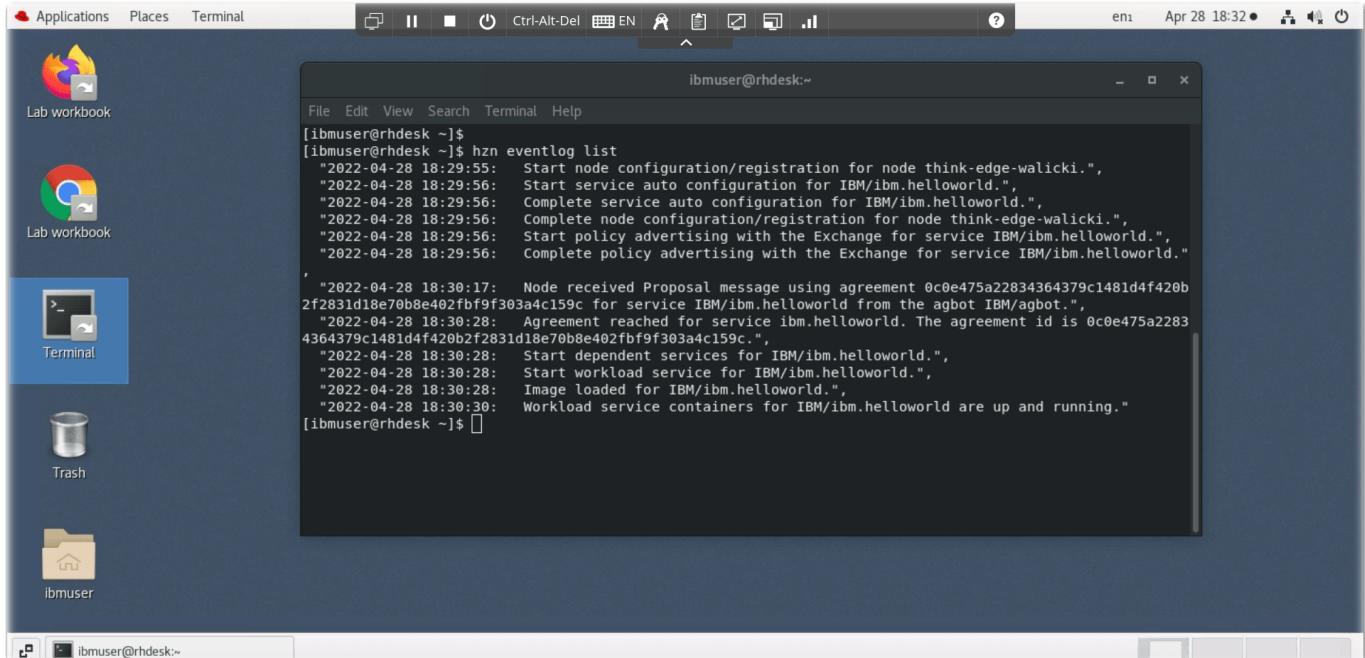


```
hzn exchange deployment listpolicy
```



- Review the event log for this node.

```
hzn eventlog list
```



The screenshot shows a Linux desktop environment with a dark blue theme. On the left is a vertical dock containing icons for 'Lab workbook' (twice), 'Terminal', 'Trash', and 'ibmuser'. A terminal window titled 'ibmuser@rhdesk:~' is open in the center, showing the command 'hzn eventlog list' followed by its output. The output details the configuration and start of a service named 'IBM/ibm.helloworld' on April 28, 2022, at 18:29:55. It includes logs for node configuration, service auto-configuration, policy advertising, and the receipt of a proposal message. The desktop bar at the top shows network status (en1), date (Apr 28 18:32), and system icons.

```
[ibmuser@rhdesk ~]$ hzn eventlog list
[2022-04-28 18:29:55: Start node configuration/registration for node think-edge-walicki.",
 "2022-04-28 18:29:56: Start service auto configuration for IBM/ibm.helloworld.",
 "2022-04-28 18:29:56: Complete service auto configuration for IBM/ibm.helloworld.",
 "2022-04-28 18:29:56: Complete node configuration/registration for node think-edge-walicki.",
 "2022-04-28 18:29:56: Start policy advertising with the Exchange for service IBM/ibm.helloworld.",
 "2022-04-28 18:29:56: Complete policy advertising with the Exchange for service IBM/ibm.helloworld."
,
 "2022-04-28 18:30:17: Node received Proposal message using agreement 0c0e475a22834364379c1481d4f420b
2f2831d18e70b8e402fbff9f303a4c159c for service IBM/ibm.helloworld from the agbot IBM/agbot.",
 "2022-04-28 18:30:28: Agreement reached for service ibm.helloworld. The agreement id is 0c0e475a2283
4364379c1481d4f420b2f2831d18e70b8e402fbff9f303a4c159c.",
 "2022-04-28 18:30:28: Start dependent services for IBM/ibm.helloworld.",
 "2022-04-28 18:30:28: Start workload service for IBM/ibm.helloworld.",
 "2022-04-28 18:30:28: Image loaded for IBM/ibm.helloworld.",
 "2022-04-28 18:30:30: Workload service containers for IBM/ibm.helloworld are up and running."
[ibmuser@rhdesk ~]$
```

Web Hello containerized workload

In this exercise, we will create a Web Hello service that runs a containerized HTTP server workload on your edge device. The [web-hello-python](#) example is an extremely simple HTTP server (written in Python) that responds on port 8000 with a hello message.

The core principle of IBM Edge Application Manager is to orchestrate containerized workloads, at scale, on edge devices. Edge developers should be familiar with creating Docker containers optimized for (CPU/Memory/Power) constrained devices. This example builds a small container, pushes it to your Docker Hub registry and creates a service and pattern in the IEAM exchange hub.

The source / instructions to build the container are posted in the [web-hello-python](#) github repository, but are copied here for the lab exercise.

- Open a Terminal window in your virtual machine
- Clone the github repository:

```
cd  
git clone https://github.com/TheMosquito/web-hello-python  
cd web-hello-python
```

- Log into your Docker Hub account so the container can be hosted for edge deployment

```
docker login
```

- Edit the variables at the top of the Makefile as desired. If you plan to push it to a Docker registry, make sure you give your docker ID. You may also want to create unique names for your service and pattern (necessary for this lab in the multi-tenant IEAM instance that is shared with other lab participants and you are all publishing this service).
 - gedit / vi / nano editors are available
 - Change the following **Makefile** lines:

```
DOCKERHUB_ID:=<your docker registry account>  
SERVICE_NAME:="web-hello-python-<yourname>"  
SERVICE_VERSION:="1.0.0"  
PATTERN_NAME:="pattern-web-hello-python-<yourname>"
```

- Create a hzn cryptographic signing keys. All edge services and deployment patterns must be cryptographically signed. If you do not already have an appropriate asymmetric cryptographic signing key pair, you must create a key pair that you can use for signing. If you need to create a new key pair, run the following command:

```
hzn key create **yourcompany** **youremail**
```

This command creates the following two files:

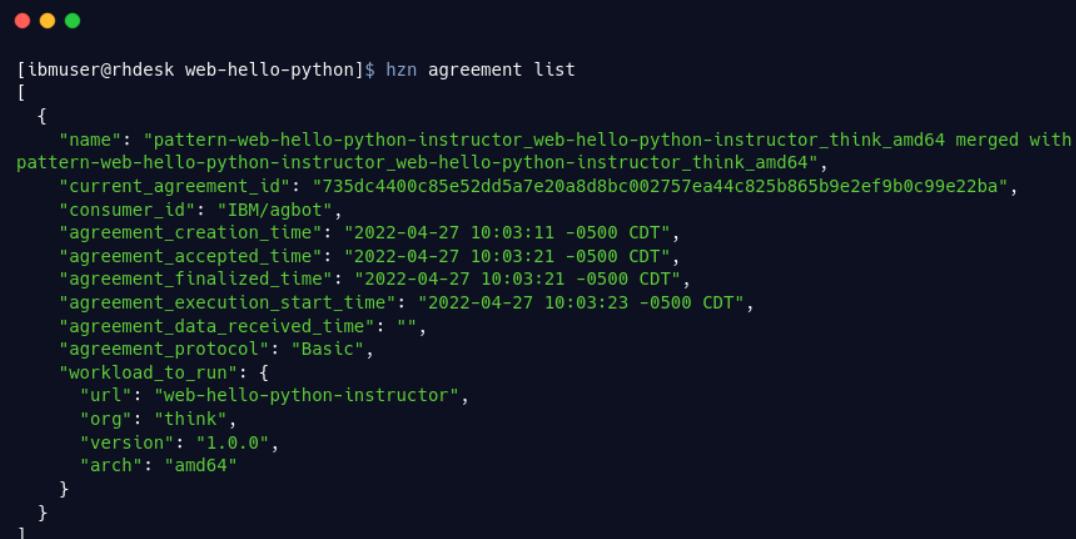
```
~/.hzn/keys/service.private.key  
~/.hzn/keys/service.public.pem
```

- Build the container, push the container to the Docker registry, publish the service and publish the pattern

```
make build  
make push  
make publish-service  
make publish-pattern
```

- Before we can register this containerized workload to run on your specific Horizon edge node, you will need to unregister the prior IEAM pattern. Remember, only one deployment pattern can be registered on an edge node.

```
hzn unregister -v  
make agent-run  
watch hzn agreement list
```



```
[ibmuser@rhdesk web-hello-python]$ hzn agreement list
[
  {
    "name": "pattern-web-hello-python-instructor_web-hello-python-instructor_think_amd64 merged with
pattern-web-hello-python-instructor_web-hello-python-instructor_think_amd64",
    "current_agreement_id": "735dc4400c85e52dd5a7e20a8d8bc002757ea44c825b865b9e2ef9b0c99e22ba",
    "consumer_id": "IBM/agbot",
    "agreement_creation_time": "2022-04-27 10:03:11 -0500 CDT",
    "agreement_accepted_time": "2022-04-27 10:03:21 -0500 CDT",
    "agreement_finalized_time": "2022-04-27 10:03:21 -0500 CDT",
    "agreement_execution_start_time": "2022-04-27 10:03:23 -0500 CDT",
    "agreement_data_received_time": "",
    "agreement_protocol": "Basic",
    "workload_to_run": {
      "url": "web-hello-python-instructor",
      "org": "think",
      "version": "1.0.0",
      "arch": "amd64"
    }
  }
]
```

- Test your web-hello containerized workload

```
make test
```

- Test your containerize workload by opening a browser session to http://localhost:8000
- Test the container on the command line

```
curl -sS http://localhost:8000

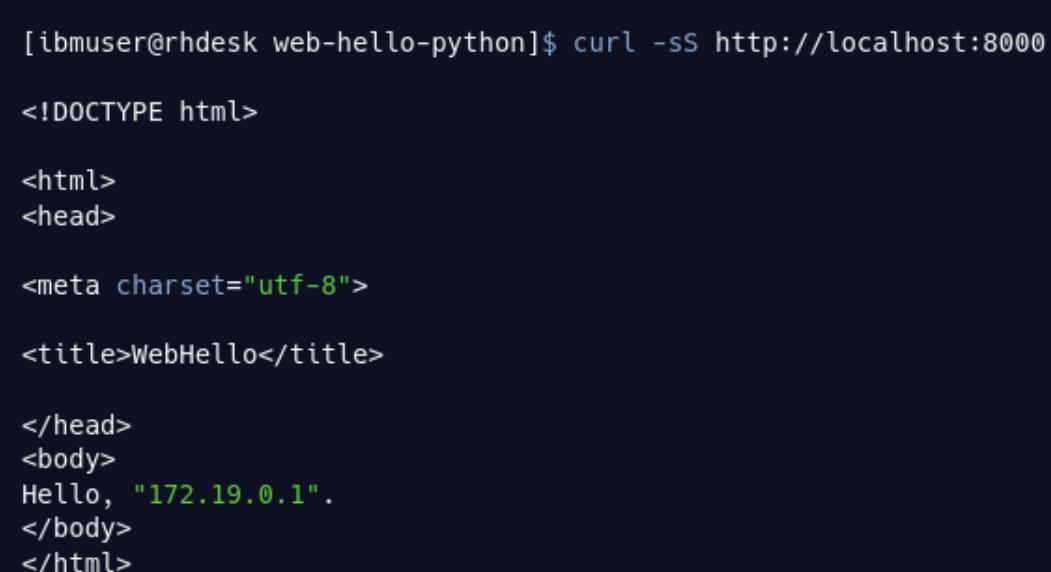
<!DOCTYPE html>

<html>
<head>

<meta charset="utf-8">

<title>WebHello</title>

</head>
<body>
Hello, "172.17.0.1".
</body>
</html>
```

A screenshot of a terminal window on a Mac OS X desktop. The window has red, yellow, and green title bar buttons. The terminal prompt is [ibmuser@rhdesk web-hello-python]\$. The user runs the command curl -sS http://localhost:8000. The output shows the generated HTML code, identical to the one shown in the previous code block.

```
[ibmuser@rhdesk web-hello-python]$ curl -sS http://localhost:8000

<!DOCTYPE html>

<html>
<head>

<meta charset="utf-8">

<title>WebHello</title>

</head>
<body>
Hello, "172.19.0.1".
</body>
</html>
```

- In this section, you will return to the IEAM web console to confirm the creation of the Web Hello service and pattern.
- Open the IEAM Web Console in the browser in the virtual machine. Find the link to the IEAM Web Console in the Bookmark bar.
- Navigate to the **Services** tab

The screenshot shows the IBM Edge Application Manager interface in a Firefox browser window. The title bar says "IBM Edge Application Manager". The main content area is titled "Services" and displays a table of services. The columns are "Service ID", "Owner", "Architecture", "Version", and "Last Updated". There are 32 services listed. One service, "web-hello-python-instructor_1.0.0_amd64", is highlighted in blue. Other services include "cpu-mqtt-example-instructor_1.0.0_amd64", "ibm.cpu2eventstreams (3)", "nginx-operator_1.0.0_amd64", and "ibm.hello-secret (3)".

| Service ID | Owner | Architecture | Version | Last Updated |
|---|--------------------|--------------|---------|----------------------------|
| web-hello-python-instructor_1.0.0_amd64 | thinkuser think | amd64 | 1.0.0 | 14 minutes ago |
| cpu-mqtt-example-instructor_1.0.0_amd64 | thinkuser think | amd64 | 1.0.0 | 2 days ago |
| ibm.cpu2eventstreams (3) | root root | Multiple | 1.4.3 | Multiple |
| nginx-operator_1.0.0_amd64 | root root | amd64 | 1.0.0 | Friday, September 24, 2021 |
| ibm.hello-secret (3) | root root | Multiple | 1.0.0 | Multiple |

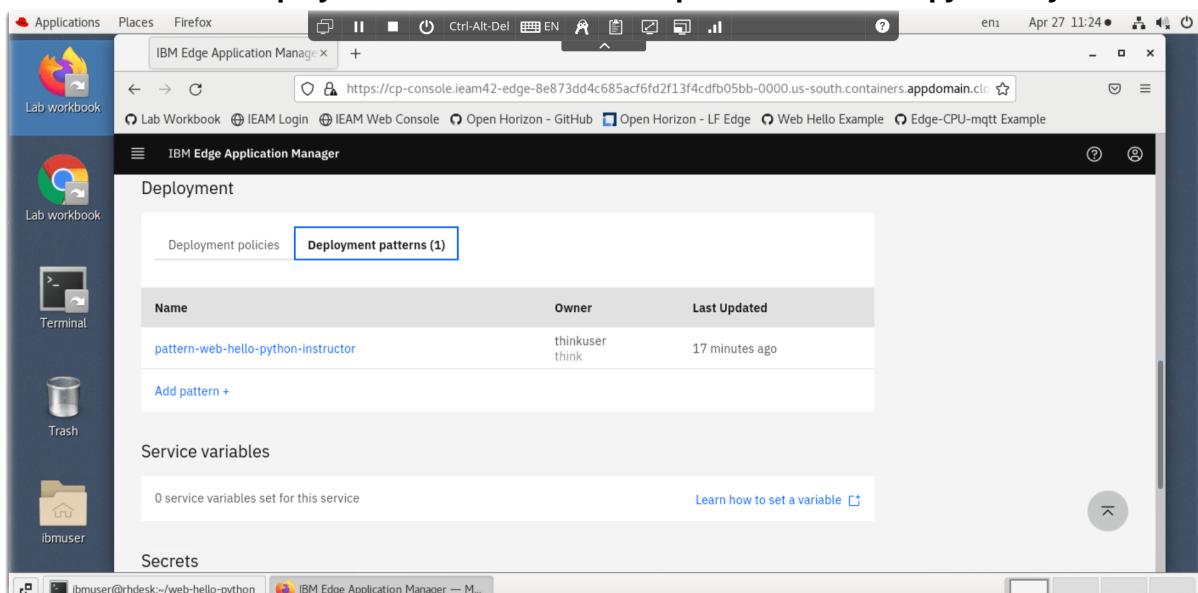
- Click on the **web-hello-python-<yourname>_1.0.0_amd64** in the Services list

The screenshot shows the "Service details" page for the "web-hello-python-instructor_1.0.0_amd64" service. The top navigation bar says "Services / web-hello-python-instructor_1.0.0_amd64". The "Delete" button is visible. The "Service details" section shows the following information:

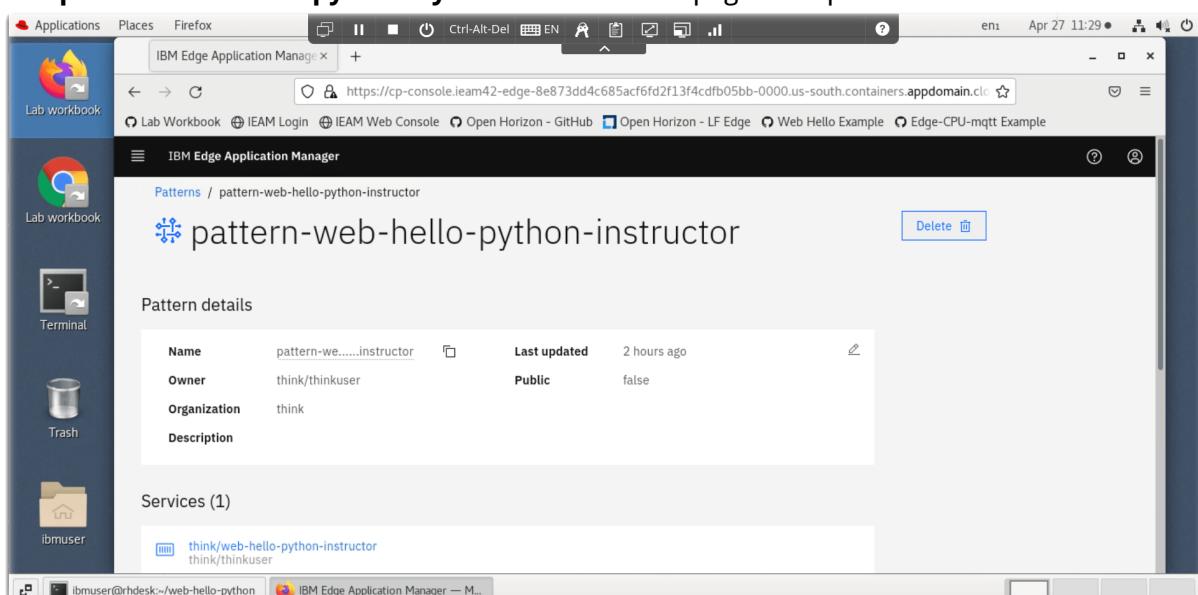
| | | | |
|--------------|-------------------------|----------------------|----------------|
| Name | web-hello.....0.0_amd64 | Last updated | 18 minutes ago |
| Owner | think/thinkuser | Public | true |
| Version | 1.0.0 | Shareable attributes | Singleton |
| Architecture | amd64 | | |
| Description | | | |

The "Service properties" section has a "Learn more about properties" link.

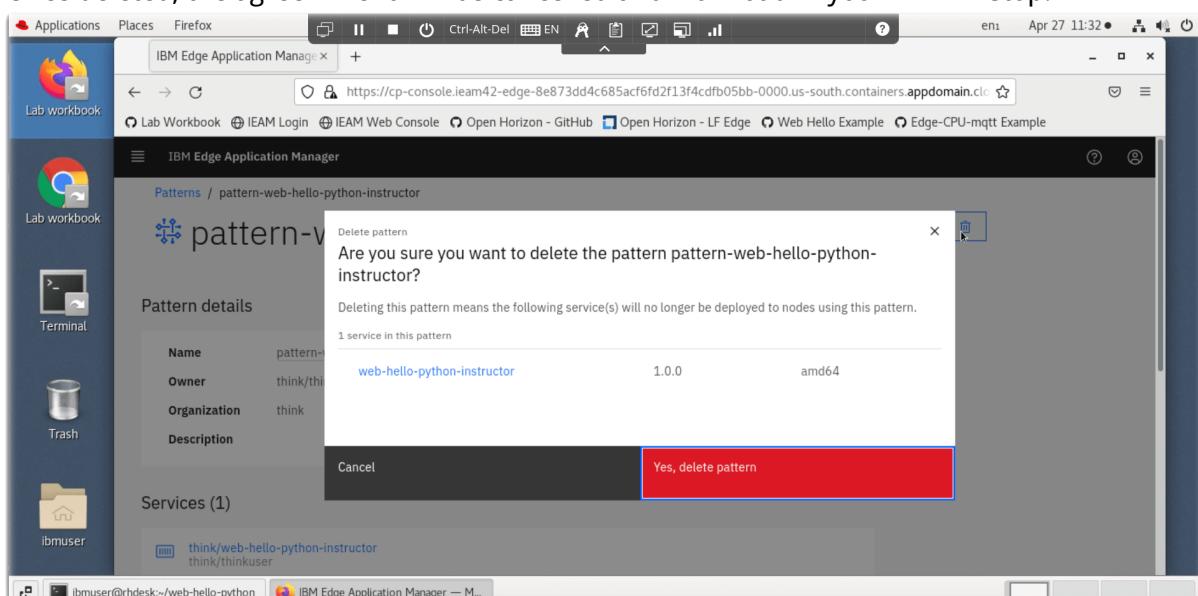
- Scroll down to the **Deployment** section and click the **pattern-web-hello-python-<yourname>**



- The **pattern-web-hello-python-<yourname>** Pattern page will open.



- Click on the Trash button and **Yes, delete pattern** confirmation button to delete your pattern. Once deleted, the agreement will be cancelled and workload in your VM will stop.



CPU Details to MQTT containerized workload

In this exercise, we will create a Docker containerized workload that can be deployed to an edge node running the Open Horizon agent. The workload can be configured as a managed service and deployment policy in IBM Edge Application Manager. It collects CPU details periodically and sends the results over MQTT to Watson IoT Platform and plots the results in a cloud hosted dashboard. This example builds a small container, pushes it to your Docker Hub registry and creates a service and policy in the IEAM exchange mgmt hub.

The source / instructions to build the container are posted in the [openhorizon-edge-cpu-mqtt](https://github.com/johnwalicki/openhorizon-edge-cpu-mqtt) github repository, but are copied here for the lab exercise.

- Open a Terminal window in your virtual machine
- Clone the github repository:

```
cd  
git clone https://github.com/johnwalicki/openhorizon-edge-cpu-mqtt  
cd openhorizon-edge-cpu-mqtt
```

- Log into your Docker Hub account so the container can be hosted for edge deployment

```
docker login
```

- Edit the variables at the top of the Makefile as desired. If you plan to push it to a Docker registry, make sure you give your docker ID. You may also want to create unique names for your service and policy (necessary for this lab in the multi-tenant IEAM instance that is shared with other lab participants and you are all publishing this service).

- gedit / vi / nano editors are available
- Change the following **Makefile** lines:

```
DOCKERHUB_ID:=<your docker registry account>  
SERVICE_NAME:="cpu-mqtt-example-<yourname>"  
SERVICE_VERSION:="1.0.0"
```

- The prior section created hzn cryptographic signing keys. If you need to create a new key pair, run the following command:

```
hzn key create **yourcompany** **youremail**
```

This command creates the following two files:

```
~/hzn/keys/service.private.key
~/hzn/keys/service.public.pem
```

- Build the container, push the container to the Docker registry and publish the service.

```
make build
make push
make publish-service
```

- Instead of publishing the policy from the `hzn` command line interface using `make publish-policy`, in this exercise, open the IEAM web console browser page again from the bookmark bar.

- Select the **Services** tab. If you sort the services in table format, you will see the **cpu-mqtt-example-<yourname>** service that was just published from the `hzn` CLI.

The screenshot shows the IBM Edge Application Manager interface. The left sidebar has icons for Lab workbook, Terminal, and ibmuser. The main window has tabs for Nodes, Services (which is selected), Patterns, and Policies. A search bar says 'Find services'. Below it, it says '32 services' and 'Last updated: 1 minute ago'. A table lists services with columns: Service ID, Owner, Architecture, Version, and Last Updated. The table shows:

| Service ID | Owner | Architecture | Version | Last Updated |
|---|--------------------|--------------|---------|-------------------|
| cpu-mqtt-example-instructor_1.0.0_amd64 | thinkuser think | amd64 | 1.0.0 | a few seconds ago |
| web-hello-python-instructor_1.0.0_amd64 | thinkuser think | amd64 | 1.0.0 | a day ago |
| ibm.cpu2evtstreams (3) | root root | Multiple | 1.4.3 | Multiple |

- Select your new service.

The screenshot shows the IBM Edge Application Manager interface. The left sidebar has icons for Lab workbook, Terminal, and ibmuser. The main window shows the 'Services / cpu-mqtt-example-instructor_1.0.0_amd64' page. It has a 'Delete' button. Below it, the 'Service details' section shows:

| Name | cpu-mqtt-e.....0.0_amd64 | Last updated | 7 minutes ago |
|--------------|--------------------------|----------------------|---------------|
| Owner | think/thinkuser | Public | true |
| Version | 1.0.0 | Shareable attributes | Singleton |
| Architecture | amd64 | | |
| Description | | | |

- Scroll down to the **Service variables** section. You will notice that the `make publish-service` command created a service with four MQTT variables. One of the variables does not have a default value. You could have used the IEAM Add Service panels to create all of these variables interactively. To avoid mistyping environment variables required by the scripts inside the container, the `service.json` file created them for you. In the last section of this workshop, you will set the missing variable via a deployment policy.

The screenshot shows the 'Service variables' section of the IBM Edge Application Manager. It lists four variables:

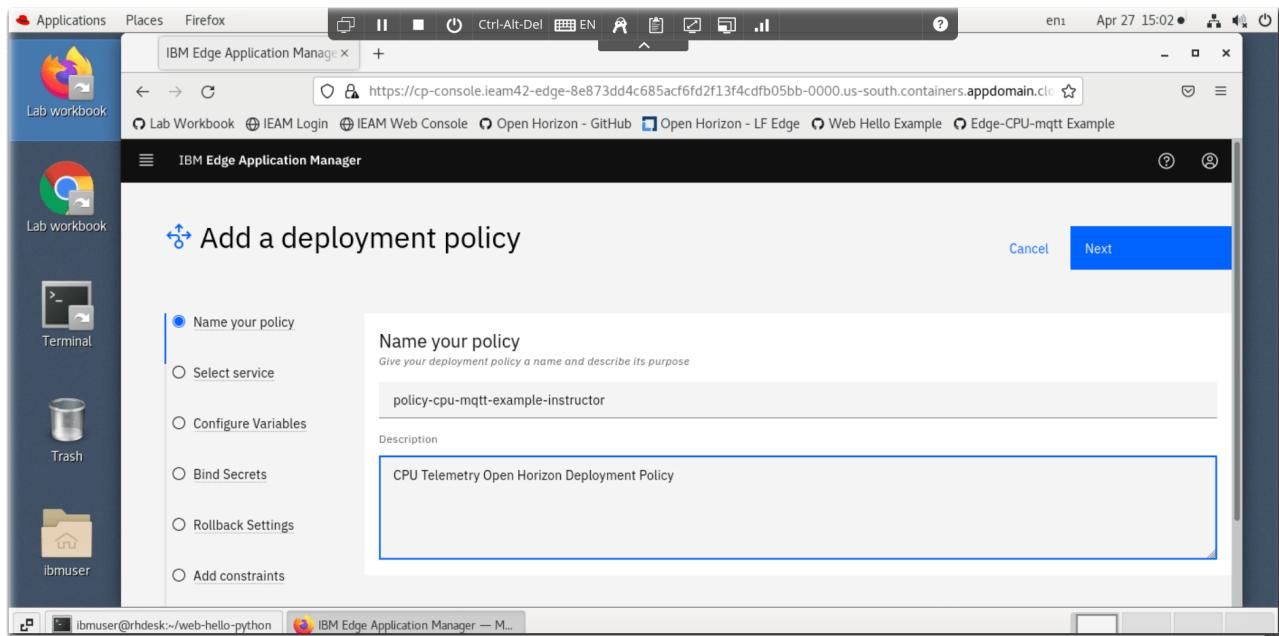
| Name | Label | Default Value |
|------------------|-------------------------|---|
| MQTT_ORGID | Watson IoT Platform Org | |
| MQTT_DEVICETYPE | Watson IoT DeviceType | ThinkEdge |
| MQTT_DEVICEID | Watson IoT Device | instructor |
| MQTT_DEVICETOKEN | Watson IoT Device Token | Think2022 |

- Now that the Service is defined, add a Policy

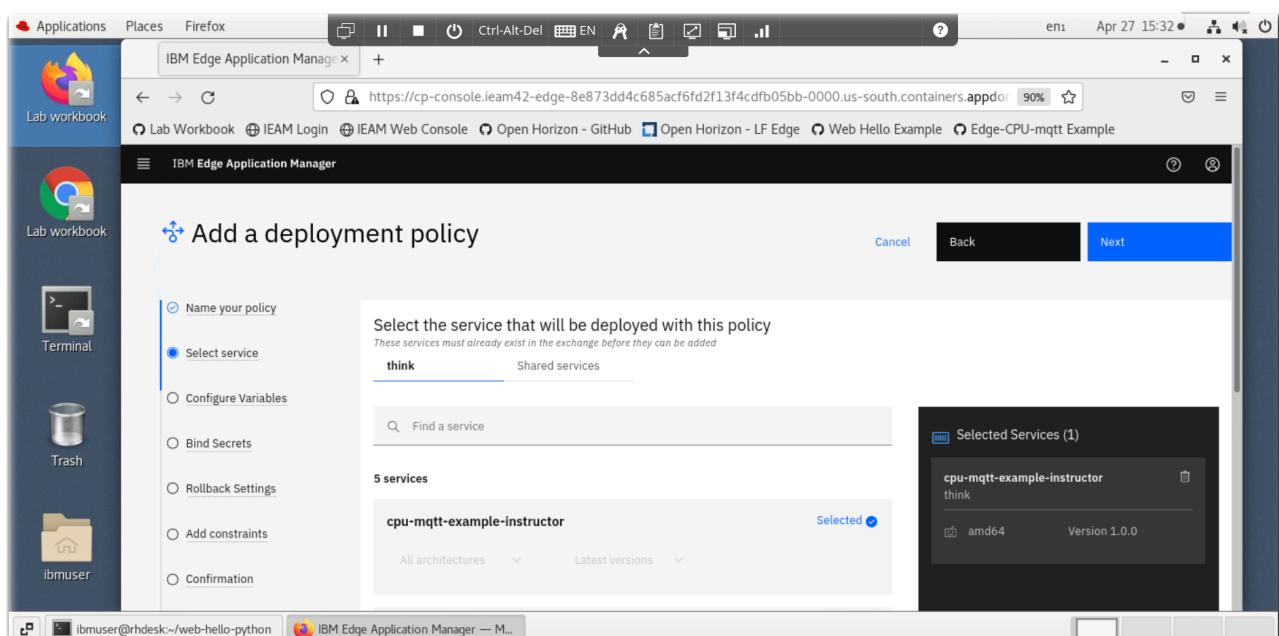
- Select the **Policies** tab and click on the **Add policy** button.

The screenshot shows the 'Policies' tab of the IBM Edge Application Manager. The 'Add policy' button is highlighted with a red box. Below it, the message 'No deployment' is displayed.

- Give your policy a name, eg `policy-cpu-mqtt-example-<yourname>` and click the **Next** button.

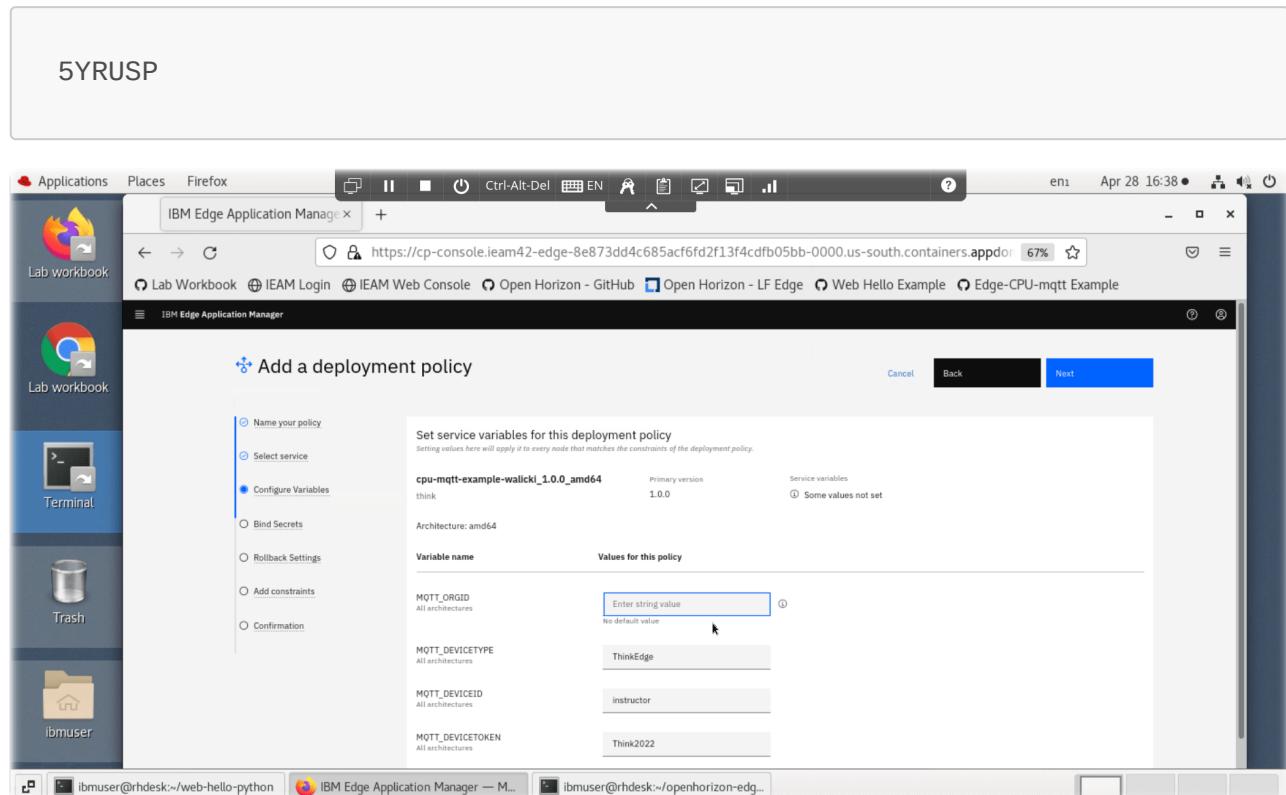


- Search / Find the `cpu-mqtt-example-<yourname>` service, press the **Add +** button and the **Next** button.

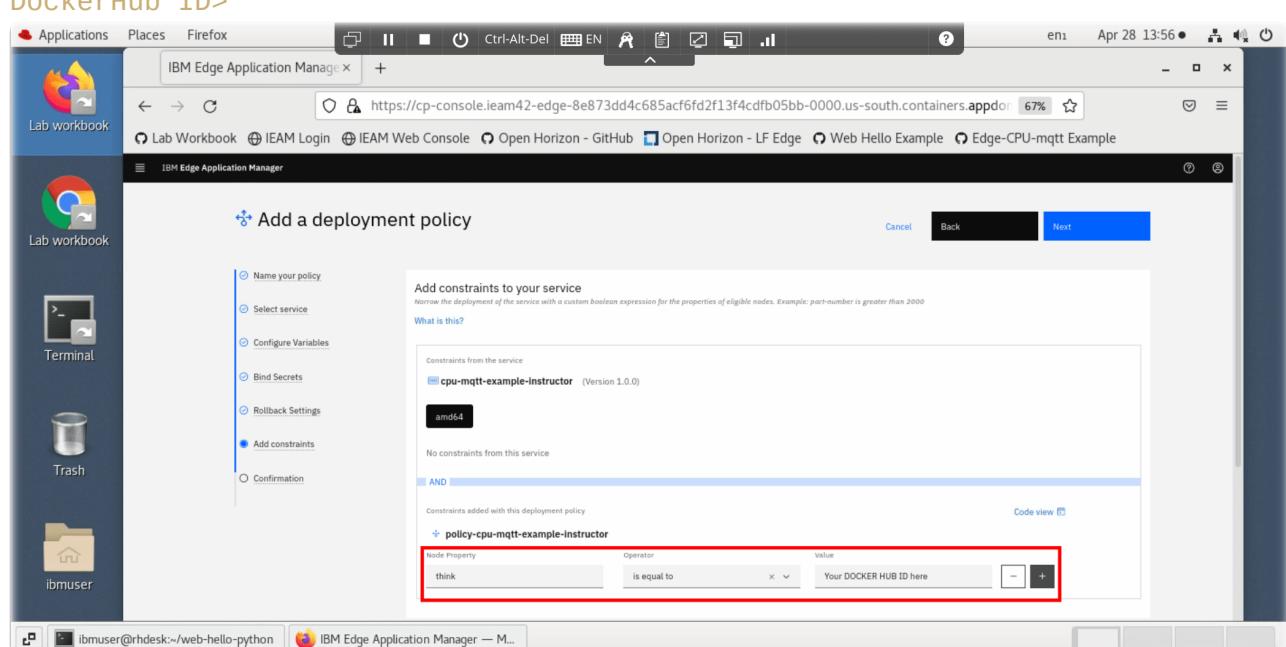


- On the **Configure Variables** panel, enter the **MQTT_ORGID** that will be dynamically added to the Service container. (For security reasons, the instructor did not want to add all the environment variables credentials to the service.json file hosted on GitHub).

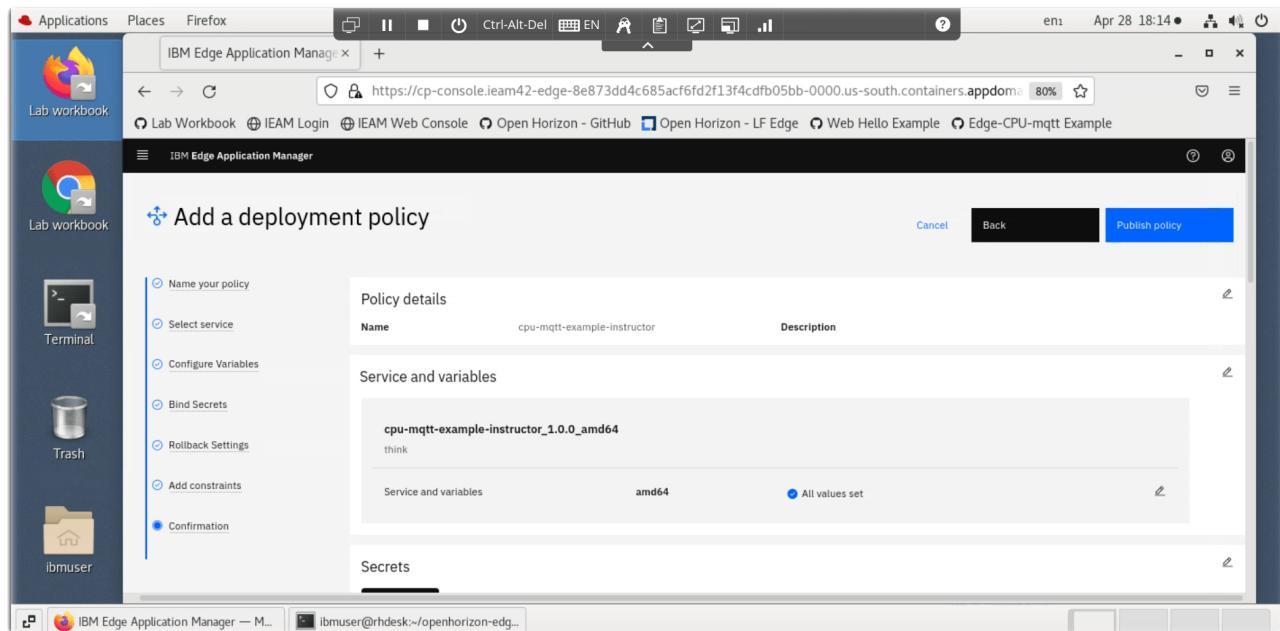
The correct value of the MQTT_ORGID is:



- Press the **Next** button to skip setting secrets for the policy
- Press the **Next** button to skip setting rollback rules for the policy
- Define constraints where this policy will be valid. Enter **think**, Enter **is equal to**, Enter <your DockerHub ID>



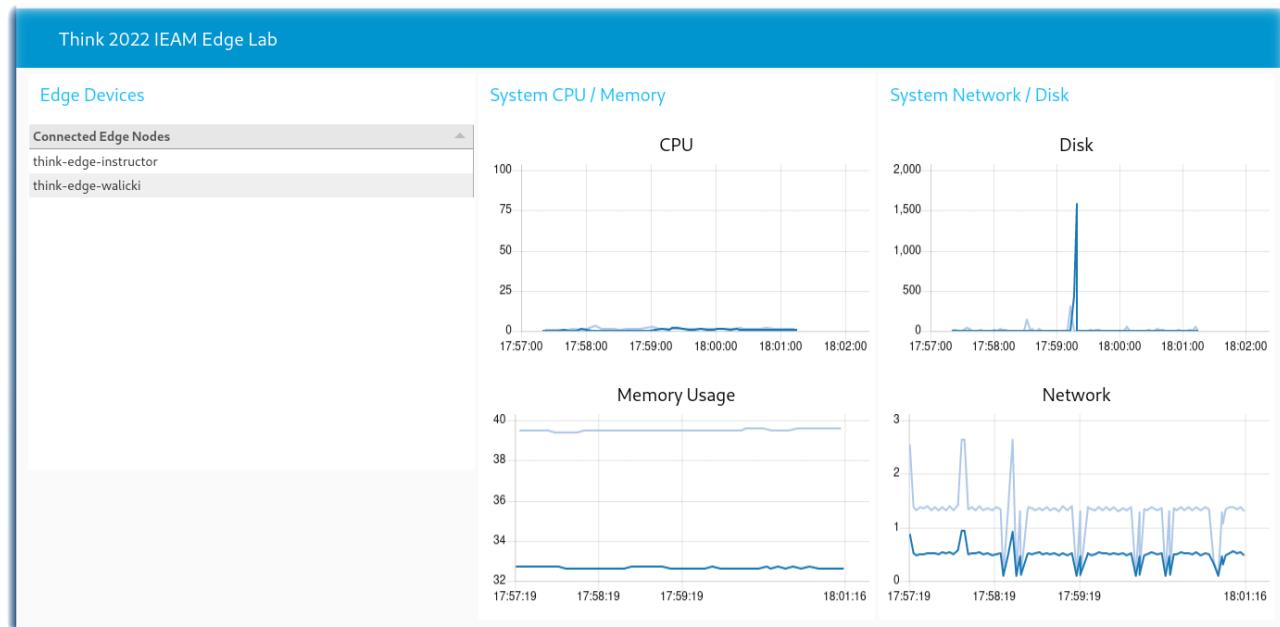
- Press the **Publish policy** button on the confirmation panel



- Before we can register this containerized workload to run on your specific Horizon edge node, you will need to unregister the prior IEAM pattern. You might have deleted it from the IEAM web console at the end of the prior section. Remember, only one deployment pattern can be registered on an edge node.

```
hzn unregister -v
make agent-run
watch hzn agreement list
```

- Observe the CPU data measured by your containerize workload by viewing the instructor's [CPU Metrics Dashboard](#)



Congratulations !

You have completed the **Think 2022 Introduction to IEAM lab**. There are additional resources below. Continue your IEAM / Open Horizon learning journey by watching the [Open Horizon YouTube video playlist](#).

If you enjoyed the session, give the [Introduction to IEAM](#) repository a GitHub star and connect with the [instructors](#).

Clean up your session before exiting the Virtual Machine by deleting your Docker credentials and unregistering your Horizon edge device.

```
rm -rf ~/.docker  
hzn unregister
```

Additional Resources

- <https://www.lfedge.org/projects/openhorizon/>
- <https://github.com/open-horizon/>
- <https://www.ibm.com/docs/en/edge-computing/4.3>
- <https://www.ibm.com/docs/en/edge-computing/4.3?topic=agent-automated-installation-registration>
- <https://github.com/open-horizon/examples>
- <https://developer.ibm.com/videos/introduction-to-ibm-edge-application-manager/>
- <https://developer.ibm.com/articles/what-is-edge-computing/>

Author

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Enjoy! Give me [feedback](#) if you have suggestions on how to improve this lab workbook.

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