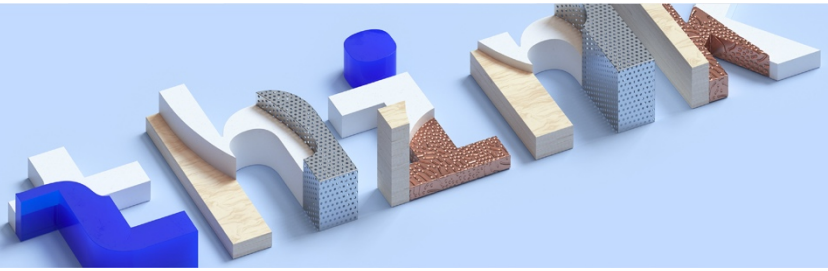


think 2018



Lab Center – Hands-on Lab

Session 4966

Getting Started with Watson IoT Edge Gateways

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1 Introduction to this lab

1.1 Welcome to this lab on Getting started with Watson IoT Edge Gateways

In this hands-on lab you will deepen your understanding about the Watson IoT Platform and the IoT Edge. You will use the Watson IoT Platform to create and configure an IoT Edge Gateway and an Edge Sensor device. You will configure and connect a small Raspberry Pi device to run as a IoT Edge Gateway. And you will develop and deploy IoT Edge workloads, like Data Management data transformation to the Edge Gateway. You will also select, provision and monitor the edge services and analytics workloads to run on the Edge Gateway.

1.2 About Watson IoT Platform

The IBM Watson Internet of Things Platform is a fully managed, cloud-hosted service available in IBM Cloud.

Devices connect and start sending data securely to the Watson IoT Platform service using the light-weight standardized MQTT messaging protocol. From there, applications can access real-time device data, and devices can be managed using secure APIs or the IoT Platform dashboard.

1.3 About Watson IoT Edge

Edge devices generally live on the edge of the network within an enterprise. They are specific hardware sensors, industrial controllers, or other industrial devices residing on private or potentially proprietary networks at a physical location.

Edge devices are creating quite a challenge for systems integrators since most are generally building cloud-based applications which rely on receiving information from IoT devices to accomplish the business goal. There are many challenges that exist in developing a path for this information flow, including: message/network protocols, bandwidth requirements, redundant data reporting and data routing/orchestration

The IBM Watson Internet of Things platform is developing new IoT Edge capabilities to create, configure and manage distribution of workloads to IoT Edge gateways. In this lab we will use IoT Edge Preview 2 beta.

Using the Watson IoT platform and IoT Edge, applications can

- Connect devices at the edge to an IoT Edge Gateway
- Avoid data loss by using the Store and Forward capability on the IoT Edge gateway

- Filter and Transform data from connected devices by distributing Data Management workloads from the Watson IoT Platform service at the IBM Cloud to the IoT Edge gateway
- Create custom edge services using Docker images and automate provisioning these services using the IoT Edge Service Catalog
- Use the MQTT message broker and routing rules on the IoT Edge gateway to publish and subscribe to messages across edge services on the IoT Edge gateway, the IoT Platform and other services on the IBM Cloud.

Watson IoT Platform and IoT Edge provides:

- IoT Edge Agent for Intel 64-bit, ARM 64-bit and ARM 64-bit Linux architectures that is installed and running on the Edge Gateway to manage the IoT edge service
- IoT Edge Service Catalog with edge services that can be configured to run on edge gateways
- Additions to Device Types and Devices in the IoT Platform Dashboard and APIs to create Edge Gateways.
- Additions to Devices in the IoT Platform Dashboard and APIs to monitor the status of edge services running at an edge gateway

In the first section of this lab you will be getting started on your workstation and logging into IBM Cloud and the Watson IoT Platform.

After the first section you will be familiarizing yourself with the Watson IoT Platform and new capabilities for IoT Edge and then start configuring the Watson IoT Platform for IoT Edge gateways and sensor devices.

2 Getting started

2.1 Starting your Workstation

In this lab you will use a Windows 7 workstation. This workstation is used to run Firefox Web browser. All access to IBM Cloud and IBM Watson IoT Platform will be made using the Firefox Web browser. Using the workstation, you will also establish an SSH connection to the Raspberry Pi using the PuTTY program.

At the start of this lab, all workstations should have been started and ready for you to use with automatic login.

Note: If you fail to log into your workstation, ask your lab facilitators for help

2.2 Logging into IBM Cloud and Watson IoT Platform

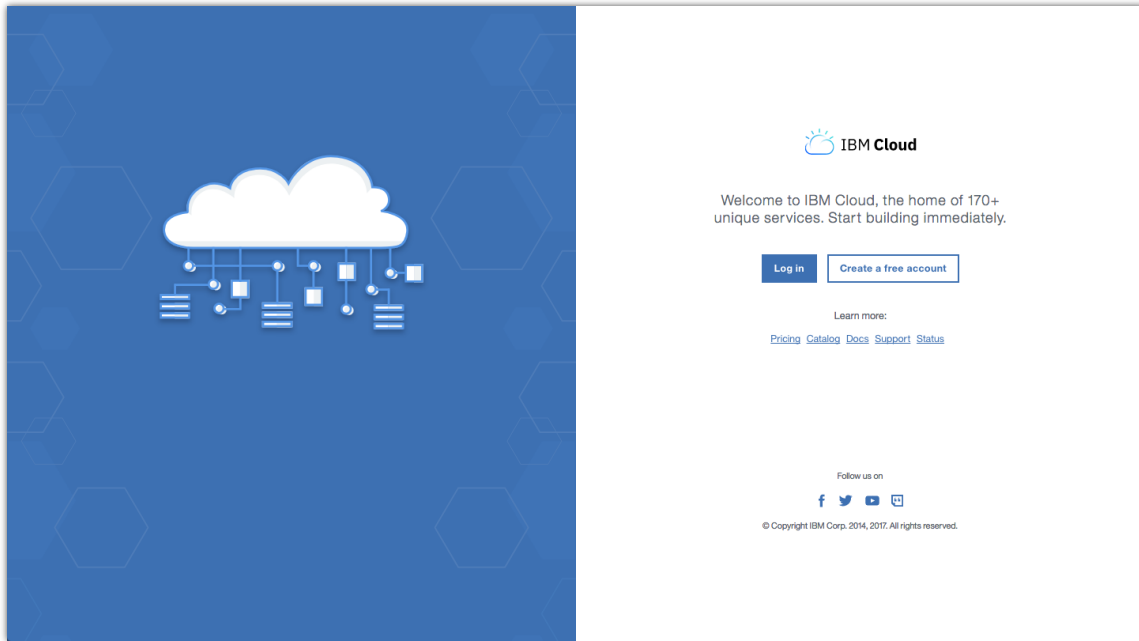
IBM Cloud, previously named Bluemix, is a cloud platform as a service (PaaS) developed by IBM. It supports several programming languages and services as well as integrated DevOps to build, run, deploy and manage applications on the cloud. IBM Cloud is based on Cloud Foundry open technology and runs on SoftLayer infrastructure.

The IBM Watson Internet of Things Platform is a fully managed, cloud-hosted service available in IBM Cloud, that makes it simple to derive value from Internet of Things (IoT) devices.

Devices can get connected and start sending data securely to the IBM Watson Internet of Things Platform cloud service using the open, lightweight MQTT messaging protocol. From there, you can setup and manage your devices using your online dashboard or our secure APIs, so that your apps can access live and historical data quickly. With your devices connected to the IoT platform, you are now ready to start creating applications using your device data.

In this lab you will use the IBM Watson Internet of Things Platform service available in IBM Cloud. To get access to the IoT platform you first have to log into IBM Cloud and then browse to the IBM Watson Internet of Things Platform service.

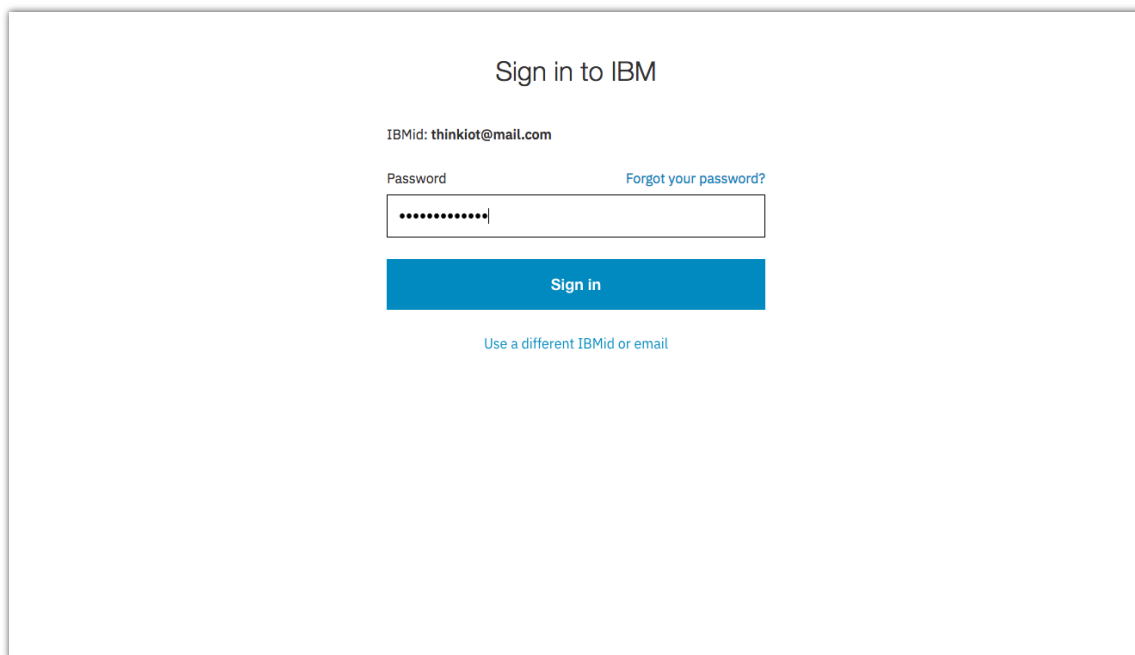
1. Open the Firefox browser on your workstation
2. Enter <https://bluemix.net>
The IBM Cloud welcome page opens



3. Click on **Log in**
4. Enter the IBM ID

The image shows the IBM Sign in page. At the top, it says "Sign in to IBM". Below this, there is a label "Enter IBMID or email" and a link "Forgot your IBMID?". A text input field contains the email address "thinkiot@mail.com". Below the input field is a blue "Continue" button. At the bottom, there is a link "New? Create an IBMID."

5. Enter the password and click **Sign in**



Sign in to IBM

IBMid: thinkiot@mail.com

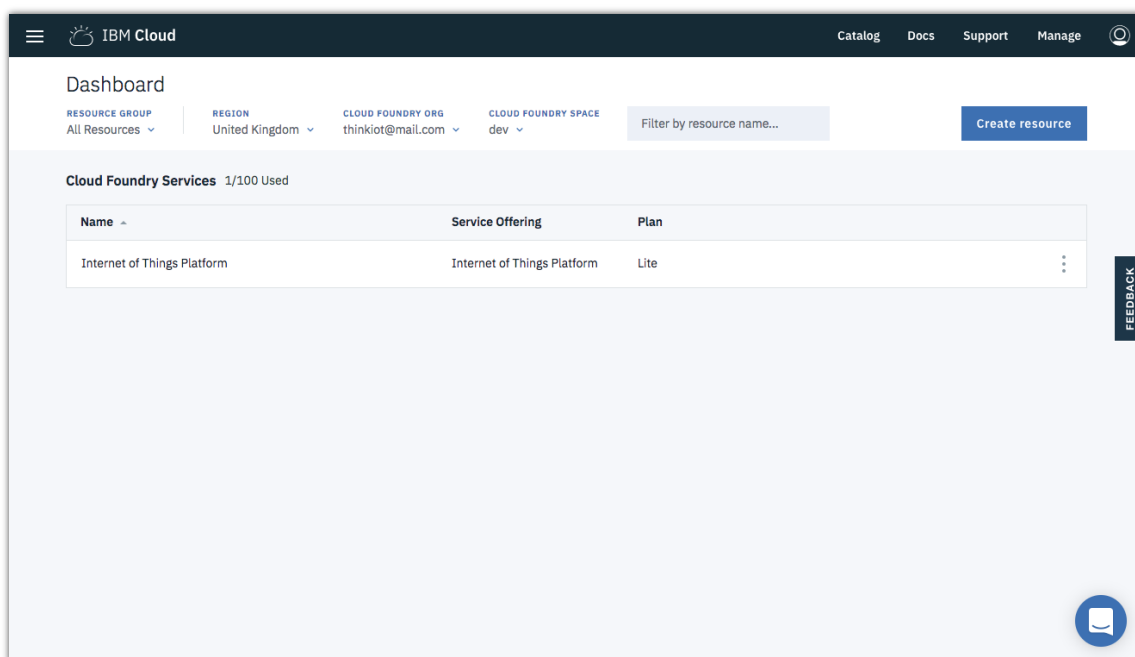
Password [Forgot your password?](#)

.....

Sign in

[Use a different IBMid or email](#)

6. The IBM Cloud Dashboard is loaded.



IBM Cloud

Dashboard

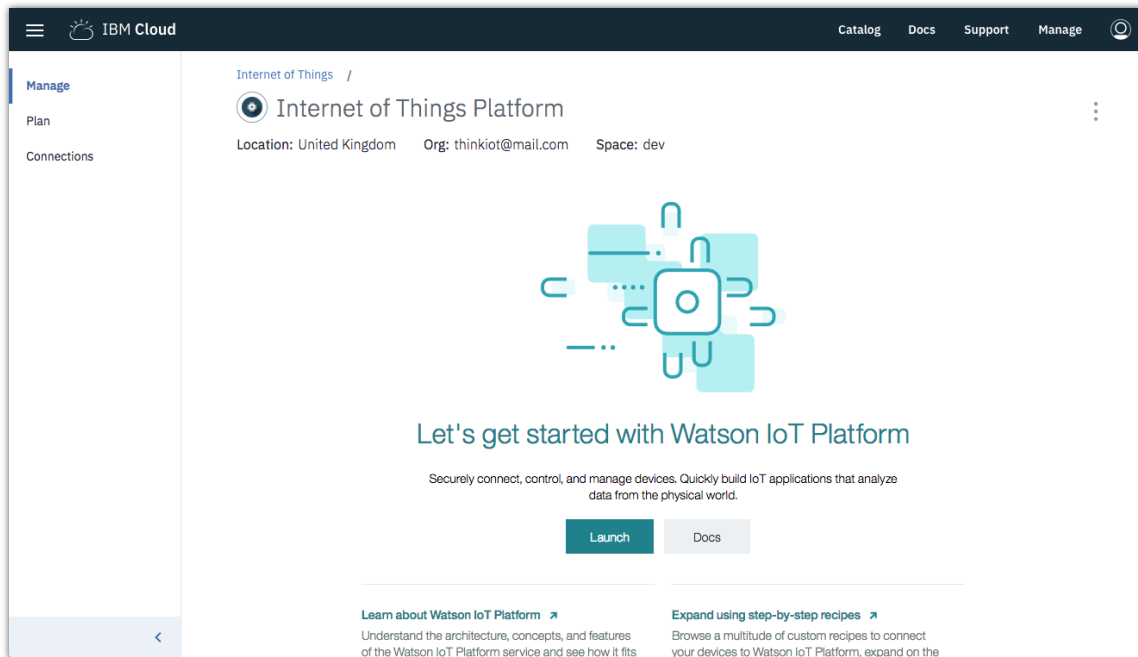
RESOURCE GROUP: All Resources | REGION: United Kingdom | CLOUD FOUNDRY ORG: thinkiot@mail.com | CLOUD FOUNDRY SPACE: dev | Filter by resource name... | **Create resource**

Cloud Foundry Services 1/100 Used

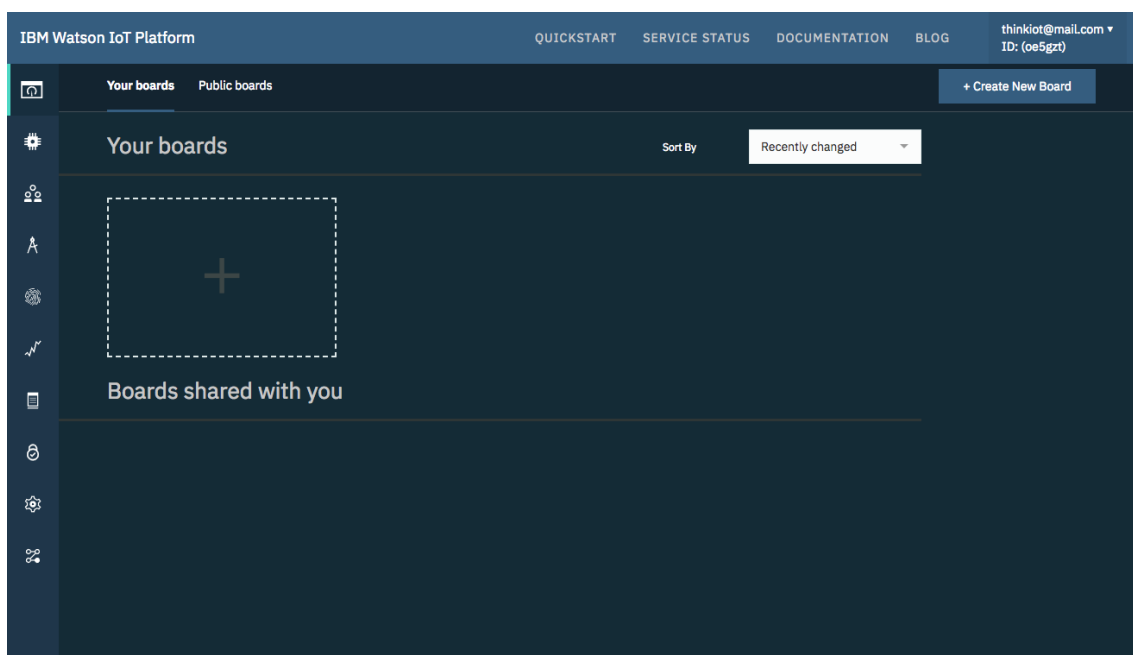
Name	Service Offering	Plan
Internet of Things Platform	Internet of Things Platform	Lite

FEEDBACK

7. In the list of Services, click on the **Watson Internet of Things Platform** service.
The Watson Internet of Things Platform service opens.



8. Click **Launch** to open the IoT platform web interface.
The Watson IoT Platform opens and shows the platform dashboard.



You have now successfully logged into IBM Cloud and launched the IBM Watson IoT Platform service. You are now ready to switch to the IoT platform *organization* that you will use in this lab.

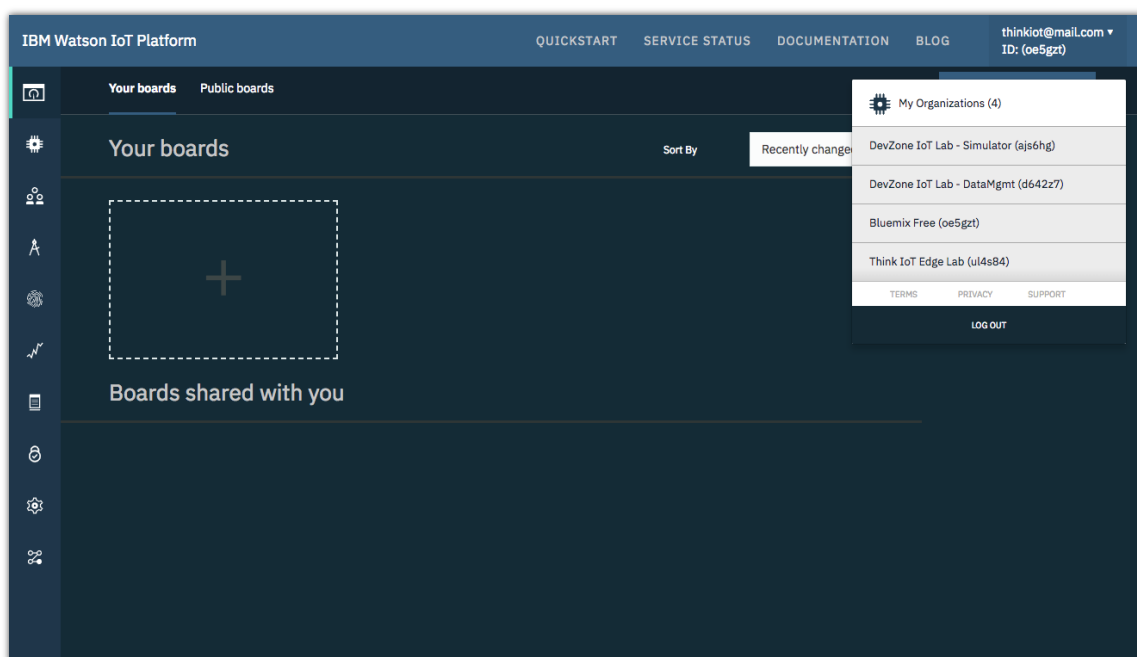
When you register with the Watson IoT Platform, you are given an organization ID. Your organization ID is a unique six-character identifier for your account. Organizations ensure that your data is organized and accessible by your devices and applications. An IoT platform organization is hence a workspace that independently of other organizations

manages users, devices and device data. An organization can be shared, and you can invite other IBM Cloud users to your organization.

In this lab we will use a shared IoT platform organization across all lab workstations. Your lab facilitators will inform you about the organization id and organization name.

To switch to the organization

1. Click on the organization menu in the upper right-hand corner of the IoT Platform screen.
2. In the list, choose the **Think IoT Edge Lab (ul4s84)** organization name to be used in this lab.
3. The Watson IoT Platform will reload the page and open the selected organization

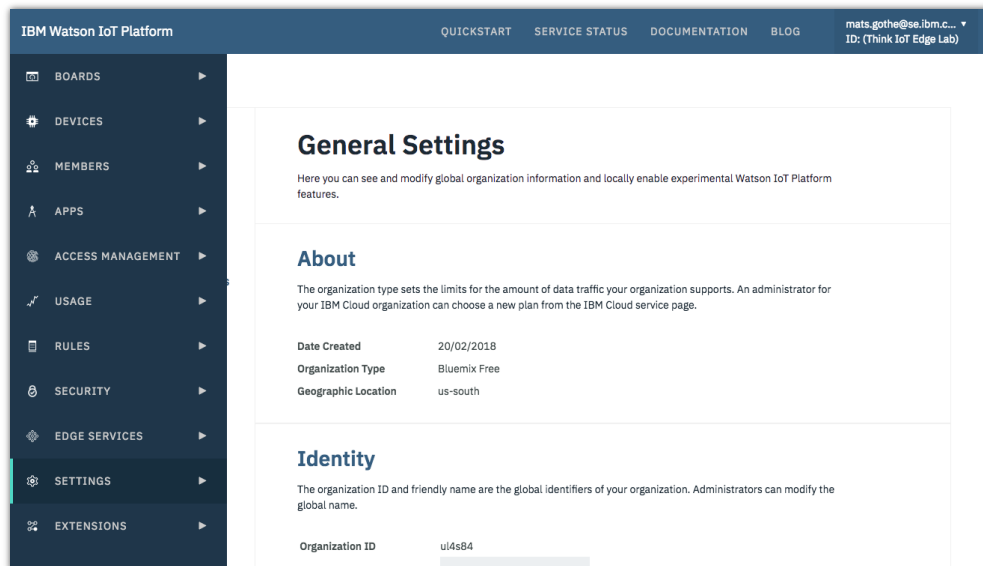


You have now successfully switched to the Watson IoT Platform organization that we will use in this lab.

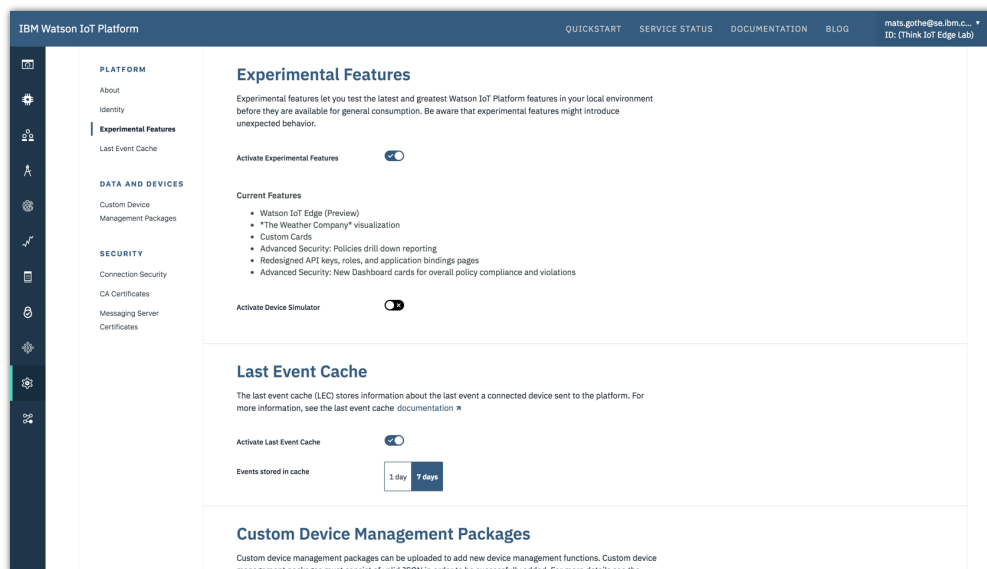
2.3 Activating IoT Edge Preview 2 Beta

In this lab we will be using the Watson IoT Platform and IoT Edge Preview 2 Beta. To activate the IoT Edge Preview 2 Beta

1. From the navigation bar, select **Settings** to open the settings page.



2. Scroll down to the Experimental Features section, or click on **Experimental Features** in the left-hand section outline



3. Experimental Features section, turn on the switch to **Activate Experimental Features**.

You have now activated Watson IoT Edge Preview 2 beta.

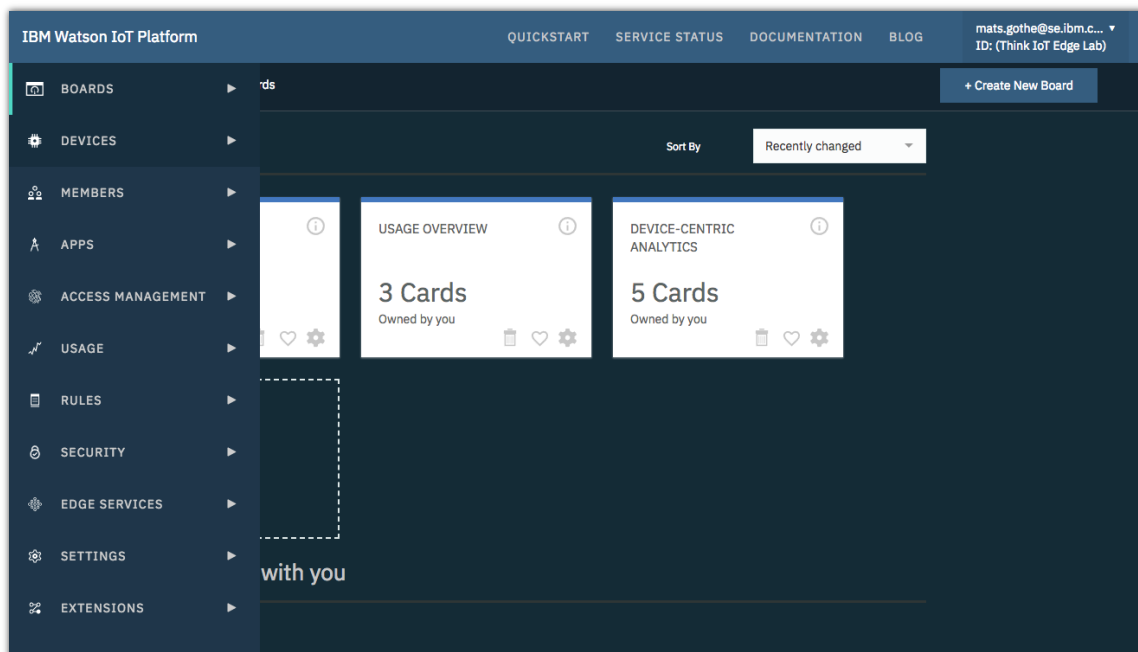
In the next section you will get an overview of the capabilities in Watson IoT Platform. We will also introduce the topic of IoT Edge.

3 Overview of the Watson IoT Platform

IBM Watson IoT Platform provides a powerful web application for administrators, operators and developers with secure access to IoT devices and device data. In this section of the lab you will familiarize yourself with the IBM Watson IoT Platform user interface.

The navigation bar on the left-hand side provides access to the capabilities of the platform

- Boards – Opens the dashboard and shows the boards and cards
- Devices – Opens a browser for registered devices and their device types
- Members – User management
- Apps – API Key management
- Access Management – Roles and Permissions
- Usage – Metrics of usage
- Rules – Analytics rules and actions
- Security – Risk and Security Policies
- Edge Services – Catalog of Services configurable to run on edge gateways
- Settings – Administration settings. For example, client and server certificates.
- Extensions – Additional capabilities, optionally enabled

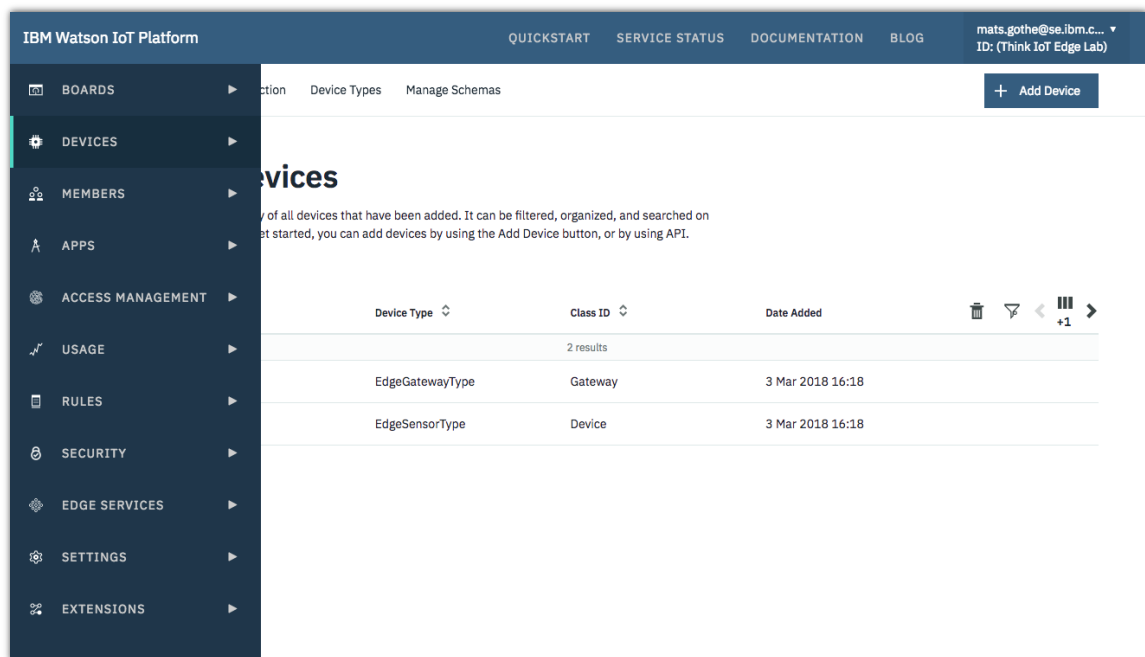


3.1 Exploring Devices and Device Types

Devices are things, like smart physical sensors and actuators, that connect to the IoT platform over internet. The Watson IoT Platform helps you define and manage your devices.

To view devices registered in the IoT platform organization

1. Move your mouse pointer to the left side navigation bar. The navigation bar slides out and shows the IoT platform capability sections.



2. In the navigation bar, choose **Devices**.
The Devices page opens. This view shows all devices registered in this organization.
Note: At the start of the lab there will only be a few devices created in the IoT platform organization.

IBM Watson IoT Platform QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas + Add Device

Browse Devices

This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.

☐	Device ID ↕	Device Type ↕	Class ID ↕	Date Added	
2 results					
☒	EdgeGateway	EdgeGatewayType	Gateway	3 Mar 2018 16:18	
☐	EdgeSensor	EdgeSensorType	Device	3 Mar 2018 16:18	

Devices of the same type, brand, make or model are of a *Device Type*. The devices view above also indicate the type for each registered device.

To view all Device Types in the IoT platform organization

1. From the section tabs at the top of the page, choose **Device Types**.
2. The Device Types page opens. This page shows all device types registered in this organization.

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Browse Diagnose Action Device Types Manage Schemas + Add Device Type

Device Types

This table lists all device types that are defined. You can filter the list and search for the name and description. You can modify and configure existing device types and add new device types.

☐	Name ↕	Description ↕	Number of Devices	
☐	EdgeGatewayType		1	
☐	EdgeSensorType		1	

Note: The Device and Device Type pages provides a list of existing resources in the IoT Platform. Using the **+ Add Device Type** and **+ Add Device** buttons, new devices and types can be added to the IoT platform

The IoT platform also categorizes devices and device types in different kinds. Each kind has a special behavior and purpose.

- *Devices* are sensors and actuators that connect directly to the IoT platform using MQTT or HTTPS protocols. Devices publish messages with sensor readings
- *Gateways* are network devices that connect directly to the IoT platform and acts on behalf of devices that are connected to the gateway. Gateways pass events and commands from and to their connected devices.
- *Edge Gateways* are a special kind of gateways that can run IoT Edge workloads like data management transformation and custom developed edge services.

To view details on a device or a device type

1. Click on a device or a device type row in the list view. For example, the device type **EdgeGatewayType**
2. The list view row expands and shows detailed information of the selected device or a device type.

IBM Watson IoT Platform

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Browse Diagnose Action **Device Types** Manage Schemas + Add Device Type

This table lists all device types that are defined. You can filter the list and search for the name and description. You can modify and configure existing device types and add new device types.

☐	Name	Description	Number of Devices	
☒	EdgeGatewayType		1	
	EdgeSensorType		1	

EdgeGatewayType

Identity Device Information Interface Edge Services

Device Type: EdgeGatewayType
Edge Capabilities: Yes
Architecture: ARM 32 bit (armhf)
Date Created: 3 Mar 2018 16:17
Description:
Number of Devices: 1 Connected Device

Note: The Device and Device Type pages provides a list of existing resources in the IoT Platform. Using the **+ Add Device Type** and **+ Add Device** buttons, new devices and types can be added to the IoT platform

You have now explored Devices and their Device Types in your IoT platform organization. We will now proceed and explore IoT Edge Services.

3.2 Exploring Edge Services

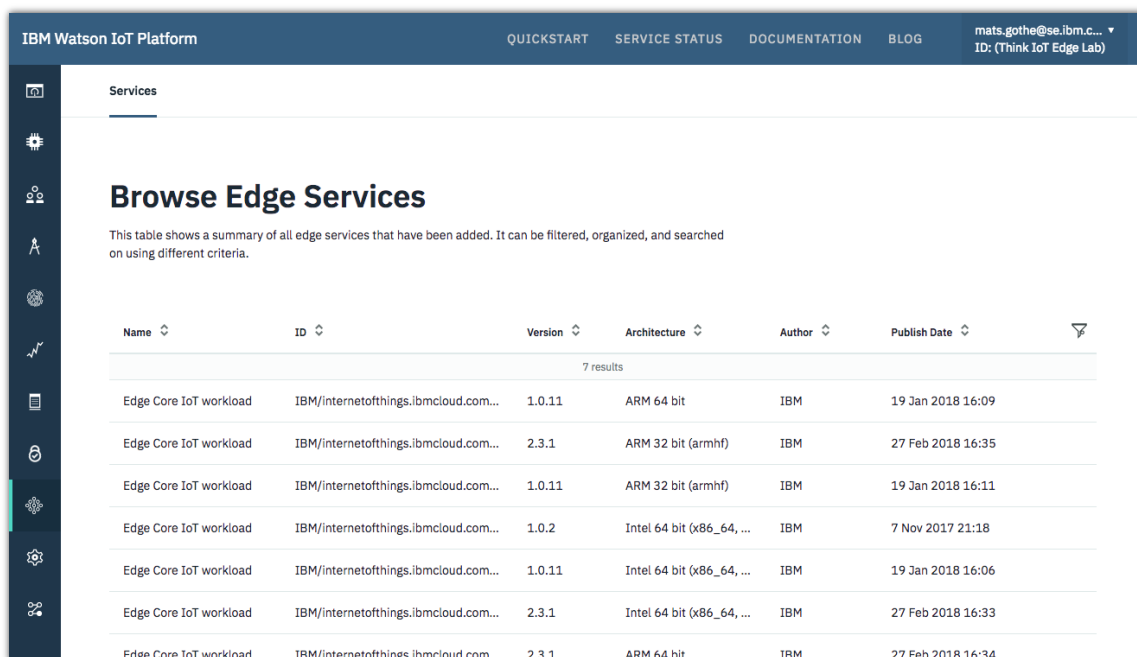
The Watson IoT Platform provides an IoT Edge Service Catalog with all edge services available to edge gateways. The catalog contains IoT edge services that are provided by IBM authors or by the authors in the currently selected IoT Platform organization.

The IoT Edge Service Catalog maintains detailed information on each IoT Edge service

- The name and version of the service
- The gateway architecture of the service, for example AMD64, ARM32 or ARM64
- The author and the creation date
- The images composing the service

To view services in the IoT Edge Service Catalog

1. From the navigation bar, select **Edge Services** to navigate to the services section.
2. The IoT Edge Service Catalog opens with the **Services** tab selected.



Name	ID	Version	Architecture	Author	Publish Date
7 results					
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 64 bit	IBM	19 Jan 2018 16:09
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	ARM 32 bit (armhf)	IBM	27 Feb 2018 16:35
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 32 bit (armhf)	IBM	19 Jan 2018 16:11
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.2	Intel 64 bit (x86_64, ...)	IBM	7 Nov 2017 21:18
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	Intel 64 bit (x86_64, ...)	IBM	19 Jan 2018 16:06
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	Intel 64 bit (x86_64, ...)	IBM	27 Feb 2018 16:33
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	ARM 64 bit	IBM	27 Feb 2018 16:34

3. Click and expand on of the edge services, for example the **Edge Core IoT workload** for **ARM 32 bit**.

The row expands and shows the detailed information on the selected edge service.

IBM Watson IoT Platform

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Services

7 results

Name	Image	Version	Architecture	Author	Publish Date
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 64 bit	IBM	19 Jan 2018 16:09
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	ARM 32 bit (armhf)	IBM	27 Feb 2018 16:35
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 32 bit (armhf)	IBM	19 Jan 2018 16:11
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.2	Intel 64 bit (x86_64, ...)	IBM	7 Nov 2017 21:18
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	Intel 64 bit (x86_64, ...)	IBM	19 Jan 2018 16:06

Identity Images

Name: Edge Core IoT workload

Description: Image for Edge Core IoT workload

ID: IBM/internetofthings.ibmcloud.com-wiotp-edge-workloads-edge-core-iot-workload_2.3.1_arm

Author: IBM

Version: 2.3.1

Architecture: ARM 32 bit (armhf)

Publish Date: 27 Feb 2018 16:35

4. Click on the **Images** tab.

Note: The images tab shows the list of Docker images that has been configured for this service. These images will be downloaded and run as Docker containers on edge gateway that are configured to run this edge service.

IBM Watson IoT Platform

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Services

7 results

Name	Image	Version
edge-core-iot-workload	wiotp-connect/edge/armhf/edge-core-iot-workload:1.0.3	1.0.3
edge-mqttbroker	wiotp-connect/edge/armhf/edge-mqttbroker:1.1.3	1.1.3
edge-connector	wiotp-connect/edge/armhf/edge-connector:2.3.2	2.3.2
edge-im	wiotp-infomgmt/edge/armhf/edge-im:1.0.12	1.0.12

Images within this Service

Name	Image	Version
edge-core-iot-workload	wiotp-connect/edge/armhf/edge-core-iot-workload:1.0.3	1.0.3
edge-mqttbroker	wiotp-connect/edge/armhf/edge-mqttbroker:1.1.3	1.1.3
edge-connector	wiotp-connect/edge/armhf/edge-connector:2.3.2	2.3.2
edge-im	wiotp-infomgmt/edge/armhf/edge-im:1.0.12	1.0.12

You have now a basic understanding of device types, devices and gateways, and edge services

We will now create a new Gateway Type and select services from the IoT Edge Service catalog.

4 Configuring Watson IoT Edge

4.1 Creating a new Edge Gateway Type

You will now create a new device type representing your type of edge gateways.

To create a new Device Type

1. On the navigation bar, select **Devices** to navigate to the devices section.

The screenshot shows the IBM Watson IoT Platform interface. The left navigation bar has 'DEVICES' selected. The main content area is titled 'Devices' and contains a table with 2 results. The table has columns for Device Type, Class ID, and Date Added. The data rows are EdgeGatewayType (Gateway) and EdgeSensorType (Device), both added on 3 Mar 2018 16:18.

Device Type	Class ID	Date Added
EdgeGatewayType	Gateway	3 Mar 2018 16:18
EdgeSensorType	Device	3 Mar 2018 16:18

2. Choose the **Device Types** tab.

The screenshot shows the IBM Watson IoT Platform interface with the 'Device Types' tab selected. The main content area is titled 'Device Types' and contains a table with 2 results. The table has columns for Name, Description, and Number of Devices. The data rows are EdgeGatewayType (1) and EdgeSensorType (1).

Name	Description	Number of Devices
EdgeGatewayType		1
EdgeSensorType		1

3. Click the **+ Add Device Type** button to add a new device type.
The Add Type page opens.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.goth@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas

Add Type Identity Device Information Edge Services

Select Type

Device types group devices that have similar characteristics, such as model number, firmware version, or location. Give the device type a unique name and a description that identifies characteristics that are shared by devices of this type.

Type Device Or Gateway

Name Enter Name

The device type name is used to identify the device type uniquely and uses a restricted set of characters to make it suitable for API use.

Description

Edge Services ☒

Architecture Intel 64 bit (x86_64, amd64)

4. On the Add Type page
 - a. Select the **Gateway** type
 - b. Enter a unique **Name**. Use the gateway type name given for your lab station
 - c. Turn on the **Edge Services** to make this type an Edge Gateway Type
 - d. In the Architecture drop-down, choose the **ARM 32 bit (armhf)** option

IBM Watson IoT Platform

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Browse Diagnose Action **Device Types** Manage Schemas

Add Type Identity Device Information Edge Services

Select Type

Device types group devices that have similar characteristics, such as model number, firmware version, or location. Give the device type a unique name and a description that identifies characteristics that are shared by devices of this type.

Type Device Or Gateway

Name EdgeGatewayTypeZ

The device type name is used to identify the device type uniquely and uses a restricted set of characters to make it suitable for API use.

Description

Edge Services ☒

Architecture ARM 32 bit (armhf)

Cancel Next

5. Click **Next**. The Device Type Information page opens.

IBM Watson IoT Platform

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Browse Diagnose Action **Device Types** Manage Schemas

Add Type Identity **Device Information** Edge Services

Device Information

You can enter more information about the device type for identification purposes.

Serial Number

Model

Description

Hardware Version

Manufacturer

Device Class

Firmware Version

Descriptive Location

+ Add Metadata

< Next

Device Types

This table lists all device types that are defined. You can filter the list and search for the name and description. You

Note: A device type may optionally specify a default template for device information metadata. In this lab we will not use this device information.

- Click **Next**. The Edge Services page opens. In this page you can select and configure the edge services to run on edge gateways of this gateway type.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas

Add Type Identity Device Information **Edge Services**

Edge Services

Edge Services on this Gateway

The Edge Core IoT service is added to all edge nodes, but you can select additional edge services to be added. Add Edge Services +

Edge Core IoT workload ⓘ
Image for Edge Core IoT workload

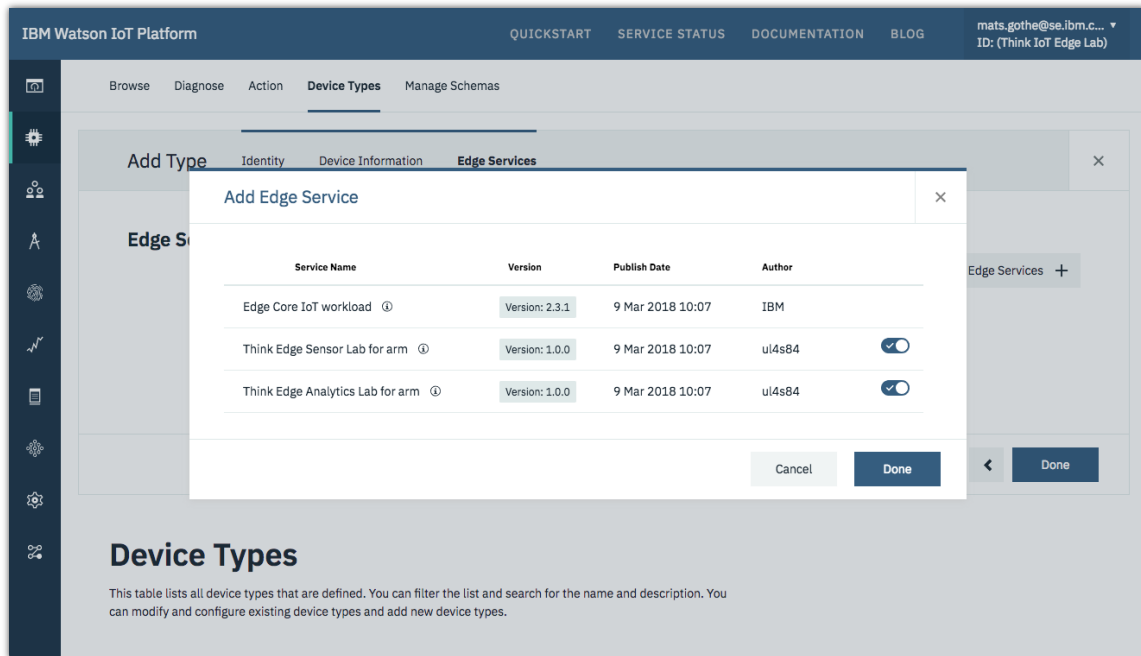
< Done

Device Types

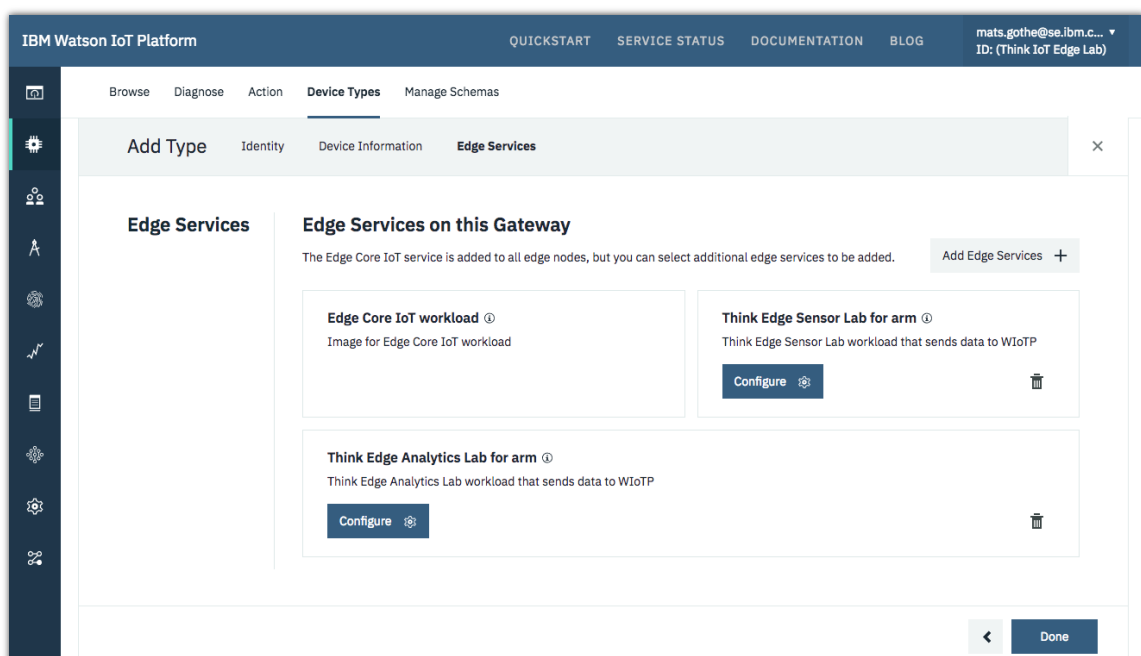
This table lists all device types that are defined. You can filter the list and search for the name and description. You can modify and configure existing device types and add new device types.

Note: The Edge Core IoT Workload is a mandatory edge service on edge gateways.

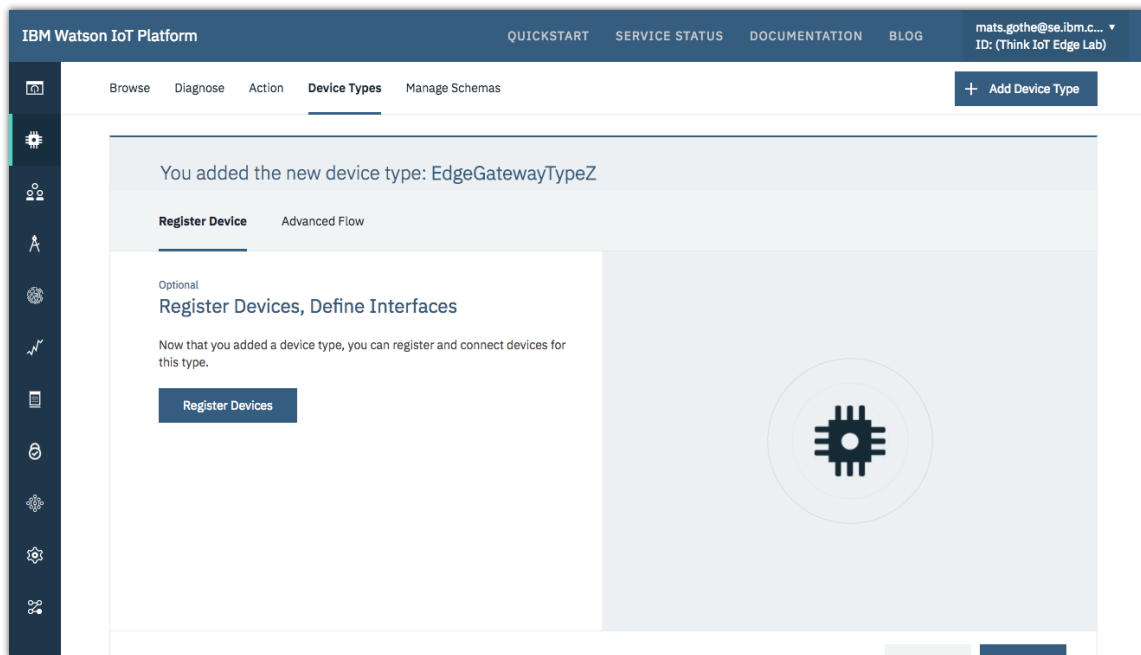
- Click on **Add Edge Service +** to add additional edge services for your edge gateway in this lab.
- In the Add Edge Services dialog, select the **Think Edge Sensor Lab for arm** and **Think Edge Analytics Lab for arm** services.



- Click **Done**



10. Click **Done** to complete the adding of the gateway type



You have now created the Edge Gateway Type that will be used when creating an Edge Gateway instance in the next section.

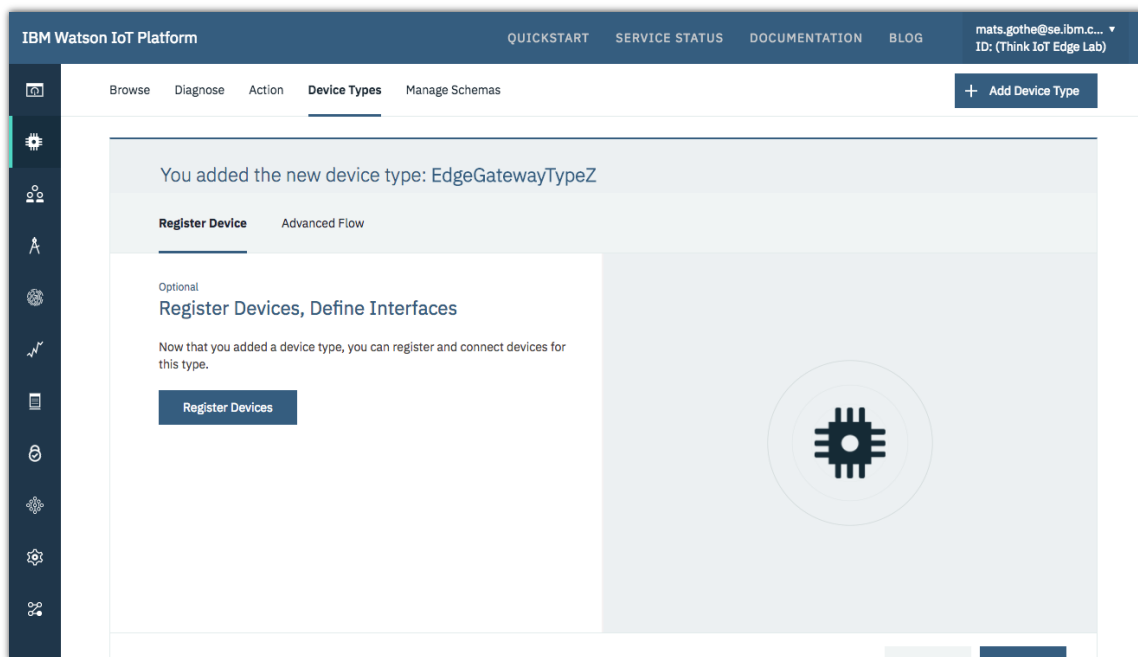
When proceeding to the next step we will use the Register Devices button on the confirmation screen above. Keep this page open for next step.

4.2 Creating a new Edge Gateway

All devices has to be registered prior to connecting to the Watson IoT Platform. Registering a device will declare its identity. A security token will be generated to be used by the device when authenticating to the IoT platform.

To create a new Edge Gateway

1. On the New Device Type information page below, click **Register Devices** button to add a new gateway.



Alternatively: In case the page above was closed, do the following.

On the navigation bar, select **Devices** to open the devices section.
Then click the **+ Add Device** button.

2. On the Add Device page, select the Edge Gateway Type you created in the previous section and **enter a unique Device ID as the gateway name.**
Note: Use the gateway name given for your lab station.

The screenshot shows the 'Add Device' modal in the IBM Watson IoT Platform. The 'Identity' tab is active. It contains a dropdown for 'Select Existing Device Type' with 'EdgeGatewayTypeZ' selected, and a text input for 'Device ID' with 'EdgeGatewayZ' entered. At the bottom right are 'Cancel' and 'Next' buttons. Below the modal, the 'Browse Devices' section is visible, stating that the table shows a summary of all devices that can be filtered, organized, and searched on.

3. Click **Next**. In this lab we will not use this device information.

The screenshot shows the 'Add Device' modal with the 'Device Information' tab selected. It contains several input fields for device details: 'Serial Number', 'Manufacturer', 'Model', 'Device Class', 'Description', 'Firmware Version', 'Hardware Version', and 'Descriptive Location'. Each field has a placeholder text like 'Enter Serial Number'. There is also an 'Add Metadata' button. At the bottom right, there is a back arrow and a 'Next' button.

- Click **Next**. On the Device Security page, enter an 8 digit Authorization Token for this device.

Note: This token will be used in later steps. Use the token **12345678**.
Alternatively, make sure you write down the token entered.

The screenshot shows the 'Add Device' dialog in the IBM Watson IoT Platform, specifically the 'Security' tab. The dialog has a sidebar with icons for various functions. The main content area is titled 'Device Security' and contains two options for selecting an authentication token: 'Auto-generated authentication token (default)' and 'Self-provided authentication token'. The 'Auto-generated' option is selected, and a text input field shows the token '12345678'. Below the input field, there is a note: 'Make a note of the generated token. Lost authentication tokens cannot be recovered. Tokens are encrypted before being stored.' and a statement: 'Authentication tokens are encrypted before we store them.'

- Click **Next**. Review the summary information about the gateway you just registered.

The screenshot shows the 'Add Device' dialog in the IBM Watson IoT Platform, specifically the 'Summary' tab. The dialog has a sidebar with icons for various functions. The main content area is titled 'Summary' and contains a list of device information: 'Device Type: EdgeGatewayTypeZ', 'Device ID: EdgeGatewayZ', and 'Security Token: 12345678'. There is a 'View Metadata' button next to the Device ID. At the bottom right, there is a 'Done' button. Below the dialog, there is a 'Browse Devices' section with a table showing a summary of all devices that have been added.

6. Click **Done**. The Device drill-down page is opened.

Note: This page shows device configuration, state and logs. It is a useful page to view device state and diagnose device connection issues.

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'QUICKSTART', 'SERVICE STATUS', 'DOCUMENTATION', and 'BLOG'. The user's email 'mats.gothe@se.ibm.c...' and ID '(Think IoT Edge Lab)' are displayed. The left sidebar contains a 'Back' button and a list of options under 'DEVICE DRILLDOWN': Device Credentials, Connection Information, Recent Events, State, Device Information, Metadata, Extension Configuration, Diagnostics, Connection Logs, and Device Actions. The main content area is titled 'Device EdgeGatewayZ' and features a 'Device Credentials' section. This section includes a warning message: 'You registered your device to the organization. Add these credentials to the device to connect it to the platform. After the device is connected, you can navigate to view connection and event details.' Below this is a table of credentials:

Organization ID	ul4s84
Device Type	EdgeGatewayTypeZ
Device ID	EdgeGatewayZ
Authentication Method	use-token-auth
Authentication Token	12345678

Below the table, a warning icon and text state: 'Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the device to generate a new authentication token.' A link 'Find out how to add these credentials to your device' is provided at the bottom.

You have now created the Edge Gateway that will be used to connect sensors and run edge services.

We will now create an Edge Sensor device type and an Edge Sensor device.

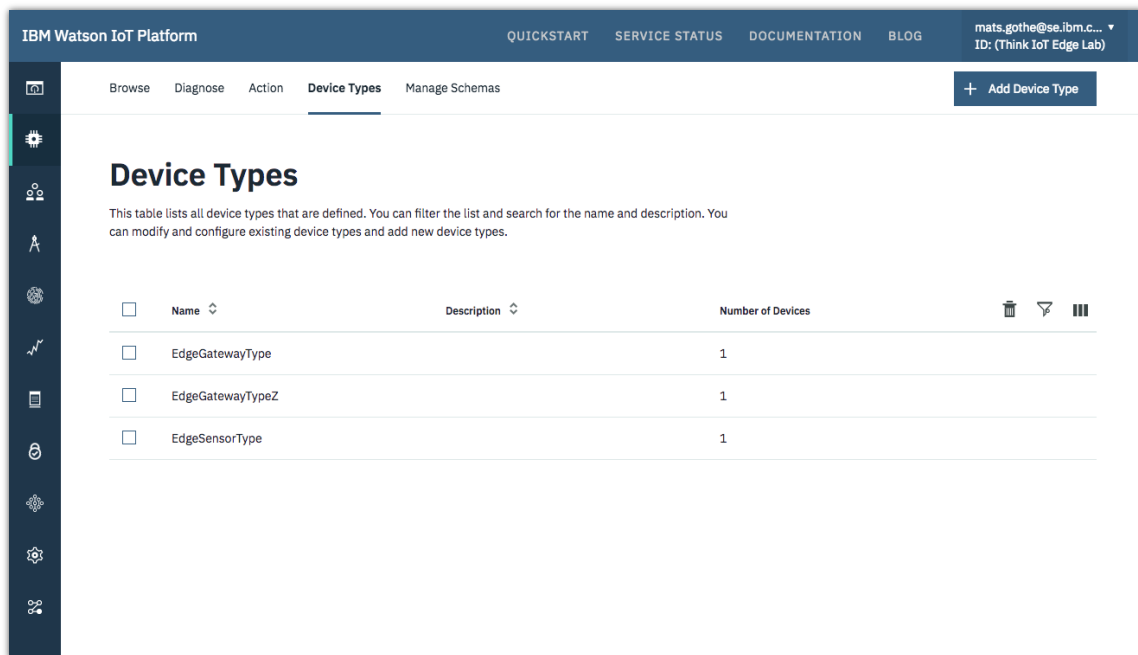
4.3 Creating an Edge Sensor Device

We will now create an edge sensor device type and an edge sensor that will be used to generate the edge sensor data in this lab.

The steps for creating an edge sensor device type and device are similar to the steps we used when creating the edge gateway type and edge gateway. We will provide less detailed instructions in this section. Ask the lab facilitators if you need help.

To create an Edge Sensor device type

1. On the navigation bar, select the **Devices** section and then the **Device Type** tab



2. Click on the **+ Add Device Type** button
3. Choose the **Device** option
4. Enter a unique **Name**.
Use the edge sensor type name provided for your workstation.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas

Add Type Identity Device Information

Select Type

Device types group devices that have similar characteristics, such as model number, firmware version, or location. Give the device type a unique name and a description that identifies characteristics that are shared by devices of this type.

Type ☒ Device Or ☐ Gateway

Name

The device type name is used to identify the device type uniquely and uses a restricted set of characters to make it suitable for API use.

Description

Cancel Next

5. Click **Next** and then click **Done** to finalize the device type definition.
6. Click **Register Devcies** button

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas + Add Device Type

You added the new device type: EdgeSensorTypeZ

Register Device Advanced Flow

Optional

Register Devices, Define Interfaces

Now that you added a device type, you can register and connect devices for this type.

Register Devices

7. On the **Add Device** page, enter a unique **Name**. use the edge sensor devcie name assigned to your workstation.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas

Add Device Identity Device Information Security Summary

Identity

Select a device type for the device that you are adding and give the device a unique ID.

Select Existing Device Type: EdgeSensorTypeZ

Device ID: EdgeSensorZ

Cancel Next

Browse Devices

This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.

8. Click **Next** and then click **Next**.
7. On the Device Security page, enter a 8 digit token for this device. Use the token **12345678**. Alternatively, make sure you write down the token entered.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas

Add Device Identity Device Information **Security** Summary

Device Security

There are two options for selecting a device authentication token.

Auto-generated authentication token (default)

Allow the service to generate an authentication token for you. Tokens are 18 characters and contain a mix of alphanumeric characters and symbols. The token is returned to you at the end of the device registration process.

Authentication Token: 12345678

Make a note of the generated token. Lost authentication tokens cannot be recovered. Tokens are encrypted before being stored.

Authentication token are encrypted before we store them.

Self-provided authentication token

Provide your own authentication token for this device. The token must be between 8 and 36 characters and contain a mix lowercase and uppercase letters, numbers, and symbols, which can include hyphens, underscores, and periods. Do not use repeated characters, dictionary words, user names, or other predefined sequences.

8. Click **Next** and then **Done**.

You have now created the Edge Sensor Type and Edge Sensor that will be used to generate sensor values in this lab.

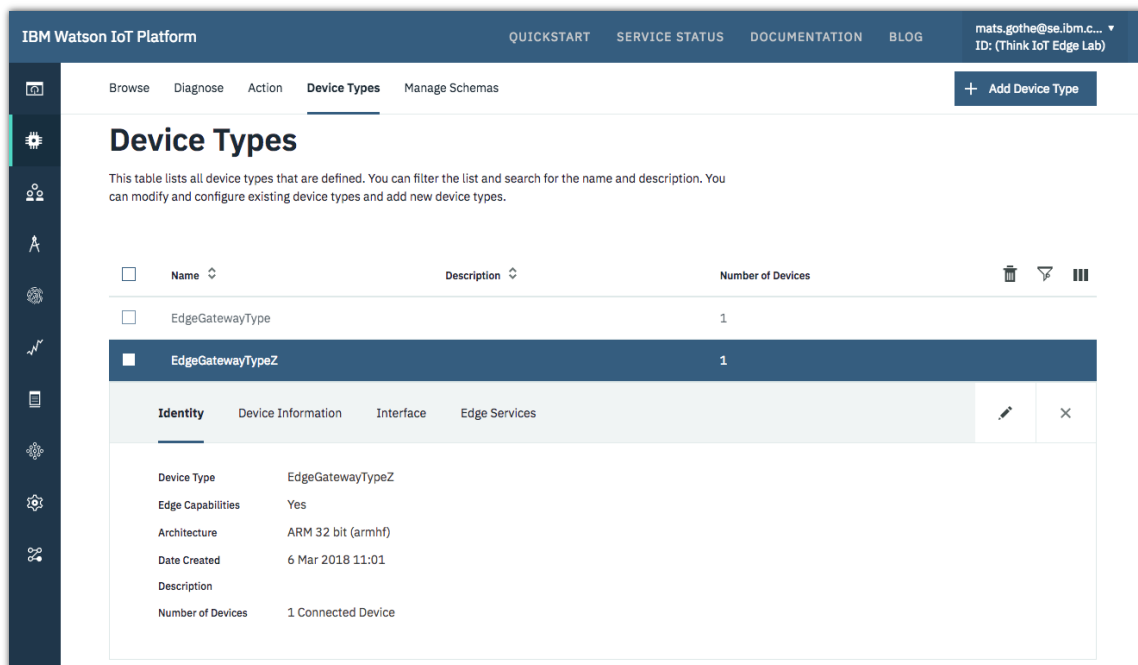
4.4 Finalizing the Edge Gateway Type configuration

In the previous section we created the Edge Sensor Type and the Edge Sensor device. We can now finalize the edge service configuration in the Edge Gateway Type.

The **Think Edge Sensor Lab for arm** and **Think Edge Analytics Lab for arm** services that we added to the Edge Gateway Type need the names of the Edge Sensor Type and Edge Sensor device to public and subscribe messages. This is achieved by defining environment property values to be set when provisioning the edge services on the edge gateway.

To configure the edge services

1. On the navigation bar, select **Devices** section and then the **Device Type** tab.
2. Locate and select your Edge Gateway Type



IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@sa.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas + Add Device Type

Device Types

This table lists all device types that are defined. You can filter the list and search for the name and description. You can modify and configure existing device types and add new device types.

☐	Name ↕	Description ↕	Number of Devices	
☐	EdgeGatewayType		1	
☒	EdgeGatewayTypeZ		1	

Identity Device Information Interface Edge Services

Device Type

EdgeGatewayTypeZ

Edge Capabilities

Yes

Architecture

ARM 32 bit (armhf)

Date Created

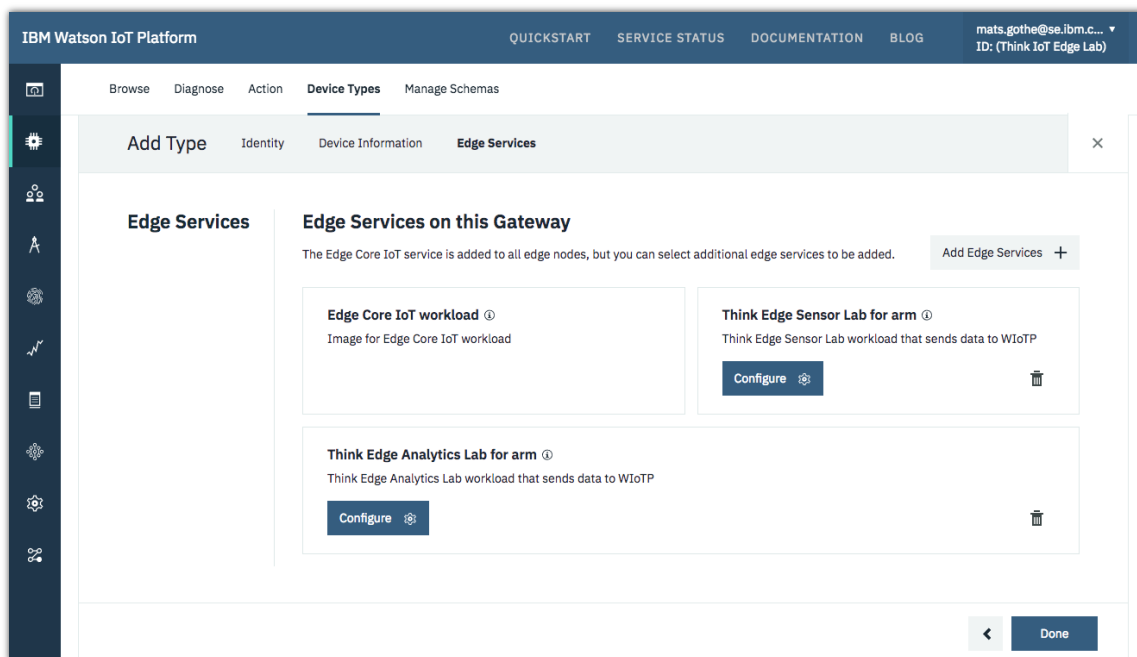
6 Mar 2018 11:01

Description

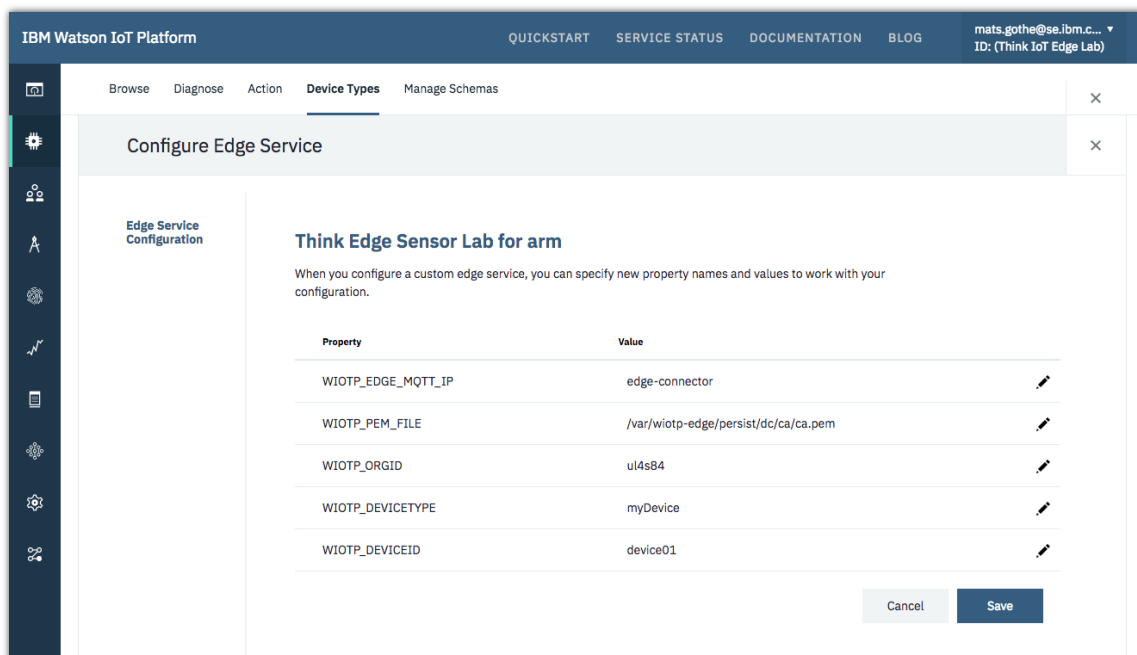
Number of Devices

1 Connected Device

3. Choose the **Edge Services** tab.



4. Click on the **Configure** button on the **Think Edge Sensor Lab for arm** service.



5. On the WIOTP_DEVICETYPE property, click on the pen icon to edit the default value.
6. Enter the name of your Edge Sensor Type device.
Remember to enter the name and your unique extension.
7. Click the check mark button to confirm your value and exit the editor.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas

Configure Edge Service

Edge Service Configuration

Think Edge Sensor Lab for arm

When you configure a custom edge service, you can specify new property names and values to work with your configuration.

Property	Value	
WIOTP_EDGE_MQTT_IP	edge-connector	
WIOTP_PEM_FILE	/var/wiotp-edge/persist/dc/ca/ca.pem	
WIOTP_ORGID	ul4s84	
WIOTP_DEVICETYPE	EdgeSensorTypeZ	
WIOTP_DEVICEID	EdgeSensorZ	

Cancel Save

8. Edit the next property, WIOTP_DEVICE, and type in the name of Edge Sensor device.
Remember to enter the name with your unique extension.
9. Click **Save**.
10. Proceed and make the exact same edits as above to the **Think Edge Analytics Lab for arm** service.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas

Configure Edge Service

Edge Service Configuration

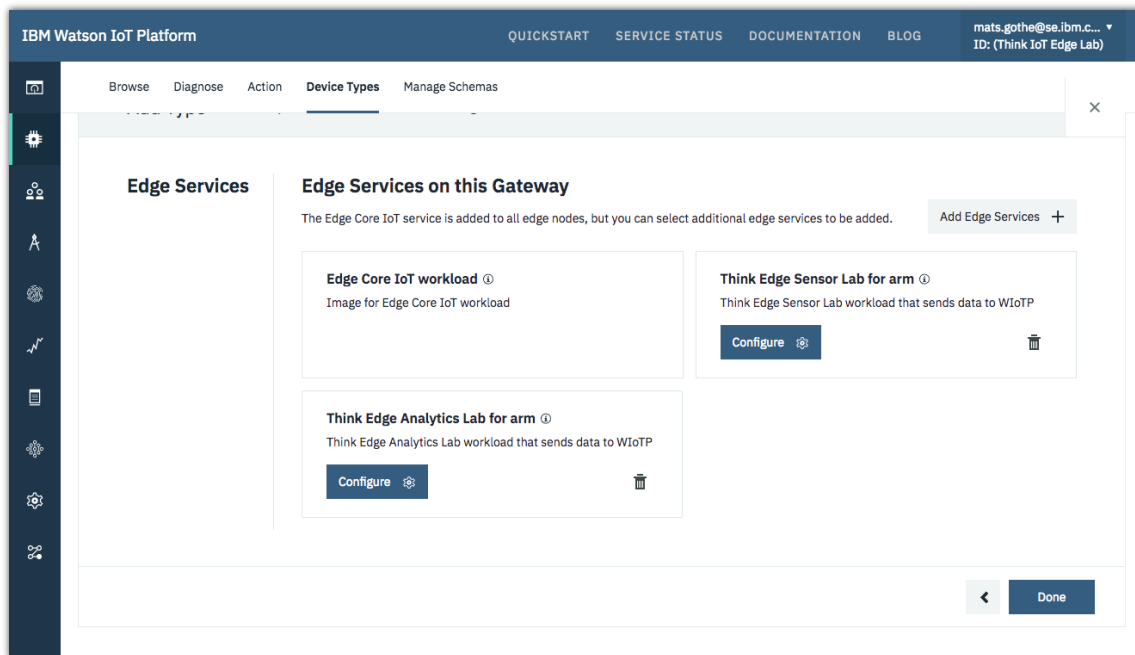
Think Edge Analytics Lab for arm

When you configure a custom edge service, you can specify new property names and values to work with your configuration.

Property	Value	
WIOTP_EDGE_MQTT_IP	edge-connector	
WIOTP_PEM_FILE	/var/wiotp-edge/persist/dc/ca/ca.pem	
WIOTP_ORGID	ul4s84	
WIOTP_DEVICETYPE	EdgeSensorTypeZ	
WIOTP_DEVICEID	EdgeSensorZ	

Cancel Save

11. Click **Save** to save the property settings for the **Think Edge Analytics Lab for arm** service.



12. Click Done to complete the final updates on the Edge Gateway Type

We have now completed the configuration of Gateways, Devices and Services in the Watson IoT Platform.

We will now start up the Raspberry Pi and configure it as an Edge Gateway.

5 Configuring the Raspberry Pi / ARM gateway

We will now log into the Raspberry Pi and configure the IoT Edge gateway. To perform the IoT Edge edge gateway configuration, we need to:

- Power up and boot the Raspberry Pi and the Raspbian OS
- Read the Raspberry Pi IP address on the Sense Hat LED display
- Establish an SSH connection to the Raspberry Pi using the PuTTY program
- Use the PuTTY SSH terminal window to run Linux commands on the Raspberry Pi
- Install the IoT Edge Agent that managed the edge services running on the gateway

Once the IoT Edge Agent is installed, configured and running, it will start the provisioning of the edge services and start the service Docker images.

To complete the edge gateway configuration, we need to:

- Verify the provisioning of the configured Edge Services to the gateway

5.1 Power up the Raspberry Pi

The Raspberry Pi is powered from the workstation using a USB cable. The Raspberry Pi is also connected to the network using a wired network cable.

To log into the Raspberry Pi

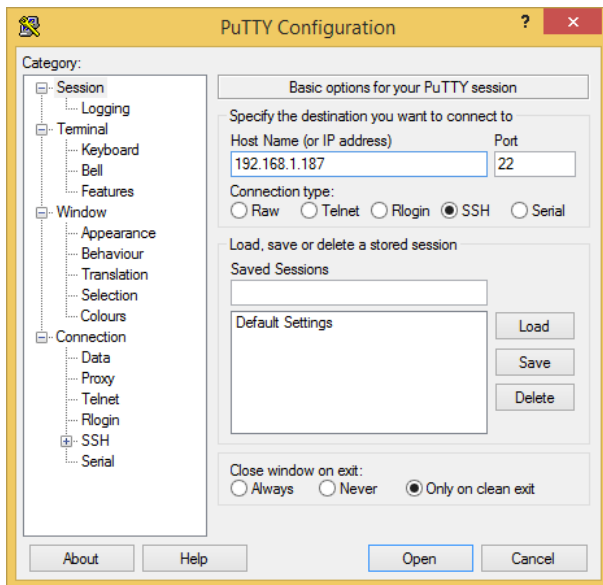
1. Power up the Raspberry Pi by attaching the USB power cable to the workstation
2. Wait a few seconds for the Raspberry Pi to boot.

View the Raspberry Pi and make a note of the IP address displayed.

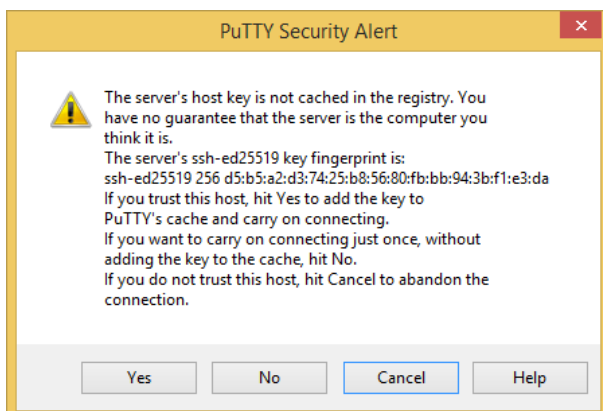
Note: The screen will display the IP address during boot time. Make sure you write down the IP address displayed. If you miss it, just detach and reattach the power to force a reboot.

3. On your Windows workstation, open the File Explorer
4. Start the putty.exe program.

Note: PuTTY is installed in C:\Program Files\PuTTY



5. Enter the IP address that you Raspberry Pi displayed at boot.
6. Click **Open**
7. In the PuTTY Security Alert dialog, click **Yes**

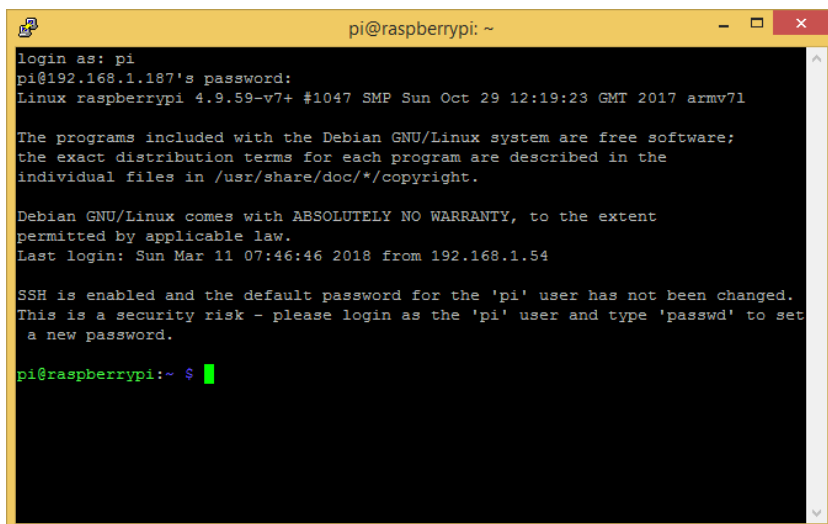


8. In the PuTTY terminal window, log in using the following account information:
 - Login as: **pi**
 - password: **raspberry**

A terminal window titled "192.168.1.187 - PuTTY" with a yellow title bar. The terminal shows a login prompt "login as: pi" and a password prompt "pi@192.168.1.187's password:" with a green cursor. The rest of the terminal is black.

```
192.168.1.187 - PuTTY
login as: pi
pi@192.168.1.187's password: 
```

9. You are now logged into your Raspberry Pi

A terminal window titled "pi@raspberrypi: ~" with a yellow title bar. The terminal shows the login banner for Raspberry Pi, including the Linux version, Debian GNU/Linux version, and a warning about SSH security. The prompt "pi@raspberrypi:~ \$" is shown with a green cursor.

```
pi@raspberrypi: ~
login as: pi
pi@192.168.1.187's password:
Linux raspberrypi 4.9.59-v7+ #1047 SMP Sun Oct 29 12:19:23 GMT 2017 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sun Mar 11 07:46:46 2018 from 192.168.1.54

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~ $ 
```

We have now established a SSH connection to the Raspberry Pi and can start configuring the IoT Edge gateway.

5.2 Installing the IoT Edge Agent

The Raspberry Pi is using an Raspbian OS pre-configured SD-card for this lab.
The following software configurations has been added:

- Raspberry SenseHat Python libraries - <https://www.raspberrypi.org/blog/sense-hat-projects/>
- Eclipse Paho Python libraries - <https://www.eclipse.org/paho/clients/python/>
- Docker CE - <https://github.com/docker/docker-ce>
- The micro editor - <https://github.com/zyedidia/micro>
- Pure FTP - <https://www.pureftpd.org/project/pure-ftpd>
- SSH enabled in Raspbian OS

To configure the Edge Gateway

1. Run as root
`sudo su -`
2. Install the IoT Edge Agent
`apt-get update && apt-get install -y horizon-wiotp`
3. Edit the following command and update with your gateway configuration details

```
wiotp_agent_setup --org ul4s84 --deviceType EdgeGatewayType --  
deviceId EdgeGateway --deviceToken 12345678 --cloudDisableCertCheck  
true
```

Note: THIS STEP IS REQUIRED TO SUCCESSFULLY CONFIGURING THE EDGE GATEWAY IN THIS LAB. ASK THE LAB FACILITATORS TO VALIDATE YOUR COMMAND.

Make sure you update the command parameters, **in red above**, matching the edge gateway type and edge gateway you have created in the Watson IoT Platform in the previous section 4.

- `--deviceType` *your edge gateway type name*
 - `--deviceId` *your edge gateway id*
 - `--deviceToken` *your edge gateway token*
4. Run your edited **wiotp_agent_setup** command on your Raspberry Pi command line.
Wait for the command to complete

You should see the following command reply

```
wiotp_agent_setup --org ul4s84 --deviceType EdgeGatewayType --deviceId EdgeGateway --
deviceToken 12345678 --cloudDisableCertCheck true
WIoT Horizon agent setup start.
Generating Edge internal certificates ...
Reading input file /etc/wiotp-edge/hznEdgeCoreIoTInput.json...
Horizon Exchange base URL:
https://ul4s84.internetofthings.ibmcloud.com/api/v0002/edgenode
Node ul4s84/g@EdgeGatewayType@EdgeGateway exists in the exchange
Initializing the Horizon node...
Setting global variables...
Setting microservice variables...
Setting workload variables...
Changing Horizon state to configured to register this node with Horizon...
Horizon node is registered. Workload agreement negotiation should begin shortly. Run
'hzn agreement list' to view.
Agent registration complete.
```

Note: If you get the command reply to

```
*** anax.json (Y/I/N/O/D/Z) [default=N] ?
```

Reply with **N** and press **return**

After the wiotp_agent_setup command has completed, the agreement negotiation and docker image provisioning starts between the IoT Edge Agent and the IoT Platform Service Registry.

5. To validate that an agreement has been made, run the command

```
hzn agreement list
```

You should see the following command reply listing the agreements for the three edge services we selected for the edge gateway.

```
hzn agreement list
[
  {
    "name": "Policy for edge-core-iot-microservice merged with
EdgeGatewayType_internetofthings.ibmcloud.com-wiotp-edge-workloads-edge-core-iot-
workload_IBM_arm",
    "current_agreement_id":
"047598d9ba0ec2ff5aee982016d743e84f98826b4315d0a9455df0900bc81521",
    "consumer_id": "IBM/wiotp-agbot-1",
    "agreement_creation_time": "2018-03-12 13:16:50 -0700 PDT",
    "agreement_accepted_time": "2018-03-12 13:17:07 -0700 PDT",
    "agreement_finalized_time": "2018-03-12 13:17:09 -0700 PDT",
    "agreement_execution_start_time": "2018-03-12 13:18:10 -0700 PDT",
    "agreement_data_received_time": "",
    "agreement_protocol": "Basic",
    "workload_to_run": {
      "url": "https://internetofthings.ibmcloud.com/wiotp-edge/workloads/edge-core-
iot-workload",
      "org": "IBM",
      "version": "2.3.1",
      "arch": "arm"
    }
  },
  {
    "name": "Policy for edge-core-iot-microservice merged with
EdgeGatewayType_internetofthings.ibmcloud.com-workloads-edgelab-analytics_ul4s84_arm",
    "current_agreement_id":
"78051fb9e71561b944a1f5b502109292d30db091ab590694debc7d6b77f16e38",
    "consumer_id": "IBM/wiotp-agbot-1",
    "agreement_creation_time": "2018-03-12 13:16:54 -0700 PDT",
    "agreement_accepted_time": "2018-03-12 13:17:12 -0700 PDT",
    "agreement_finalized_time": "2018-03-12 13:17:14 -0700 PDT",
```

```

    "agreement_execution_start_time": "2018-03-12 13:18:27 -0700 PDT",
    "agreement_data_received_time": "",
    "agreement_protocol": "Basic",
    "workload_to_run": {
      "url": "https://internetofthings.ibmcloud.com/workloads/edgelab-analytics",
      "org": "ul4s84",
      "version": "1.0.0",
      "arch": "arm"
    }
  },
  {
    "name": "Policy for edge-core-iot-microservice merged with
EdgeGatewayType_internetofthings.ibmcloud.com-workloads-edgelab-sensor_ul4s84_arm",
    "current_agreement_id":
"ddaa8f913e6457effc8e1ecd2b82b8b5fbbdaed6e8e889d974bc8f0e52d41716",
    "consumer_id": "IBM/wiotp-agbot-1",
    "agreement_creation_time": "2018-03-12 13:16:57 -0700 PDT",
    "agreement_accepted_time": "2018-03-12 13:17:16 -0700 PDT",
    "agreement_finalized_time": "2018-03-12 13:17:19 -0700 PDT",
    "agreement_execution_start_time": "",
    "agreement_data_received_time": "",
    "agreement_protocol": "Basic",
    "workload_to_run": {
      "url": "https://internetofthings.ibmcloud.com/workloads/edgelab-sensor",
      "org": "ul4s84",
      "version": "1.0.0",
      "arch": "arm"
    }
  }
]

```

6. To validate that the edge service Docker images has been downloaded, run the command

docker images

Note: There may take a few minutes to download the images to your gateway.

You should see the following command reply

```

docker images
REPOSITORY                                TAG                IMAGE ID
CREATED                                SIZE
wiotp-connect/edge/armhf/edge-connector    2.4.1              17f451a5e04e
4 days ago                                17MB
wiotp-infomgmt/edge/armhf/edge-im          1.0.15             bdb5bc447c65
5 days ago                                48.5MB
ibmiotest/workload_arm_edgelab-sensor      1.0.0              4829111aefb2
5 days ago                                392MB
ibmiotest/workload_arm_edgelab-analytics   1.0.0              a80c875178be
5 days ago                                392MB
wiotp-connect/edge/armhf/edge-mqttbroker   1.1.3              d1c9d48ff6eb
2 weeks ago                                19MB
wiotp-infomgmt/edge/armhf/edge-im          1.0.12             10bb4d9657d6
2 weeks ago                                48.5MB
wiotp-connect/edge/armhf/edge-connector    2.3.2              58cfe54a44fd
4 weeks ago                                21.4MB
wiotp-connect/edge/armhf/edge-core-iot-workload 1.0.3              7dfb00cbc477
3 months ago                                12.8MB
armhf/ubuntu                               latest             fa40ea71de37
15 months ago                                106MB

```

7. To validate that the edge service Docker containers has been started, run the command

docker ps

You should see the following command reply

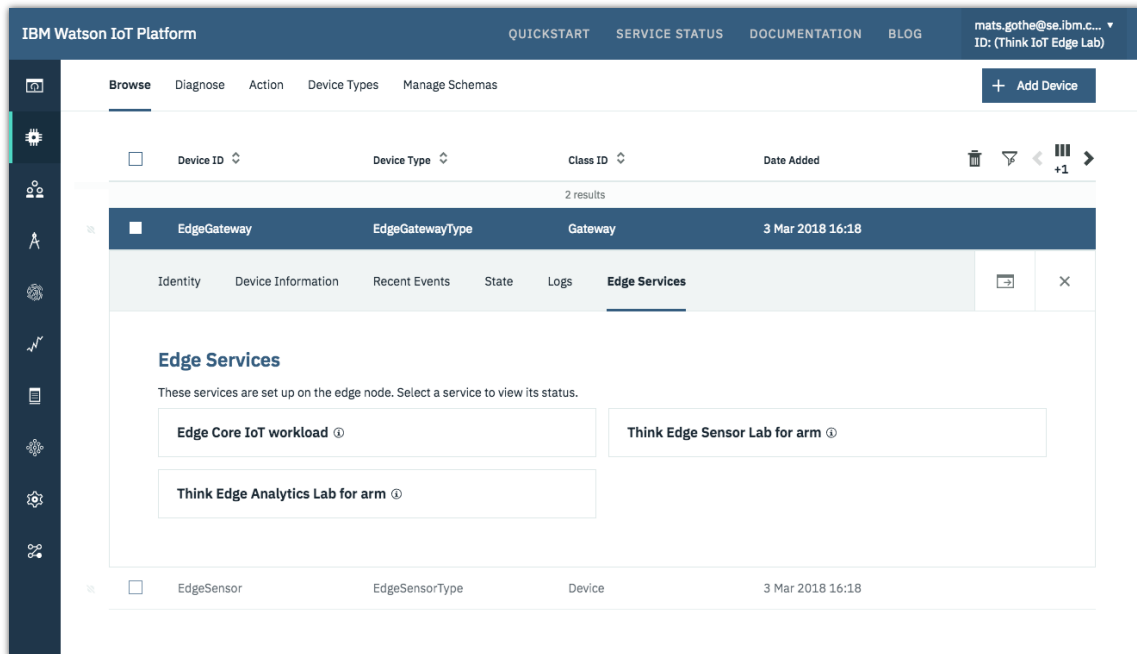
```
docker ps
CONTAINER ID        IMAGE                                     COMMAND
CREATED            STATUS                                PORTS
NAMES
6861c473c4fd       ibmiottest/workload_arm_edgelab-sensor:1.0.0   "python
/edgelab-sen..."  2 minutes ago      Restarting (1) 44 seconds ago
ddaa8f913e6457effc8e1ecd2b82b8b5fbbdaed6e8e889d974bc8f0e52d41716-edgelab-sensor
97cdb6ab7a3c       ibmiottest/workload_arm_edgelab-analytics:1.0.0   "python
/edgelab-ana..."  3 minutes ago      Up 3 minutes
78051fb9e71561b944a1f5b502109292d30db091ab590694debc7d6b77f16e38-edgelab-analytics
adb4092380fd       wiotp-connect/edge/armhf/edge-core-iot-workload:1.0.3
"/start.sh"        3 minutes ago      Up 3 minutes
047598d9ba0ec2ff5aee982016d743e84f98826b4315d0a9455df0900bc81521-edge-core-iot-
workload
506b89d3c746       wiotp-infomgmt/edge/armhf/edge-im:1.0.15
"/start.sh"        3 minutes ago      Up 3 minutes
internetofthings.ibmcloud.com-wiotp-edge-microservices-edge-core-iot-
microservice_2.4.0_66163459-7692-48b8-8243-1ff8b83adc69-edge-im
911b1c90eda7       wiotp-connect/edge/armhf/edge-connector:2.4.1
"/start.sh"        3 minutes ago      Up 3 minutes
0.0.0.0:1883->1883/tcp, 0.0.0.0:8883->8883/tcp   internetofthings.ibmcloud.com-wiotp-
edge-microservices-edge-core-iot-microservice_2.4.0_66163459-7692-48b8-8243-
1ff8b83adc69-edge-connector
cd06abe0b875       wiotp-connect/edge/armhf/edge-mqttbroker:1.1.3
"/start.sh"        3 minutes ago      Up 3 minutes
internetofthings.ibmcloud.com-wiotp-edge-microservices-edge-core-iot-
microservice_2.4.0_66163459-7692-48b8-8243-1ff8b83adc69-edge-mqttbroker
a0e5a3aea10e       ibmiottest/workload_arm_edgelab-sensor:1.0.0   "python
/edgelab-sen..."  About an hour ago   Restarting (1) About an hour ago
51836e0ff948da8372773d0068325e38e84c5c08433864a932993079adbed125-edgelab-sensor
```

5.3 Monitoring the Edge Gateway status

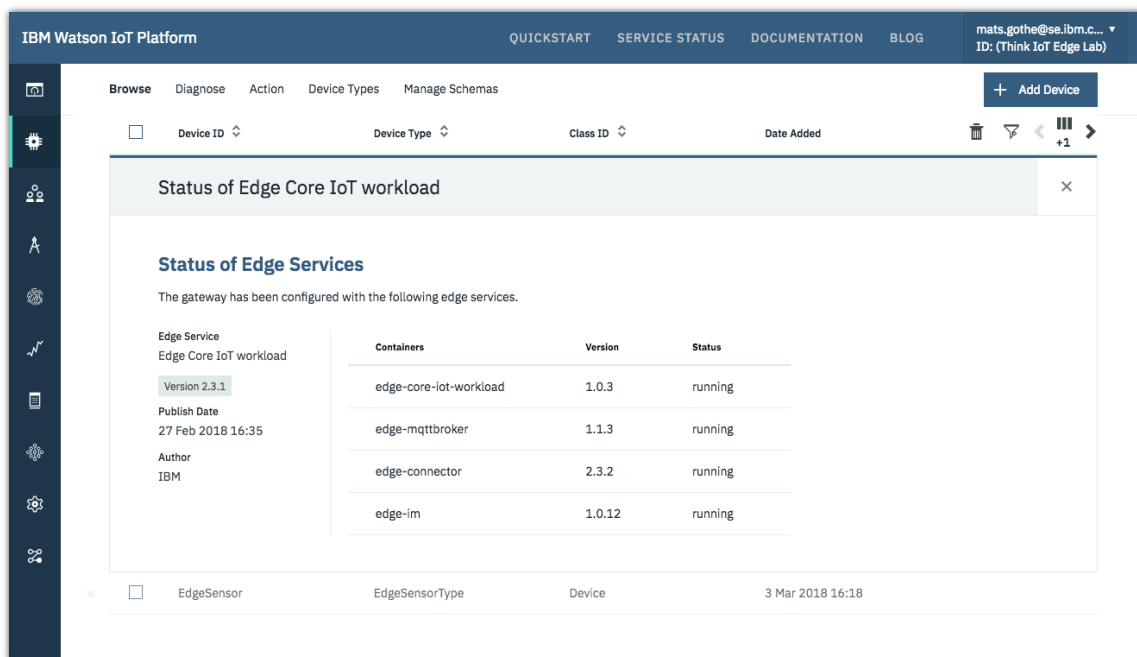
You can also monitor the state of the IoT Edge services and Docker containers running on an edge gateway using the Watson IoT Platform.

To view the services running on an Edge Gateway

1. On the navigation bar, select **Devices** to navigate to the list of gateways and devices.
2. Find, select and expand your Edge Gateway in the list.



3. Select the **Edge Services** tab
4. Select one of the edge services, for example the **Edge Core IoT** service



5. View the state of each Docker container in the service
- Note:** All Docker containers should be in state **running**
6. Explore the state of the other edge services on your Edge Gateway

Once you have confirmed that all services have started on the edge gateway you are ready to proceed to next step and start monitoring the device data sent from the gateway to the Watson IoT Platform.

6 Working with IoT Edge Data Management workloads

6.1 Viewing Edge Sensor Data

The Raspberry Pi used in this lab is connected to a Sense Hat board that has multiple sensors integrated to the board.

- Temperature
- Humidity
- Pressure
- 3-axis gyro
- 3-axes accelerometer

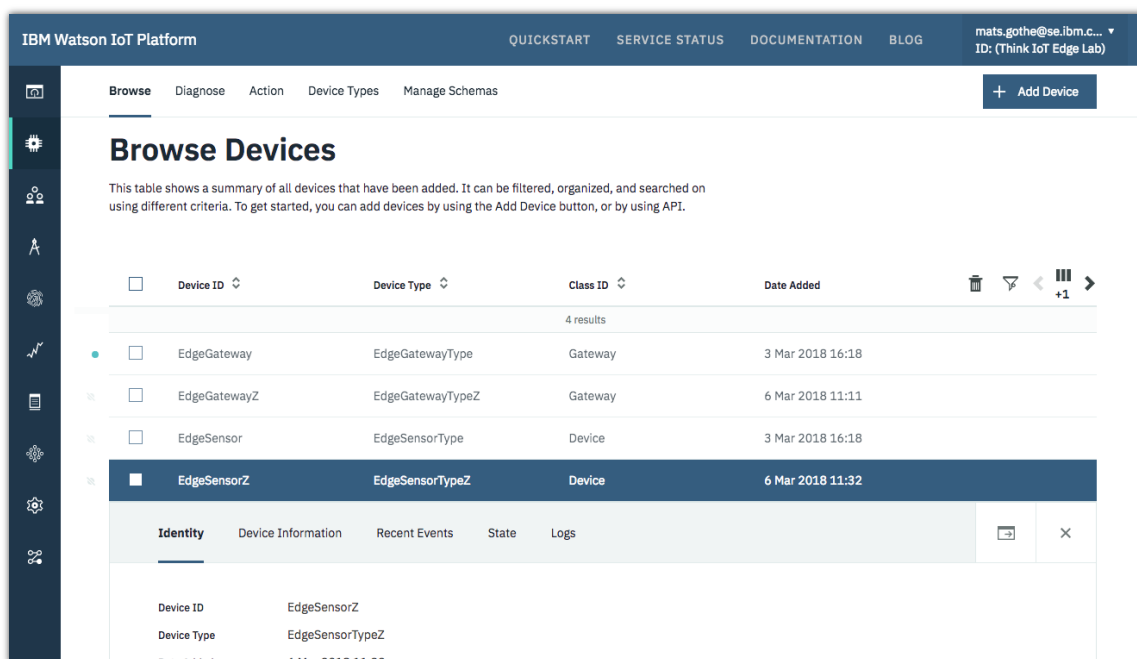
The **Think Edge Sensor Lab for arm** service in your Edge Gateway service configuration is running a `edgelab-sensors` Docker container that publishes sensor readings.

The sensor data is published to three event topics

- An environment event **env** on the topic **iot-2/evt/env/fmt/json**
- A motion event **mov** on the topic **iot-2/evt/mov/fmt/json**
- An acceleration event **acc** on the topic **iot-2/evt/acc/fmt/json**

To view device data received on the IoT platform

1. On the navigation bar, select **Devices** to navigate to the list of gateways and devices.
2. Find, select and expand your Edge Sensor device in the list.



IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothie@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas + Add Device

Browse Devices

This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.

☐	Device ID ↕	Device Type ↕	Class ID ↕	Date Added	
4 results					
☐	EdgeGateway	EdgeGatewayType	Gateway	3 Mar 2018 16:18	
☐	EdgeGatewayZ	EdgeGatewayTypeZ	Gateway	6 Mar 2018 11:11	
☐	EdgeSensor	EdgeSensorType	Device	3 Mar 2018 16:18	
☒	EdgeSensorZ	EdgeSensorTypeZ	Device	6 Mar 2018 11:32	

Identity Device Information Recent Events State Logs

Device ID EdgeSensorZ
Device Type EdgeSensorTypeZ
Date Added 6 Mar 2018 11:32

3. Select the **Recent Events** tab. Wait for events to be received from the edge sensors. Events should be published every 15th second.

Note: The three event types should be showing in the list; **env**, **mov** and **acc**

Event	Value	Format	Last Received
env	{"temp":33.86,"pres":1001.54,"hum":24.1...	json	a few seconds ago
mov	{"rol":0,"pit":0}	json	a few seconds ago
env	{"temp":33.94,"pres":1001.54,"hum":24.1...	json	a few seconds ago
mov	{"rol":0,"pit":0}	json	a few seconds ago
env	{"temp":33.9,"pres":1001.56,"hum":24.1...	json	a few seconds ago

4. Click on one of the event, for example an **env** event.

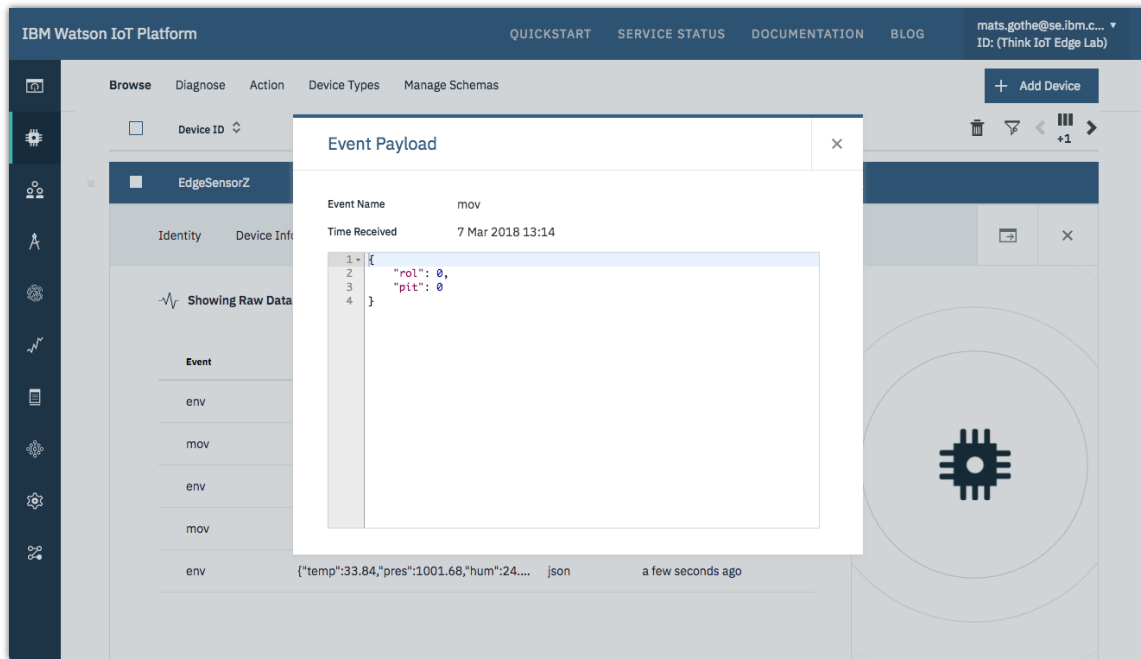
Note: The **env** environment event is sending **temp**, **pres** and **hum** data values in the event payload. The data is formatted in JSON.

Event Name: env
Time Received: 7 Mar 2018 13:14

```
1 {  
2   "temp": 33.83,  
3   "pres": 1001.58,  
4   "hum": 23.9  
5 }
```

5. Select and view the **mov** motion event.

Note: The event is sending **pit** (x-axis pitch) and **rol** (y-axis roll) data values in the event payload.



6. Select and view the **acc** acceleration event.

Note: The event is sending acceleration data values in the event payload. The acc value is the amplitude of the acceleration vector.

6.2 Filtering and Transforming Edge Sensor Data

IoT devices generally publish sensor data at a regular heartbeat. The frequency depends on the IoT analytics and control use-cases of the application, like every second, every minute, every hour, or once a day.

The network infrastructure may be sensitive to too much data being published by thousands or millions of devices to the cloud. There is a desire to reduce the data sent by the cloud by

- filtering sensor data that is not required by the IoT cloud application
- lowering the frequency of sensor values
- only send changing sensor values
- compute the state of the device at the edge and only send state updates

The IoT platform provides a Data Management capability that allows developers to define abstractions and transformations that filter, abstract and transform event data. We will refer to such transformation as workloads.

The IoT Edge capability provides distribution of Data Management workloads to the edge. That enables filtering and transformation of event data to happen on the edge, without any

need to have data transferred to the cloud. It also enables the compute power of an edge gateway to perform any transformation directly at the source of the data at the edge.

Data Management uses two types of **Interface** definitions added to a device type.

- *Physical Interface* – A physical interface represents the events that a device of a particular device type can send.
- *Logical Interface* – A logical interface represents the state of a device at a point in time. It's a canonical view which can be shared across multiple device types

6.3 Adding Interfaces

To create Interfaces for the Edge Sensor devices

1. On the navigation bar, select **Devices** section and the **Device Type** tab.
2. Find, select and expand your Edge Sensor Type in the list

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action **Device Types** Manage Schemas + Add Device Type

Device Types

This table lists all device types that are defined. You can filter the list and search for the name and description. You can modify and configure existing device types and add new device types.

☐	Name ↕	Description ↕	Number of Devices	
☐	EdgeGatewayType		1	
☐	EdgeGatewayTypeZ		1	
☐	EdgeSensorType		1	
☒	EdgeSensorTypeZ		1	

Identity Device Information Interface

Device Type

EdgeSensorTypeZ

Date Created

6 Mar 2018 11:26

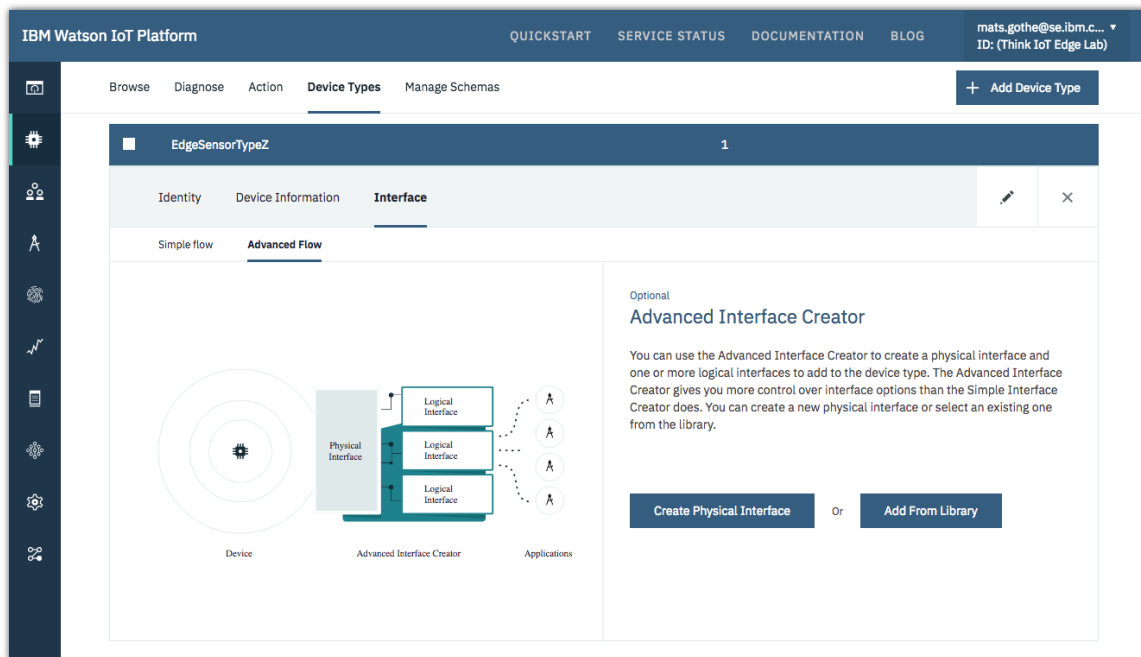
Description

Number of Devices

1 Connected Device

3. On the device information card, select the **Interfaces** tab

4. On the Interface page, select the **Advanced Flow**



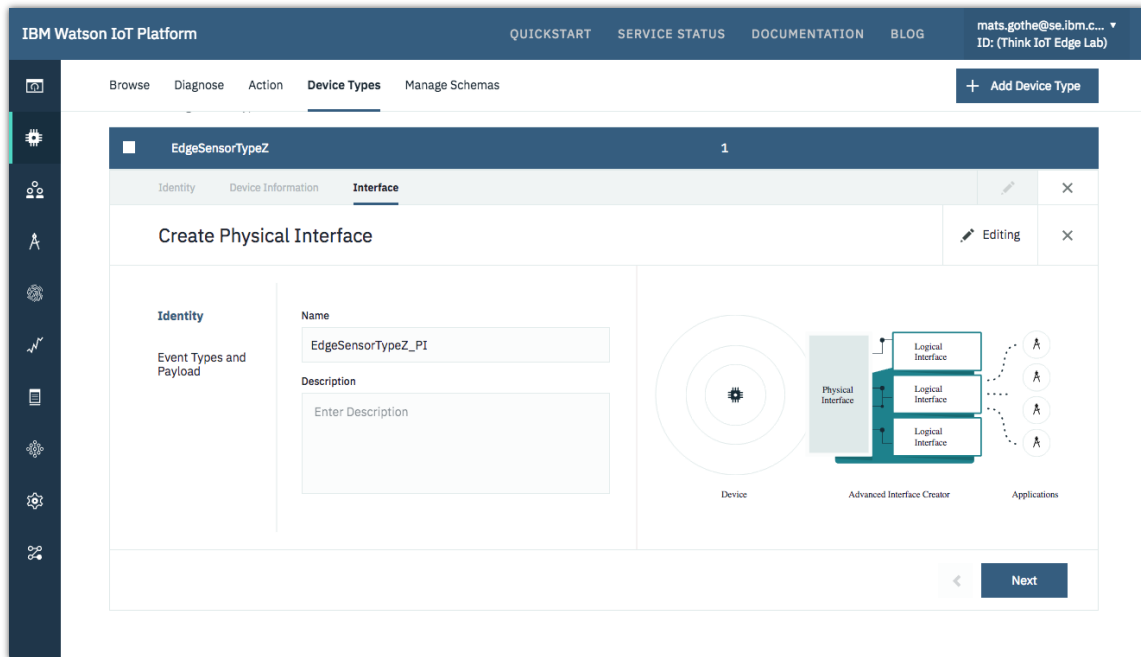
We are now ready to start creating the physical and logical interfaces for the Edge Sensor device type.

6.4 Adding an Edge Sensor Type Physical Interface

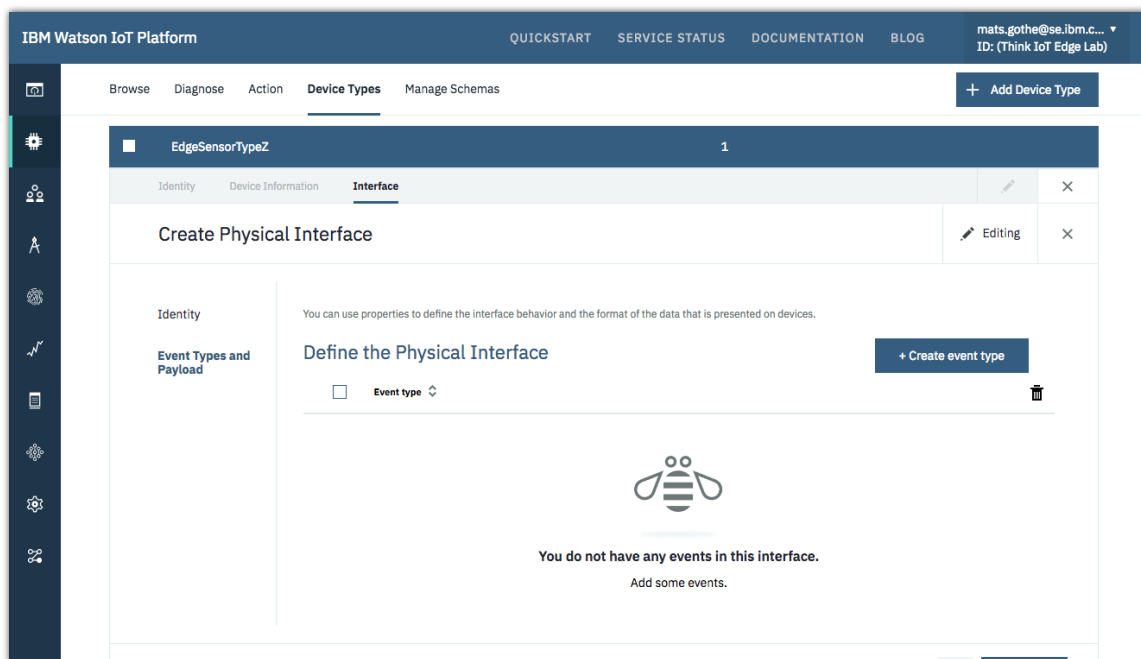
To add a Physical Interface

1. Click **Create Physical Interface** button. The Physical Interface editor page is shown.

Note: In most cases its favorable to use a unique name for the physical interface. Keep the default name and click **Next**.

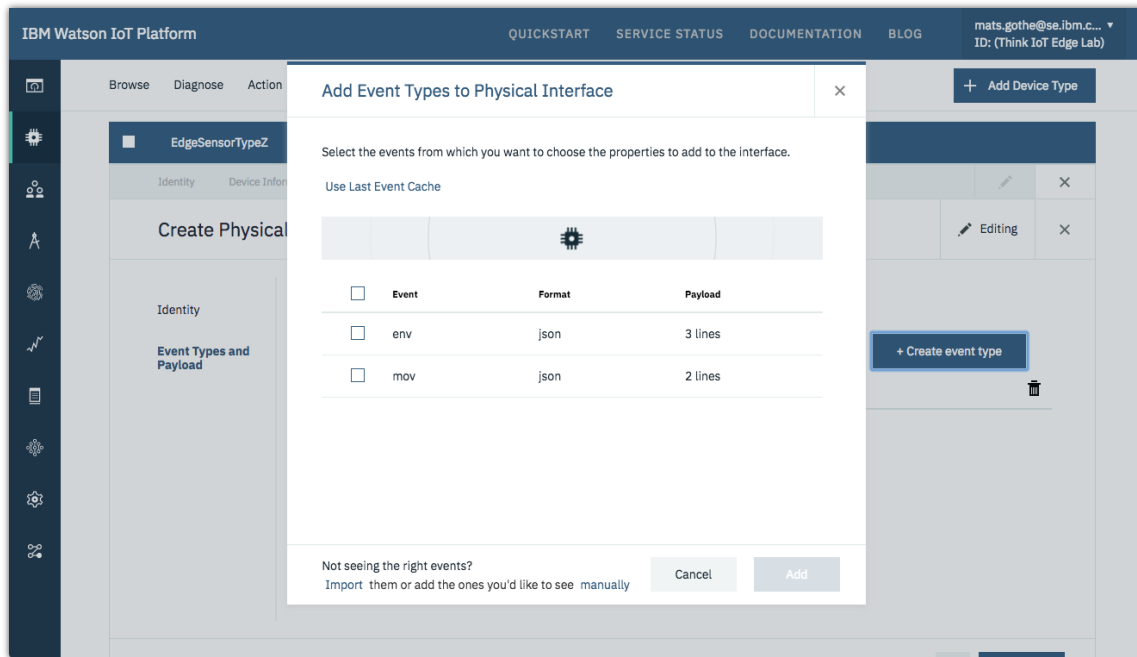


2. On the Event Types and Payload page, click the **+ Create Event Type** button

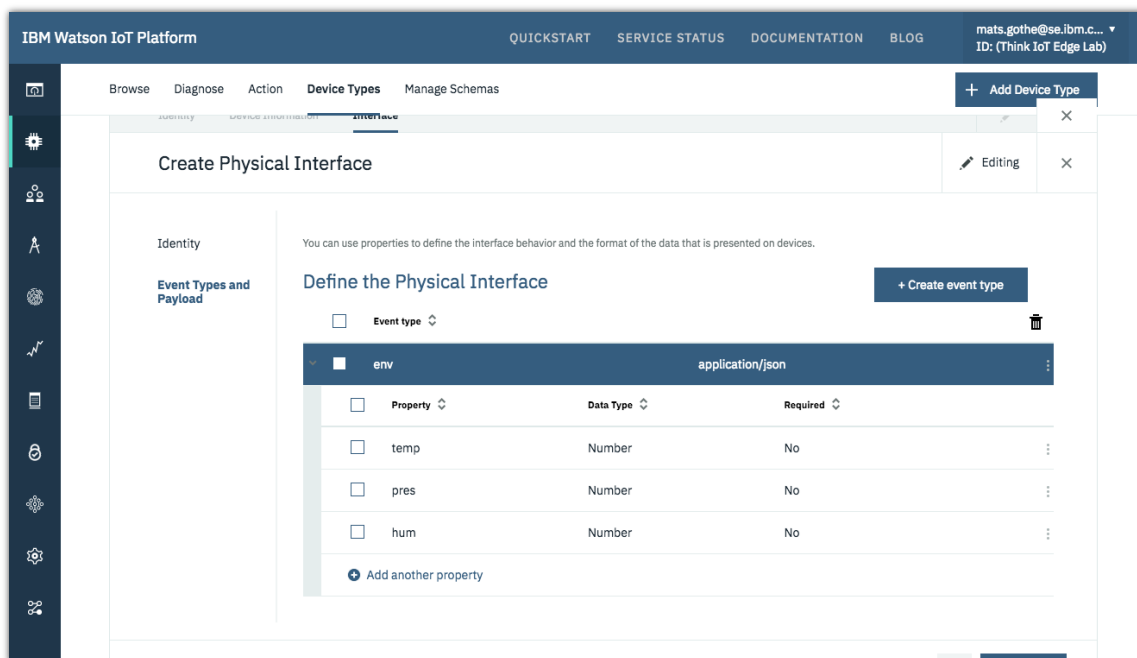


3. The Add Events Types dialog opens and start to listen for events. Wait for events to be received.

4. Select the **env** event and click **Add**



- The event type schema for the **env** event is added to the physical interface. Expand the row to see the details of the event type schema.



We have now added the event type schema for one of the event types published by the Edge Sensor device, that is the **env** events. For an IoT application this may be sufficient sensor data required by the application. By omitting any further event types in the Physical Interface will be filter out all other event data from being sent to the further processing and transfers to the cloud.

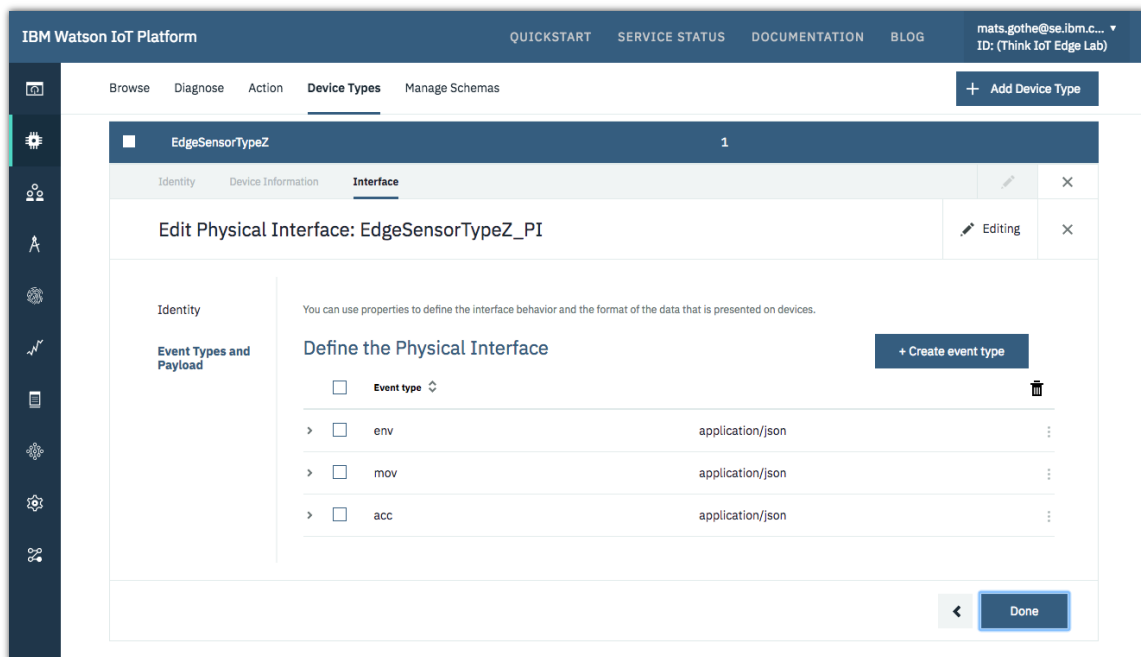
In this lab you may optionally proceed and add the **acc** and **mov** events type schemas.

6. Optionally, repeat the steps above to add event type schemas for the **acc** and **mov** events.

To add the additional **acc** and **mov** event type schemas

- i. Click the **+ Create Event Type** button
- ii. Wait for the event to be received, select and click **Add**
- iii. Expand the added event type to see its event type schema details

7. Once all events types have been added, click **Done**

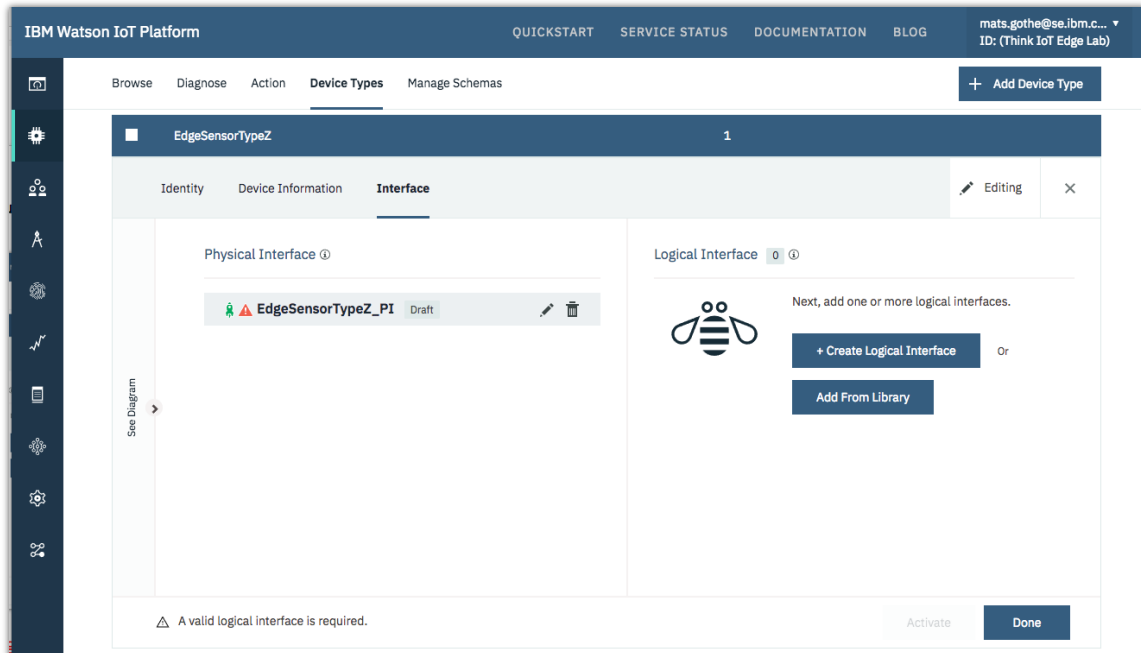


You have now created a Physical Interface for the Edge Sensor device type.

We will now add a Logical Interface for the type.

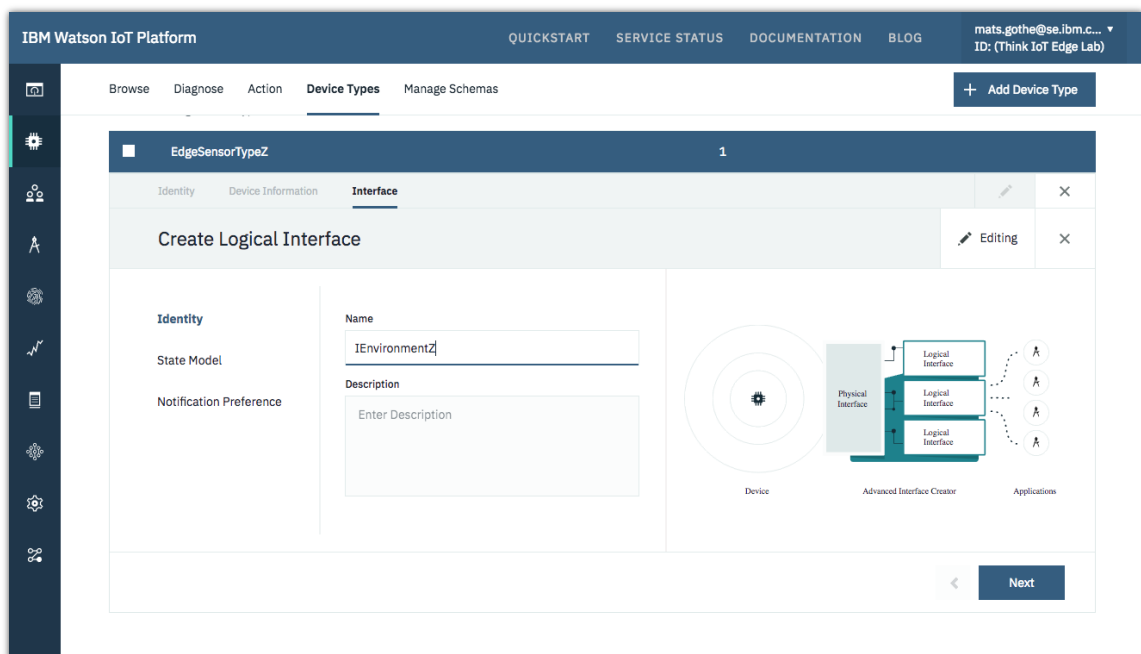
6.5 Adding an IEnvironment Logical Interface

1. On the Interface page, click **Add Logical Interface** button. The logical interface editor opens.



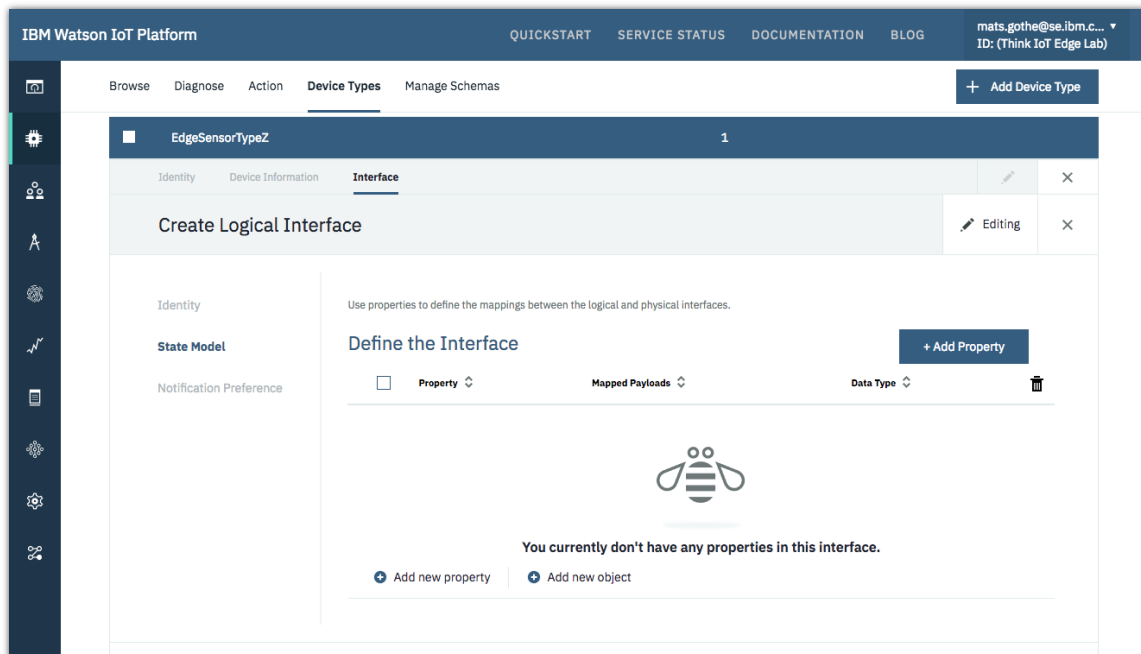
2. Replace the default name with a unique name starting with **IEnvironment**. Use the name extension given for your workstation. Click **Next**.

Note: Logical Interface are a reuse asset. It's important to give the interface a name that corresponds to the abstraction its defining. In this case we will expose the state of environment and the IEnvironment is a suitable name for this abstraction.

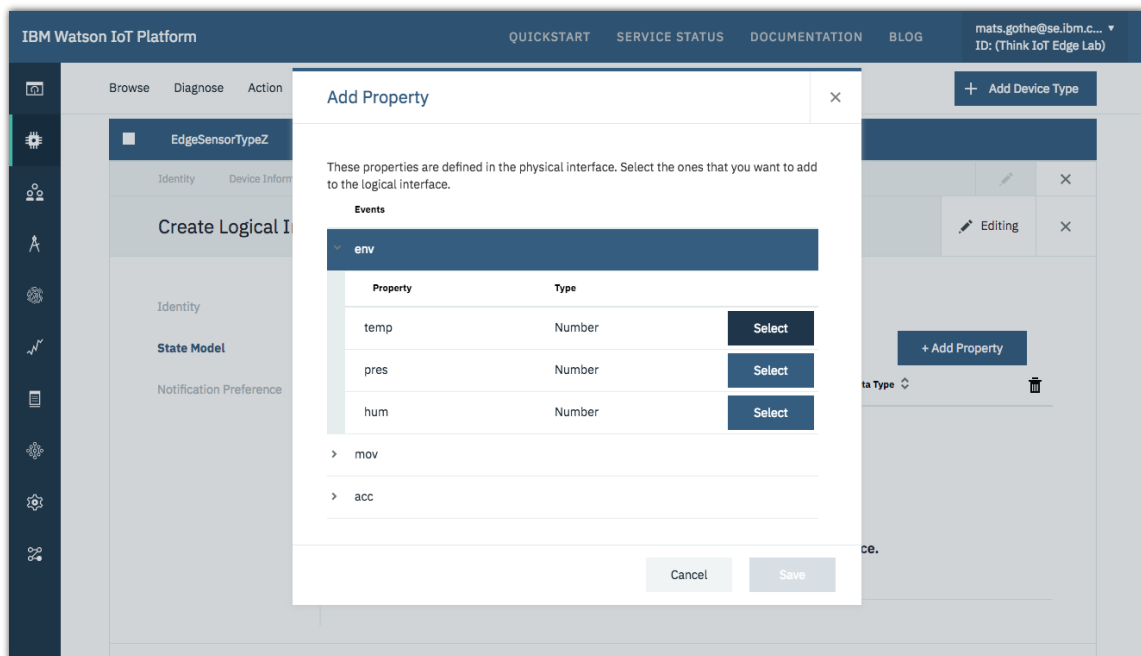


We will now add the state properties of the Logical Interface. The State properties define the abstraction of the interface.

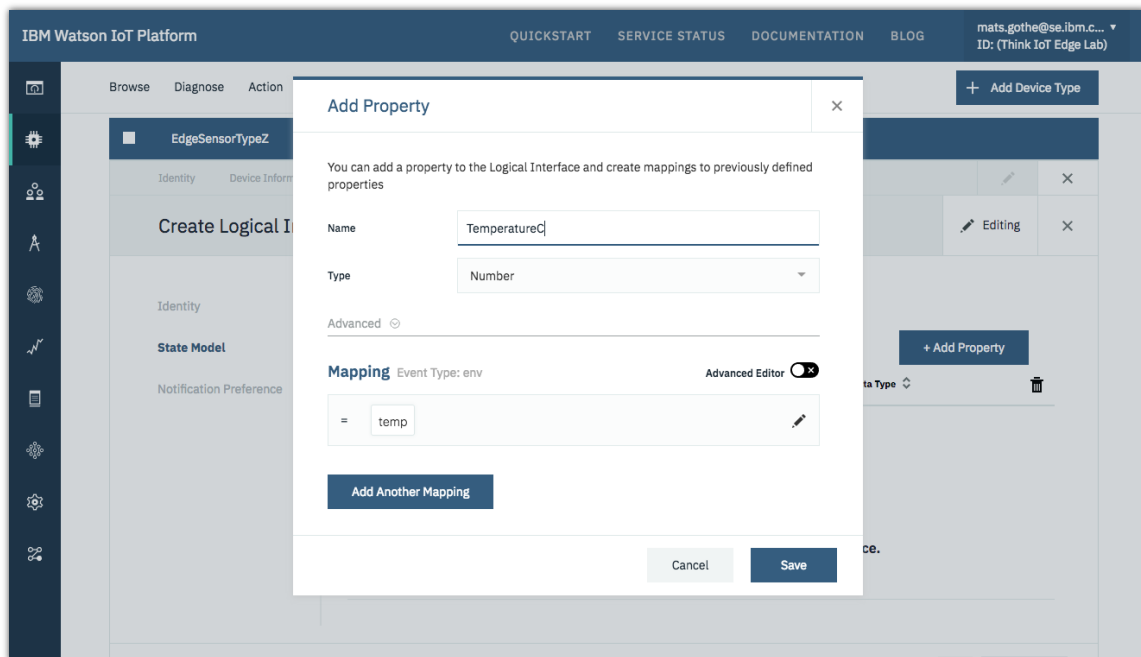
3. On the State Model page, click the **+ Add Property** button



4. In the Add Property dialog, expand the **env** event type, then click **Select** on the **temp** property row.



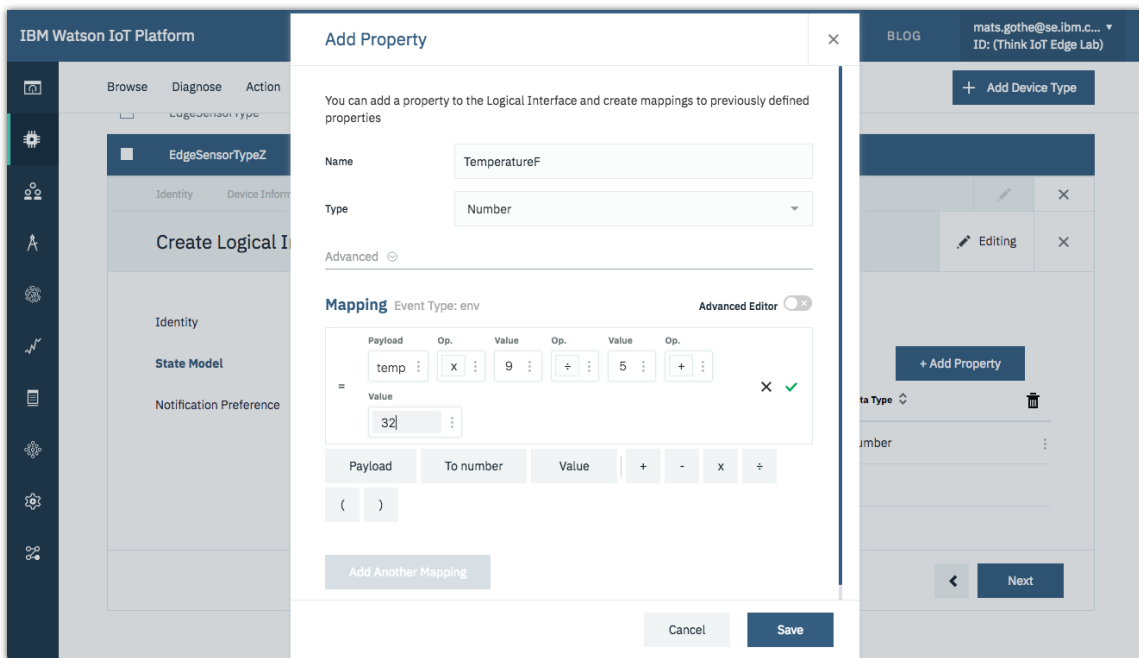
5. The temp property is now added to the mapping expression for the temperature state property. In the Add property dialog, edit the default name to **TemperatureC**. Click **Save**.



6. Repeat the steps above and add a second property.
Add a new property.
Select the **evt** event **temp** property.
Rename the property TemperatureF.

7. Click on pen icon  in the expression builder to start editing. Then, use the editor buttons to build an expression that converts a Celsius temperature to Fahrenheit.

$$^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$$



8. Repeat the steps above to add state properties for Pressure and Humidity.

Note: These two properties do not need any transformations, just create a mapping by selecting the **pres** and **hum** properties in the **env** event type schema.

After completing the definition of all state properties, click **Next**

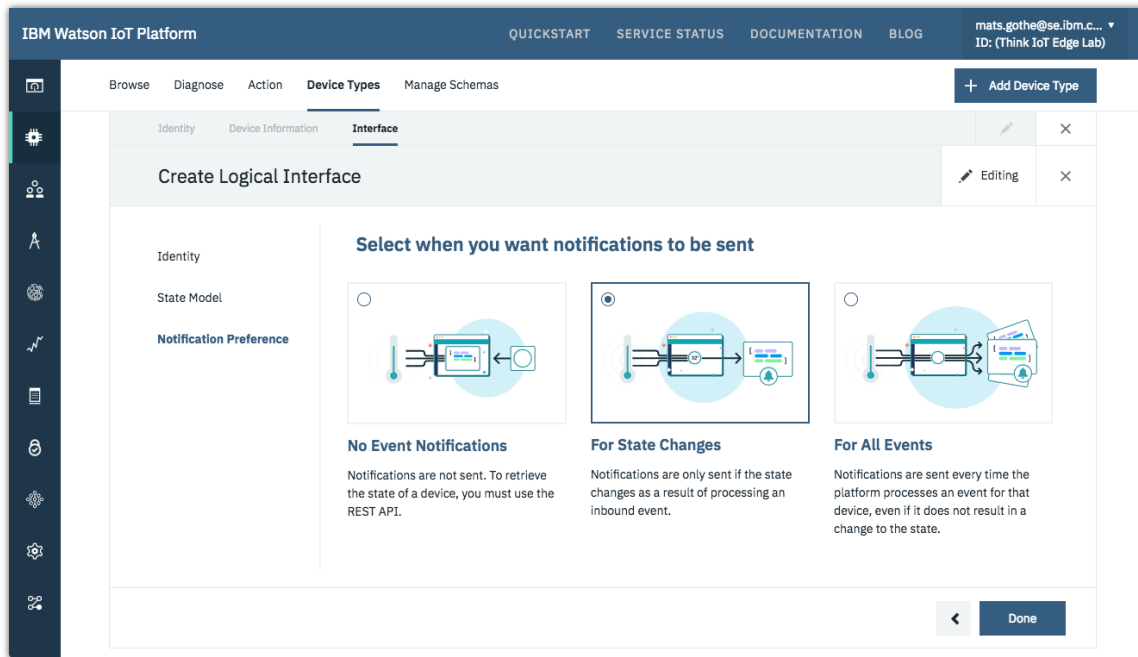
9. On the following Notification page, select how notifications of state changes will be submitted.

The options, in the dialog, are

- Send a notification after each device event is received
- Send a notification only after state has changes,
- or never.

In this lab, choose **For State Changes**.

Click **Done**.



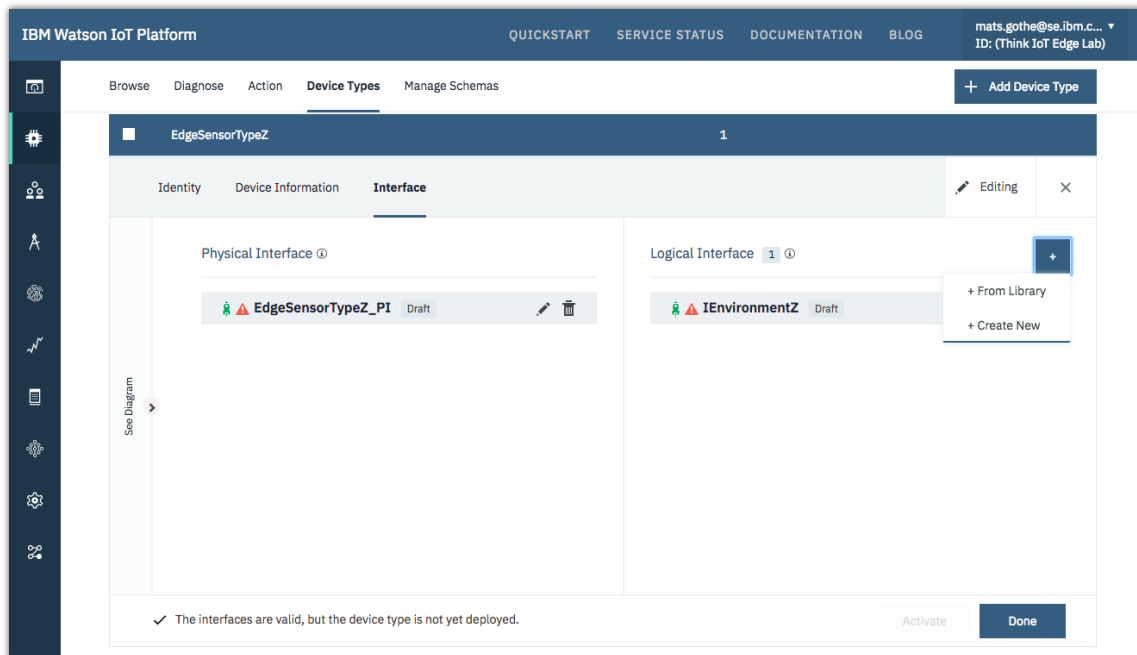
10. The device type page now shows the new logical interface added to the Interface page.

You may now optionally add a second Logical Interface

6.6 Optional: Adding an IMotion Logical Interface

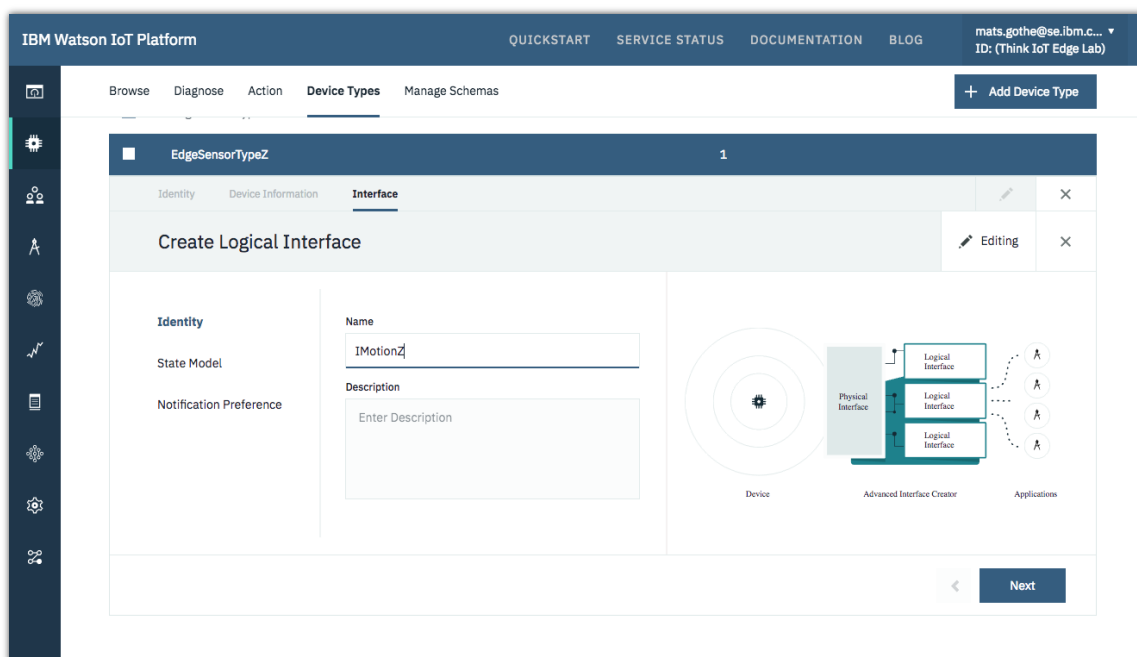
In this section you may optionally add a second logical interface that provides the motion state for Edge Sensor devices. This logical interface will demonstrate how to map state properties to multiple event types.

1. Add an additional logical interface by clicking the + button and then clicking on the + **Create New** option.



A new logical interface is created.

Give a unique name for this new interface using **IMotion** and your unique name extension.



2. For this interface, add state properties for

- *Roll*, a number type property mapped to the **rol** property in the **mov** event type
- *Pitch*, a number type property mapped to the **pit** property in the **mov** event type
- *Acceleration*, a number type property mapped to the **acc** property in the **acc** event type

The screenshot shows the 'Define the Interface' step in the IBM Watson IoT Platform. The interface is titled 'Create Logical Interface' and is in 'Editing' mode. It features a table with three rows of properties to be defined:

Property	Mapped Payloads	Data Type
Roll	rol [mov]	Number
Pitch	pit [mov]	Number
Acceleration	acc [acc]	Number

Below the table are buttons for 'Add new property' and 'Add new object'. A 'Next' button is at the bottom right.

3. Click **Next** and then choose **For State Changes** for the notification setting.

4. Click **Done** to complete the logical interface.

The screenshot shows the 'Interface' screen for 'EdgeSensorTypeZ'. It displays two interfaces: 'Physical Interface 1' and 'Logical Interface 2'. The Physical Interface contains 'EdgeSensorTypeZ_PI' (Draft). The Logical Interface contains 'IEnvironmentZ' (Draft) and 'IMotionZ' (Draft). A status message at the bottom states: 'The interfaces are valid, but the device type is not yet deployed.' There are 'Activate' and 'Done' buttons at the bottom right.

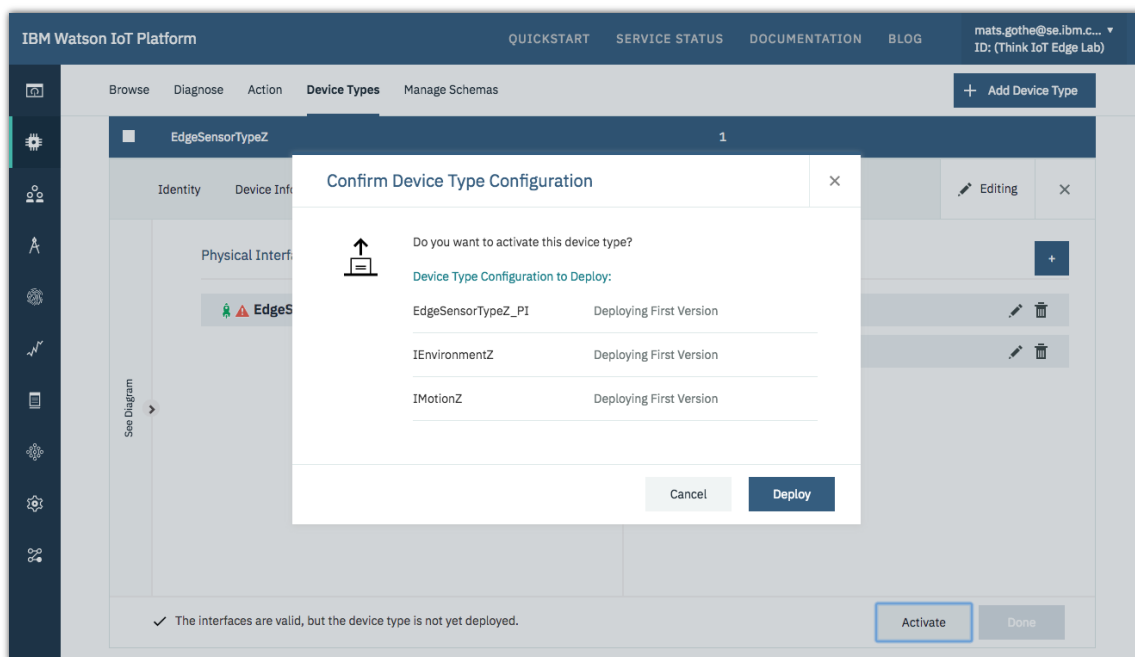
5. Click **Done**.

6.7 Activating the Physical and Logical Interfaces

In this section we will activate the interfaces. The activation step will move the interfaces we just created from a DRAFT deployment configuration to an ACTIVE deployment configuration. The Data Management ACTIVE deployment configuration represents the compiled resources deployed into an event processing pipeline in the Watson IoT Platform. After the interfaces has been activated and deployed, updates can be made and saved to the DRAFT deployment configuration. Such changes can then later be activated and updates made to the running ACTIVE deployment configuration.

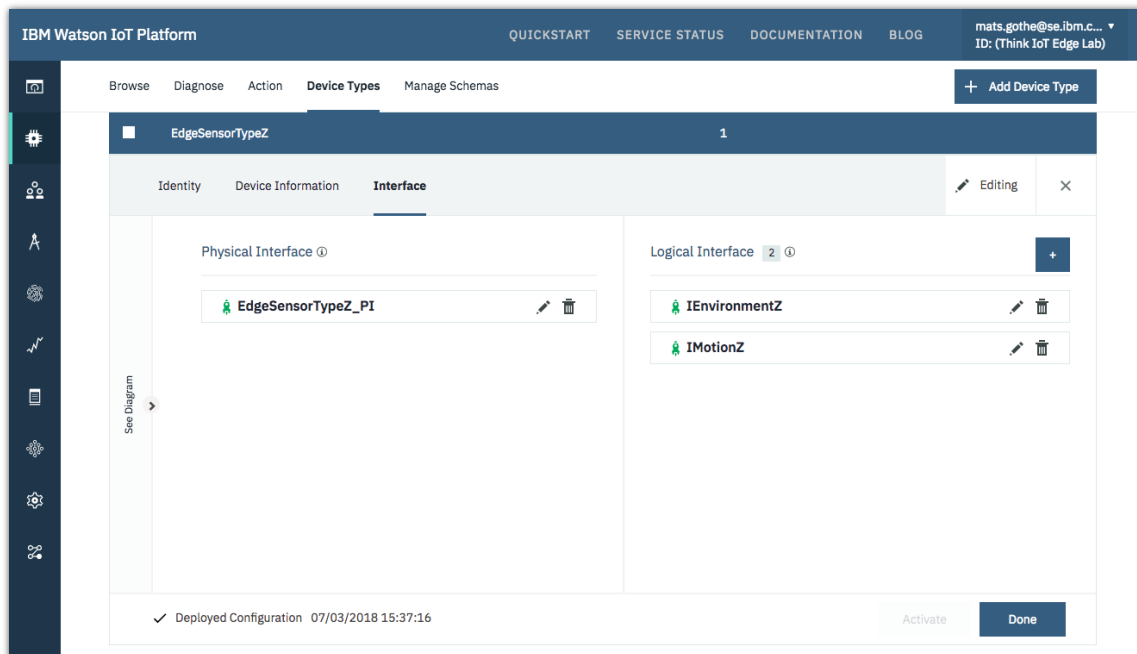
To activate the physical and logical interfaces

1. On the Interface page, click **Activate** to bring the interfaces into the event processing pipeline.
A confirmation dialog is shown listing all interface resources that will be activated.
2. Click **Deploy**



3. After the activation is completed the Interface page is updated with state information.

Note: The Interface page shows the activation state and timestamp of the interfaces.



4. Click **Done** to close the page.

6.8 Viewing Device State

Using the Edge Sensor interfaces, we can now view the device state and updates to the state.

To view device state

1. From the navigation bar, select **Devices** section.
2. Locate your Edge Sensor in the list of devices.
3. Select and expand the device details.
4. Select the **State** tab

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes links for QUICKSTART, SERVICE STATUS, DOCUMENTATION, and BLOG. The user is logged in as mats.gothe@se.ibm.c... with ID: (Think IoT Edge Lab). The left sidebar contains various icons for navigation. The main content area shows a list of devices with columns for Device ID, Device Type, Class ID, and Date Added. The device 'EdgeSensorZ' is selected, and its details are expanded. The 'State' tab is active, showing a table of sensor data. The table has columns for Property, Value, Type, Event, and Last Received. The data is as follows:

Property	Value	Type	Event	Last Received
rol	-1	Number	mov	a few seconds ago
pit	0	Number	mov	a few seconds ago
temp	33.81	Number	env	a few seconds ago
pres	999.94	Number	env	a few seconds ago
hum	24.25	Number	env	a few seconds ago

5. By default, the **Raw Data** from all event type schemas are shown

To view the state of an interface, choose the interface from the **Interface** dropdown.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas

+ Add Device

Device ID Device Type Class ID Date Added

EdgeSensorZ EdgeSensorTypeZ Device 6 Mar 2018 11:32

Identity Device Information Recent Events **State** Logs

Interface:

Raw Data

Raw Data

IEnvironmentZ

IMotionZ

Property	Value	Type	Event	Last Received
pit	0	Number	mov	a few seconds ago
temp	33.58	Number	env	a few seconds ago
pres	1000.03	Number	env	a few seconds ago
hum	25.55	Number	env	a few seconds ago

6. Select your **IEnvironmentZ** interface. The list of properties is updated, and the state of the environmental properties are presented.

Note: The state for the properties are updated as new device events are received.

Note: The Celsius temperature is received from the device. The Fahrenheit temperature is computed by the interface.

IBM Watson IoT Platform

QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)

Browse Diagnose Action Device Types Manage Schemas

+ Add Device

Device ID Device Type Class ID Date Added

EdgeSensorZ EdgeSensorTypeZ Device 6 Mar 2018 11:32

Identity Device Information Recent Events **State** Logs

Interface:

IEnvironmentZ

Property	Value	Type	Event	Last Received
Humidity	24.61	Number		a few seconds ago
TemperatureC	33.48	Number		a few seconds ago
TemperatureF	92.264	Number		a few seconds ago
Pressure	1000.1	Number		a few seconds ago

7. Choose the IMotion interface. Move and shake the Raspberry Pi to generate motion events with varying data.

6.9 Conclusions on IoT Edge Data Management workloads

We have now completed the section in this lab that explores IoT Edge with Data Management workloads.

In this section we have:

- Defined the filtering, transformation and abstractions of an Edge Sensor and defined its Environment and Motion characteristics
- Created a Physical Interface and declared the event types schemas for the messages that we will use in the transformations. Other events will be discarded by the physical interface.
- Created three Logical Interfaces for Environment state, Motion state and Analytic state computations.
- We have defined these Data Management resources in the IoT Platform on the cloud. We have discussed that the IoT Edge will distribute these resource from the cloud to the edge gateway and start an event processing pipeline on the edge gateway for any device connecting to the gateway of a type that has interfaces defined.
- We have disuses the value for device developer to define the Data Management resources and have them deployed into edge gateways as needed by the device connection topology.
- We have discussed the value for application developers to be agnostic to the instrumentation of devices.

In the next section of this lab will we now explore the Edge Service workloads for the IoT Edge.

7 Working with IoT Edge Service workloads

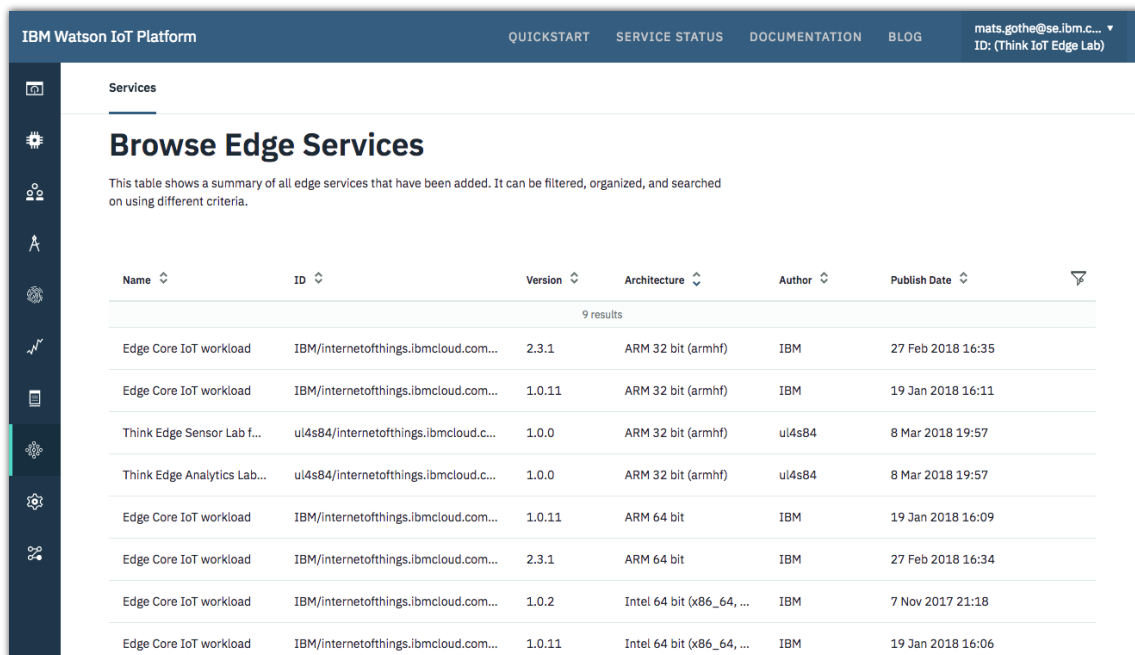
In the initial section of this lab we configured the EdgeGatewayType with the **Think Edge Sensor Lab for arm** and **Think Edge Analytics Lab for arm** edge services.

We will now explore some more details of these services.

7.1 Exploring the Edge Lab Sensor Workload

To view the edge services and images in the IoT Edge Catalog:

1. From the navigation bar, select **Edge Services** section



IBM Watson IoT Platform						
QUICKSTART SERVICE STATUS DOCUMENTATION BLOG mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)						
Services						
Browse Edge Services						
This table shows a summary of all edge services that have been added. It can be filtered, organized, and searched on using different criteria.						
Name	ID	Version	Architecture	Author	Publish Date	
9 results						
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	ARM 32 bit (armhf)	IBM	27 Feb 2018 16:35	
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 32 bit (armhf)	IBM	19 Jan 2018 16:11	
Think Edge Sensor Lab f...	ul4s84/internetofthings.ibmcloud.c...	1.0.0	ARM 32 bit (armhf)	ul4s84	8 Mar 2018 19:57	
Think Edge Analytics Lab...	ul4s84/internetofthings.ibmcloud.c...	1.0.0	ARM 32 bit (armhf)	ul4s84	8 Mar 2018 19:57	
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	ARM 64 bit	IBM	19 Jan 2018 16:09	
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	2.3.1	ARM 64 bit	IBM	27 Feb 2018 16:34	
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.2	Intel 64 bit (x86_64, ...	IBM	7 Nov 2017 21:18	
Edge Core IoT workload	IBM/internetofthings.ibmcloud.com...	1.0.11	Intel 64 bit (x86_64, ...	IBM	19 Jan 2018 16:06	

2. Locate the **Think Edge Sensor Lab for arm** service in the list.
Select the row to see the edge service details.

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'QUICKSTART', 'SERVICE STATUS', 'DOCUMENTATION', and 'BLOG'. The user is logged in as 'mats.gothe@se.ibm.c...' with the role 'ID: (Think IoT Edge Lab)'. The left sidebar contains various icons for navigation. The main content area displays a list of services under the 'Services' tab. The 'Think Edge Sensor Lab for arm' service is highlighted in blue. Below the service list, a modal window is open showing the 'Identity' tab for the selected service. The modal contains the following details:

Identity	
Name	Think Edge Sensor Lab for arm
Description	Think Edge Sensor Lab workload that sends data to WIoT
ID	ul4s84/internetofthings.ibmcloud.com-workloads-edgelab-sensor_1.0.0_arm
Author	ul4s84
Version	1.0.0
Architecture	ARM 32 bit (armhf)
Publish Date	8 Mar 2018 19:57

3. In the **Think Edge Sensor Lab for arm** details page, select the **Image** tab to view the Docker images configured in the service.

The screenshot shows the same IBM Watson IoT Platform interface, but now the 'Images' tab is selected in the modal window. The modal displays the following information:

Images within this Service

Name	Image	Version
edgelab-sensor	ibmiotest/workload_arm_edgelab-sensor:1.0.0	1.0.0
edge-mqttbroker	wiotp-connect/edge/armhf/edge-mqttbroker:1.1.3	1.1.3
edge-connector	wiotp-connect/edge/armhf/edge-connector:2.3.2	2.3.2
edge-im	wiotp-infomgmt/edge/armhf/edge-im:1.0.12	1.0.12

Note: The Edge Lab Sensors Workload consist of the *edgelab-sensor* image that is the Docker container that we have used in the previous sections in this lab. The *edgelab-sensor* image is written in Python and uses Eclipse Paho Python library to publish and subscribe to local events on the edge gateway. The container is simulating the Edge Sensor device and is submitting events with the `env` and `mov` events.

The service also references other images used like the MQTT broker image, the edge connector image and the IM image running the Data Management workload.

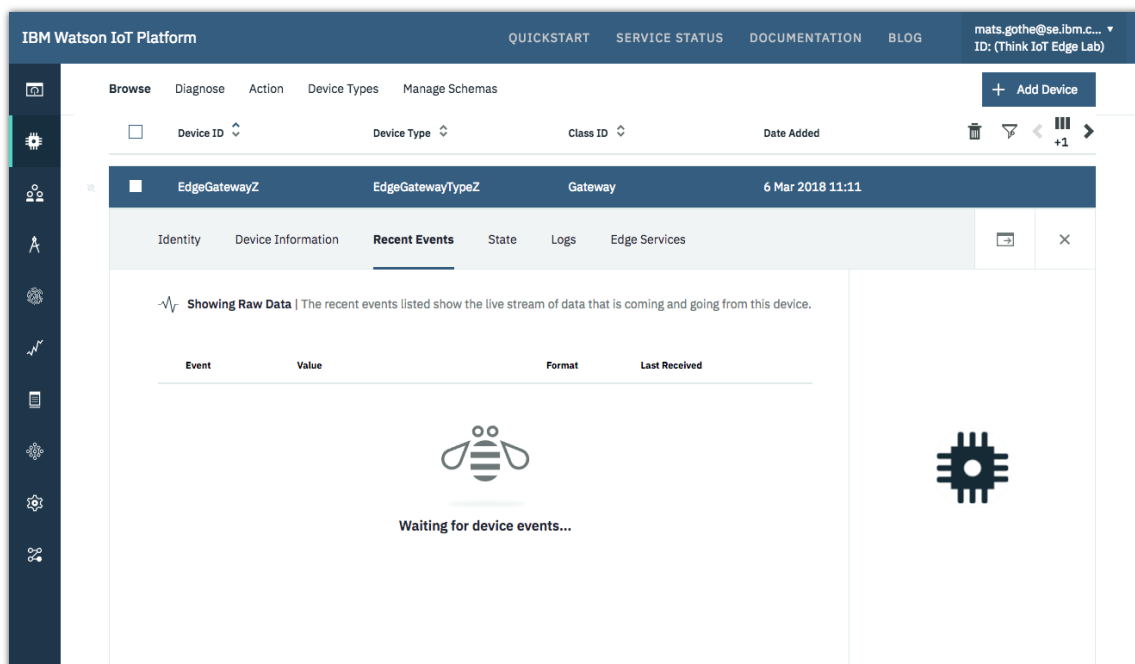
4. Scroll the list of services and select the **Think Edge Analytics Lab for arm** service. Click the **Image** tab to view the Docker images configured in the service. This service includes the *edgelab-analytics* image.

We will now explore analytics performed by the edgelab-analytics Docker component.

7.2 Viewing the IoT Edge Service Analytics events

To view events from the edgelab-analytics application:

1. From the navigation bar, select **Devices** section
2. Locate the Edge Gateway in the list of devices
3. Select and expand the device details.
4. Select the **Recent Events** tab



5. Wait for application events to be received

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'QUICKSTART', 'SERVICE STATUS', 'DOCUMENTATION', and 'BLOG'. The user is logged in as 'mats.gothe@se.ibm.c... ID: (Think IoT Edge Lab)'. The left sidebar contains various icons for navigation. The main content area is titled 'EdgeGateway' and shows a table of recent events. The table has columns for 'Event', 'Value', 'Format', and 'Last Received'. The events are 'stat' events, each containing a JSON payload with 'rol' and '2sigma' fields. The 'Last Received' column shows timestamps like 'a few seconds ago' and 'a minute ago'.

Event	Value	Format	Last Received
stat	{"rol":{"avg":-0.24,"sigma":1.62,"2sigma":...	json	a few seconds ago
stat	{"rol":{"avg":-0.38,"sigma":1.61,"2sigma":...	json	a few seconds ago
stat	{"rol":{"avg":-0.41,"sigma":1.66,"2sigma":...	json	a few seconds ago
stat	{"rol":{"avg":-0.48,"sigma":1.71,"2sigma":...	json	a minute ago
stat	{"rol":{"avg":-0.52,"sigma":1.77,"2sigma":...	json	a minute ago

6. The edge analytics application is submitting **stat** events every 15th sec. Select one of the **stat** event to view its details.

The screenshot shows the IBM Watson IoT Platform interface with an 'Event Payload' modal window open. The modal displays the details of a 'stat' event received on 7 Mar 2018 at 19:53. The event payload is a JSON object containing analytics for five units: 'rol', 'pit', 'temp', 'pres', and 'hum'. Each unit has 'avg', 'sigma', and '2sigma' values.

```
1 {
2   "rol": {
3     "avg": -0.07,
4     "sigma": 1.61,
5     "2sigma": 3.22
6   },
7   "pit": {
8     "avg": 1.55,
9     "sigma": 4.91,
10    "2sigma": 9.83
11  },
12  "temp": {
13    "avg": 31.85,
14    "sigma": 7.07,
15    "2sigma": 14.14
16  },
17  "pres": {
18    "avg": 976.58,
19    "sigma": 216.98,
20    "2sigma": 433.95
21  },
22  "hum": {
23    "avg": 23.8,
24    "sigma": 5.35,
25    "2sigma": 10.7
26  }
27 }
```

7. The event payload contains average, standard deviation and sigma analytics for each unit if data.

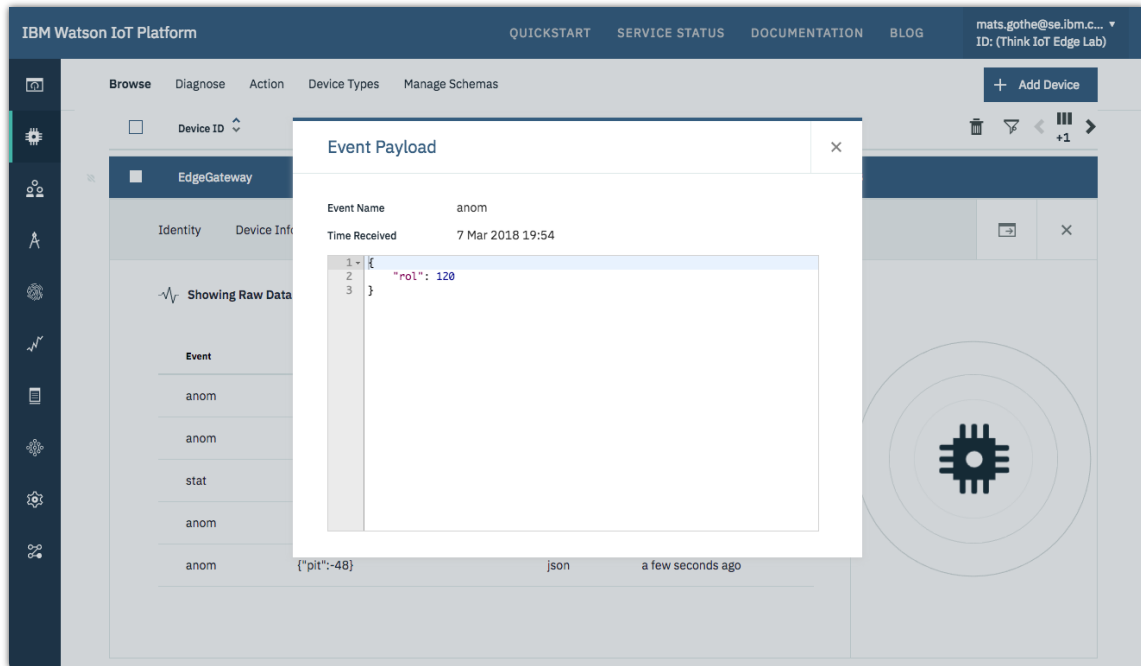
8. The edge analytics application also identifies anomalies in the data and sends an **anom** event when data is larger or smaller than 2sigma.

Pick up the Raspberry Pi to generate anomalies

- Tilt the Raspberry Pi more than 90 deg
- Shake the Raspberry Pi more than 3G

9. View anomaly events received from the edge application.

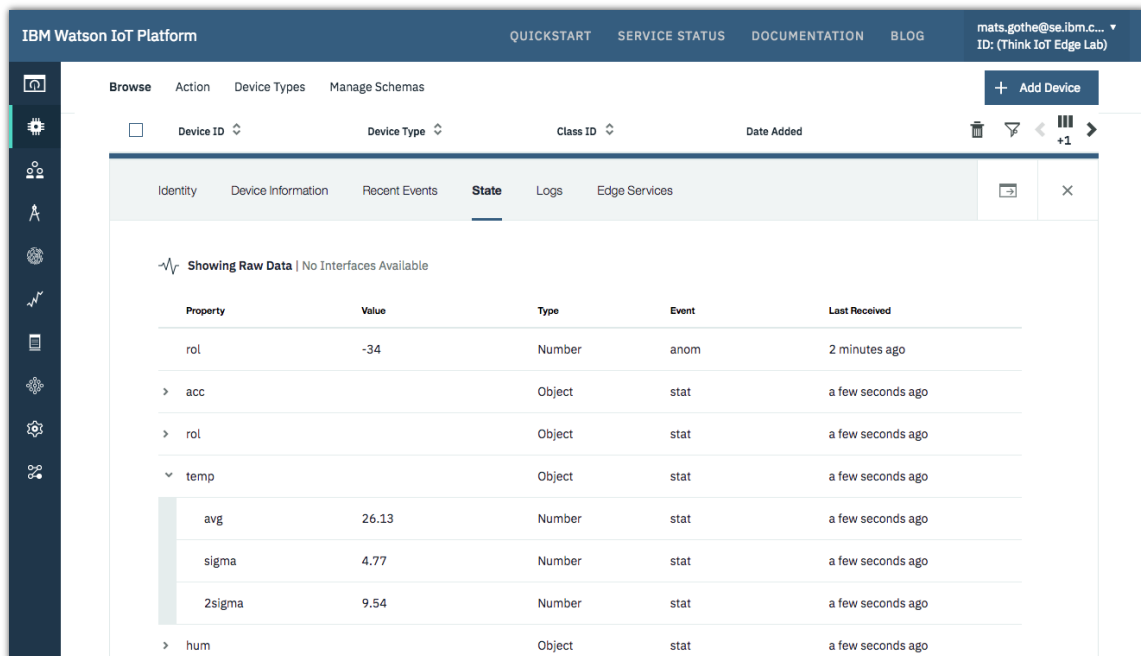
10. Click on an event to view details.



The state tab provides a more structured view with live updates of event data.

11. Choose the **State** tab

12. Expand the structure to view the analytics for each sensor value



The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'QUICKSTART', 'SERVICE STATUS', 'DOCUMENTATION', and 'BLOG'. The user is logged in as 'mats.gothe@se.ibm.c...' with ID 'ID: (Think IoT Edge Lab)'. The left sidebar contains various icons for navigation. The main content area is titled 'State' and shows a table of raw data. The table has columns for Property, Value, Type, Event, and Last Received. The data is organized into a tree structure under the 'temp' property.

Property	Value	Type	Event	Last Received
rol	-34	Number	anom	2 minutes ago
> acc		Object	stat	a few seconds ago
> rol		Object	stat	a few seconds ago
▼ temp		Object	stat	a few seconds ago
avg	26.13	Number	stat	a few seconds ago
sigma	4.77	Number	stat	a few seconds ago
2sigma	9.54	Number	stat	a few seconds ago
> hum		Object	stat	a few seconds ago

We have now completed the exploration of the edgelab-analytics container.

7.3 Conclusions on Edge Service Workloads

We have now completed the section in this lab that explores IoT Edge Service workloads.

In this section we have:

- Explored the Edge IoT Core workload and the mandatory images that provides messaging on the gateway
- Explored the Edge Lab Sensors workload that has provided environment and motion data to this lab.
- Viewed data published to the IoT Platform by the Analytics edge application.

In the next section of this lab will we now explore the code of an edge safety application. We will build and run the edge service and a Docker container.

8 Advanced Topics – Safety Edge Application

Many IoT business solutions use the basic concepts that we have explored in this lab. Worker safety in IoT for Insurance is one example for such solutions. Other are medical solutions and home care solutions.

To demonstrate these IoT Edge concepts in the context of Worker Safety we have evolved the Analytics application into a Safety edge application. This application is subscribing to environmental events from Edge Sensors located on a construction site. The application is also subscribing to motion events from Biometric sensors on the worker or on safety wearables on a worker. Analyzing the sensor data, applying machine learning, and detecting anomalies will improve worker safety.

The safety application will detect a number of safety situations and generate alerts based on these conditions.

- A tilt on the sensor more than 90 degrees from the normal working vector will generate a TILT notification.
- If the sensor comes back to an UP direction within 3 sec, the notification is withdrawn.
- If the TILT state remains for more than 3 sec, the safety application will raise a DOWN notification.
- If the sensor then comes back to an UP direction the notification will be withdrawn.
- If the safety application detects an acceleration of more than 3G, a DOWN notification will instantly be sent.

The state of the safety application is shown on the Raspberry Sense Hat for visual feedback.

In this last section you will familiarize yourself with developing and running custom applications as Docker containers on the IoT Edge Gateway.

You may also ask your lab facilitators for a demo of the safety application.

8.1 Exploring the Edge Lab Safety Application

To view the edgelab-safety application

1. Log into the Raspberry Pi
2. On the command line, run the following commands

```
cd /home/pi/edgelab/docker/edgelab-safety
micro edgelab-safety.py
```
3. Browse the edgelab-safety python application

In the edgelab-safety application code notice a few IoT related commands

- ```
IOT_BROKER = "edge-connector"
client.connect(IOT_BROKER, 8883, 7200)
```

The edgelab-safety python application is connecting to the local edge-connector container and the local MQTT broker using a TLS connection
- ```
APP_ID = "a:edgelab-safety"
```

The edgelab-safety python application is publishing as an application to the IoT Platform
- ```
client.subscribe(SENSOR_MOTION_TOPIC)
client.subscribe(SENSOR_ACCELERATION_TOPIC)
```

The edgelab-safety python application is subscribing to motion and acceleration events from the sensor
- ```
SAFETY_TOPIC = "iot-2/evt/saf/fmt/json"
```

The edgelab-safety python application is to the **saf** event
- ```
def mqtt(state):
 m = '{"state":"' + state + '"'
 client.publish(SAFETY_TOPIC, m)
```

The edgelab-safety python application is publishing a state JSON payload with the worker state

## 8.2 Building the Edge Lab Safety Application

To build the Edge Lab Safety Application:

1. Log into the Raspberry Pi
2. On the command line, run the following commands  

```
cd /home/pi/edgelab/docker/edgelab-safety
sudo docker build -t edgelab-safety .
```
3. Edit the command below. Replace the sections marked in red with

- the organization id used in this lab
- the edge sensor type name
- the edge sensor name

```
sudo docker run --privileged -v /var/wiotp-edge/persist/dc/ca:/var/wiotp-edge/persist/dc/ca --env
WIOTP_ORGID=ul4s84 --env WIOTP_DEVICETYPE=EdgeSensorType --env
WIOTP_DEVICEID=EdgeSensor --network $(sudo docker network ls |
grep "edge-core-iot" | awk '{print $2}') -it edgelab-safety:0.0.9
```

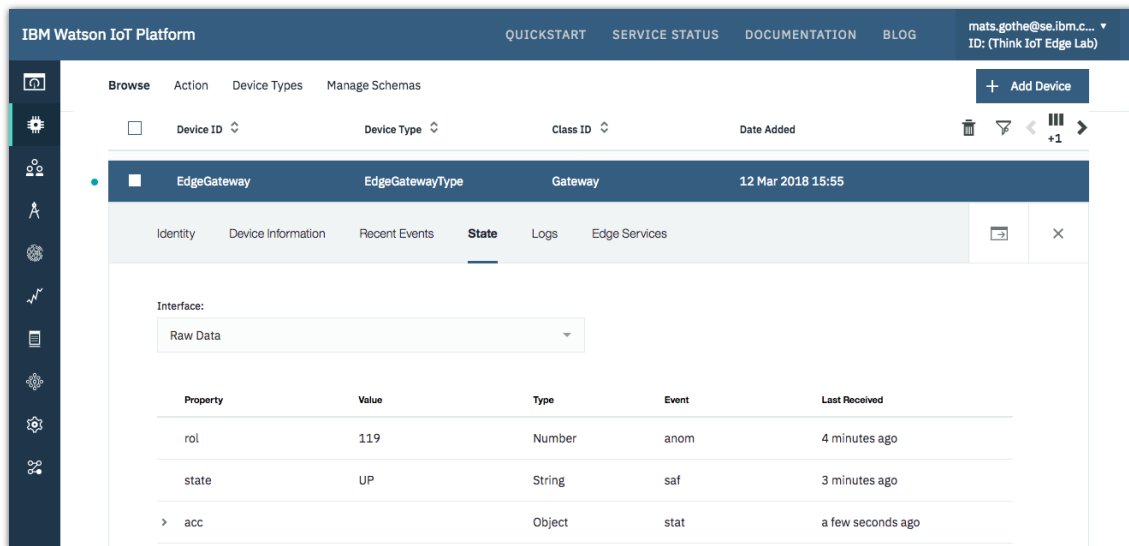
4. Run the edited command
5. The edgelab-safety Docker container now starts on the Raspberry Pi and lightens up the screen with a green up arrow
6. The application will output log information to the screen.  
Note messages published and subscribed by the application.

```
pi@raspberrypi:~/docker/edgelab-safety $ sudo docker run --privileged -v /var/wiotp-edge/persist/dc/ca:/var/wiotp-edge/persist/dc/ca --env WIOTP_ORGID=ul4s84 --env WIOTP_DEVICETYPE=EdgeSensorType --env WIOTP_DEVICEID=EdgeSensor --network internetofthings.ibmcloud.com-wiotp-edge-microservices-edge-core-iot-microservice_2.3.1_0a964799-7ebf-4208-b645-9a3456803d84 -it edgelab-safety
INFO LOG 16Sending CONNECT (u1, p1, w0, w0, c1, k7200) client_id=edgelab-safety
INFO LOG 16Received CONNACK (0, 0)
INFO CONNECT 0
INFO LOG 16Sending SUBSCRIBE (d0) [{'iot-2/type/'+id+'/'+evt/mov/fmt/json', 0}]
INFO LOG 16Sending SUBSCRIBE (d0) [{'iot-2/type/'+id+'/'+evt/acc/fmt/json', 0}]
INFO LOG 16Received SUBACK
INFO SUBSCRIBE <paho.mqtt.client.Client object at 0x75f54af0>
INFO LOG 16Received SUBACK
INFO SUBSCRIBE <paho.mqtt.client.Client object at 0x75f54af0>
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (22 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":0.0, "pit":0.0}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (22 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":0.0, "pit":0.0}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (24 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":97.0, "pit":7.0}
INFO FALL
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (16 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"FALL"}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (25 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":102.0, "pit":-5.0}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (24 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":94.0, "pit":-5.0}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (24 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":94.0, "pit":-5.0}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (12 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/acc/fmt/json {"acc":2.06}
INFO DOWN
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (16 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"DOWN"}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (24 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":53.0, "pit":-9.0}
INFO UP
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (14 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"UP"}
INFO DOWN
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (16 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"DOWN"}
INFO UP
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (14 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"UP"}
INFO LOG 16Received PUBLISH (d0, q0, r0, m0), 'iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json', ... (24 bytes)
INFO MESSAGE iot-2/type/EdgeSensorTypeZ/id/EdgeSensorZ/evt/mov/fmt/json {"rol":27.0, "pit":-3.0}
INFO DOWN
INFO LOG 16Sending PUBLISH (d0, q0, r0, m0), 'iot-2/evt/saf/fmt/json', ... (16 bytes)
INFO PUBLISH iot-2/evt/saf/fmt/json {"state":"DOWN"}
```

## 8.3 Monitoring Worker Safety

To monitor the safety application notifications:

1. From the navigation bar, select **Devices** section
2. Locate and select your Edge Gateway Type in the list
3. Select the **State** tab and monitor state changes on the **saf** event and **state** property.



Play the role as a worker and simulate a fall to the side.

1. Tilt the Raspberry Pi to the side to simulate a fall.  
The display shows an orange warning of fall.  
The IoT platform receives a **saf** event with a **TILT** status
2. Get back up by resuming the up direction of the Raspberry Pi  
The display goes back green  
The IoT platform receives a **saf** event with a **TILT ^ UP** status
3. Now fall again and remain in a fall position.  
The display goes orange and then red indicating a DOWN  
The IoT Platform receives a **saf** event with a **DOWN** status
4. Get back up again after the fall and wait for the display to go back to a green state
5. Shake the Raspberry Pi to simulate a fall with a strong hit to the ground.  
The display should go red instantly indicating a DOWN.  
The IoT platform receives a **saf** event with a worker **DOWN** status
6. When you are done, press **ctrl-c** to stop the edgelab-safety Docker container

You have now completed the exploration of the Safety edge application.

## 9 Conclusions from this Watson IoT Edge lab

You have now completed this hands-on lab on Getting started with IoT Edge Gateways.

During this lab you have:

- Depend your understanding of the Watson IoT platform and the new IoT Edge capabilities
- You have configured Edge Gateways Types for IoT Edge
- You have configured a Raspberry Pi as an IoT Edge Gateway
- You have explored two kinds of edge workloads:
  - Data Management workloads defining the filtering, transformation and abstractions of edge devices
  - Edge Services running Docker containers on the IoT Edge Gateway using the Edge Core IoT service for local and cloud messaging
- You have finally explored an IoT application that uses these edge capabilities in a Worker Security scenario

We hope that you have found this lab informative, educational, and fun.

### 9.1 Further reading

To learn more about IoT Edge Preview 2 beta

- Developing for Watson IoT Platform Edge (Preview)  
[https://console.bluemix.net/docs/services/IoT/edge/WIoTPlatformEdgeDev.html#edge\\_dev](https://console.bluemix.net/docs/services/IoT/edge/WIoTPlatformEdgeDev.html#edge_dev)
- Edge Developer Quickstart Guide  
<https://github.com/open-horizon/examples/wiki/Edge-Developer-Quickstart-Guide>

To learn more about the Watson IoT Platform

- Watson Internet of Things  
<https://www.ibm.com/internet-of-things>
- Watson IoT Platform on ibm.com  
<https://www.ibm.com/internet-of-things/spotlight/watson-iot-platform>
- Watson IoT Platform blog  
<https://developer.ibm.com/iotplatform/blog>
- Watson IoT Platform on IBM Developer Works  
<https://www.ibm.com/developerworks/learn/iot/>

To further explore, sign up for a trial account on IBM Cloud, create the IBM Watson IoT Platform service, and start connecting your IoT devices

## 9.2 We Value Your Feedback!

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- Access the Think 2018 agenda tool to quickly submit your surveys from your smartphone, laptop or conference kiosk.

## 10 Troubleshooting

This hands-on lab is using the IoT Edge Preview 2 beta version. We expect there to be missing capabilities and defects in the software components running in the Watson IoT Platform, the services in the IoT Edge Service catalog, and the IoT Platform Agent and IoT Edge services running on the Edge Gateway.

This section provides a few steps on how to resolve problems

### 10.1 Removing Edge IoT

To remove the IoT Edge Agent and any edge services from the edge gateway

1. Run the command  
`sudo hzn unregister`
2. Reboot the Raspberry Pi  
`sudo reboot`

### 10.2 Reinstalling Edge IoT

To reinstall IoT Edge Agent and the services on the edge gateway

1. Unregister  
`sudo hzn unregister`
2. Run the command after updating the parameters to your names  
`sudo wiotp_agent_setup --org ul4s84 --deviceType EdgeGatewayType --deviceId EdgeGateway --deviceToken 12345678 --cloudDisableCertCheck true`
3. Wait for the agreements to be settled  
`sudo hzn agreement list`
4. Wait for the docker containers to be downloaded  
`sudo docker images`
5. Wait for the docker containers to run  
`sudo docker ps`

## 10.3 Manually starting the Edge Lab Services

To start Edge Lab services on the edge gateway

1. Edit the command

```
sudo docker run --privileged -v /var/wiotp-
edge/persist/dc/ca:/var/wiotp-edge/persist/dc/ca --env
WIOTP_ORGID=ul4s84 --env WIOTP_DEVICETYPE=EdgeSensorType --env
WIOTP_DEVICEID=EdgeSensor --network $(sudo docker network ls | grep
"edge-core-iot" | awk '{print $2}') -it edgelab-sensor
```

2. Update `WIOTP_DEVICETYPE` and `WIOTP_DEVICEID` with the values that apply to your system
3. Run the command
4. Update the command and run it with the parameter  
`-it edgelab-analytics`
5. Update the command and run it with the parameter  
`-it edgelab-safety`

## 10.4 Manually building the Edge Lab Services locally

To build the Edge Lab services on the edge gateway

1. Go to the source directory

```
cd /home/pi/edgelab/docker/edgelab-sensor
```

2. View the README.md file

```
more README.md
```

3. Run the command

```
sudo docker build -t edgelab-sensor:0.0.9 .
```

4. Repeat the steps for the edgelab-analytics and edgelab-safety images

```
/home/pi/edgelab/docker/edgelab-analytics
```

```
/home/pi/edgelab/docker/edgelab-safety
```

