



# Maximo Asset Monitor 101

Hands-on Lab

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# 1 Introduction to this lab

## 1.1 Welcome to this lab: Maximo Asset Monitor 101

In this hands-on lab you will learn about how to get started with IBM Maximo Asset Monitor to quickly and take advantage of operational monitoring using the leading AI and IoT platform for industrial IoT.

You will get an end-to-end overview and hands-on experience of the Maximo Asset Monitor. You will explore device and event data ingestion using the Watson IoT Platform, use AI capabilities like analytics and anomaly models to get notifications of abnormal data points and take actions to assign work orders on the alerts.

## 1.2 About Maximo Asset Monitor

The IBM Maximo Asset Monitor is a fully managed, preconfigured cloud-hosted service available in IBM Cloud providing advanced AI-powered remote monitoring at enterprise scale for assets and operations. Essential insights for intelligent asset maintenance and operations.

Maximo Asset Monitor is a solution for bringing AI into the operational process control and asset maintenance worlds. With Maximo Asset Monitor, asset maintenance and operational leaders can aggregate IT data with operating state data and process parameters across existing control systems, historians, IoT sensors, and other repositories to provide enterprise-wide visibility into performance. Data can be fused in real time and the solution can be scaled quickly and easily across the enterprise.

AI brings asset monitoring to life, resulting in a full operationally-scalable monitoring solution. AI-powered anomaly detection and configurable dashboards ensures only the right alerts are identified while helping you understand complex relationships between factors causing failures. This empowers your OT and IT teams to act with confidence to understand when something has changed, explore root cause variables and drive digital re-invention.

## 1.3 Key capabilities of Asset Monitor

The key capabilities of IBM Maximo Asset Monitor solution are

Configurable dashboards, alerts, & drill-down

Quickly customize dashboards and configure rules-based alerts to surface data that is tied to specific standards and KPIs. Easily drill down for root-cause analysis

Enterprise-wide view of operations

Integrate data from multiple systems, historians, IoT sensors, and other data sources across multiple sites and processes. Hybrid cloud-based solution designed to scale across the enterprise.

Workflow to drive ownership of issues

Configurable to existing workflows to ensure seamless ownership of business issues

Auto-generation of work orders

Able to integrate to Maximo Enterprise Asset Management or other asset management system for automated execution of critical tasks

Rapid data integration

Supports multiple integration approaches, including bulk data integration via REST APIs, message-oriented integrations to IoT gateways, and custom connectors

Hierarchical data filtering and management

Supports asset and systems hierarchies for easy data filtering and root-cause analysis

## 1.4 About this lab

In this hands-on lab you will deepen your understanding and experience with Maximo Asset Monitor. You will use the Maximo Asset Monitor to gain analytics insights into the IBM Munich IoT Center building.

In the first part of this lab, you will explore the sensors and data events sent from the devices instrumenting the 27<sup>th</sup> floor in the IBM Munich IoT Center building. You will explore the data transformation performed as sensor data is ingested into Maximo Asset Monitor.

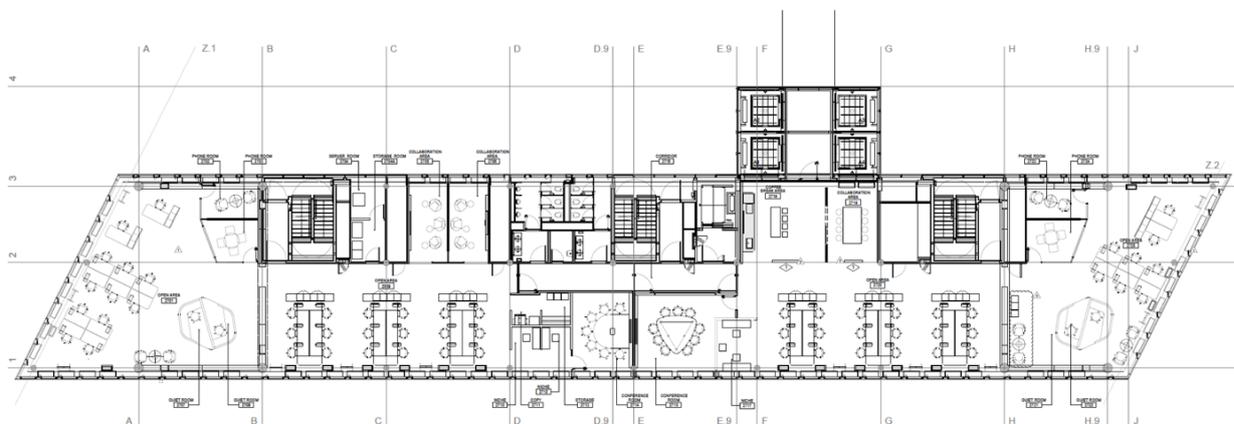
In the second part of the lab you will explore monitoring of operational metrics and performance KPIs of the IBM Munich IoT Center building. You will deep-dive into the analytics capabilities in Maximo Asset Monitor and explore metrics on facility conditions, comfort levels and utilization. You will also explore how to configure dashboards for monitoring operational metrics and performance KPIs.

## 1.5 About Watson IoT Munich

IBM is investing over \$3 billion USD into Internet of Things – including \$200 million USD to the Munich IoT Center. In Munich, the Internet of Things comes of age with advanced Watson cognitive computing technologies and the world's first state-of-the-art client 'collaboratories'. With over 6,000 clients and partners and home to 1,000 IBM'ers, Watson IoT Munich is quickly becoming the center of the smart new global ecosystem.

Take a virtual tour of the Watson IoT Center in Munich at <https://www.ibm.com/internet-of-things/learn/iotcenter/>

The floor plan of the Munich Twin Tower building, hosting the IBM IoT Center, is sectioned into East- and West-wing workspaces and meeting rooms. The wings are separated by the central elevator section, conference rooms, hallways and utility spaces.



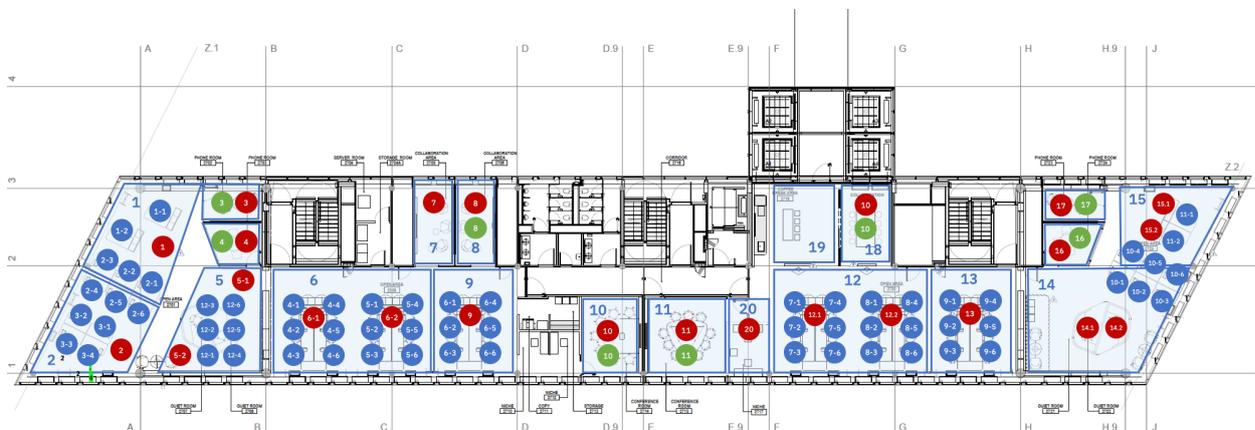
## 1.6 About Sensor Instrumentation

The IBM IoT Center in Munich has been instrumented with devices and sensors from many IBM IoT business partners. In this lab we will use devices from Yanzi Networks ([www.yanzi.se](http://www.yanzi.se)) deployed to most of the floors of the building.

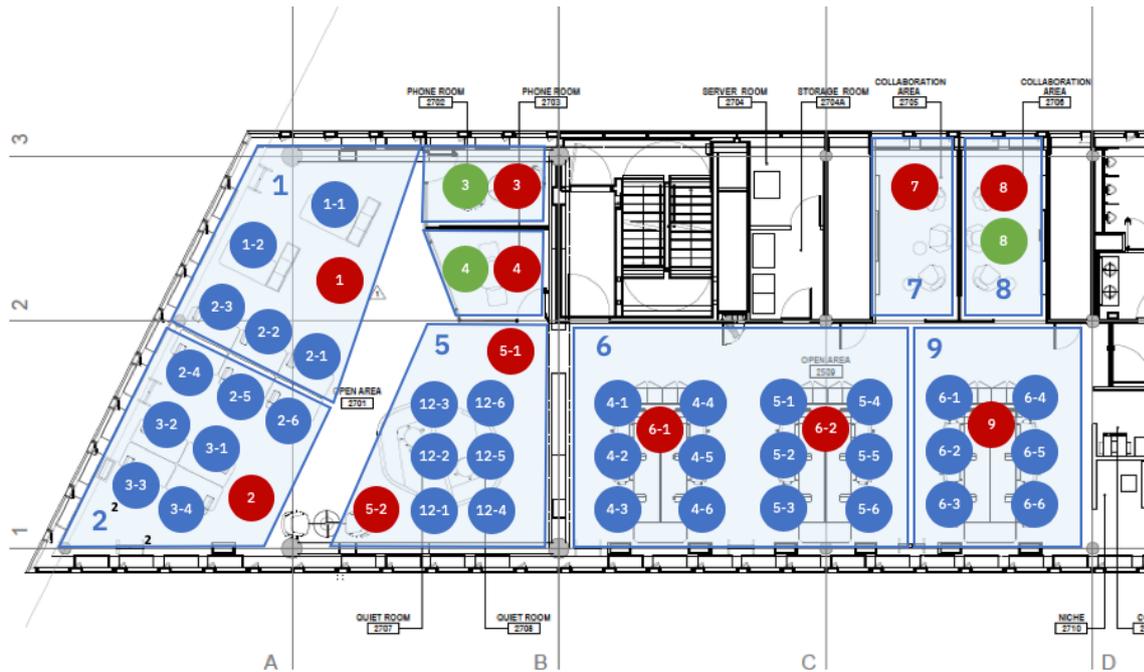
Three types of devices are used:

- **Yanzi Motion** detects motion and monitors the temperature.
- **Yanzi Motion+** devices for monitoring occupancy as well as temperature, humidity, ambient light, and sampled ambient noise.
- **Yanzi Comfort** monitors air quality by measuring levels of carbon dioxide (CO2) and volatile organic compounds (VOC), as well as temperature, humidity, barometric pressure and ambient noise.

The floors in the building has been instrumented to monitor worker safety, comfort levels, and workspace presence and utilization. The devices are assigned to zones representing conference rooms, utility rooms and general workspace areas. The floor plan illustration below indicates the zones in light blue and the devices deployed into each zone as colored circles. Motion type devices are shown as blue circles, devices of Motion+ type as red and devices of Comfort type as green.



Each device is assigned a Region, Building, Floor, Zone and Workstation in Watson IoT Platform service. This metadata information is used to logically associate the device with its location and is used for analytics purposes. As an example, as shown in the illustration below, the meeting rooms zone 3 are instrumented with Motion+ and Comfort type devices.



The two devices in zone 3 register several individual sensors in the Watson IoT Platform. For example, the comfort sensor with id EUI64-0080E10300045A93 is registering individual temperature, CO<sub>2</sub>, Air Pressure, Sound Pressure, Humidity and Volatile Organic Compound sensors in Watson IoT Platform. The name of each sensor, of a device, takes the name of the device and adds a sensor post-fix identity to the name. See table below.

**Comfort** sensor **EUI64-0080E10300045A93** in **Floor 27, Zone 3**.

Device id	Device Type
809646_EUI64-0080E10300045A93-10	soundPressureLevel
809646_EUI64-0080E10300045A93-3	relativeHumidity
809646_EUI64-0080E10300045A93-5	volatileOrganicCompound
809646_EUI64-0080E10300045A93-4	carbonDioxide
809646_EUI64-0080E10300045A93-6	pressure
809646_EUI64-0080E10300045A93-3	temperatureK

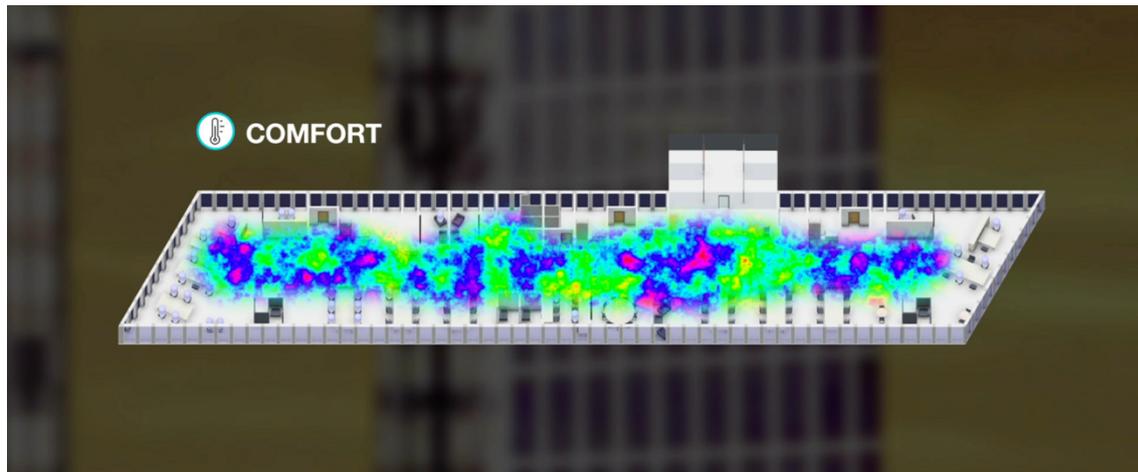
**Motion+** sensor **EUI64-0080E10300045266** in **Floor 27, Zone 3**.

Device id	Device Type
809646_EUI64-0080E10300045266-5	illuminance
809646_EUI64-0080E10300045266-10	soundPressureLevel
809646_EUI64-0080E10300045266-3	temperatureK
809646_EUI64-0080E10300045266-4	motion
809646_EUI64-0080E10300045266-3	relativeHumidity

Using the sensor values from these two devices the IoT Platform service can compute state properties for the meeting room 3 on floor 27, like CO<sub>2</sub> levels, occupancy and utilization.

Similarity for workspaces, the occupancy of a single desk can be provided using the deployed motion sensors in the zone, for example sensors 1-1, 1.2 and 2-1 to 1-3. The occupancy and utilization of a zone can then be computed by analyzing the sensor values.

Comfort levels can be computed from temperature, humidity, CO<sub>2</sub> levels, light intensity and noise levels. For worker safety regulatory purposes, the office may be monitored ensuring that the comfort levels of temperature, humidity and noise are within compliant levels and that alerts are notifying of CO<sub>2</sub> levels outside of regulatory bounds. The illustration below shows a concept design on visualizing comfort data analytics using the derived IoT data.



## 1.7 Logging into Maximo Asset Monitor

In this lab you will use a workstation and a web browser to access the Maximo Asset Monitor on IBM Cloud. If you are attending an on-line event you may use your personal workstation. If you are attending an IBM hosted event a workstation may be provided to you. At the start of this lab, all IBM provided workstations should have been started and ready for you to use with automatic login.

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

IBM Cloud 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.

In this lab you will use the Maximo Asset Monitor and the services running in IBM Cloud. All attendees in this lab will use a shared Maximo Asset Monitor tenant across all lab workstations.

To log into the Maximo Asset Monitor.

1. Open the Firefox browser on your workstation
2. Enter the tenant URL <http://ibm.biz/iotx2020-assetmonitor>

Or use the full tenant URL <https://dashboard-us.connectedproducts.internetofthings.ibmcloud.com/preauth?tenantid=Think-2019&isAPM=true>

3. The Maximo Asset Monitor login page opens

IBM Maximo Asset Monitor

### Welcome to IBM Maximo Asset Monitor

You can use IBM Maximo Asset Monitor to turn your device data into meaningful insights. Use these data insights to optimize your business processes and inform the future design of your products or services. IBM Maximo Asset Monitor provides tools that allow you to process IoT data with both real-time and historical analytics, add "smarts" in the IBM Cloud for non-smart products, match appliances with customers, and securely connect your own existing apps and tools to the IBM Maximo Asset Monitor infrastructure.

[Log in to Monitor-Demo](#) [Learn more](#)

**Usage / My cloud industrial plan** 32% Number of events: 0 Connected 0 Remaining

Monitor your usage levels across the services that you are subscribed to and view details about those services.

Name	Usage	Subscribed	Connected	Plan coverage	Status
Maximo IoT Platform Service	<a href="#">View Details</a>	<a href="#">Click to view metrics</a>	25,313 MB	0 MB	Active
Data exchange	<a href="#">View Details</a>	<a href="#">Click to view metrics</a>	25,313 MB	0 MB	Active
Data analytics	<a href="#">View Details</a>	<a href="#">Click to view metrics</a>	25,313 MB	0 MB	Active
Edge data analysis	<a href="#">View Details</a>	<a href="#">Click to view metrics</a>	25,313 MB	0 MB	Active
IBM Warehouse on Cloud	<a href="#">View Details</a>	<a href="#">Expand to view page (2 metrics)</a>	✓	✓	Active
IBM Event Streams	<a href="#">View Details</a>	<a href="#">Expand to view page (2 metrics)</a>	✓	✓	Active

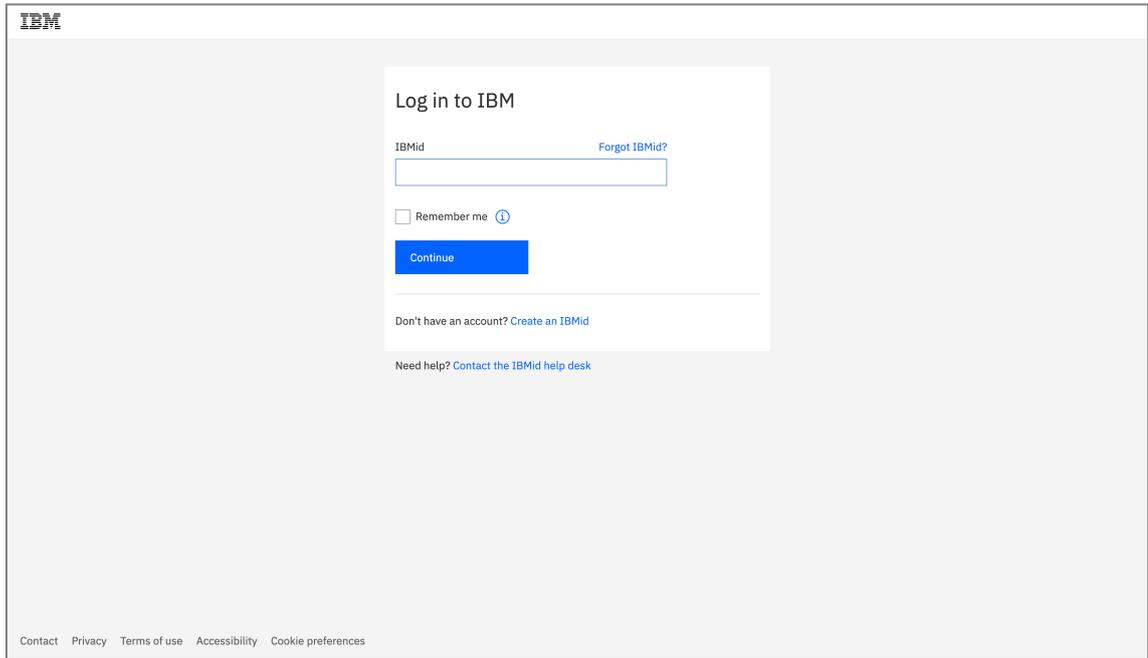
**Need more information?**

Need more information? Browse the documentation to learn more about getting started, product architecture, and how to access developer resources. If you still have questions, contact us, and we will help you find what you need.

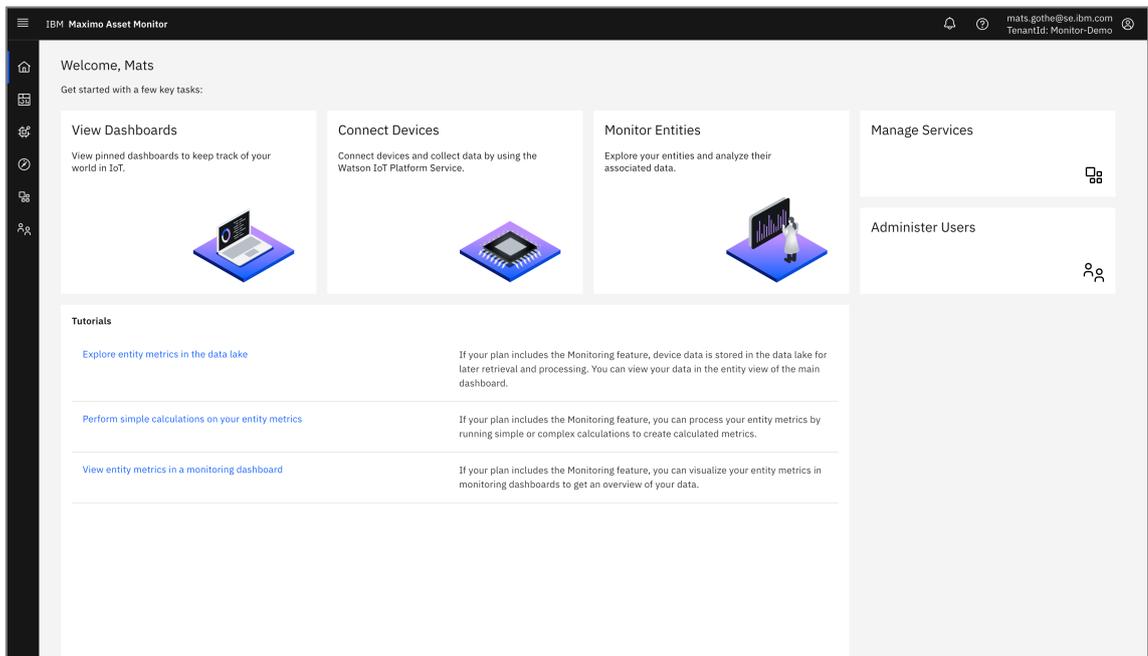
[Go to IBM Knowledge Center](#) [Contact IBM](#)

[Cookie Preferences](#)

4. Click on **Log in to Think-2019**
5. Enter the IBM ID “thinkiot@mail.com”  
Enter the password provided by your workshop facilitator
6. Click **Log in**



7. The Maximo Asset Monitor Home page is loaded.



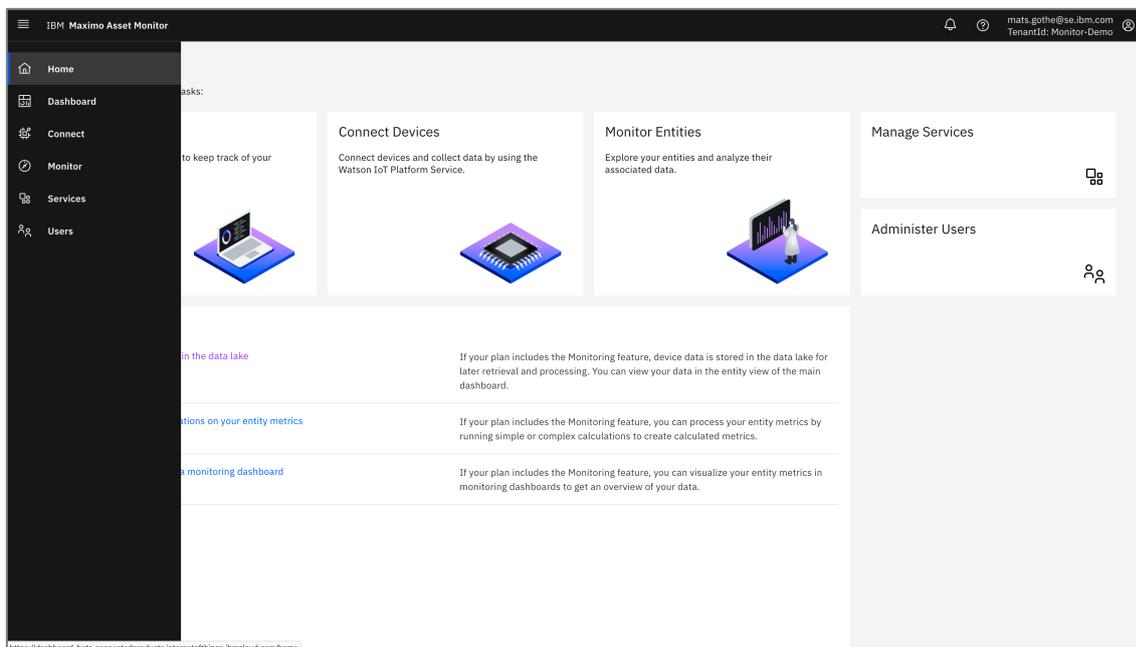
You have now successfully launched and logged into Maximo Asset Monitor.

In the two parts of this lab we will in-depth explore the usage of the **Connect** and **Monitor** in Maximo Asset Monitor. In the last section of this lab we will also overview the capabilities for Maximo Asset Monitor **Service Administration** and **User Management**.

## 1.8 Overview of Maximo Asset Monitor

The Maximo Asset Monitor home page presents the main capability sections:

- The **Home** section provides quick access to all main capability sections in Maximo Asset Monitor
- The **Dashboard** section provides quick access to your pinned dashboards for monitoring your Entities
- The **Connect** section launches the Watson IoT Platform Service used to connect and manage devices.
- The **Monitor** section provides access to the data lake and Entity time series data
- The **Manage Services** section provides access to the preconfigured services for messaging and data storage.
- The **Administer Users** section provides control of users and permissions.



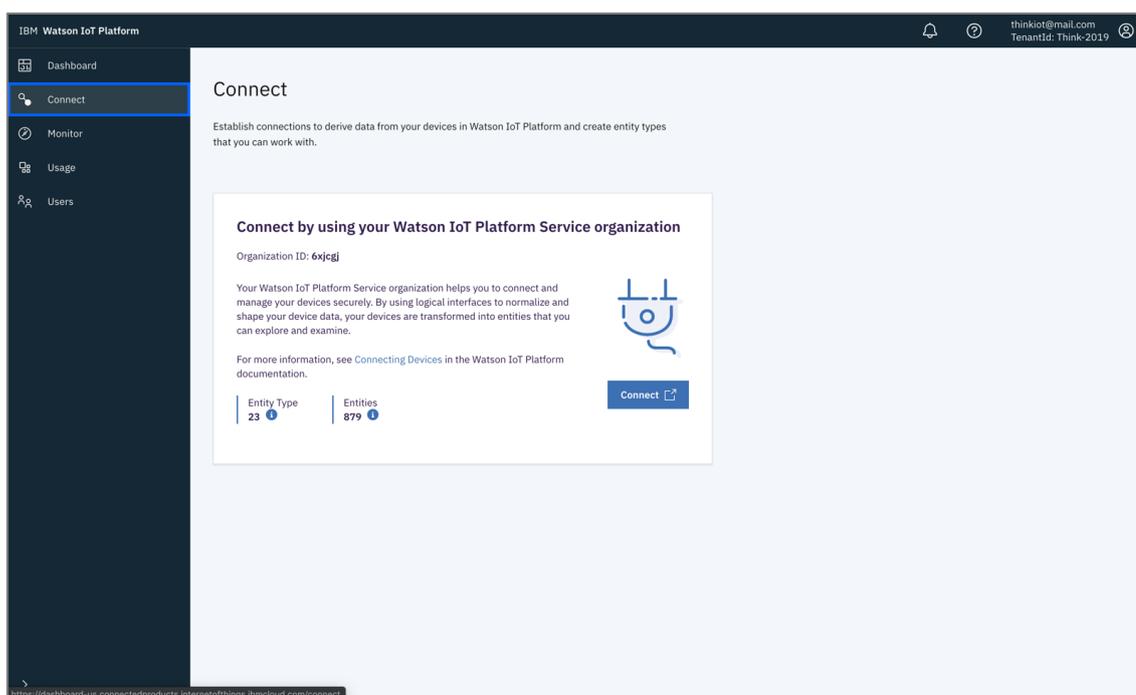
## 2 Exploring Connect – Watson IoT Platform Service

In this first part of the Maximo Asset Monitor 101 lab we will explore the Connect capabilities in IBM® Maximo™ Asset Monitor.

We are now ready to launch the IoT Platform Service, used in this lab to view device connections and events. Watson IoT Platform Service is preconfigured part of the Watson IoT Platform. This is the service where you define, register and manage your connected devices. Each Watson IoT Platform service, or *organization*, is given a unique six-character organization ID. Watson IoT Platform Organizations ensure that your connections and data are securely organized and accessible only to your devices, cloud services and business applications. In this lab we will use organization ID: **6xjcgj**.

To open the Watson IoT Platform service

1. Select the **Connect** section on the Watson IoT Platform banner.
2. The Connect page opens



- On the Connect page, click on the **Connect** button to launch the Watson IoT Platform Service.
- The Watson IoT Platform Service opens in a new browser tab

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
809646_EUI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300046D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E103000468E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E1030004745B-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300047891-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 13, WORKSTATION 13	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300045A94-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 16, WORKSTATION 16	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300046C8A-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 19, WORKSTATION 19	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300045A95-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 20, WORKSTATION 20	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E103000476F9-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 1, WORKSTATION 1	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E103000478CE-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 2, WORKSTATION 2	a-6xjcgj-au4dtzk2ik	
809646_EUI64-0080E10300047456-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2ik	

- Note**, in some cases the Watson IoT Platform Service do not open with the organization 6xjcgj selected, as shown below.

Collect data from **Cars** and make value from it

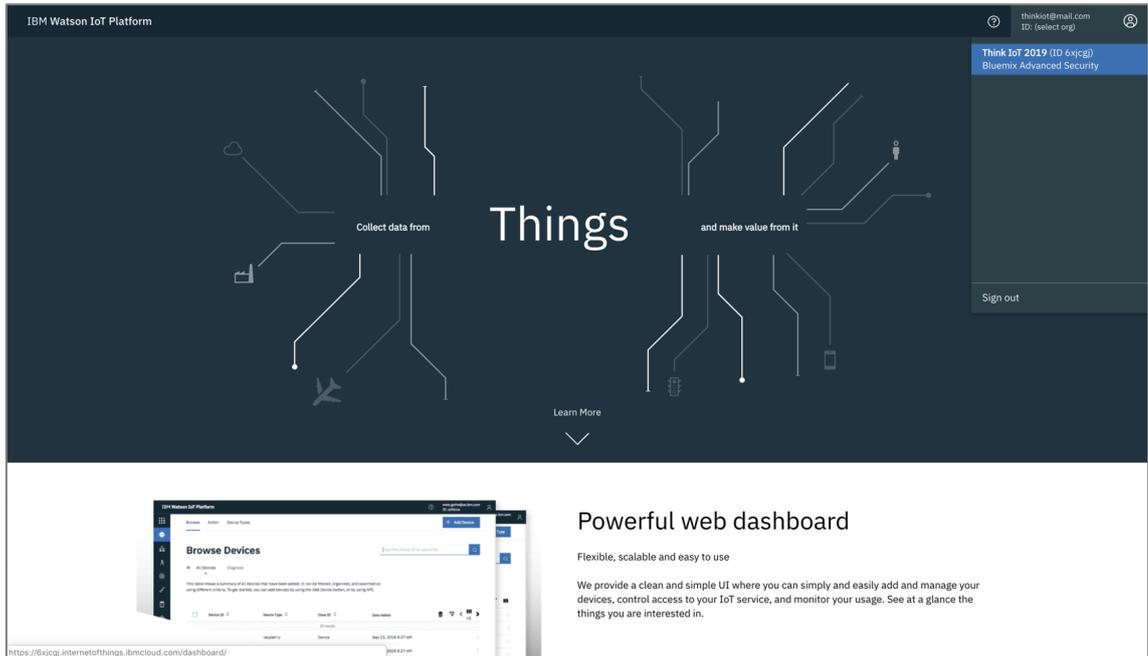
Learn More

**Powerful web dashboard**

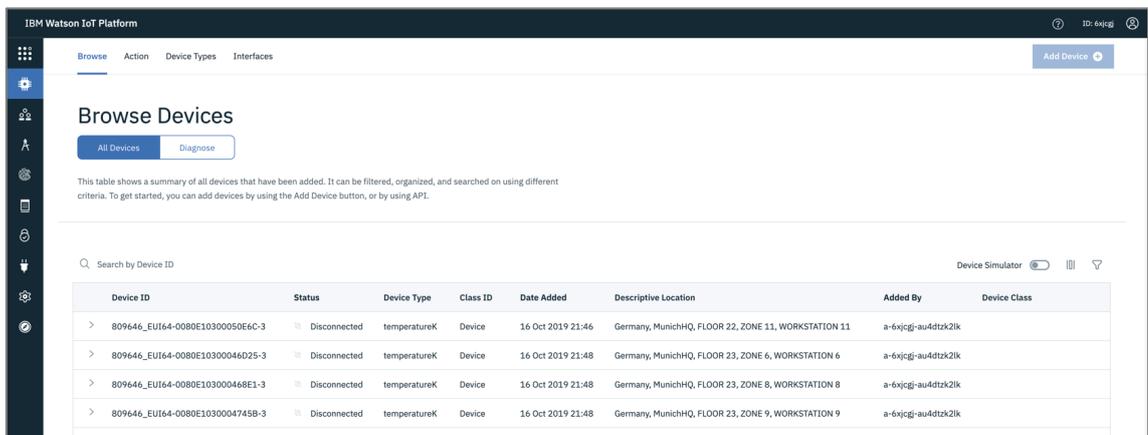
Flexible, scalable and easy to use

We provide a clean and simple UI where you can simply and easily add and manage your devices, control access to your IoT service, and monitor your usage. See at a glance the things you are interested in.

- Click on the organization switcher menu on the top right and choose “**Think IoT 2019 (ID 6xjcgj)**” from the menu.



**Note:** By selecting the organization id in the switcher menu, the page will reload and show the selected IoT Platform Service organization.



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

## 2.1 IoT Platform Navigation

IBM Watson IoT Platform Service provides a powerful web application for operators, administrators 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 Service user interface.

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

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
UI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjgji-au4dtzk2ik	
UI64-0080E10300046D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjgji-au4dtzk2ik	
UI64-0080E103000468E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjgji-au4dtzk2ik	
UI64-0080E10300047458-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjgji-au4dtzk2ik	
UI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjgji-au4dtzk2ik	
UI64-0080E10300047891-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 13, WORKSTATION 13	a-6xjgji-au4dtzk2ik	
UI64-0080E10300045A94-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 16, WORKSTATION 16	a-6xjgji-au4dtzk2ik	
UI64-0080E10300046C8A-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 19, WORKSTATION 19	a-6xjgji-au4dtzk2ik	
UI64-0080E10300045A95-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 20, WORKSTATION 20	a-6xjgji-au4dtzk2ik	
UI64-0080E103000476F9-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 1, WORKSTATION 1	a-6xjgji-au4dtzk2ik	
UI64-0080E103000478CE-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 2, WORKSTATION 2	a-6xjgji-au4dtzk2ik	
UI64-0080E10300047456-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 3, WORKSTATION 3	a-6xjgji-au4dtzk2ik	

The IoT platform navigation sections are

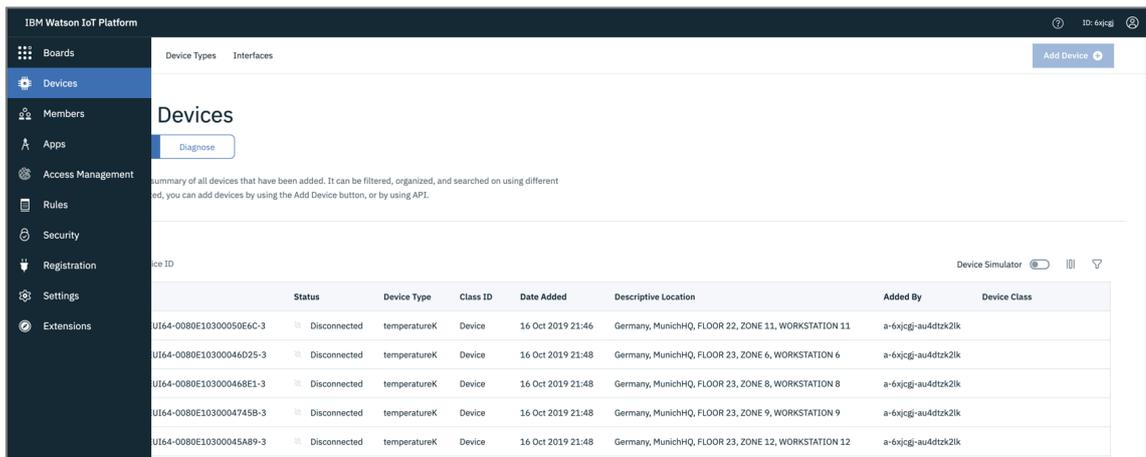
- **Boards** – Opens the dashboard and shows the boards and cards
- **Devices** – Opens a browser for registered devices and their device types
- **Members** – User management
- **Apps** – API Key management
- **Access Management** – Roles and Permissions
- **Usage** – Metrics of usage
- **Rules** –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

## 2.2 Exploring Device Types

*Devices* are things, like smart physical sensors and actuators, that connect to the IoT platform over internet. The Watson IoT Platform Service helps you define and manage your devices. Devices of the same type, brand, make or model are of a *Device Type*.

To view the Device Types registered in the IoT platform service

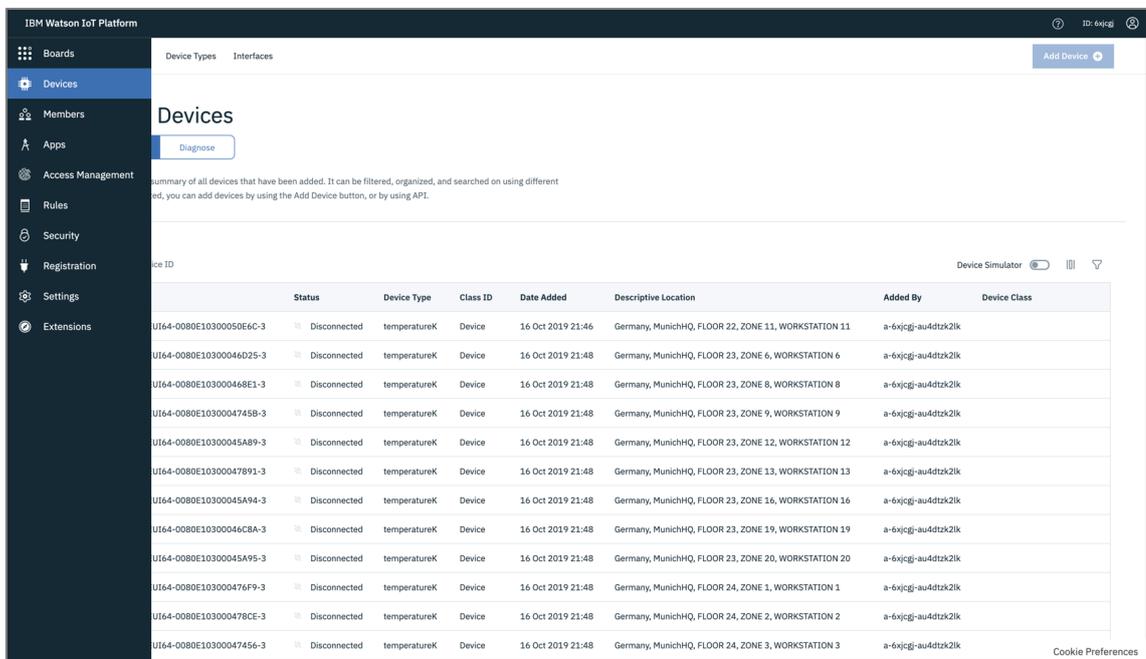
1. Move your mouse pointer to the left side navigation bar. The navigation bar slides out and shows the IoT platform capability sections.
2. In the navigation bar, choose **Devices**.



The screenshot shows the IBM Watson IoT Platform interface. The left navigation bar is expanded, and 'Devices' is selected. The main content area displays a table of devices. The table has columns for Status, Device Type, Class ID, Date Added, Descriptive Location, Added By, and Device Class. All devices listed are 'Disconnected' and of type 'temperatureK'.

ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
UI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjgji-au4dtzk2lk	
UI64-0080E10300044D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjgji-au4dtzk2lk	
UI64-0080E103000448E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjgji-au4dtzk2lk	
UI64-0080E1030004745B-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjgji-au4dtzk2lk	

3. The Devices page opens. This view shows all devices registered in this organization.



The screenshot shows the IBM Watson IoT Platform interface. The left navigation bar is expanded, and 'Devices' is selected. The main content area displays a table of devices. The table has columns for Status, Device Type, Class ID, Date Added, Descriptive Location, Added By, and Device Class. All devices listed are 'Disconnected' and of type 'temperatureK'.

ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
UI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjgji-au4dtzk2lk	
UI64-0080E10300044D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjgji-au4dtzk2lk	
UI64-0080E103000448E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjgji-au4dtzk2lk	
UI64-0080E1030004745B-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjgji-au4dtzk2lk	
UI64-0080E10300047891-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 13, WORKSTATION 13	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A94-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 16, WORKSTATION 16	a-6xjgji-au4dtzk2lk	
UI64-0080E103000446C8A-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 19, WORKSTATION 19	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A95-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 20, WORKSTATION 20	a-6xjgji-au4dtzk2lk	
UI64-0080E103000476F9-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 1, WORKSTATION 1	a-6xjgji-au4dtzk2lk	
UI64-0080E103000478CE-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 2, WORKSTATION 2	a-6xjgji-au4dtzk2lk	
UI64-0080E10300047456-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 3, WORKSTATION 3	a-6xjgji-au4dtzk2lk	

4. On the Device page, choose the **Device Types** tab.
5. The Device Types page opens.  
This page shows all device types registered in this organization.

The screenshot shows the 'Device Types' page in the IBM Watson IoT Platform. The page title is 'Device Types' and it includes a sub-header: '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.' Below this is a search bar with the placeholder text 'Type the name to search...'. The main content is a table with the following data:

Name	Description	Number of Devices	Class ID	Date Added
> HMIFrameLineWelding	HMI Frame Line Welding	11	Device	2019-03-01T13:12:59.085Z
> HMIFrameLineWeldingSec	HMI Frame Line Welding Secondary Line	10	Device	2019-03-01T15:15:20.964Z
> HMIPCBInspection	HMI PCB Inspection	1	Device	2019-03-21T14:26:10.626Z
> HMISB		3	Gateway	2019-03-14T11:01:55.730Z
> HMISmartfactoryKL_DT	HMI Smart Factory	2	Device	2019-03-04T14:04:24.810Z
> Kinexon-GW	Kinexon Gateway	1	Gateway	2019-03-07T10:01:27.201Z
> Kinexon-Tag	Kinexon Tags	4	Device	2019-03-07T10:07:10.897Z
> NewDevice		0	Device	2019-09-04T08:14:51.055Z
> PSB40DEV	PSB40DEV	1	Device	2019-03-14T11:25:43+00:00
> Workstation		407	Device	2019-10-21T11:25:28.654Z

At the bottom of the table, there are pagination controls: 'Items per page 10 | 1-10 of 24 items' and '1 of 3 pages' with navigation arrows. A 'Cookie Preferences' link is also visible in the bottom right corner.

**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.

In this lab we will use the devices deployed at the IBM Munich IoT Center. There are several device types of devices. Viewing the device types page, we see a summary of the device types and the number of devices registered of each type, for example

- Carbon Dioxide sensors
- Air Pressure sensors
- Relative Humidity sensors
- Sound Pressure Level sensors
- Motion sensors
- Temperature sensors

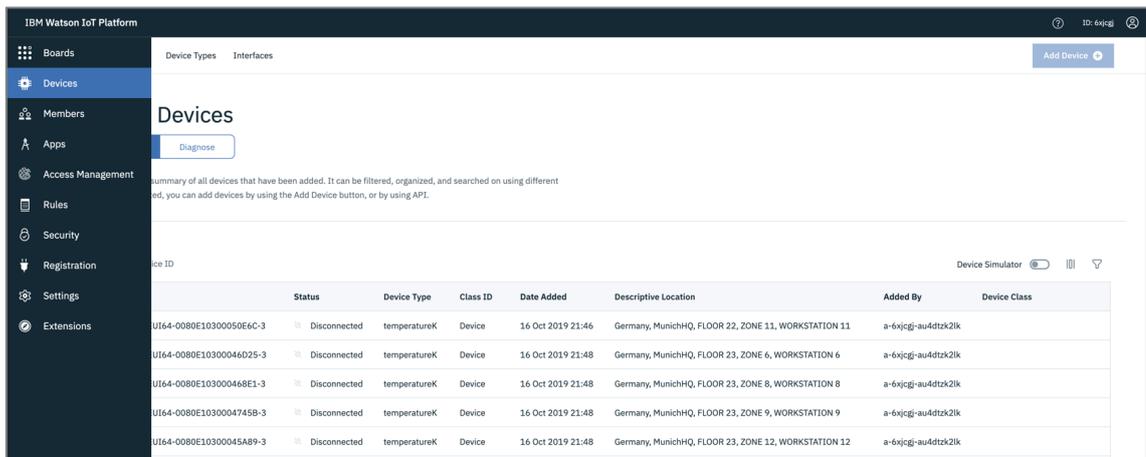
We will later in the section return to this page and explore more details on the data transformation performed by the IoT platform for these device types.

## 2.3 Exploring Devices

Devices are the physical sensors and actuators that connect to the IoT platform over internet. The Watson IoT Platform Service helps you define and manage your devices and ensures a secure connection for transferring data from the device to the cloud.

To view devices registered in the IoT platform organization

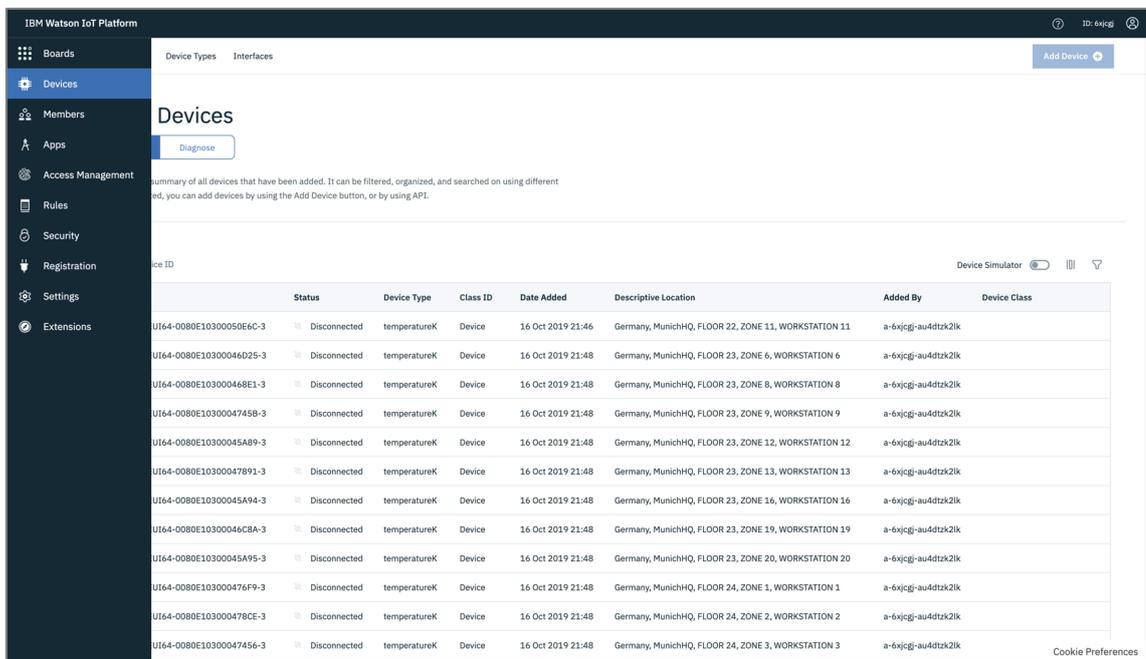
1. Move your mouse pointer to the left side navigation bar. The navigation bar slides out and shows the IoT platform capability sections.
2. In the navigation bar, choose **Device**



The screenshot shows the IBM Watson IoT Platform interface. The left navigation bar is expanded, and the 'Devices' option is selected. The main content area displays the 'Devices' page with a search bar and a 'Diagnose' button. Below this, there is a table listing registered devices. All devices shown are in a 'Disconnected' status.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
UI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjgji-au4dtzk2lk	
UI64-0080E10300046D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjgji-au4dtzk2lk	
UI64-0080E103000468E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjgji-au4dtzk2lk	
UI64-0080E1030004745B-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjgji-au4dtzk2lk	

3. The Devices page opens. This view shows all devices registered in this organization.

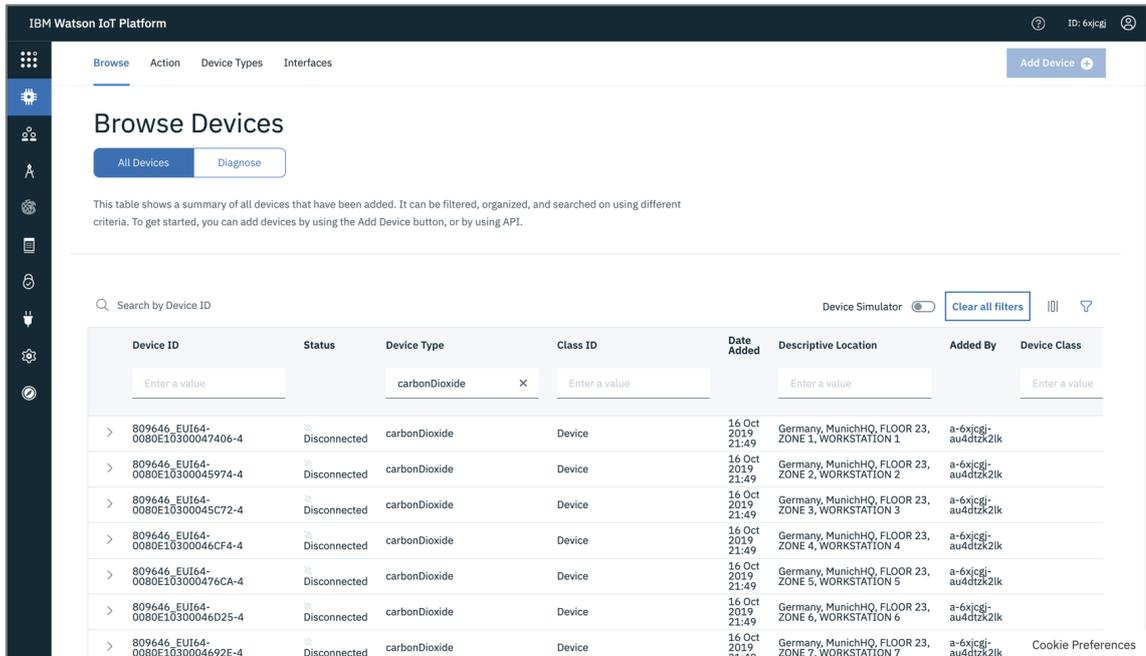


This screenshot shows the same IBM Watson IoT Platform interface as the previous one, but with a larger list of 16 devices. All devices are still in a 'Disconnected' status.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
UI64-0080E10300050E6C-3	Disconnected	temperatureK	Device	16 Oct 2019 21:46	Germany, MunichHQ, FLOOR 22, ZONE 11, WORKSTATION 11	a-6xjgji-au4dtzk2lk	
UI64-0080E10300046D25-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjgji-au4dtzk2lk	
UI64-0080E103000468E1-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 8, WORKSTATION 8	a-6xjgji-au4dtzk2lk	
UI64-0080E1030004745B-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 9, WORKSTATION 9	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A89-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 12, WORKSTATION 12	a-6xjgji-au4dtzk2lk	
UI64-0080E10300047891-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 13, WORKSTATION 13	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A94-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 16, WORKSTATION 16	a-6xjgji-au4dtzk2lk	
UI64-0080E10300046C8A-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 19, WORKSTATION 19	a-6xjgji-au4dtzk2lk	
UI64-0080E10300045A95-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 23, ZONE 20, WORKSTATION 20	a-6xjgji-au4dtzk2lk	
UI64-0080E103000476F9-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 1, WORKSTATION 1	a-6xjgji-au4dtzk2lk	
UI64-0080E103000478CE-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 2, WORKSTATION 2	a-6xjgji-au4dtzk2lk	
UI64-0080E10300047456-3	Disconnected	temperatureK	Device	16 Oct 2019 21:48	Germany, MunichHQ, FLOOR 24, ZONE 3, WORKSTATION 3	a-6xjgji-au4dtzk2lk	

- The Devices are by default sorted by the Device ID column. Use the sort icon to sort the devices by any column. Click on the Device Type column filter icon  to filter devices by type.
- Type “carbonDioxid” in the Device Type column filter and complete the text entry by the **Return** or **Tab** key.

The Device table applies the filter and shows the carbonDioxide sensors.



IBM Watson IoT Platform

Browse Action Device Types Interfaces

### Browse Devices

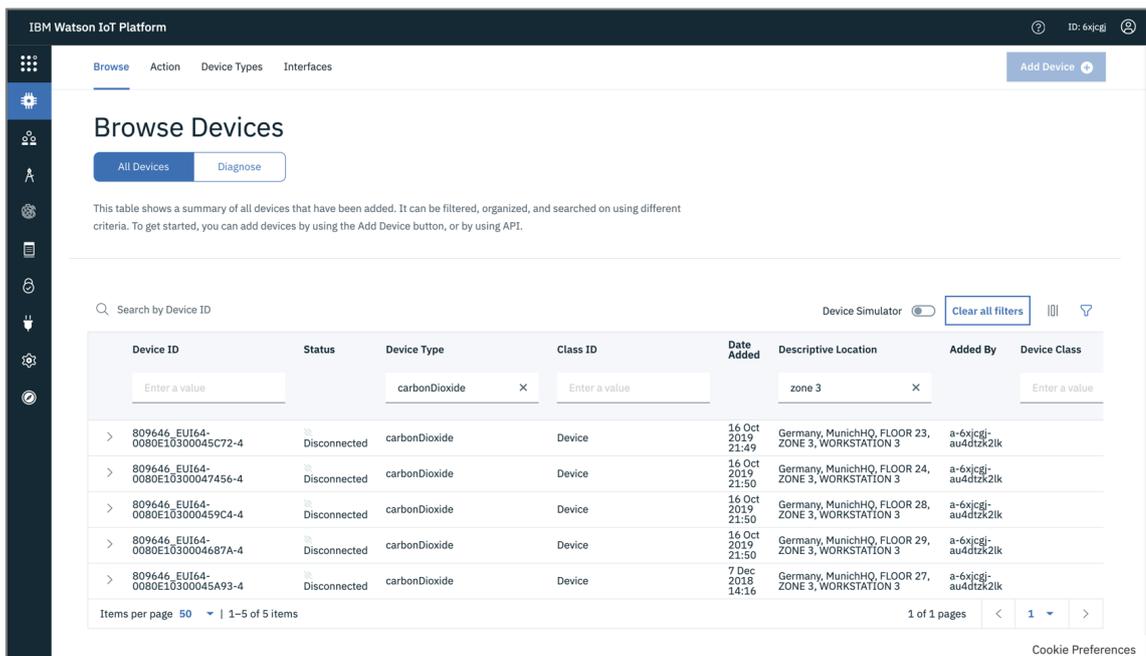
All Devices Diagnose

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.

Search by Device ID Device Simulator  Clear all filters

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
<input type="text" value="Enter a value"/>		carbonDioxide <input type="text" value="x"/>	<input type="text" value="Enter a value"/>		<input type="text" value="Enter a value"/>		<input type="text" value="Enter a value"/>
> 809646_EUI64-0080E10300047406-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 1, WORKSTATION 1	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300045974-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 2, WORKSTATION 2	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300045C72-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300046CF4-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 4, WORKSTATION 4	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E103000476CA-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 5, WORKSTATION 5	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300046D25-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 6, WORKSTATION 6	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E1030004692E-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 7, WORKSTATION 7	a-6xjcgj-au4dtzk2lk	Cookie Preferences

- Apply a second filter by entering “zone 3” to the **Descriptive Location** column. Complete the text entry by the **Return** or **Tab** key.



IBM Watson IoT Platform

Browse Action Device Types Interfaces

### Browse Devices

All Devices Diagnose

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.

Search by Device ID Device Simulator  Clear all filters

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
<input type="text" value="Enter a value"/>		carbonDioxide <input type="text" value="x"/>	<input type="text" value="Enter a value"/>		zone 3 <input type="text" value="x"/>		<input type="text" value="Enter a value"/>
> 809646_EUI64-0080E10300045C72-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:49	Germany, MunichHQ, FLOOR 23, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300047456-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:50	Germany, MunichHQ, FLOOR 24, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E103000459C4-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:50	Germany, MunichHQ, FLOOR 28, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E1030004687A-4	Disconnected	carbonDioxide	Device	16 Oct 2019 21:50	Germany, MunichHQ, FLOOR 29, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300045A93-4	Disconnected	carbonDioxide	Device	7 Dec 2018 14:16	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	

Items per page 50 | 1-5 of 5 items 1 of 1 pages < 1 >

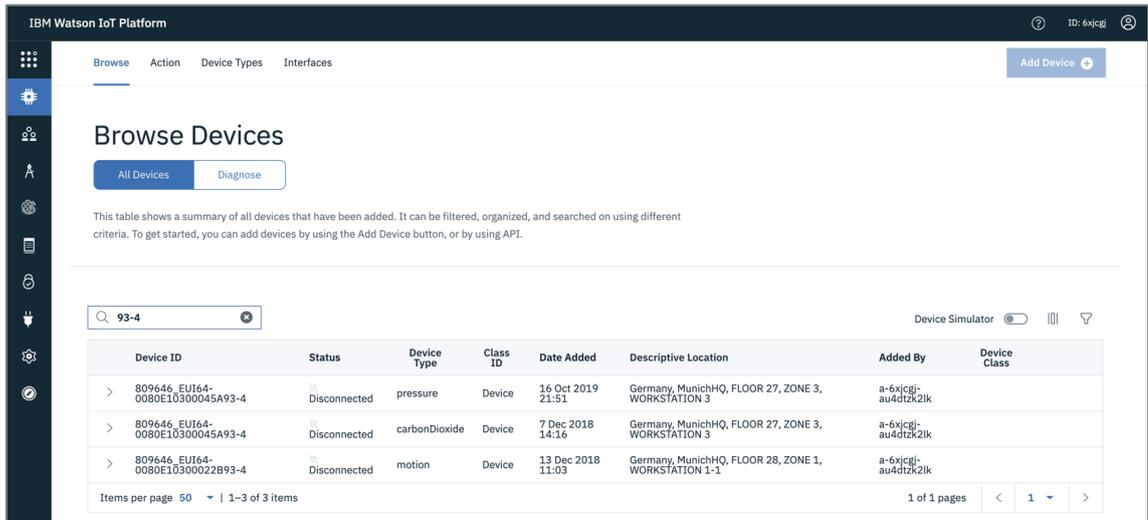
Cookie Preferences

**Note:** Five carbon dioxide sensors have been deployed in the zone 3’s of the building. On floors 23, 24, 27, 28 and 29.

7. Click the **Clear all filters** or the filter icon  to disable filtering.

The device table has a Search function that quickly finds matching devices by name. To find a device, or a group of devices

1. Enter a search string into the search field. Type a full device id, like “809646\_EUI64-0080E10300045A93-3”, or just a part of the name, like “93-4”
2. The carbon dioxide sensor 809646\_EUI64-0080E10300045A93-4 is found and shown in the list



The screenshot shows the IBM Watson IoT Platform interface. The main heading is "Browse Devices". Below the heading, there are two tabs: "All Devices" (selected) and "Diagnose". A search bar contains the text "93-4". To the right of the search bar, there is a "Device Simulator" toggle switch and a filter icon. Below the search bar is a table with the following columns: Device ID, Status, Device Type, Class ID, Date Added, Descriptive Location, Added By, and Device Class. The table contains three rows of data, all with a status of "Disconnected".

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
> 809646_EUI64-0080E10300045A93-4	Disconnected	pressure	Device	16 Oct 2019 21:51	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300045A93-4	Disconnected	carbonDioxide	Device	7 Dec 2018 14:16	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
> 809646_EUI64-0080E10300022B93-4	Disconnected	motion	Device	13 Dec 2018 11:03	Germany, MunichHQ, FLOOR 28, ZONE 1, WORKSTATION 1-1	a-6xjcgj-au4dtzk2lk	

Items per page 50 | 1-3 of 3 items 1 of 1 pages < 1 >

## 2.4 Exploring Events

*Events* is the mechanism by which devices publish data at a regular heartbeat to the Watson IoT Platform. The frequency is decided by the device, for example every second, every minute, every hour, or once a day. The device controls the content, or *payload*, of the event. Similar events are defined as an *Event Type*, and the payload data structure of the event type is defined by a schema. Events can be published in different formats, for example, JSON, string, binary, and more. By default, the Watson IoT Platform expects events in JSON format specified by a JSON schema.

To view events sent by a device

1. Choose a device in the device table, for example the temperature sensor 809646\_EUI64-0080E10300045A93-3. (Workstation 3 in Zone 3)

Clicking on the device row in the table will show more details on the device

The screenshot shows the IBM Watson IoT Platform interface. The main heading is "Browse Devices". Below the heading are two buttons: "All Devices" and "Diagnose". A search bar contains "93-3". A table lists devices with the following columns: Device ID, Status, Device Type, Class ID, Date Added, Descriptive Location, Added By, and Device Class. Two rows are visible, both with a status of "Disconnected". The second row is selected, and a modal window displays its details:

Identity	Device Information	Recent Events	State
Device ID	809646_EUI64-0080E10300045A93-3		
Device Type	temperatureK		
Date Added	2018-12-07T13:22:46.351Z		
Added By	a-6xjcgj-au4dtzk2lk		
Connection Status	Disconnected		

At the bottom of the modal, it says "Items per page 50 | 1-2 of 2 items". The page footer includes "1 of 1 pages" and "Cookie Preferences".

## 2. Choose the **Recent Events** tab

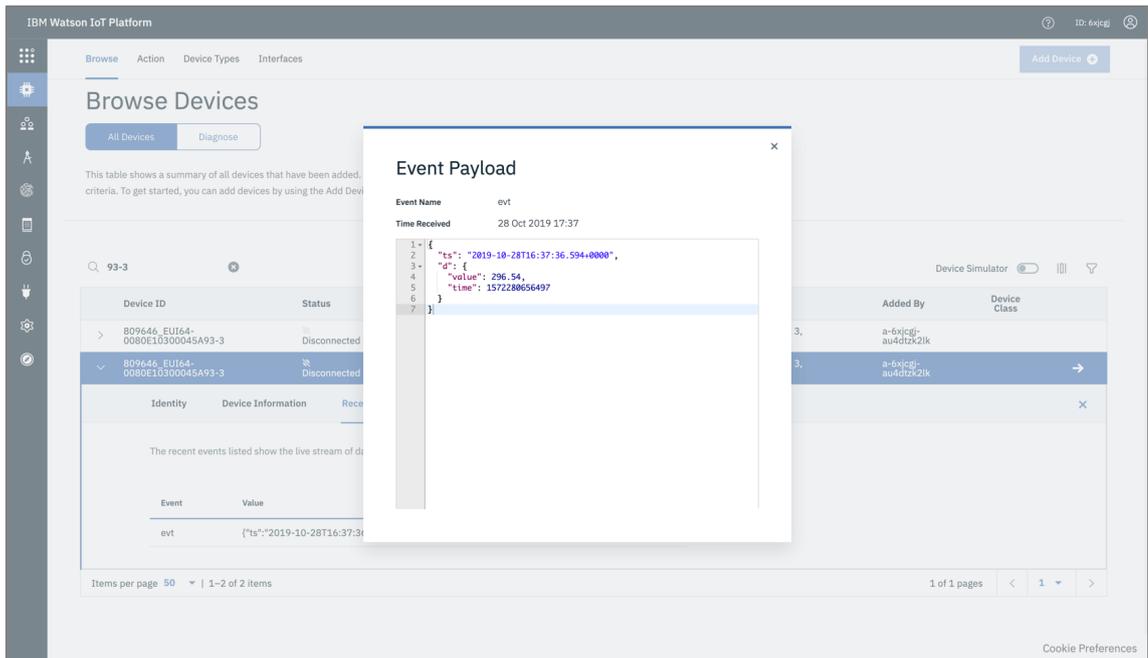
The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. A search bar contains '93-3'. Below the navigation is a table of devices. The second device is selected, and its details are shown in a modal window. The 'Recent Events' tab is active, displaying a message: 'The recent events listed show the live stream of data that is coming and going from this device.' Below this is a table with columns: Event, Value, Format, and Last Received. The table is currently empty, with a 'Waiting for device events...' message and a device icon below it. The bottom of the modal shows 'Items per page 50' and '1 of 2 items'.

**Note:** The screen does not at first show any events. Wait a minute for the next event sent from the device to show.

## 3. Newly received events from the device are shown in the recent events list.

The screenshot shows the IBM Watson IoT Platform interface. The top navigation bar includes 'Browse', 'Action', 'Device Types', and 'Interfaces'. A search bar contains '93-3'. Below the navigation is a table of devices. The second device is selected, and its details are shown in a modal window. The 'Recent Events' tab is active, displaying a message: 'The recent events listed show the live stream of data that is coming and going from this device.' Below this is a table with columns: Event, Value, Format, and Last Received. The table now contains one event: 'evt' with a JSON payload in the Value column and 'a few seconds ago' in the Last Received column. The bottom of the modal shows 'Items per page 50' and '1 of 2 items'.

4. Click on an event in the recent event list to view the event payload.  
The JSON payload is shown with Value and Time data.



**Note:** The data payload from a temperatureK sensor has a *Value* element that contains the temperature level expressed in Kelvin degrees. The Kelvin temperature scale uses the absolute zero (0 K) as is equivalent to  $-273.15\text{ }^{\circ}\text{C}$  or  $-459.67\text{ }^{\circ}\text{F}$ . The *Time* element is the timestamp when the value sample was taken.

## 2.5 Exploring Device State

The Watson IoT Platform provides transformation and normalization event data into a single logical view called *device state*. This feature greatly simplifies application development as applications can rely on a common interface abstraction and be independent of device event type schema variations across devices of different versions, variants and brands.

To view the device state of a temperature sensor

1. Choose a device in the device table, for example the previously explored temperature sensor 809646\_EUI64-0080E10300045A93-3.
2. Choose the **State** tab.

The current state of the selected temperature sensor is shown.

The screenshot shows the IBM Watson IoT Platform interface. At the top, there are navigation tabs for 'Browse', 'Action', 'Device Types', and 'Interfaces'. A search bar contains '93-3'. Below the search bar is a table of devices. The selected device is expanded to show its 'State' tab, which includes a dropdown menu for 'Interface' set to 'Raw Data'. Below this is a table of event data.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location	Added By	Device Class
809646_EUI64-0080E10300045A93-3	Disconnected	relativeHumidity	Device	7 Dec 2018 14:12	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	
809646_EUI64-0080E10300045A93-3	Disconnected	temperatureK	Device	7 Dec 2018 14:22	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3	a-6xjcgj-au4dtzk2lk	

Property	Value	Type	Event	Last Received
ts	2019-10-28T16:38:37.52...	String	evt	a few seconds ago
d		Object	evt	a few seconds ago
value	296.54	Number	evt	a few seconds ago
time	1572280717431	Number	evt	a few seconds ago

**Note:** By default, the Raw Data interface is shown. Note that these are the data items delivered in the device event. Also note the Last Received property that indicated the time period since this event was received.

- From the Interface drop down, choose the **TemperatureK\_LI** interface.

The screenshot shows the 'Interface' dropdown menu with 'Raw Data' selected. Below the dropdown is a table of event data, which is now normalized for the 'temperatureK\_LI' interface.

Property	Value	Type	Event	Last Received
ts	2019-10-28T16:38:37.52...	String	evt	a few seconds ago
d		Object	evt	a few seconds ago
value	296.54	Number	evt	a few seconds ago
time	1572280717431	Number	evt	a few seconds ago

The table now shows a normalized of the temperature sensor, including the raw event data items, value and time, and the temperature transformed to Celsius, Fahrenheit and Kelvin temperatures. The interface also concludes a comfort level value. We will return to the analysis of comfort levels in an later section.

These data transformations are defined on the Device Type and apply to all devices of the type.

The screenshot displays the IBM Watson IoT Platform interface. At the top, there are navigation tabs for 'Browse', 'Action', 'Device Types', and 'Interfaces'. A search bar contains '93-3'. Below the search bar is a table of devices. The second device is selected, and its details are shown in a modal window. The modal window has tabs for 'Identity', 'Device Information', 'Recent Events', and 'State'. The 'State' tab is active, showing a table of properties for the 'temperatureK\_L1' interface.

Property	Value	Type	Last Received
time	1572280776382	Number	a few seconds ago
value	296.54	Number	a few seconds ago
temperatureC	23.390000000000043	Number	a few seconds ago
temperatureF	74.102000000000007	Number	a few seconds ago
temperatureK	296.54	Number	a few seconds ago
comfortLevel	1	Number	a few seconds ago

By using an interface, devices of a type may provide a common abstraction with defined data names and values. An application can trust that any temperature sensor type will provide a Celsius, Fahrenheit and Kelvin temperature regardless of its event types and payload data structures.

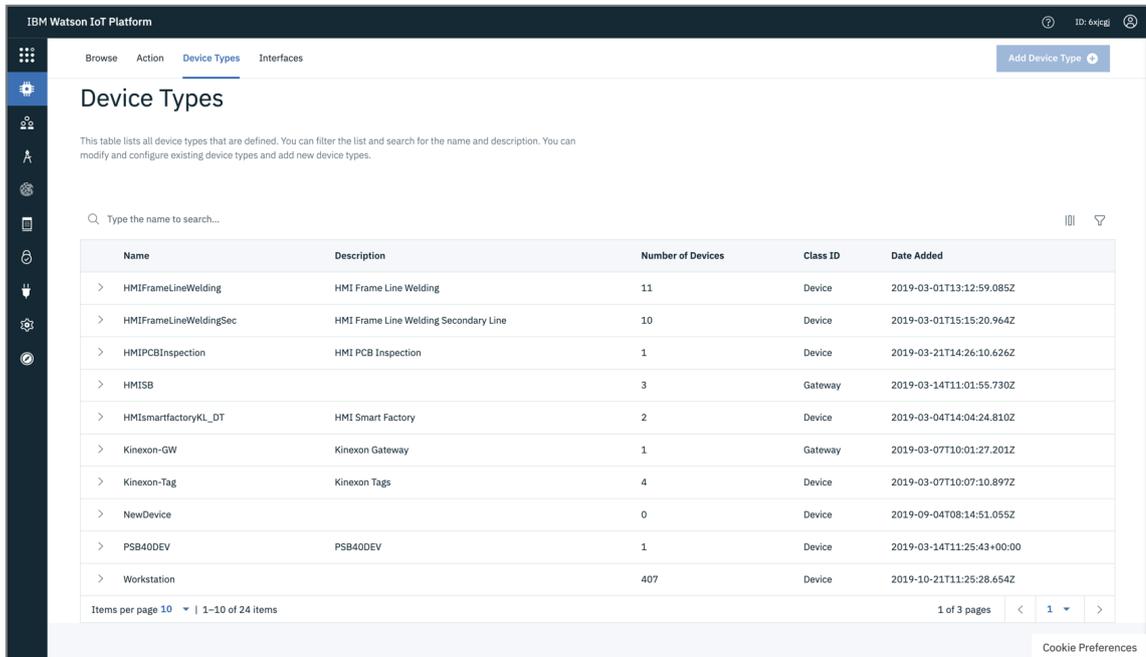
4. Select devices of other types to explore their data items, JOSN payload structures and interface definitions. For example,

- The **motion** device type that defines `isOccupied` and `lastOccupied` properties for workspace occupancy.
- The **soundPressureLevel**, **relativeHumidity** and **carbonDioxid** device types that each defines a `comfortLevel` property based on sensor values and regulated office comfort levels.

## 2.6 Exploring Interfaces

To view *device types* registered in the IoT platform service

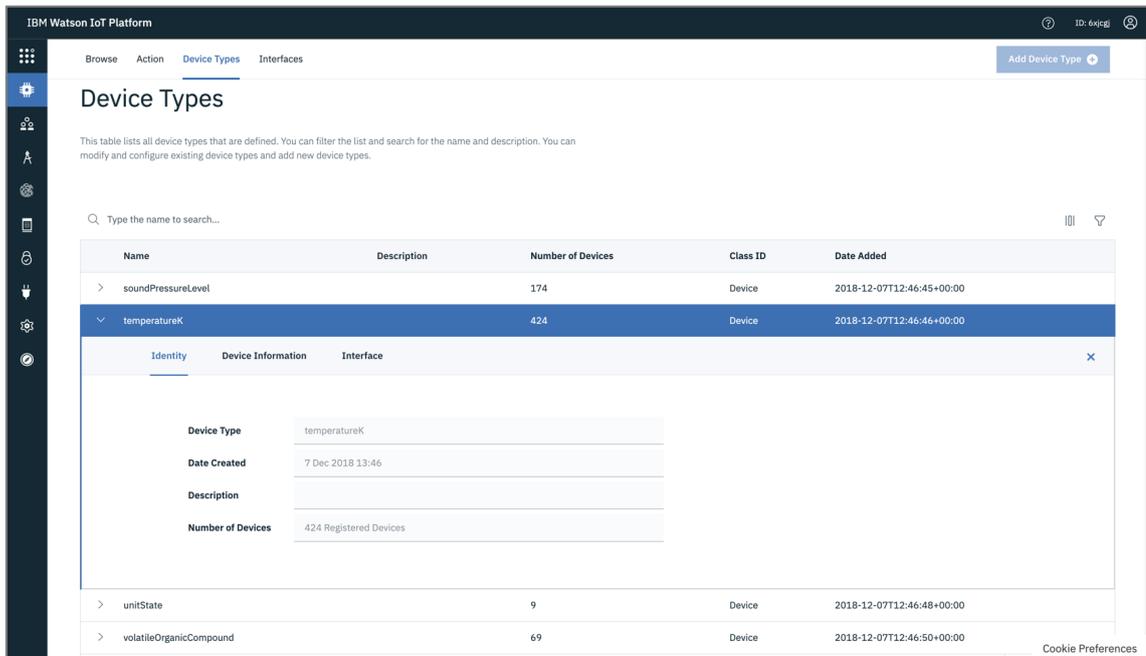
1. In the navigation bar, choose **Devices**.
2. On the Devices section, choose the **Device Type** tab



The screenshot shows the 'Device Types' page in the IBM Watson IoT Platform. The page title is 'Device Types' and it includes a search bar and a table of device types. The table has columns for Name, Description, Number of Devices, Class ID, and Date Added. The 'temperatureK' device type is highlighted in blue.

Name	Description	Number of Devices	Class ID	Date Added
> HMIFrameLineWelding	HMI Frame Line Welding	11	Device	2019-03-01T13:12:59.085Z
> HMIFrameLineWeldingSec	HMI Frame Line Welding Secondary Line	10	Device	2019-03-01T15:15:20.964Z
> HMIPCBInspection	HMI PCB Inspection	1	Device	2019-03-21T14:26:10.626Z
> HMISB		3	Gateway	2019-03-14T11:01:55.730Z
> HMISmartfactoryKL_DT	HMI Smart Factory	2	Device	2019-03-04T14:04:24.810Z
> Kinexon-GW	Kinexon Gateway	1	Gateway	2019-03-07T10:01:27.201Z
> Kinexon-Tag	Kinexon Tags	4	Device	2019-03-07T10:07:10.897Z
> NewDevice		0	Device	2019-09-04T08:14:51.055Z
> PSB40DEV	PSB40DEV	1	Device	2019-03-14T11:25:43+00:00
> Workstation		407	Device	2019-10-21T11:25:28.654Z

3. In the Device Type list, select the **temperatureK** device type. Use the search filed or go to the 3<sup>rd</sup> page to see the type in the list.



The screenshot shows the 'Device Types' page in the IBM Watson IoT Platform. The 'temperatureK' device type is selected, and its details are displayed in a modal window. The modal window has tabs for 'Identity', 'Device Information', and 'Interface'. The 'Identity' tab is active, showing the following details:

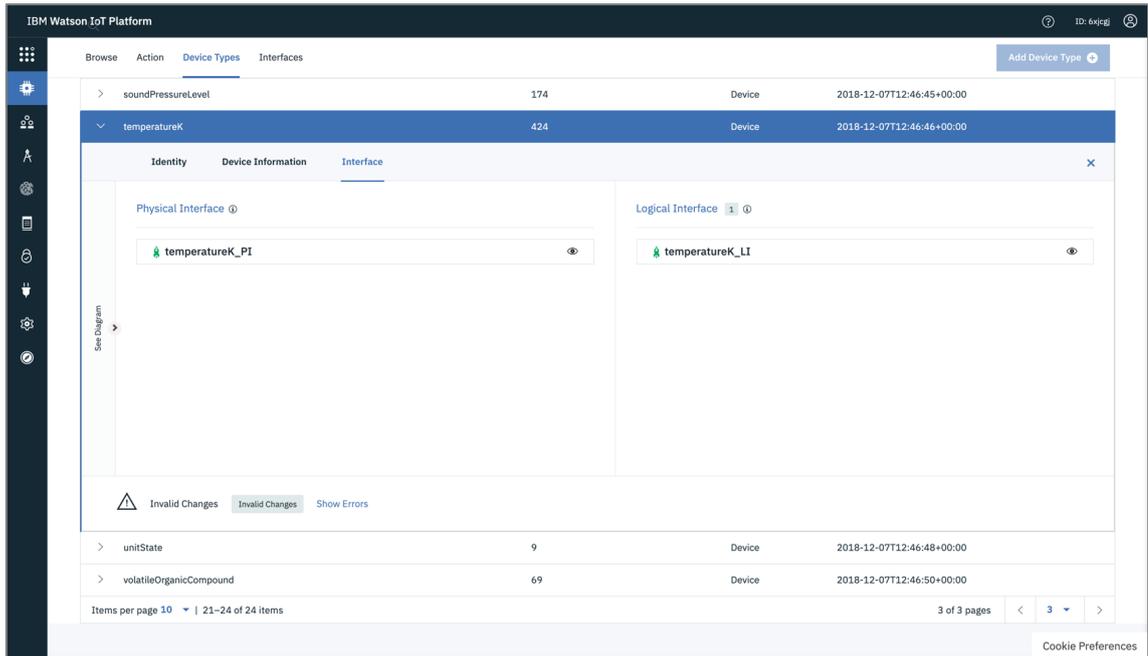
Name	Description	Number of Devices	Class ID	Date Added
> soundPressureLevel		174	Device	2018-12-07T12:46:45+00:00
temperatureK		424	Device	2018-12-07T12:46:46+00:00
> unitState		9	Device	2018-12-07T12:46:48+00:00
> volatileOrganicCompound		69	Device	2018-12-07T12:46:50+00:00

Modal Window Details:

Property	Value
Device Type	temperatureK
Date Created	7 Dec 2018 13:46
Description	
Number of Devices	424 Registered Devices

4. Select the **Interface** tab.

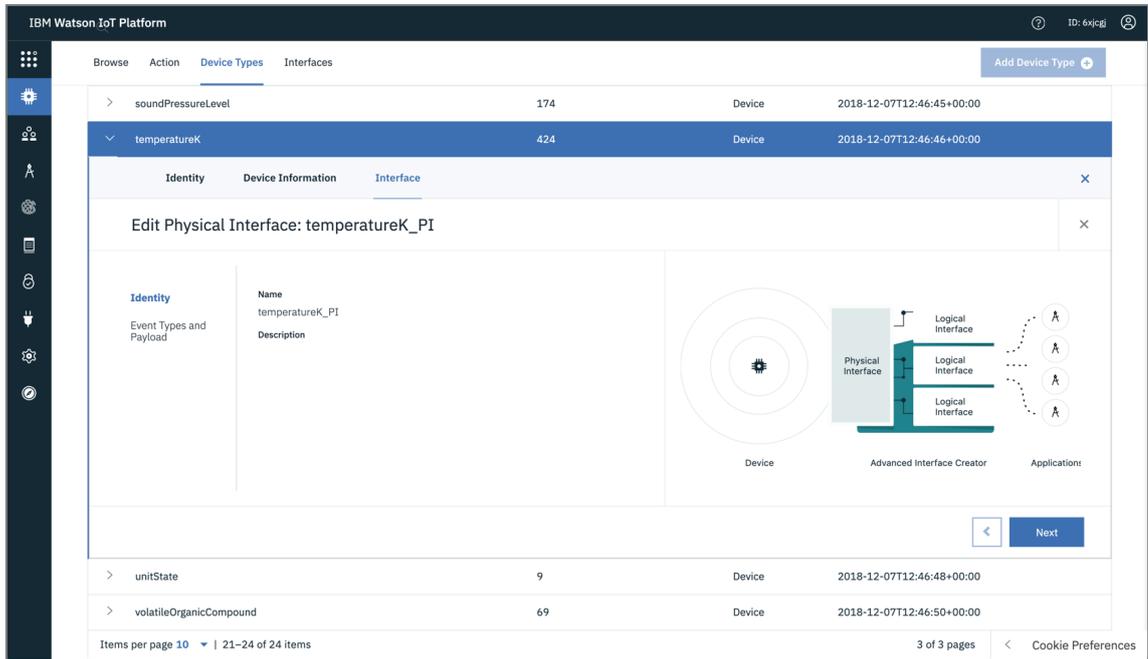
The interface tab shows the interfaces defined for the type.



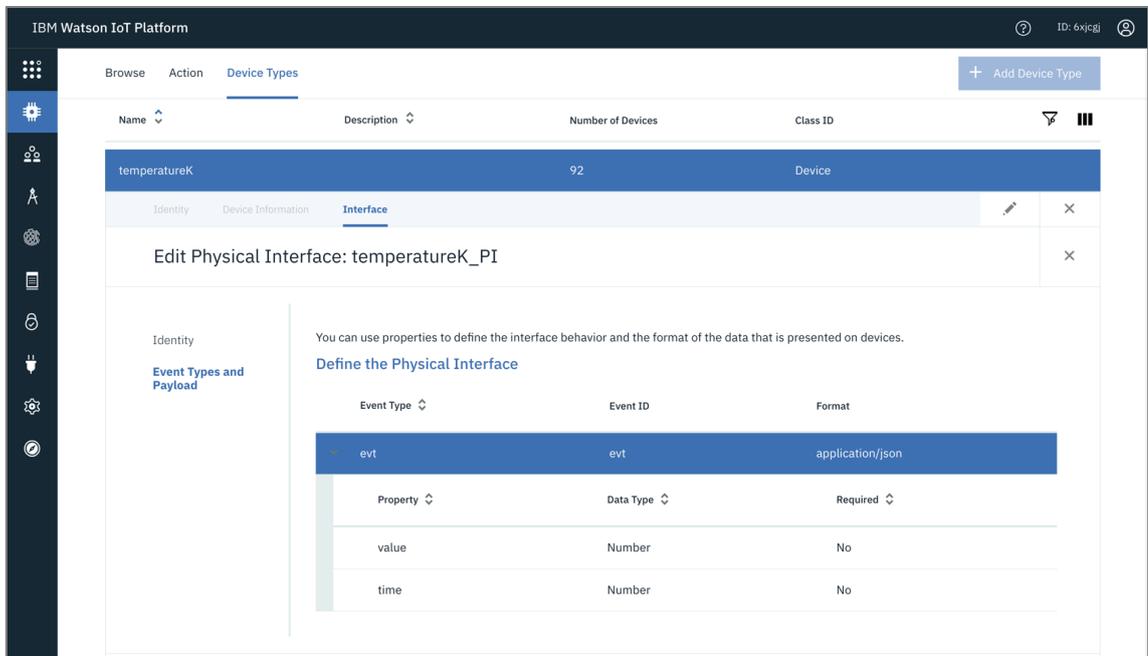
The Watson IoT Platform uses two types of interfaces for filtering, normalizing, transforming and abstracting event data into a device state.

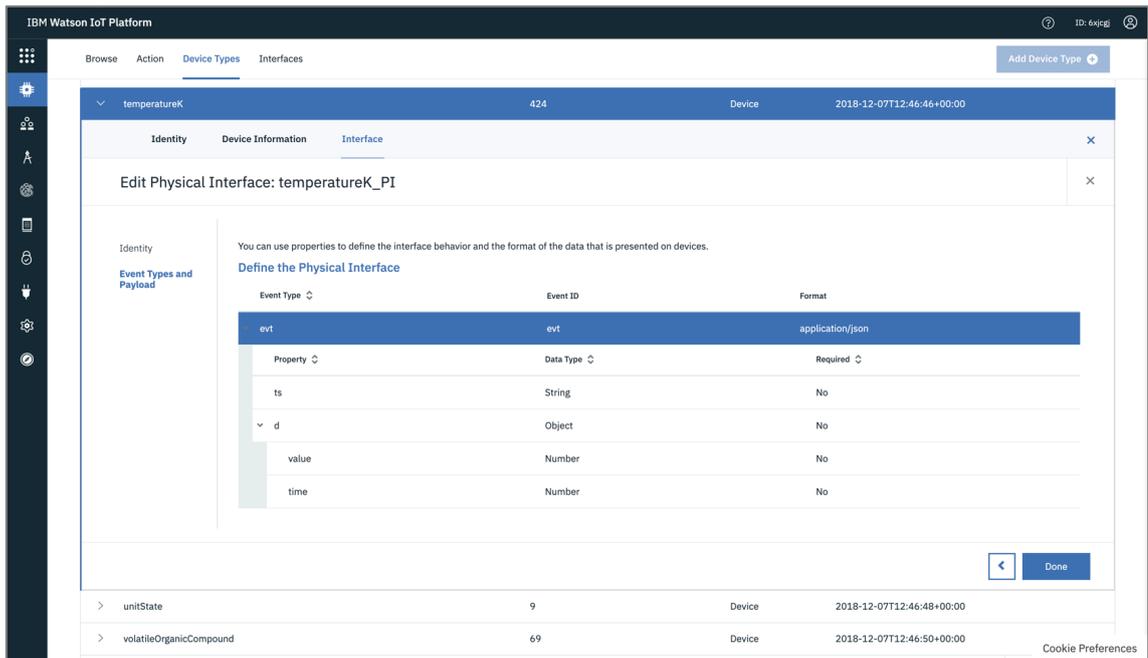
- `temperature_PI` – *Physical Interface* – A physical interface represents the event types that a device of a particular device type can send. Events types not included in the physical interface will be filtered and discarded by the IoT platform
- `temperatureK_LI` – A *Logical Interface* represents the state of a device. It's a canonical view which can be shared across multiple device types.
- A device type also provides *mapping expressions* that computes the state in the logical interface from received events declared in the physical interface.

- Click on the view icon  to explore the temperature\_PI physical interface. The physical interface editor opens on the Identity page



- Click **Next**. The Event Types and Payload page opens.
- In the Event Types list, expand the **evt** event type to view its event properties



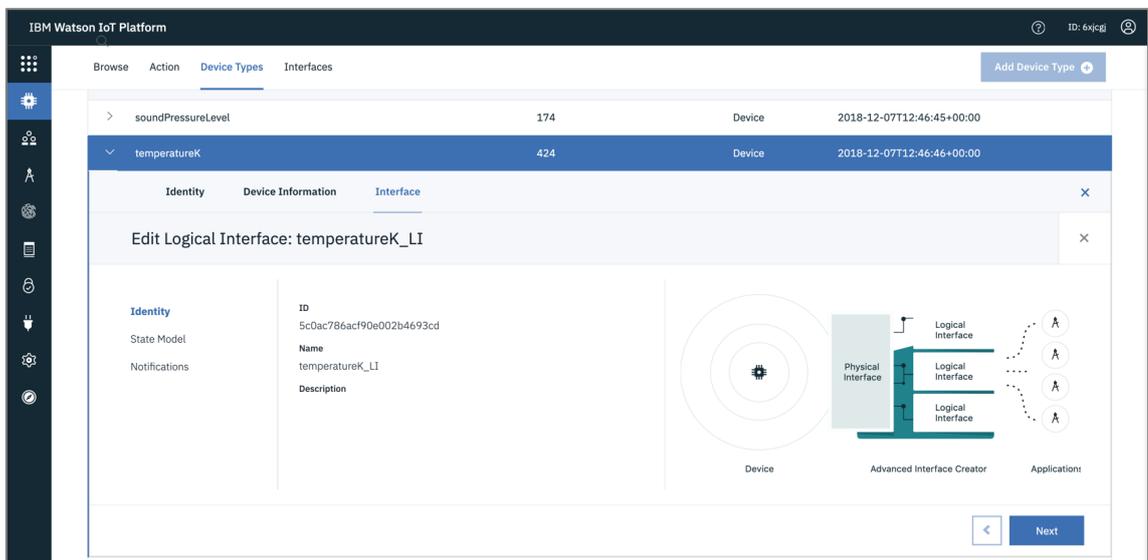


**Note:** The evt event type with the value and time properties are the event that we explored in the previous sections of this lab.

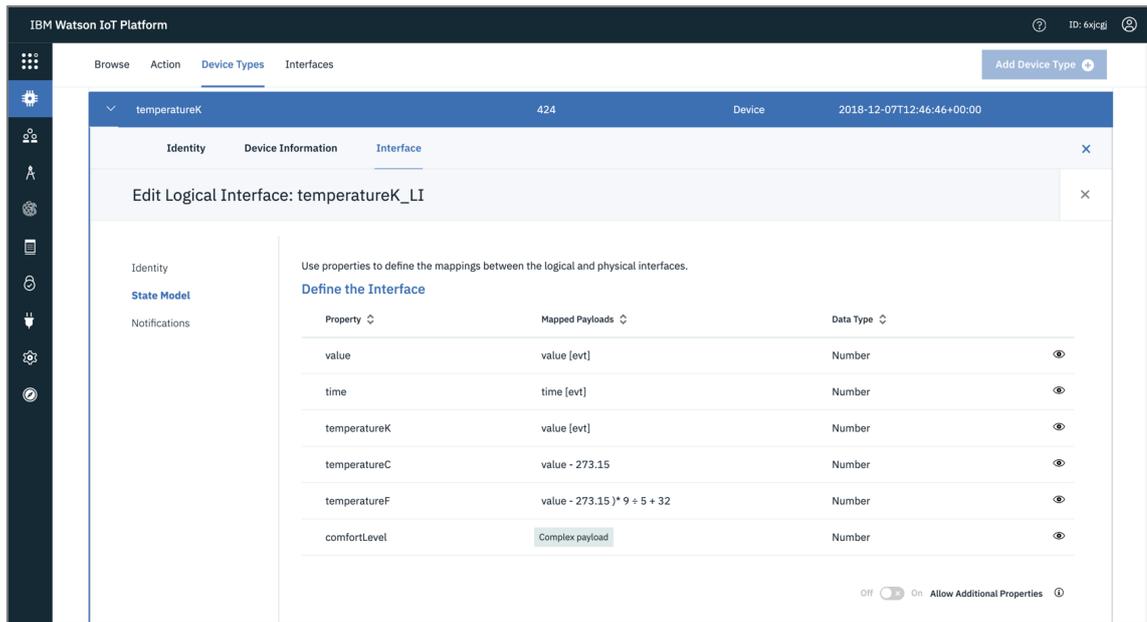
8. Click **Done** to close the physical interface editor and return to the Interface tab.

9. Click on the view icon  to explore the temperature\_LI logical interface

The logical interface editor opens with the Identity page.

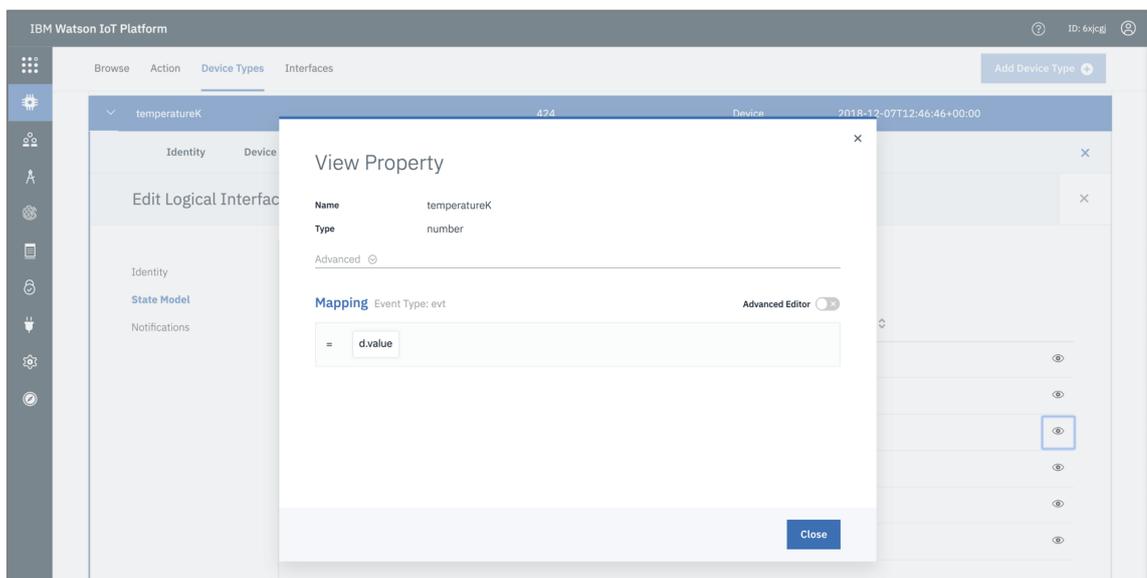


10. Click **Next**. The State Model page opens.



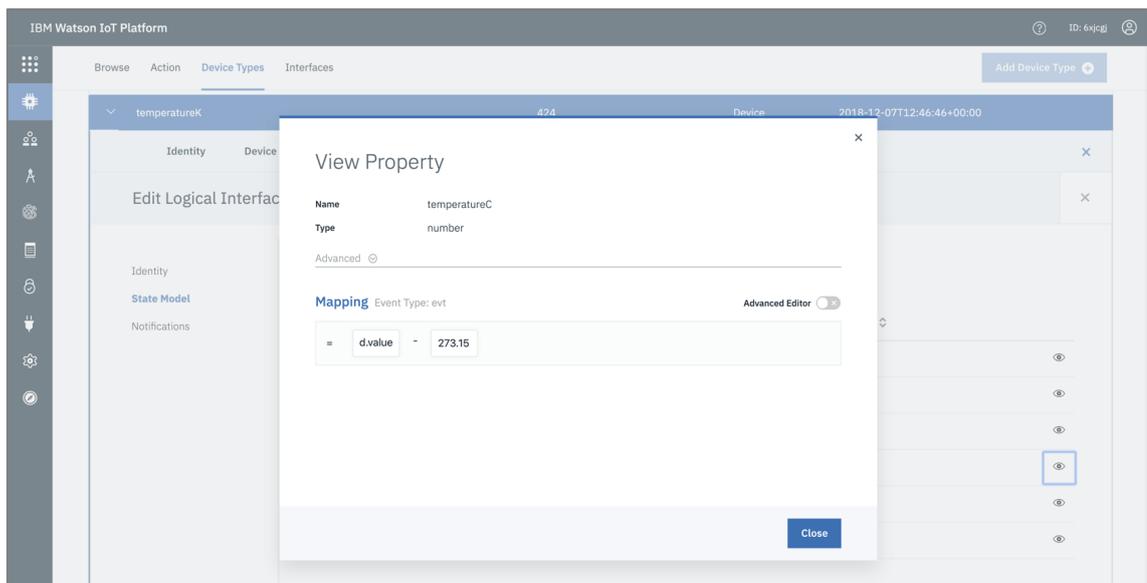
**Note:** The properties in the list corresponds to the state properties we previously explored in the temperatureK device state.

11. Click on the view icon  on the temperatureK row to explore the expression computing the Kelvin temperature value.



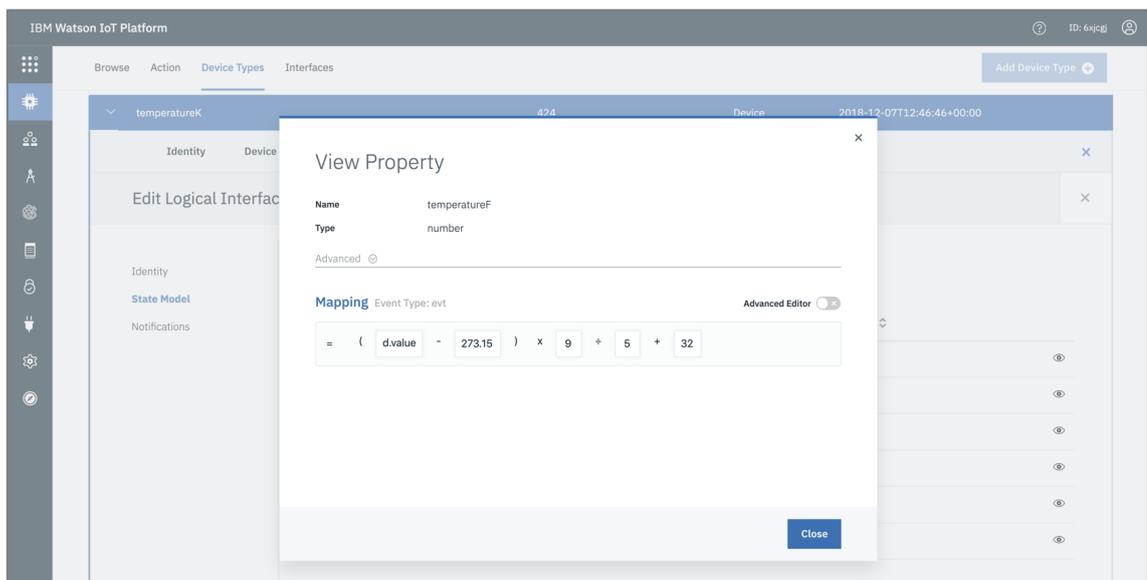
**Note:** The temperatureK expression is just returning the value property from the evt event.

12. Close the dialog and view the expression for temperatureC.



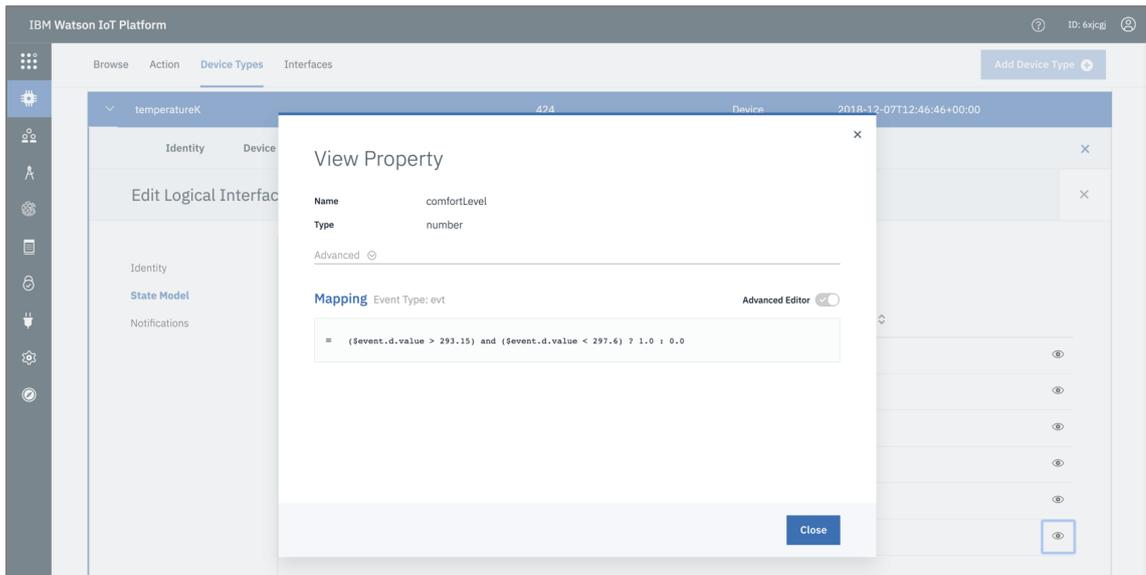
**Note:** The temperatureC expression is computing the Celsius temperature by subtracting -273.15 from the Kelvin value.

13. Close the dialog and view the expression for temperatureF.



**Note:** The temperatureF expression is computing the Fahrenheit temperature by subtracting -273.15, multiplying by 9/5 and adding 32 to the Kelvin value.

14. Close the dialog and view the expression for comfortLevel.



**Note:** The comfortLevel is a conditional expression that return a 100% comfort if the Kelvin temperature is within the 293.15 to 297.6 range (68-76 degrees Fahrenheit). The function will return 1.0 (100%) if the temperature is comfortable, 0.0 (0%) if the temperature is uncomfortable. We will in a later section see how analytics are applied to such comfort levels.

## 2.7 Exploring Other Device Types

We have now explored the Device Types and Devices views in Watson IoT Platform Service and learned how to view, filter and search at scale across connected devices. We explored the event data from the temperature devices and the transformations performed by the Watson IoT Platform using interfaces and mapping expressions.

Before completing this section of the lab, you can proceed and explore some of the other devices and device types connected to the IoT platform.

For example

- Carbon Dioxide sensors that measures the concentration of CO<sub>2</sub> in PPM (parts per million)
- Pressure sensors that measure the air pressure in Pa (Pasqual)
- Relative Humidity sensors that measure the humidity in %
- Sound Pressure Level sensors that measure the noise level in mBA (milli Bell A-rated)
- Motion sensors that measure movement and provide a value for timeLastMotion

Explore the logical interfaces for the device types, for example,

- The **motion** device type that defines `isOccupied` and `lastOccupied` properties for workspace occupancy.
- The **soundPressureLevel**, **relativeHumidity** and **carbonDioxid** device types that each defines a `comfortLevel` property based on sensor values and regulated office comfort levels.

You have now completed the exploration of the Watson IoT Platform Service.

### 3 Exploring Monitor - Maximo Asset Monitor

In this second part of the Maximo Asset Monitor 101 lab we will explore the Monitor and Dashboard capabilities in IBM® Maximo™ Asset Monitor.

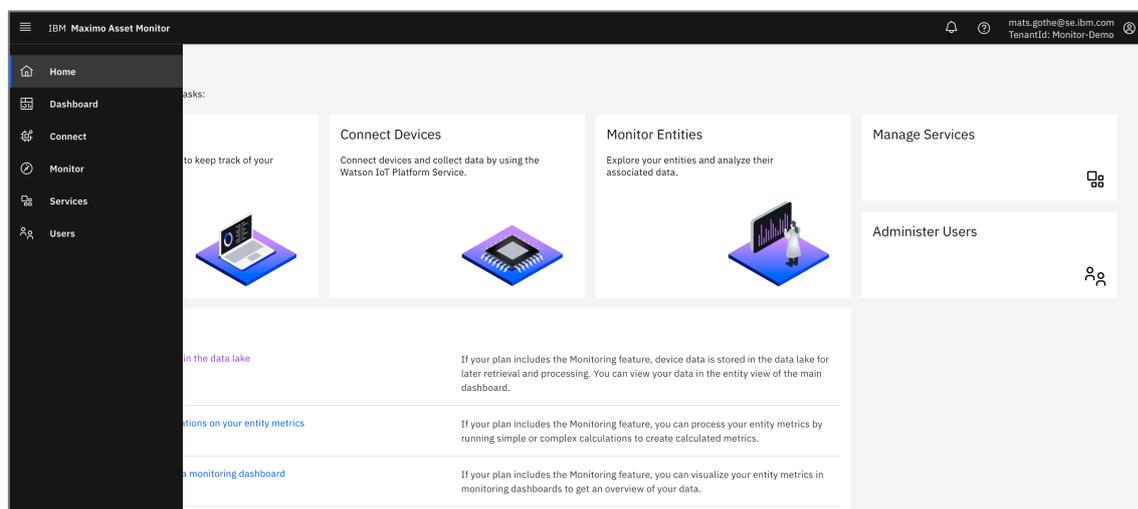
We will start by exploring the Entity Types, Entities and Data representing the device data ingested from the Watson IoT Platform service and stored the data lake in Db2 Warehouse. We will then look at the insights we gain from this data by exploring the environmental conditions and compliance metrics, the occupancy metrics and alerts from abnormal CO<sub>2</sub> levels. We will also explore monitor dashboards providing overview and insights to the Munich IoT Center building its floors, zones and workstations. We will also briefly view the administration of users and tenant services in Maximo Asset Monitor.

In the first part of this lab we initially logged into the Maximo Asset Monitor tenant **Think-2019**. We then switched into the Watson IoT Platform service to deep-dive into device types, devices, events and data management. We will now return to Maximo Asset Monitor.

We will now return to Maximo Asset Monitor. In case you have been logged out, or have closed the Maximo Asset Monitor browser window, log into the platform using the tenant URL <http://ibm.biz/iotx2020-assetmonitoror> or the full tenant URL <https://dashboard-us.connectedproducts.internetofthings.ibmcloud.com/preauth?tenantid=Think-2019&isAPM=true>

After logging in you are taken to the Maximo Asset Monitor home page. In this second part of the lab we will explore

- The **Dashboard** section provides quick access to your pinned dashboards
- The **Monitor** section provides access to the data lake and Entity time series data
- The **Manage Services** section provides access to the preconfigured services for messaging and data storage.
- The **Administer Users** section provides control of users and permissions.



## 3.1 Exploring Entity Types and Data

We will now explore Entity Types, Entities and Data representing the device data stored the Maximo Asset Monitor data lake.

*Entities* are the digital representation of items of data sources to your IoT solution. They produce data, or they have data you would like to track. In most cases, like in this lab, Entities are the devices registered in the Watson IoT Platform Service.

The Maximo Asset Monitor data lake is organized around Entities and their time-series data from corresponding devices. Each entity takes its name from the corresponding Device. An Entity is of an *Entity Type*, corresponding to the Device Type.

Entities can be monitored by *metrics*, such as temperature, humidity, weight, or load. *Metrics* are data items derived from the properties of the Logical Interface and hence the device state. The state properties of a device are expected to vary, as will the metric values on an entity. These metrics can be used when producing new calculated metrics.

Entities can also have additional metadata called *dimensions*. *Dimensions* are typically static values that do not change or change slowly over time. For example, a dimension might be the equipment's serial number, or its location, or an associated customer. Some dimensions are subject to change, for example, the operator of a piece of equipment can vary from one day to the next. In this lab we will use dimensions to hold the *information model taxonomy* like Region, Building, Floor, Zone, Workstation for the sensors in the IoT Center in Munich.

In the previous section of this lab we explored the temperatureK device type. We will now explore the temperatureK entity types, entities and data stored in the Db2 data lake.

To view the temperatureK Entity Type

1. Choose the **Monitor** section on the left-hand navigator.  
View the list of Entity Types
2. On the table header, click on the **Search** icon  and type **temperatureK** in the search field

Entity type	Number of entities	Dimensions	Metrics
temperatureK	272	BUILDING, DEVICE, FLOOR, REGION, WORKSTATION, ZONE	RCV_TIMESTAMP_UTC, comfortLevel, comfortLevel_Temperature_max, comfortLevel,

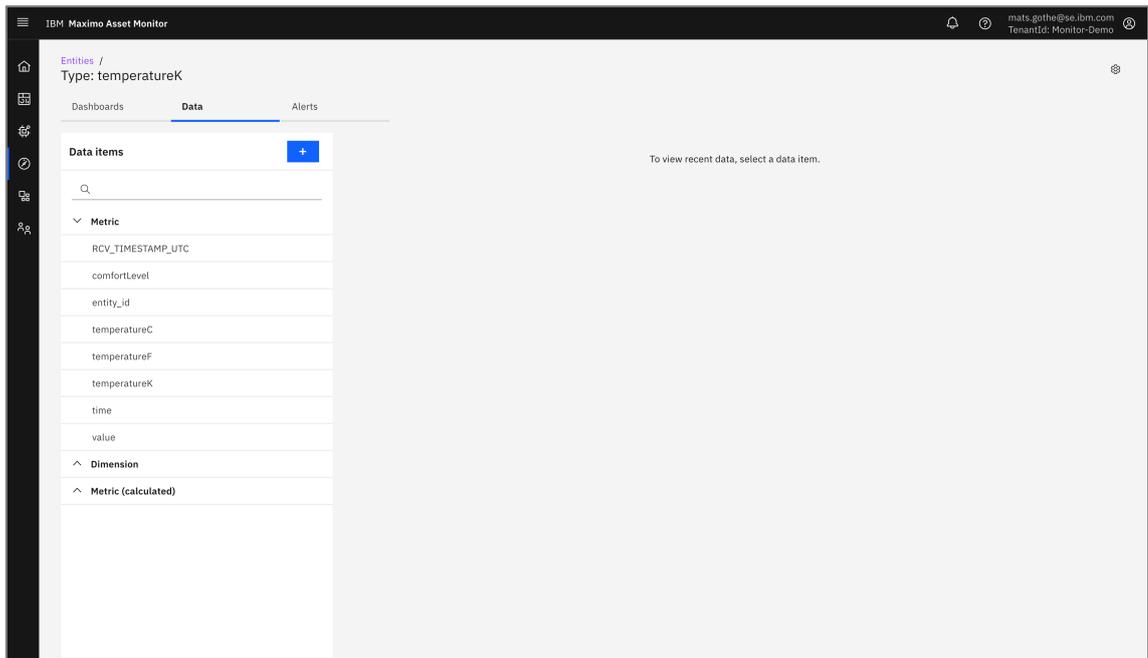
**Note:** The list shows the Entity Types, the number of Entities of each type and the metrics in the data lake of each type.

3. In the list of Entity Types, click on the **temperatureK** entity type.

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EU164-0080E1030005113E-5	27	MunichHQ	1	809646_EU164-0080E1030005113E	1-1	Germany
809646_EU164-0080E103000516EC-5	27	MunichHQ	1	809646_EU164-0080E103000516EC	2-3	Germany
809646_EU164-0080E10300052752-5	27	MunichHQ	1	809646_EU164-0080E10300052752	2-2	Germany
809646_EU164-0080E10300022634-5	27	MunichHQ	2	809646_EU164-0080E10300022634	3-3	Germany
809646_EU164-0080E1030002416E-5	27	MunichHQ	2	809646_EU164-0080E1030002416E	2-6	Germany
809646_EU164-0080E10300024510-5	27	MunichHQ	2	809646_EU164-0080E10300024510	3-4	Germany
809646_EU164-0080E10300051973-5	27	MunichHQ	2	809646_EU164-0080E10300051973	3-1	Germany
809646_EU164-0080E10300051B4B-5	27	MunichHQ	2	809646_EU164-0080E10300051B4B	3-2	Germany
809646_EU164-0080E10300052215-5	27	MunichHQ	2	809646_EU164-0080E10300052215	2-4	Germany
809646_EU164-0080E103000526DD-5	27	MunichHQ	2	809646_EU164-0080E103000526DD	2-5	Germany

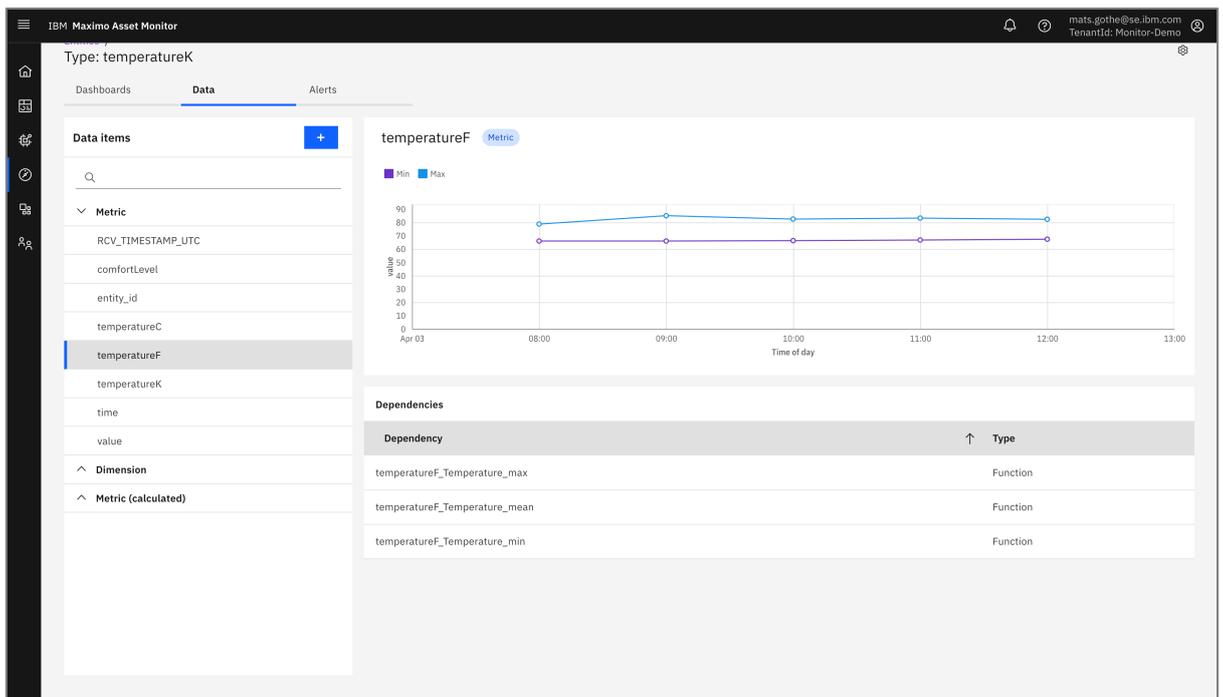
**Note:** The temperatureK entity type page loads and shows the list of temperatureK entities. We will soon explore individual entities, but will start with the common data for the temperatureK type

- Select the **Data** tab. The entity type data page opens. Wait for the data to be loaded.



**Note:** The left-hand side Data explorer provides an overview of the available metrics on the entity type. Note that some of these are the property names we recognize from the temperatureK\_LI interface like comfortLevel, temperatureC, temperatureF, temperatureK and value state properties.

- In the left-hand side **Data** explorer, click on the **temperatureF** metric. The graph loads the Fahrenheit temperature time-series values with upper (Max) and lower (Min) value bounds.



**Note:** The graph presents the aggregated data across all 270+ temperature sensors in the Munich IoT Center. In the graph we see that the upper and lower bound of temperature values across all workstations by hour.

We can gain insights on the temperature's fluctuations in the building at office days as compared to weekends. Mouse over the graph to see detailed data values.

- Click on the **temperatureC** metric. The graph updates with Celsius temperature values.

**Note:** The data values are the time-series data of the temperature values calculated in the temperatureK\_LI interface that we explored in section Exploring Device State above.

- Expand the **Metric (calculated)** data browser section and click on the **temperatureF\_Temperature\_max** metric. The graph updates with the maximum temperature values.
- Scroll down on the page to view the max values recorded for each temperature sensor.

	Timestamp	Entity Id	temperatureF_Temperature_max	FLOOR	BUILDING	ZONE	DEVICE	WORKSTATION	REGION
Metric	04/03/2020 12:00	809646_EUI64-0080E1030002457A-5	75.2	28	MunichHQ	12	809646_EUI64-0080E1030002457A	12-9	Germany
Dimension	04/03/2020 12:00	809646_EUI64-0080E10300045407-3	75.092	27	MunichHQ	9	809646_EUI64-0080E10300045407	6-2	Germany
Metric (calculated)									
comfortLevel_Temperature_max	04/03/2020 12:00	809646_EUI64-0080E10300051888-5	74.3	23	MunichHQ	12	809646_EUI64-0080E10300051888	22	Germany
comfortLevel_Temperature_mean	04/03/2020 12:00	809646_EUI64-0080E1030005100F-5	74.3	24	MunichHQ	6	809646_EUI64-0080E1030005100F	6	Germany
comfortLevel_Temperature_min	04/03/2020 12:00	809646_EUI64-0080E10300024598-5	74.3	27	MunichHQ	14	809646_EUI64-0080E10300024598	10-3	Germany
temperatureC_Temperature_max	04/03/2020 12:00	809646_EUI64-0080E10300051174-5	74.3	23	MunichHQ	9	809646_EUI64-0080E10300051174	16	Germany
temperatureC_Temperature_mean	04/03/2020 12:00	809646_EUI64-0080E10300052444-5	74.3	23	MunichHQ	12	809646_EUI64-0080E10300052444	20	Germany
temperatureC_Temperature_min	04/03/2020 12:00	809646_EUI64-0080E1030005100A-5	74.3	28	MunichHQ	12	809646_EUI64-0080E1030005100A	12-1	Germany
temperatureF_Temperature_max	04/03/2020 12:00	809646_EUI64-0080E10300047888-3	73.97600000000008	23	MunichHQ	17	809646_EUI64-0080E10300047888	17	Germany
temperatureF_Temperature_mean	04/03/2020 12:00	809646_EUI64-0080E103000246CE-5	73.4	27	MunichHQ	15	809646_EUI64-0080E103000246CE	10-6	Germany
temperatureF_Temperature_min	04/03/2020 12:00	809646_EUI64-0080E10300052443-5	73.4	23	MunichHQ	6	809646_EUI64-0080E10300052443	4	Germany
temperatureK_Temperature_mean	04/03/2020 12:00	809646_EUI64-0080E1030005133F-5	73.4	27	MunichHQ	9	809646_EUI64-0080E1030005133F	6-1	Germany
	04/03/2020 12:00	809646_EUI64-0080E1030005324E-5	73.4	27	MunichHQ	12	809646_EUI64-0080E1030005324E	7-4	Germany

- Click on the **temperature\_Temperature\_max** column header to sort by temperature value. Look for the floor, zone and workstation with the highest temperature. Is this workstation in compliance with the temperature comfort level?

## 3.2 Monitoring Entity Data

We will now explore the data items of temperatureK Entities

1. Click on the **Dashboards** tab on the temperatureK entity page.

The Entity page opens showing the list of temperatureK Entities. We will explore the data items on the temperature sensor in floor 27, zone 3.

2. Use the table filter and filter the table columns to entities on Floor 27 and Zone 3.

The screenshot shows the IBM Maximo Asset Monitor interface. The page title is "Entities / Type: temperatureK". The "Dashboards" tab is selected. Under "Summary Dashboards", there is a "Temperature" dashboard with dimensions: FLOOR, BUILDING, ZONE, DEVICE, WORKSTATION, REGION and time: Hourly. Below this, the "Instance Dashboards" section contains a table with the following columns: ID, Floor, Building, Zone, Device, Workstation, and Region. The table is filtered with "Floor: 27" and "Zone: 3". The table contains 7 rows of data.

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EUI64-0080E10300045266-3	27	MunichHQ	3	809646_EUI64-0080E10300045266	3	Germany
809646_EUI64-0080E10300045A93-3	27	MunichHQ	3	809646_EUI64-0080E10300045A93	3	Germany
809646_EUI64-0080E10300051709-5	27	MunichHQ	13	809646_EUI64-0080E10300051709	9-4	Germany
809646_EUI64-0080E103000519ED-5	27	MunichHQ	13	809646_EUI64-0080E103000519ED	9-3	Germany
809646_EUI64-0080E10300051B3D-5	27	MunichHQ	13	809646_EUI64-0080E10300051B3D	9-5	Germany
809646_EUI64-0080E103000527A8-5	27	MunichHQ	13	809646_EUI64-0080E103000527A8	9-6	Germany
809646_EUI64-0080E103000527C8-5	27	MunichHQ	13	809646_EUI64-0080E103000527C8	9-2	Germany

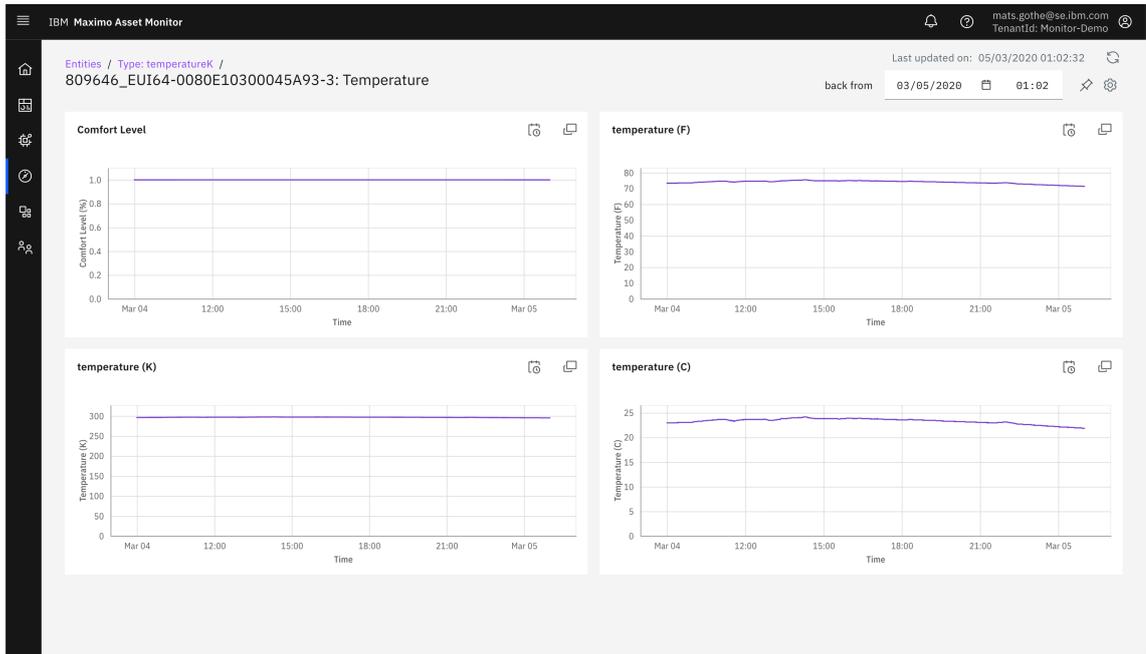
Alternatively, use the **Search** field to locate entity "809646\_EUI64-0080E10300045A93-3", or just "93-3" in the list.

The screenshot shows the same IBM Maximo Asset Monitor interface, but the search field is used to filter the table. The search query is "a93-3". The table now displays only one row of data.

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EUI64-0080E10300045A93-3	27	MunichHQ	3	809646_EUI64-0080E10300045A93	3	Germany

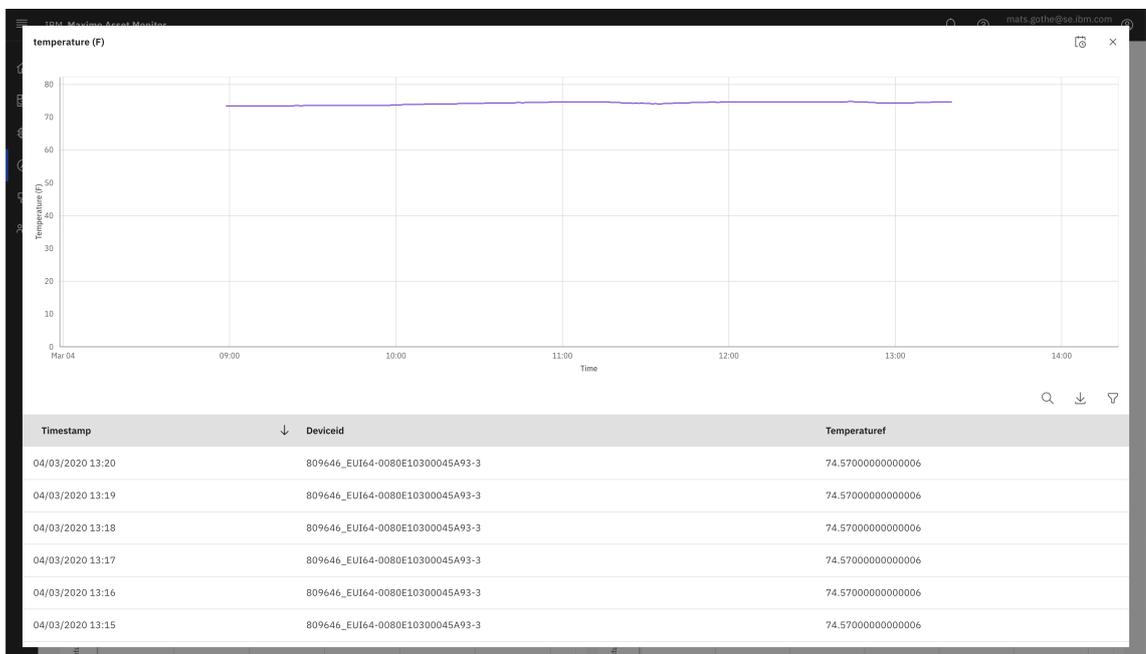
- Click on entity row for 809646\_EUI64-0080E10300045A93-3.

The Entity Dashboard opens.



**Note:** The dashboard is configured with the four metrics of the temperatureK entity type; temperatureF, temperatureC, temperatureK and comfortLevel.

- On the temperatureF graph, click on the Full Size icon  on the to size up to full screen.



**Note:** The values in the graph and the table are the recorded values from the temperature sensor in floor 27, zone 3. Click the Download icon  to get a CSV file with the sensor data.

### 3.3 Exploring Analytics on Temperature Comfort Levels

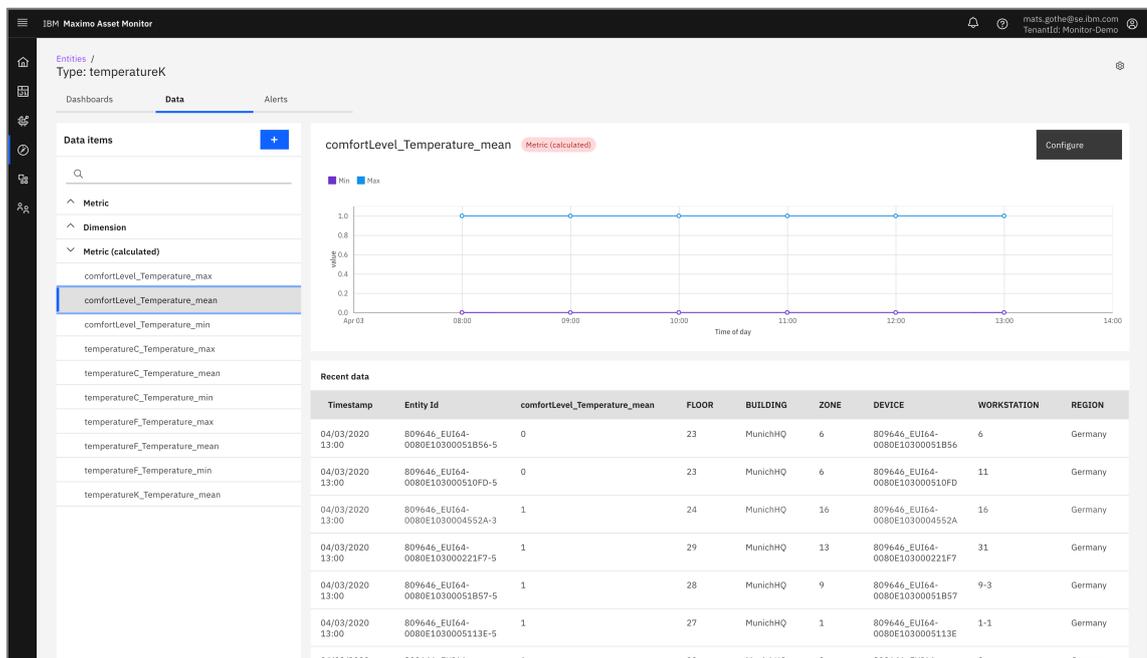
The temperatureK devices are providing compliance to comfort levels as part of the temperatureK\_LI. This comfortLevel property is computed by the logical interface using the following expression:

```
($event.value > 293.15) and ($event.value < 297.6)? 1.0 : 0.0
```

The logic of this expression is that the property will be set to the value 1.0 if the temperature is in the range of 68-76 degrees Fahrenheit. (Note that the temperatures in the expression are given in Kelvin degrees). If the temperature is outside of this range the comfortLevel is set to 0.0. The value 1.0 is given as a percentage (%) of compliance to the comfort level. While this value makes little sense as a single value of a single sensor it becomes valuable raw data for metric aggregation and statistics. For example, as an average over a time period, for example computing a statement of comfort level over a day. Or as an average over sensors, computing a statement of compliance across sensors in a zone or a floor.

To view the compliance of the temperature comfort level

1. Select the **comfortLevel\_Temperature\_mean** metric from the **Data** explorer on the **temperatureK** entity type.
2. View the graph on the daily variance of comfort levels



As mentioned above the diagram do not provide any significant insights, only that there is a distribution of values across 0.0 to 1.0.

3. Scroll down the page and view the table with comfort levels values across the various sensors. View the computed comfort Level for the last hour.

	Timestamp	Entity Id	comfortLevel_Temperature_mean	FLOOR	BUILDING	ZONE	DEVICE	WORKSTATION	REGION
Metric	04/03/2020 13:00	809646_EUI64-0080E10300051B56-5	0	23	MunichHQ	6	809646_EUI64-0080E10300051B56	6	Germany
Dimension	04/03/2020 13:00	809646_EUI64-0080E103000510FD-5	0	23	MunichHQ	6	809646_EUI64-0080E1030004510FD	11	Germany
Metric (calculated)	04/03/2020 13:00	809646_EUI64-0080E1030004552A-3	1	24	MunichHQ	16	809646_EUI64-0080E1030004552A	16	Germany
comfortLevel_Temperature_max	04/03/2020 13:00	809646_EUI64-0080E103000221F7-5	1	29	MunichHQ	13	809646_EUI64-0080E103000221F7	31	Germany
comfortLevel_Temperature_mean	04/03/2020 13:00	809646_EUI64-0080E10300051B57-5	1	28	MunichHQ	9	809646_EUI64-0080E10300051B57	9-3	Germany
comfortLevel_Temperature_min	04/03/2020 13:00	809646_EUI64-0080E1030005113E-5	1	27	MunichHQ	1	809646_EUI64-0080E1030005113E	1-1	Germany
temperatureC_Temperature_max	04/03/2020 13:00	809646_EUI64-0080E1030004537E-3	1	29	MunichHQ	9	809646_EUI64-0080E1030004537E	9	Germany
temperatureC_Temperature_mean	04/03/2020 13:00	809646_EUI64-0080E10300052804-5	1	28	MunichHQ	15	809646_EUI64-0080E10300052804	15-3	Germany
temperatureC_Temperature_min	04/03/2020 13:00	809646_EUI64-0080E10300051B5C-5	1	23	MunichHQ	13	809646_EUI64-0080E10300051B5C	33	Germany
temperatureF_Temperature_max	04/03/2020 13:00	809646_EUI64-0080E10300051174-5	1	23	MunichHQ	9	809646_EUI64-0080E10300051174	16	Germany
temperatureF_Temperature_mean	04/03/2020 13:00	809646_EUI64-0080E10300045590-3	1	23	MunichHQ	17	809646_EUI64-0080E10300045590	17	Germany
temperatureF_Temperature_min	04/03/2020 13:00	809646_EUI64-0080E10300022410-5	1	27	MunichHQ	15	809646_EUI64-0080E10300022410	11-2	Germany
temperatureK_Temperature_mean	04/03/2020 13:00	809646_EUI64-0080E10300051B57-5	0	23	MunichHQ	6	809646_EUI64-0080E10300051B57	12	Germany

**Note:** On the day of capturing these notes, non-compliance to regulations and uncomfortable temperatures were detected by the sensors on floor 23, zone 6. The other floors and zones are in compliance.

### 3.4 Exploring the Temperature Monitor Dashboard

As discussed in sections above, devices and entities are associated with metadata defining the location of the device using Region, Building, Floor, Zone, Workstation and Device taxonomy values. These taxonomy values have relations that forms hierarchies. Buildings in Regions. Devices are instrumenting a Workstation, located in a Zone in a Floor of the Building.

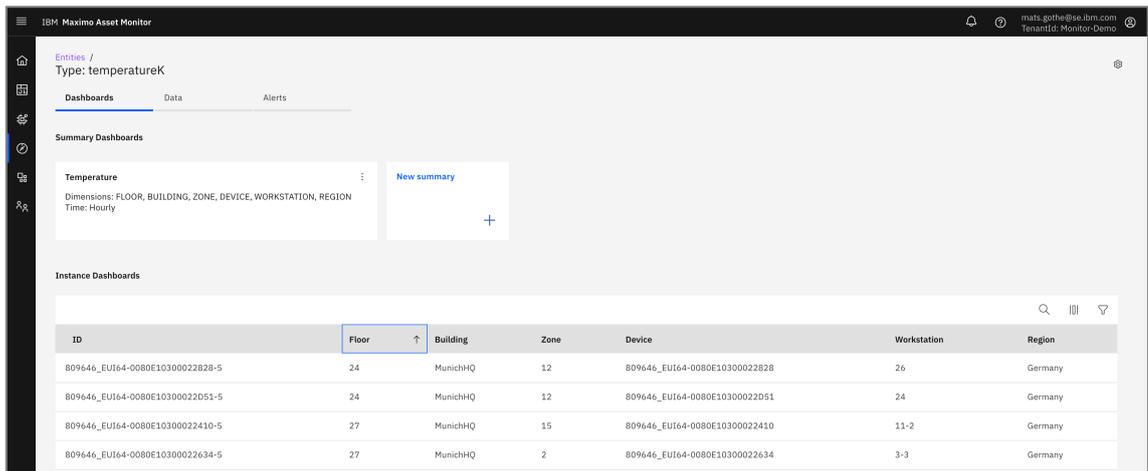
Aggregating entity data using the dimensional taxonomy hierarchy and time would provide key metrics and KPIs. For example,

- The max temperature at a floor in a building
- The presence in a zone, or the utilization of the zone over a week.
- The count of all CO<sub>2</sub> alerts in the building.
- The count of all CO<sub>2</sub> alerts in a zone last week.

The Monitor dashboards in Watson IoT Platform provides these capabilities. We will start exploring dashboards for temperature, motion and carbon dioxide values. We will in a later scion discuss general aspects of how to manage dashboards.

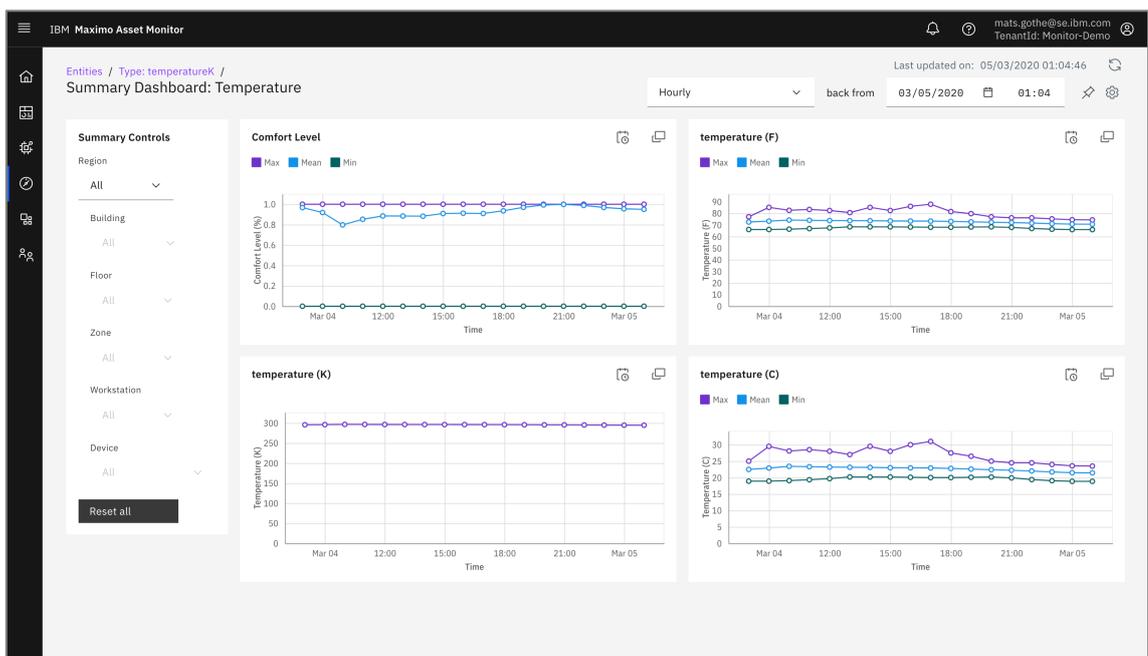
To view the Summary Dashboard for Temperatures

1. On the **TemperatureK** Entity type, choose the **Dashboards** tab
2. Open the dashboard by clicking on the **Temperature** dashboard panel.

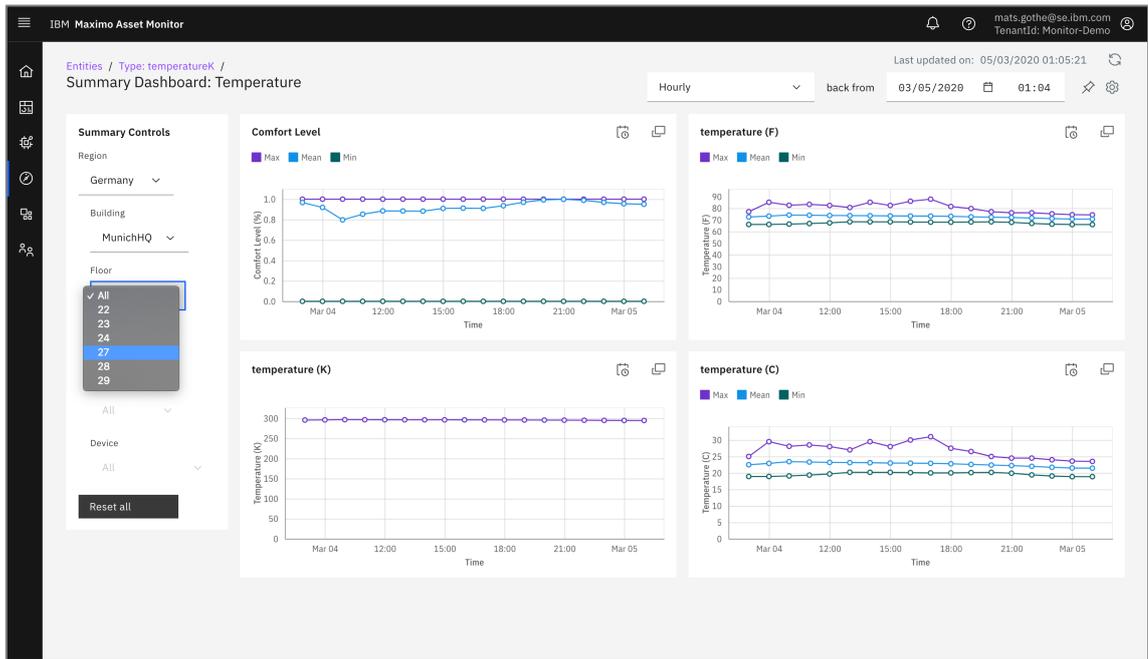


3. View the line graph cards on the dashboard

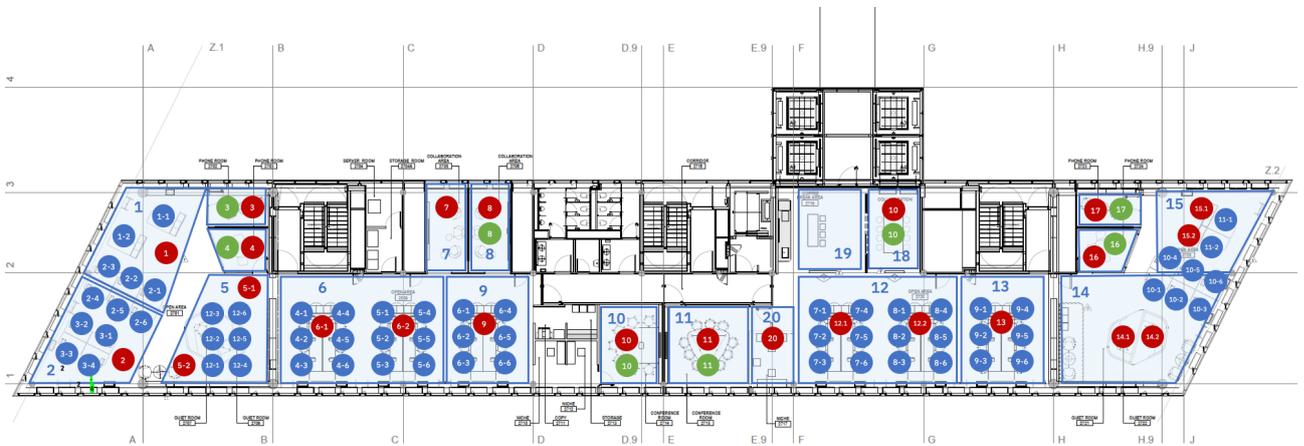
- Comfort level
- Temperature graphs in Fahrenheit, Celsius and Kelvin



- In the Summary Control section, use the filters to show the temperature in Region: Germany, Building: Munich HQ, and Floor: 27.



- Drill into Zones and Workstations. Can you detect temperature anomalies in the values when comparing East and West wing zones in the Munich building?



We have now completed the exploration of temperatures. In next section we will explore analytics on occupancy and utilization using motion sensor data.

### 3.5 Exploring Analytics on Occupancy and Utilization

The Maximo Asset Monitor can perform data analytics on entity data using analytics functions out-of-the-box in the function catalog. Functions are also used to support computing of analytic data to be shown on monitor dashboards.

Custom analytics functions in Python can be added to extend the catalog. In this lab we will only use predefined functions from the function catalog.

To exemplify more analytics functions and visualizations we will explore the utilization of zones at the 27<sup>th</sup> floor in the IoT Center in Munich. Most all zones in the Munich IoT Center have been equipped with motion sensors, as indicated by blue and red circles in the floor plan below. The Yanzi Motion and Yanzi Motion+ sensors send periodic events to the IoT platform with three motion properties; value, time and timeLastMotion. The *value* property is the amplitude or size of motion detected near the sensor. The *time* is a time-stamp expressed in milliseconds. and the *timeLastMotion* is the time-stamp of the last previous event when motion was detected.



Using the time and timeLastMotion, the IoT platform can compute occupancy in the workspace. The assumption made is that a workspace is occupied if motion is detected within a 1 ½ minute interval. Hence, “isOccupied” is a state property computed by the motion\_LI logical interface using the JSONata expression below.

```
($event.time - $event.timeLastMotion)<90000 ? 1.0 : 0.0
```

If the ‘time since last motion detected’ is less than 90,000 milliseconds, the space is considered ‘occupied’ and property value set to 1.0. In not, the space is unoccupied and the value set to 0.0. Similar to the comfort level, this property can be used for time-series and aggregation metrics.

**Note:** Explore the definitions of these state properties in the logical interface of the motion device type. To learn more about JSONata, visit the <http://jsonata.org> home page.

To view motion entity type data

1. Click on **Monitor** to view the **Entity types**
2. Select the **motion** entity type in the list, or use the Search bar

The screenshot shows the IBM Maximo Asset Monitor interface. The top navigation bar includes 'Dashboards', 'Data', and 'Alerts'. The main content area is titled 'Entities / Type: motion'. Below this, there are sections for 'Summary Dashboards' and 'Instance Dashboards'. The 'Instance Dashboards' section contains a table with the following data:

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EUI64-0080E1030005113E-4	27	MunichHQ	1	809646_EUI64-0080E1030005113E	1-1	Germany
809646_EUI64-0080E103000516EC-4	27	MunichHQ	1	809646_EUI64-0080E103000516EC	2-3	Germany
809646_EUI64-0080E10300052752-4	27	MunichHQ	1	809646_EUI64-0080E10300052752	2-2	Germany
809646_EUI64-0080E10300022634-4	27	MunichHQ	2	809646_EUI64-0080E10300022634	3-3	Germany

3. Select the Data tab and the **isOccupied** metric

The screenshot shows the IBM Maximo Asset Monitor interface with the 'Data' tab selected. The 'Data items' list on the left includes 'isOccupied'. The main area displays a line graph for the 'isOccupied' metric. The graph shows a constant value of 1.0 (Max) from 09:00 to 13:00 and 0.0 (Min) from 13:00 to 14:00. Below the graph, a 'Dependencies' table is shown:

Dependency	Type
isOccupied_Occupancy_max	Function
isOccupied_Occupancy_mean	Function
isOccupied_Occupancy_min	Function

**Note:** The graph shows the hourly isOccupied state value across all motion sensors. As previously discussed, the sensors send a numeric 0.0 or 1.0 value, and the graph will show these values as the Min and Max numbers. This may not be that interesting, but analytics on groups of sensors will be more descriptive of the utilization. We will explore that later in this section.

Using the isOccupied metric, Maximo Asset Monitor can compute the occupancy, or utilization, of workspace. The assumption is made that the average of occupancy is a utilization percentage 0-100% of the zone over a given time window. The utilization applies to both aggregates over time-series, sensor aggregates in a zone, or sensor aggregates over multiple zones. The utilization will in itself be an hourly, daily time series with Max, Min and Average metrics.

To view the statistical mean value of isOccupied, or occupancy

4. In the data explorer, select the **isOccupied\_Occupancy\_mean** metric.

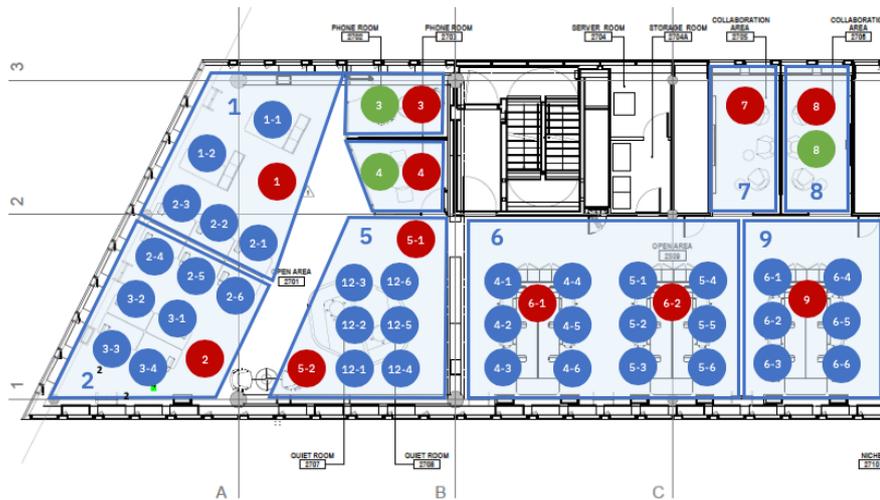
Scroll down on the page to view the latest occupancy data. Sort by the **isOccupied\_Occupancy\_mean** column.

The screenshot shows the IBM Maximo Asset Monitor interface. The 'Data' tab is selected, and the 'Data Items' list on the left includes 'isOccupied\_Occupancy\_mean'. The main table displays recent data for this metric, sorted by its value in descending order. The table columns are: Timestamp, Entity Id, isOccupied\_Occupancy\_mean, FLOOR, BUILDING, ZONE, DEVICE, WORKSTATION, and REGION.

Timestamp	Entity Id	isOccupied_Occupancy_mean	FLOOR	BUILDING	ZONE	DEVICE	WORKSTATION	REGION
04/03/2020 13:00	809646_EU164-0080E10300045264-4	1	27	MunichHQ	4	809646_EU164-0080E10300045264	4	Germany
04/03/2020 13:00	809646_EU164-0080E10300045424-4	1	27	MunichHQ	15	809646_EU164-0080E10300045424	15-2	Germany
04/03/2020 13:00	809646_EU164-0080E10300045266-4	0.9906542056074766	27	MunichHQ	3	809646_EU164-0080E10300045266	3	Germany
04/03/2020 13:00	809646_EU164-0080E10300051B3D-4	0.989010989010989	27	MunichHQ	13	809646_EU164-0080E10300051B3D	9-5	Germany
04/03/2020 13:00	809646_EU164-0080E1030004507E-4	0.9411764705882353	27	MunichHQ	8	809646_EU164-0080E1030004507E	8	Germany
04/03/2020 13:00	809646_EU164-0080E10300045154-4	0.8941176470588236	27	MunichHQ	11	809646_EU164-0080E10300045154	11	Germany
04/03/2020 13:00	809646_EU164-0080E10300051B4B-4	0.8625	27	MunichHQ	2	809646_EU164-0080E10300051B4B	3-2	Germany
04/03/2020 13:00	809646_EU164-0080E103000457D9-4	0.8	27	MunichHQ	14	809646_EU164-0080E103000457D9	14-2	Germany
04/03/2020 13:00	809646_EU164-0080E10300022410-4	0.7971014492753623	27	MunichHQ	15	809646_EU164-0080E10300022410	11-2	Germany
04/03/2020 13:00	809646_EU164-0080E10300024510-4	0.044444444444444444	27	MunichHQ	2	809646_EU164-0080E10300024510	3-4	Germany
04/03/2020 13:00	809646_EU164-0080E103000246CE-4	0	27	MunichHQ	15	809646_EU164-0080E103000246CE	10-6	Germany
04/03/2020 13:00	809646_EU164-0080E103000511F9-4	0	27	MunichHQ	12	809646_EU164-0080E103000511F9	8-2	Germany
04/03/2020	809646_EU164-	0	27	MunichHQ	9	809646_EU164-	6-1	Germany

**Note:** The occupancy data shows the workstations that are fully, partly or not occupied over the last hour, given as an Occupancy metric.

We will now explore the occupancy for the motion sensor in the west wing of floor 27, zone 3.



To view the motion sensor data

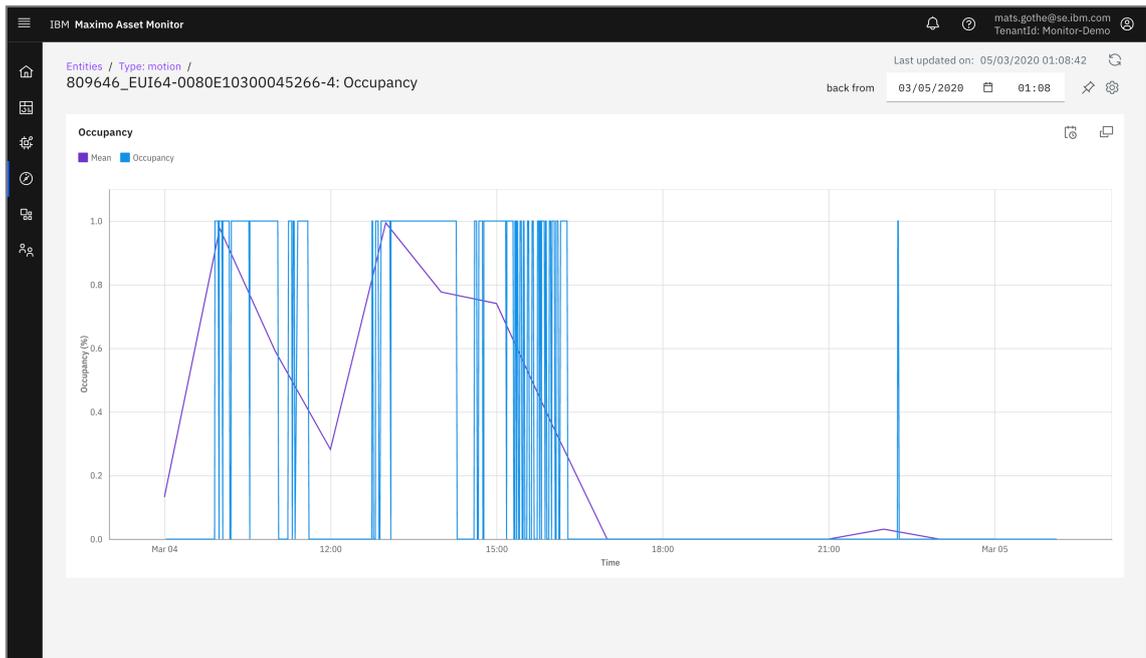
5. Select the **Dashboard** tab to see the list of motion entities. Use the column filters to identify the motion sensor in floor 27, zone 3.

The screenshot shows the IBM Maximo Asset Monitor interface. The top navigation bar includes 'Entities / Type: motion', 'Dashboards', 'Data', and 'Alerts'. Below this, there are 'Summary Dashboards' and 'Instance Dashboards'. The 'Instance Dashboards' section displays a table of motion entities with the following columns: ID, Floor, Building, Zone, Device, Workstation, and Region. The table is filtered to show only entities on floor 27 and in zone 3.

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EUI64-0080E10300045266-4	27	MunichHQ	3	809646_EUI64-0080E10300045266	3	Germany
809646_EUI64-0080E10300051709-4	27	MunichHQ	13	809646_EUI64-0080E10300051709	9-4	Germany
809646_EUI64-0080E103000519ED-4	27	MunichHQ	13	809646_EUI64-0080E103000519ED	9-3	Germany
809646_EUI64-0080E10300051B3D-4	27	MunichHQ	13	809646_EUI64-0080E10300051B3D	9-5	Germany
809646_EUI64-0080E103000527CB-4	27	MunichHQ	13	809646_EUI64-0080E103000527CB	9-2	Germany

At the bottom of the table, it shows 'Items per page: 10' and '1-5 of 5 Items'. The page number is '1' of 1 pages.

6. Click on the entity 809646\_EUI64-0080E10300045266-4 to open the entity dashboard. The dashboard opens and shows the Occupancy metric and its mean values over the day.



**Note:** The graph shows the Occupancy, and Utilization, of zone 3 over the day. We detect patterns of longer and shorter meetings. And a lunch break around noon. A group of shorter calls in the afternoon and then the close of office hours around 4:30pm. We also see the hourly graph of mean occupancy over the day.

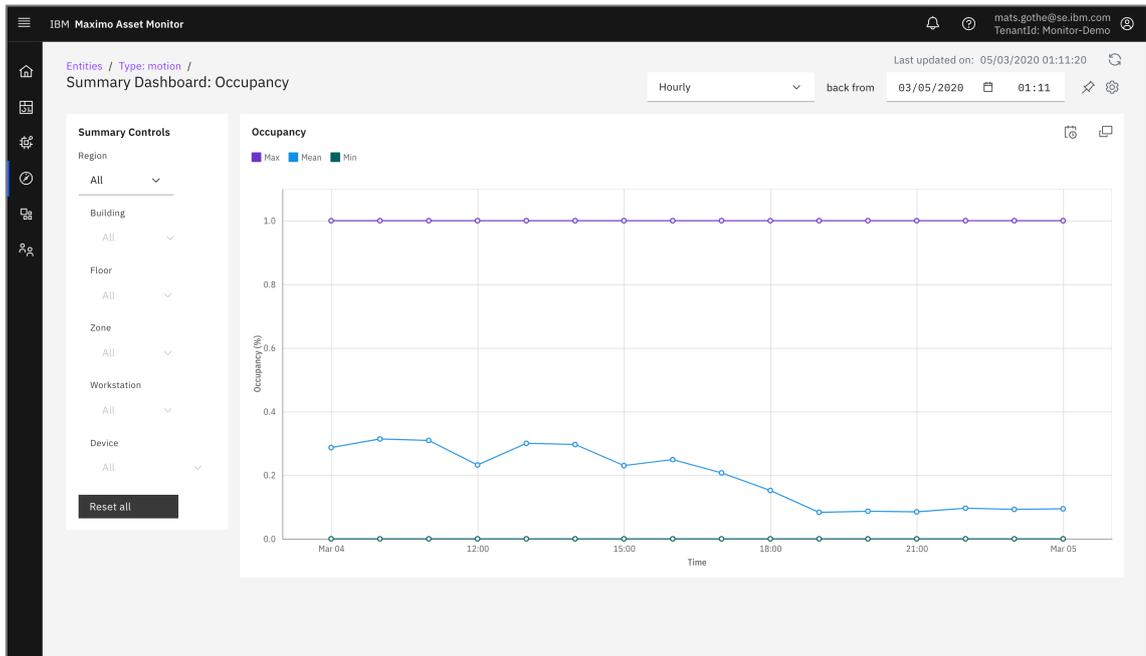
The graphs we just analyzed focus on Occupancy, and Utilization over time. We can also use the Maximo Asset Monitor dashboards to analyze utilization over the office spaces, like floors and zones.

7. Return to the **Type: monitor** page by clicking in the page breadcrumb.

The screenshot shows the 'Type: motion' dashboard. It features a 'Summary Dashboards' section with an 'Occupancy' card that includes a 'New summary' button and a '+' icon. Below this is an 'Instance Dashboards' section containing a table with the following data:

ID	Floor	Building	Zone	Device	Workstation	Region
809646_EUI64-0080E1030005113E-4	27	MunichHQ	1	809646_EUI64-0080E1030005113E	1-1	Germany

8. Click on the **Occupancy** summary dashboard.



Note: We conclude by the graph that the Utilization of the office across all floors and zones are around 30% over the day.

9. Use the Summary Controls to filter to see the Utilization on floor 27 and some of its zones. Do you see any difference in the Utilization?

Drawing conclusions on the Utilization KPI of spaces in a facility will help us understand how to better utilize resource.

We have now completed the exploration of motion, occupancy and utilization. In the section we will explore conditional functions and alerts.

## 3.6 Exploring CO<sub>2</sub> Alerts and Analytics on Office Safety

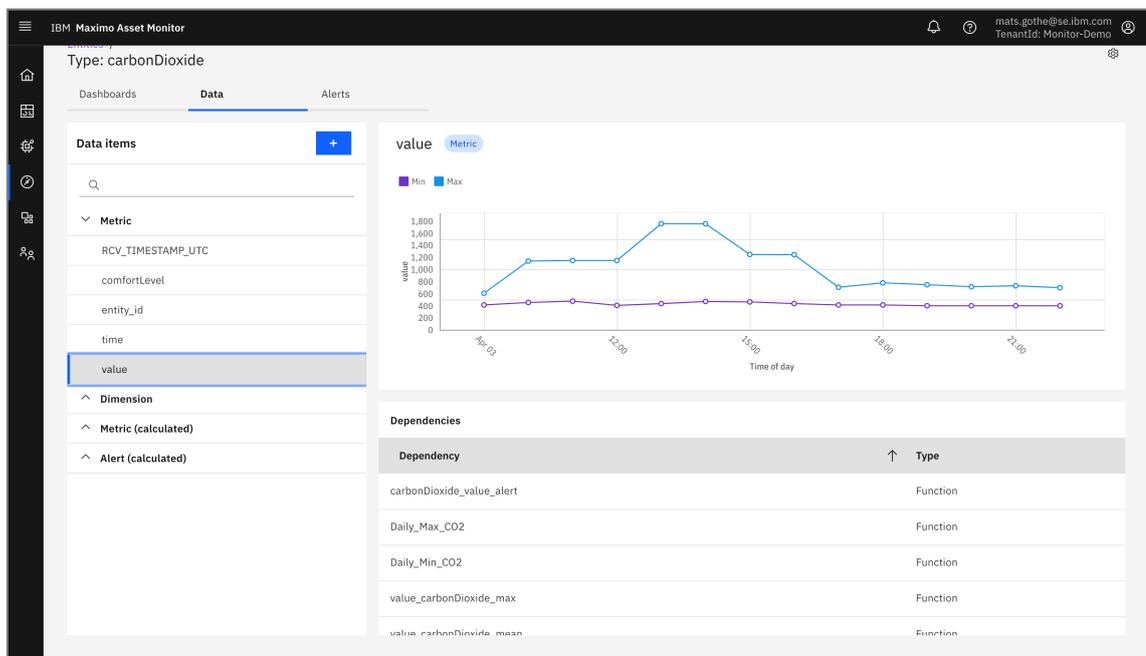
Maximo Asset Monitor provides a catalog of AI functions with anomaly models, thresholds and conditional functions producing alerts. Alerts are saved in the data lake and can be viewed in the Monitor section pages and on dashboards. Alerts can for example be configured to notify when entity metrics exceeds specific thresholds, or when anomaly function scores indicate an abnormal data pattern.

To configure an alert in Maximo Asset Monitor, you use functions from the Function Catalog. Function may take simple threshold values for upper or lower levels. Other function may take custom Python Boolean expressions with combinations of values, variables, operators, and other Python library functions. Expressions can contain operations, such as simple additions or subtractions.

**Note:** Maximo Asset Monitor Functions supports Pandas libraries for building expressions.

To view alerts on CO<sub>2</sub> levels

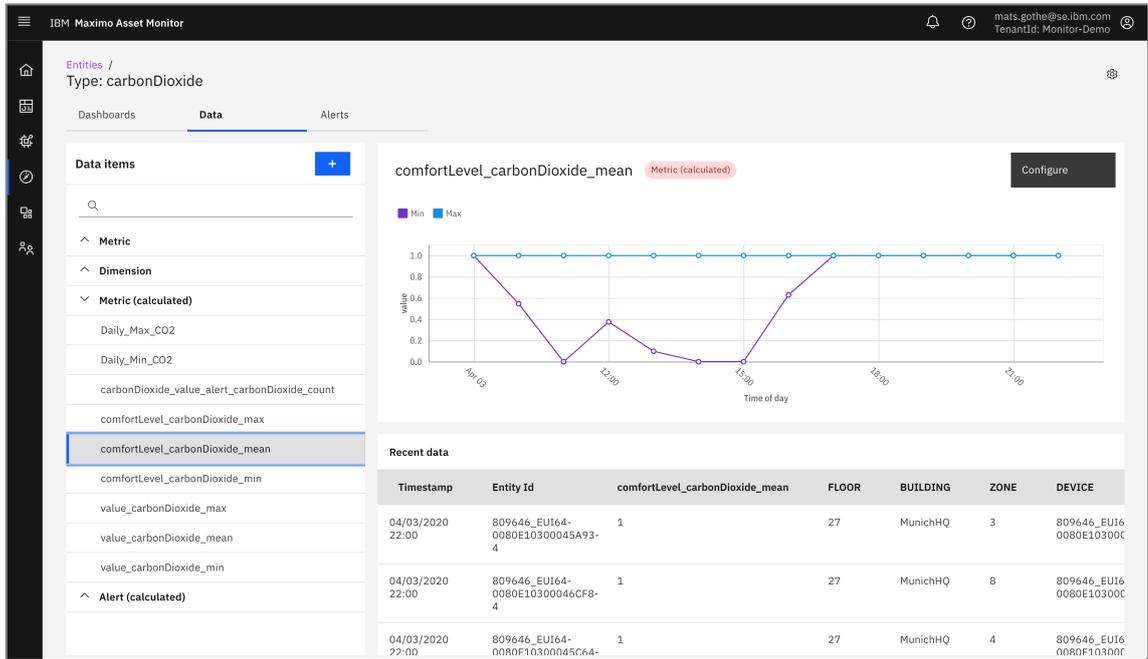
1. Return to the Monitor page by clicking **Entities** in the page breadcrumb.
2. Search and select the **carbonDioxide** entity type
3. Select **Data** tab
4. Select the **value** property  
The Min and Max CO<sub>2</sub> levels of the Munich IoT Center building are shown.



**Note:** On the day of capturing these notes, high CO<sub>2</sub> levels was detected at office hours and less at non-office hours. Levels were above the comfort levels of 1000 PPM.

The computed comfortLevel metric is also indicating this issue of low compliance to office regulations by high CO<sub>2</sub> levels.

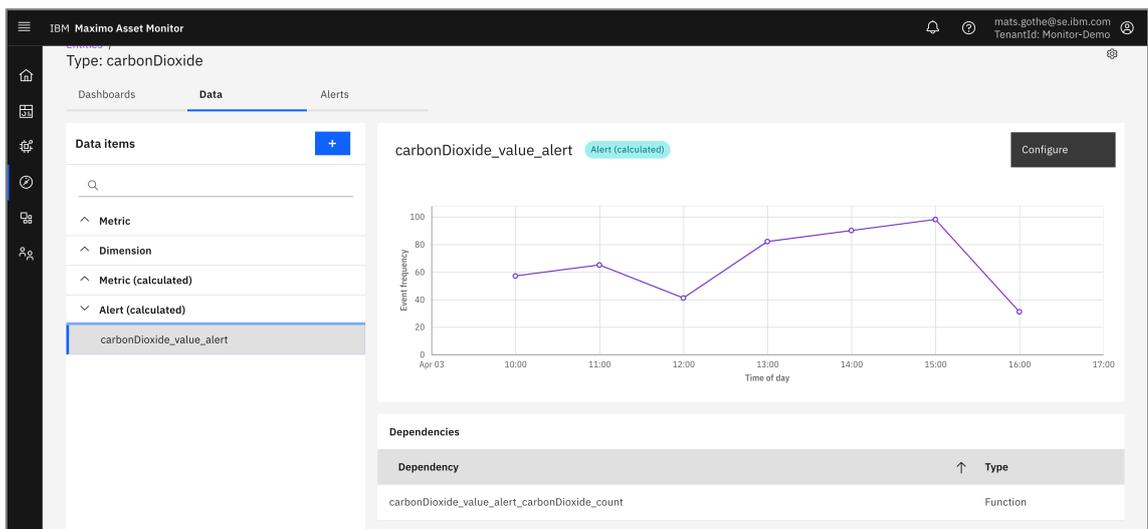
5. Select the **comforLevel\_carbonDioxide\_mean** data item



To configure an alert in Maximo Asset Monitor, you use functions from the Function Catalog. Function may take simple threshold values for upper or lower levels.

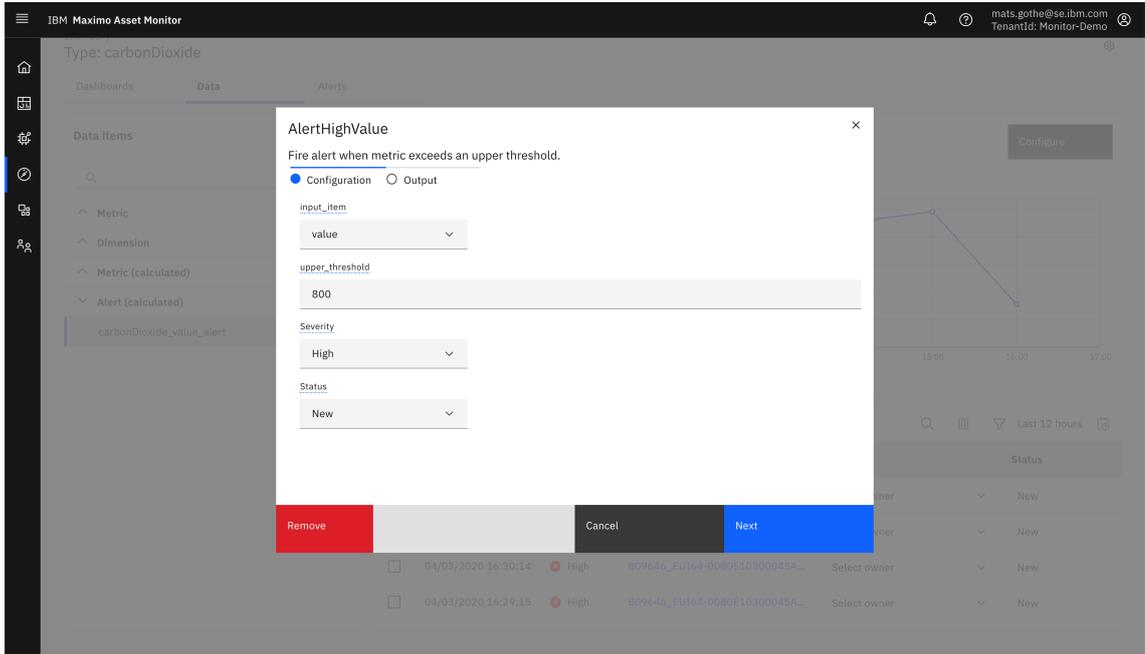
To view the configuration of CO<sub>2</sub> levels alarms.

1. Select the **carbonDioxide\_value\_alert** alerts in the **Alerts (calculated)** section of the data browser.



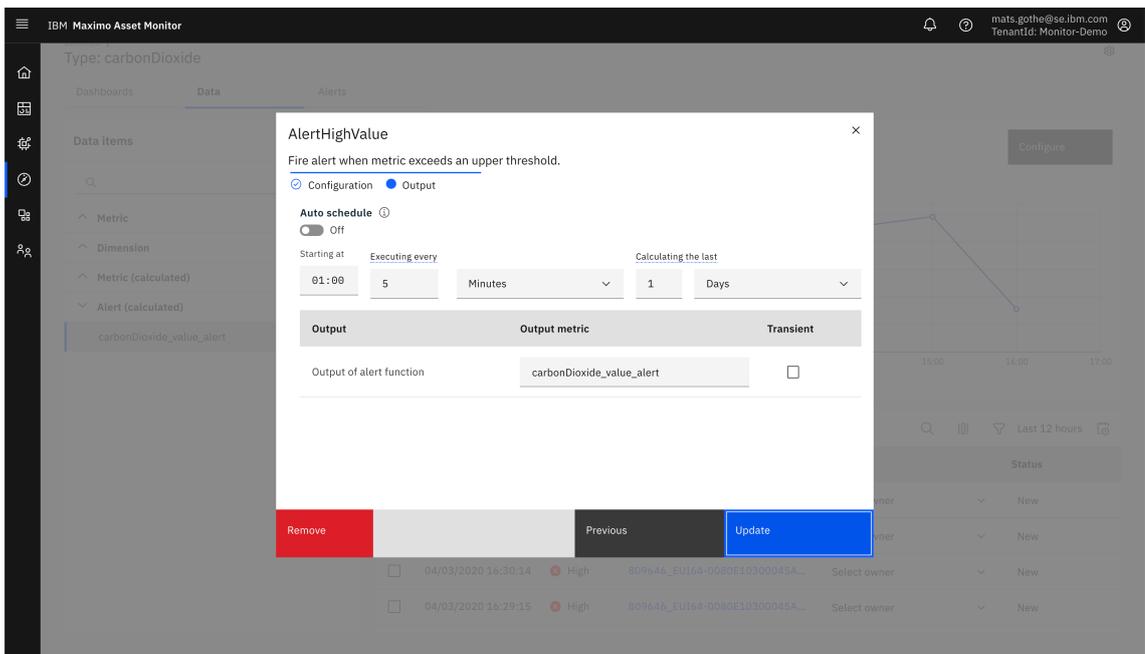
**Note:** The graph is indicating the count of alerts triggered throughout the hour.

- Click on the **Configure** button to the right above the graph. The function editor opens.



**Note:** The function used for CO<sub>2</sub> level alerts is a threshold function. The configuration of the function is setting the upper threshold value for CO<sub>2</sub> alerts to 800. Level of CO<sub>2</sub> above 1000 PPM causes headaches and drowsiness and impacts worker safety. In this lab we set the threshold to a warning level of 800 to generate more alerts to explore.

- Click **Next** in the alert function editor.



**Note:** All analytics functions have one or more output data metrics. Adding a function will add the data metrics to the data item browser under the Metrics

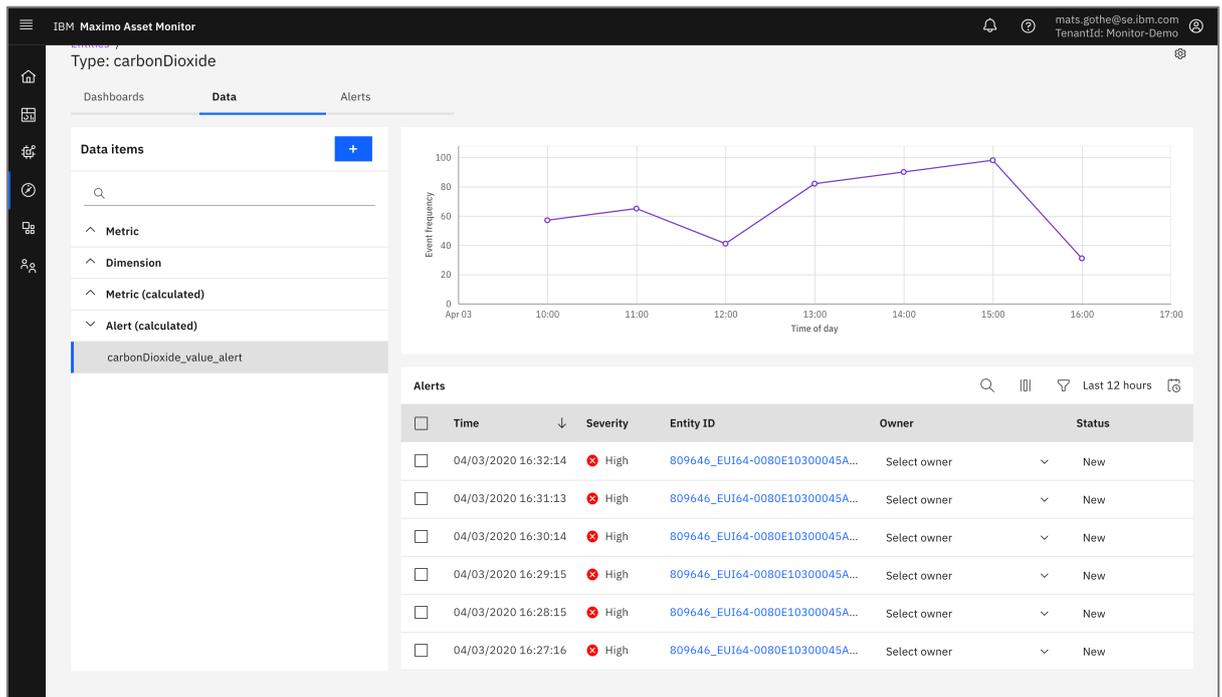
(calculated) or Alerts (calculated) sections. In this case the **carbonDioxide\_value\_alert** data alert item.

4. Click **X** in the upper right to close the alert function editor.

To view the CO<sub>2</sub> level alerts

5. On the **carbonDioxide\_value\_alert** data item, scroll down to the **Alerts** section.

The Alerts section is listing all alerts indicating abnormal conditions.

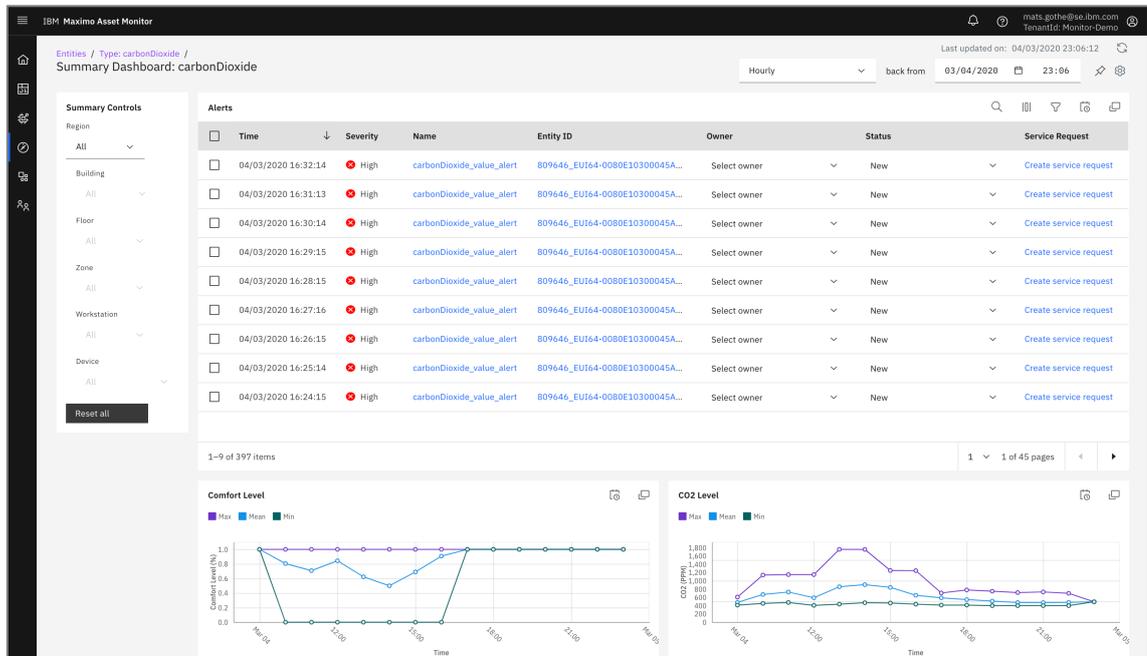


**Note:** Viewing the graph we see high number of alerts from the sensor in the meeting rooms at floor 27, indicating presence of multiple people in the room.

## 3.7 Exploring CO<sub>2</sub> Dashboards

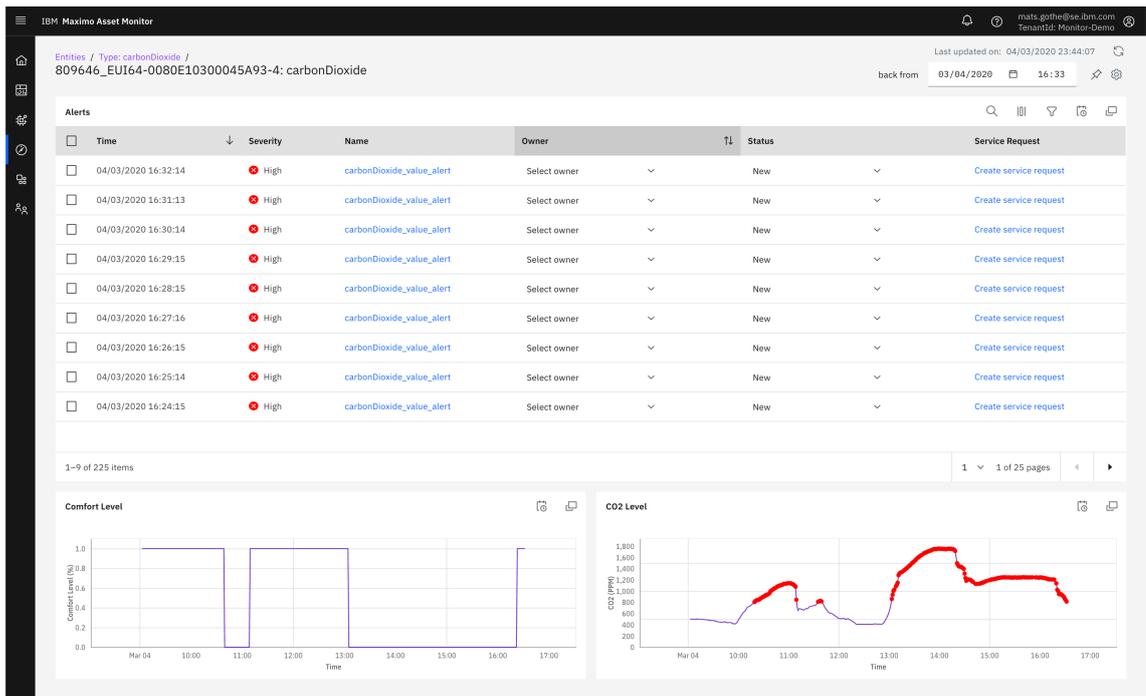
To gain deeper insights into the CO<sub>2</sub> levels we will explore the summary and instance dashboards configured with CO<sub>2</sub> data.

1. In the carbonDioxide entity type, click on the **Dashboard** tab. Click to open the **carbonDioxide** dashboard.



**Note:** View the **Alert** table, the **Comfort Level** and **CO2 Level** graphs. Looking at the graphs we can conclude that the CO<sub>2</sub> level rises over the 800 PPM alert level during office hours and start triggering alerts.

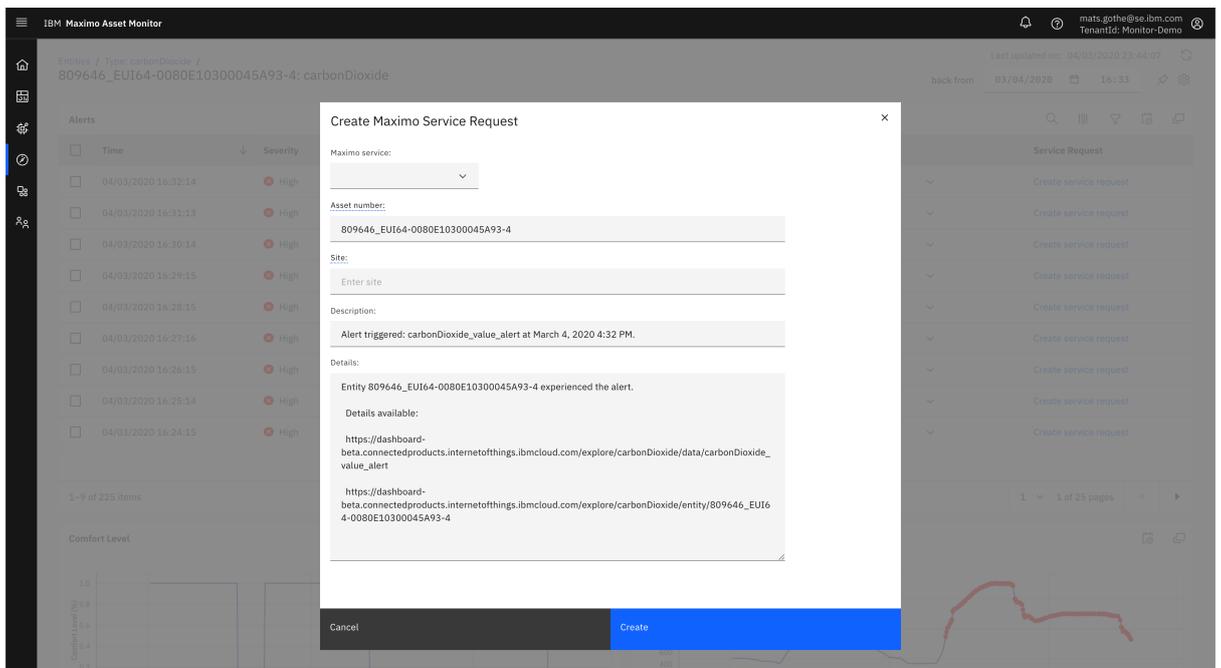
2. Use the Summary Controls to explore the levels at the meetings rooms at floor 27. Do you see any patterns? Are there indicators of high CO<sub>2</sub> levels in some or all meeting rooms?
3. View the CO<sub>2</sub> **Alerts** table card. Click on the Entity ID of one of the alerts. The Entity Dashboard loads for the selected entity.



**Note:** The Entity Diagram shows the CO2 level with an overlay of alerts.

We can now conclude the meeting room air quality throughout the day in some of the meeting room zones and not compliant to regulations. We may suspect an issue with the HVAC system. To resolve the issue a Maximo Service Request should be submitted to the facility engineering team.

- To create a Service Request, click on the command Create Service Request on an alert. A Create Maximo Service Request modal opens with the alert information filled in.



We have now completed the exploration of the Watson IoT Platform Analytics Service.

### 3.8 Exploring Workstation Dashboards and Configurations

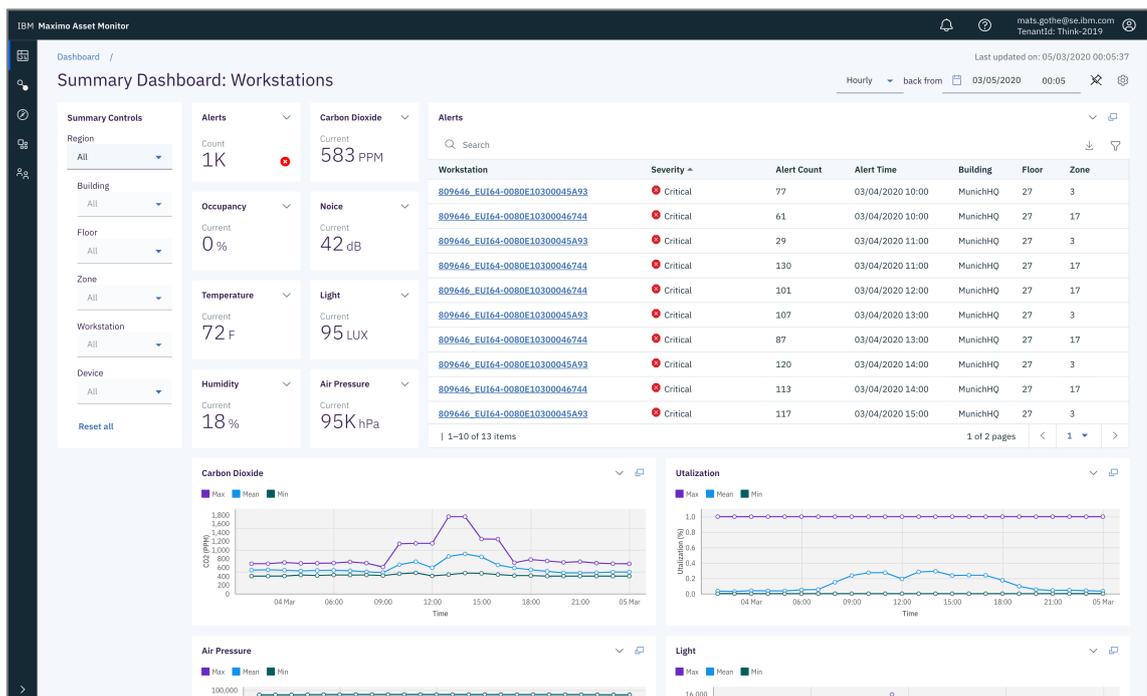
In this section of the lab we will explore the details of monitor dashboards using the Workstation type.

Watson IoT Platform provides a monitoring solution for data visibility, root-cause troubleshooting, and rule driven alerts at scale. Summary dashboards display aggregated data from all entities of a specific entity type based on a time grain and custom taxonomy dimensions. For example the Region, Building, Floor, Zone, Workstation and Device dimensions used in previous sections. Instance dashboards provide a view of the data based on a single instance (entity ID).

The devices / entities used in this lab are connected as individual device types measuring a single unit, for example temperature, CO<sub>2</sub>, humidity, sound, pressure. To create an overview of the building we have created a device type that provides the aggregated data from all devices attached to the workspace, for example as desk or a room. We call this type a Workstation. The workstation takes the name from the sensors, but drops the \_3, \_4, \_5, \_6, \_10 description in the sensor names. The logical interface of a workstation is an aggregation of the sensor **value** and **comfortLevel** properties.

To view the Workstation dashboard

1. Select the **Monitor** section in the left-hand side navigator. Alternatively, click **Entities** in the page breadcrumb.
2. Select the **Workstation** type.
3. On the Workstation page, open the **Workstations** summary dashboard  
The Workstations dashboards loads and presented the roll-up aggregated Metrics across all workstations.

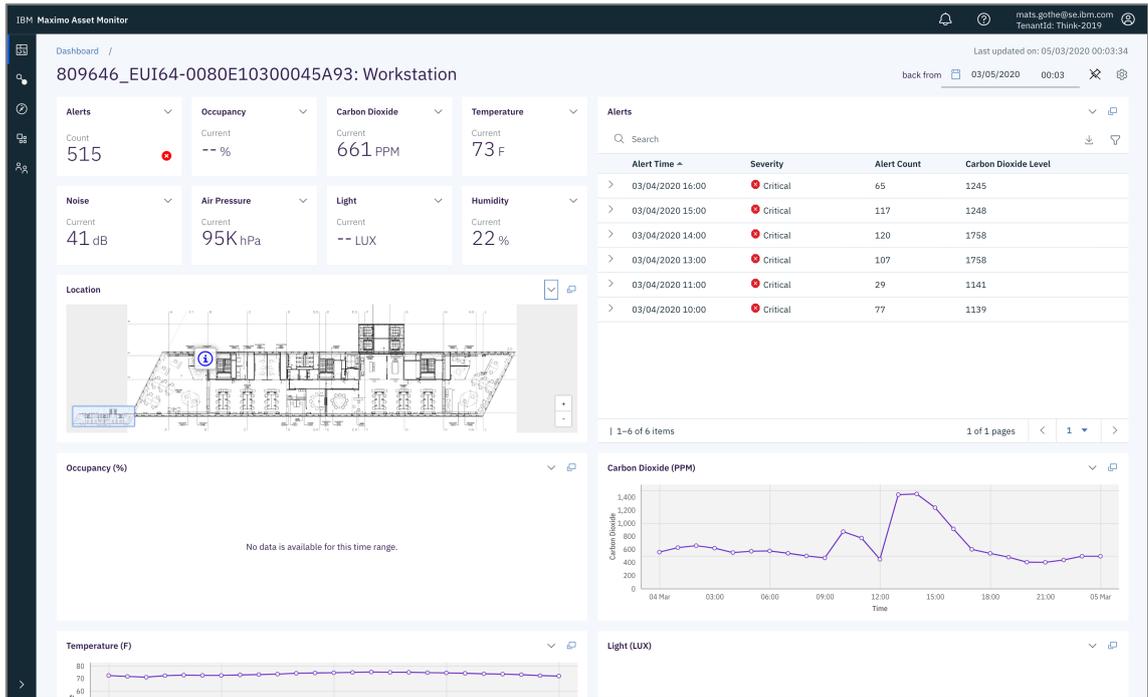


- Use the Summary Controls to filter the workstations to floor 27 in the Munich building.

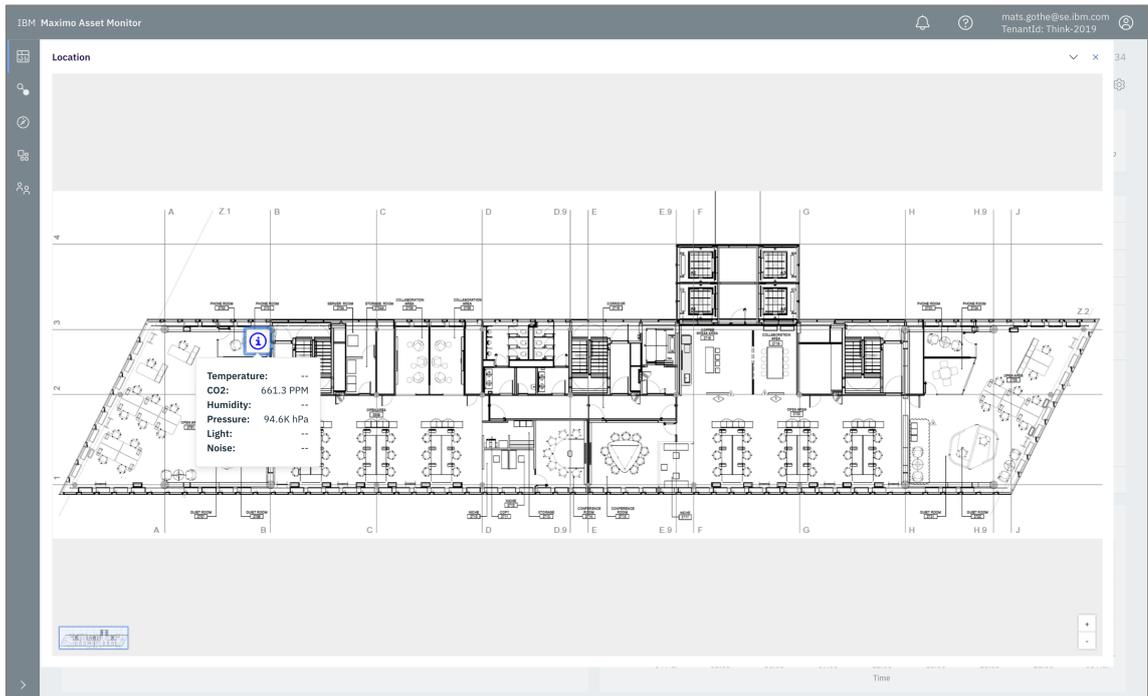
- In the Alerts table, click on workstation id to open the dashboard for the workstation notifying the alerts.

Workstation	Severity	Alert Count	Alert Time	Building	Floor	Zone
<a href="#">809646_EUI64-0080E10300045A93</a>	Critical	32	10/28/2019 09:00	MunichHQ	27	3
<a href="#">809646_EUI64-0080E10300045A93</a>	Critical	55	10/28/2019 14:00	MunichHQ	27	3
<a href="#">809646_EUI64-0080E10300045A93</a>	Critical	45	10/28/2019 15:00	MunichHQ	27	3
<a href="#">809646_EUI64-0080E10300045A93</a>	Critical	117	10/28/2019 16:00	MunichHQ	27	3

- The entity dashboard opens with workstation 809646\_EUI64-0080E10300045A93



- Click on the Full Size icon  the on the Location image card. The card fills the screen and shows the workstation location on the floor.

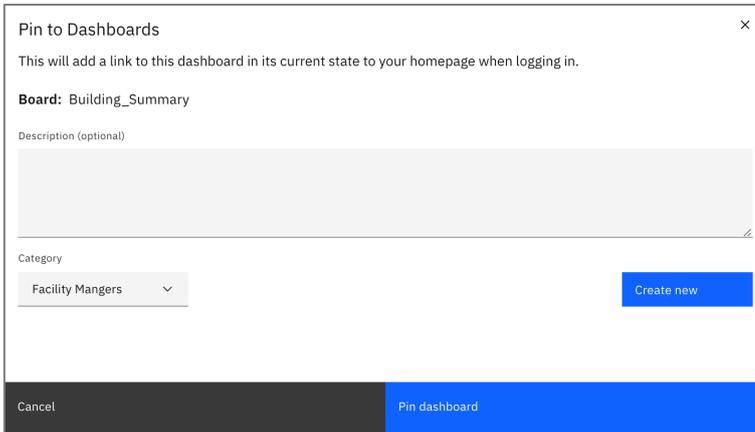


- Click on the information icon at the workstation location. A value card opens with the workstation data items.
- Click the **X** button to close the full-size card.

Dashboard can be pinned to the Dashboard navigation page for quick access directly to the dashboard.

To pin a dashboard

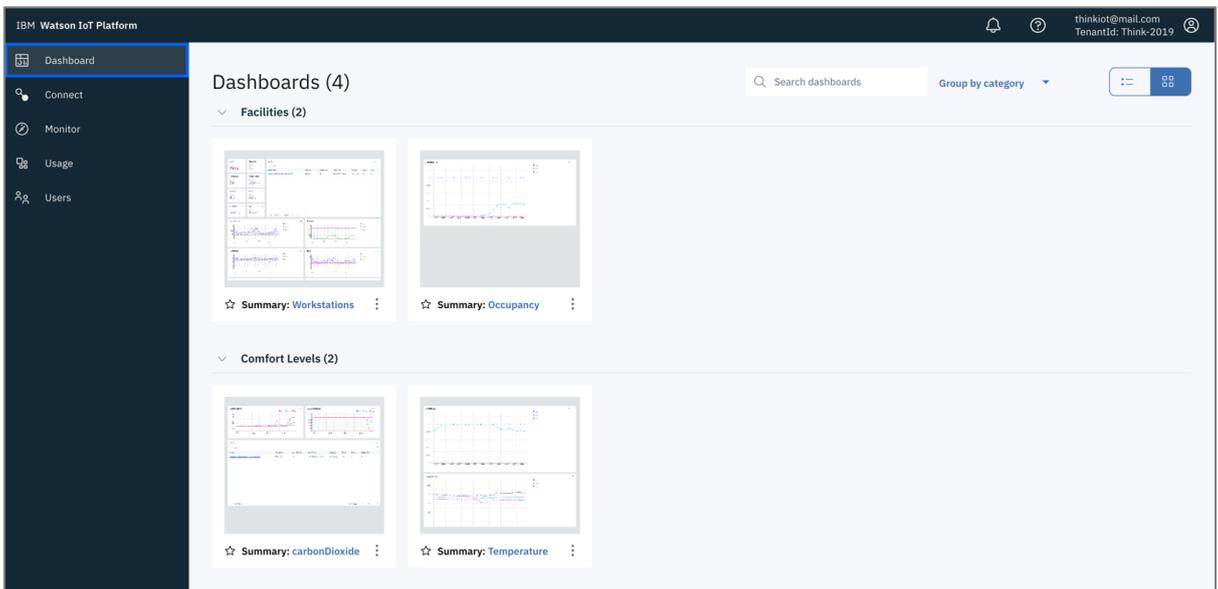
1. On a dashboard, click on the  icon in the upper right corner
2. In the **Pin to Dashboards**, explore the description and category fields.



3. Click **Cancel** to close the dialog

To open a pinned dashboard

4. Choose the **Dashboard** section from the left-hand navigator



5. Click on one of the pinned dashboards, for example the **Workstations** summary dashboard. The selected dashboard opens

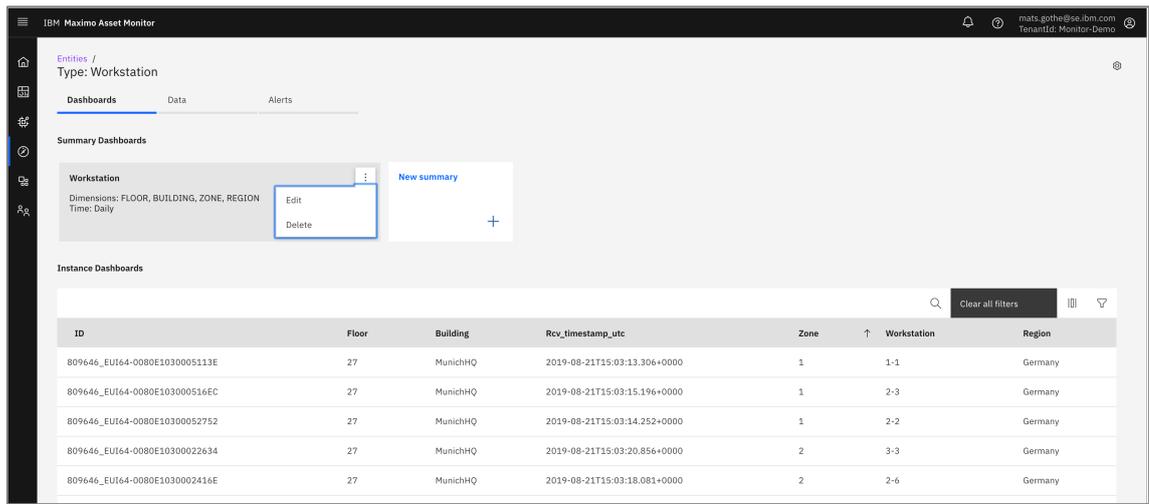
In the next section we will explore the Workstation summary dashboard and the card configurations in JSON that produce the dashboard.

### 3.9 Exploring the Workstation dashboard configuration

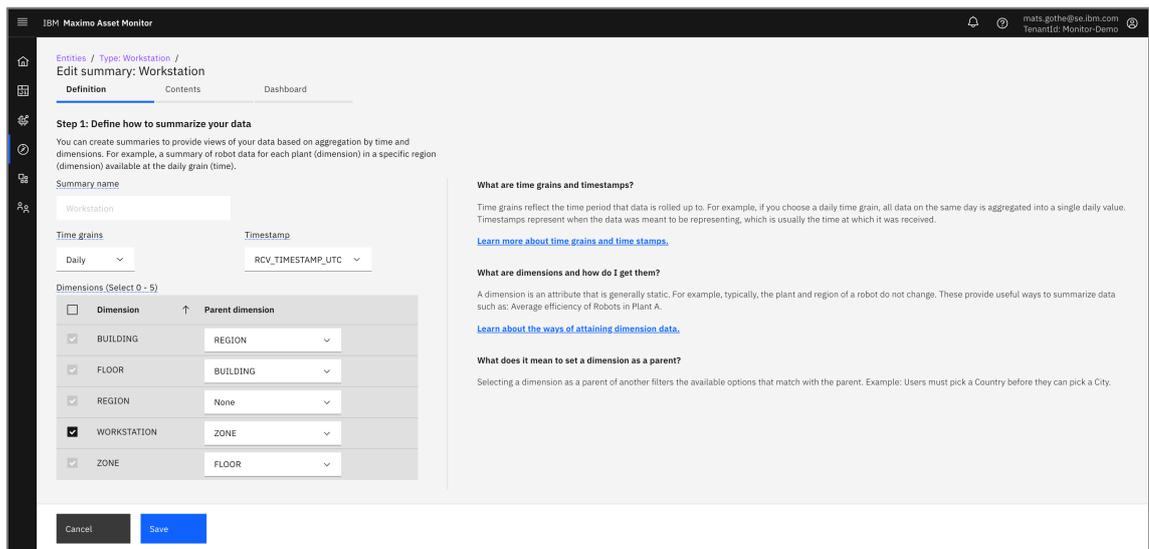
The Watson IoT Platform provides an editor for creating new Summary Dashboards. In this lab we will not create a new dashboard but view the existing Workstation dashboard configuration.

To open a dashboard editor

1. On the Workstation entity type page, select **Edit** from the dashboard overflow menu.



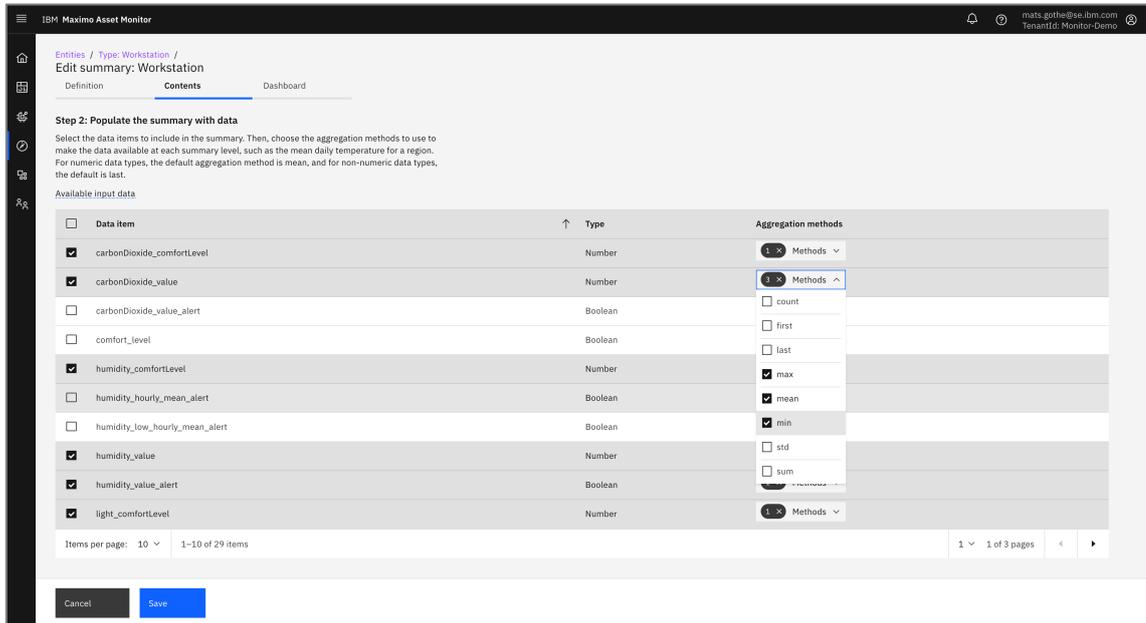
2. The dashboard editor opens
3. The **Definition** page in the dashboard editor configures the dashboard name and the default time grain. The taxonomy dimensions and their hierarchical relations are defined.



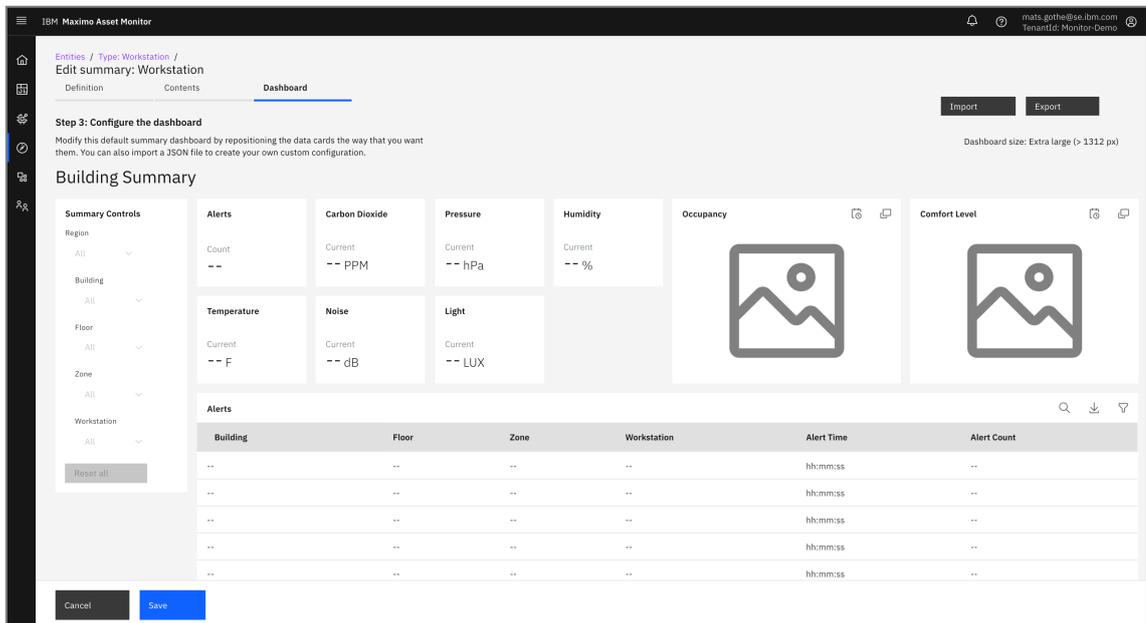
**Note:** When creating a new dashboard, the dimensions are selected, and the parent of each level is chosen for each dimension. For the workstation dashboard the

taxonomy hierarchy is defined as Region > Building > Floor > Zone > Workstation > Device.

- The **Contents** page in the editor selects the Workstation data items to visualize on the dashboard. Each data item also provides a list of aggregates to be visualized.



- The Dashboard page in the dashboard editor provides a graphical view of the cards. In this view, the layout can be defined by dragging the cards into position.



6. Dashboard layouts may be configured for various screen size. Maximum > 1800 px, Extra large > 1312 px, Large > 1056 px, Medium > 672 px, Small > 320 px. By changing the browser window size a new layout may be configured.

The screenshot shows the IBM Maximo Asset Monitor interface for configuring a dashboard. The top navigation bar includes the IBM logo, 'Maximo Asset Monitor', and user information: 'mats.gothe@se.ibm.com' and 'TenantId: Monitor-Demo'. The main content area is titled 'Edit summary: Workstation' and has three tabs: 'Definition', 'Contents', and 'Dashboard' (which is active). There are 'Import' and 'Export' buttons in the top right. Below the tabs, the text reads: 'Step 3: Configure the dashboard' and 'Modify this default summary dashboard by repositioning the data cards the way that you want them. You can also import a JSON file to create your own custom configuration.' The 'Dashboard size: Medium (> 672 px)' is indicated. The main section is titled 'Building Summary' and contains a grid of data cards. On the left, there are filters for 'Region', 'Building', 'Floor', 'Zone', and 'Workstation', each with a dropdown menu set to 'All' and a 'Reset all' button. The data cards are: 'Alerts' (Count), 'Temperature' (F, Current), 'Carbon Dioxide' (PPM, Current), 'Noise' (dB, Current), 'Pressure' (hPa, Current), and 'Humidity' (%). At the bottom, there are 'Cancel' and 'Save' buttons.

7. Additional configurations to the dashboard are made in the JSON definition of the dashboard. Click on **Export** to download the JSON definition file.
8. Click **Cancel** to close the editor.

In the next section we will explore the JSON dashboard definition file.

### 3.10 Exploring the Workstation JSON definition file

A dashboard is defined using a JSON definition file. A definition file can be used for

- Being a starting point for a new dashboard from a template
- Adding cards not automatically added by the dashboard editor
- Setting or updating card details, like card titles, labels, and data units
- Setting icons and color for state

A JSON definition file contains

- A “title” for the dashboard name
- A “cards” array with all cards
- A “layouts” array with the card layout for each screen size

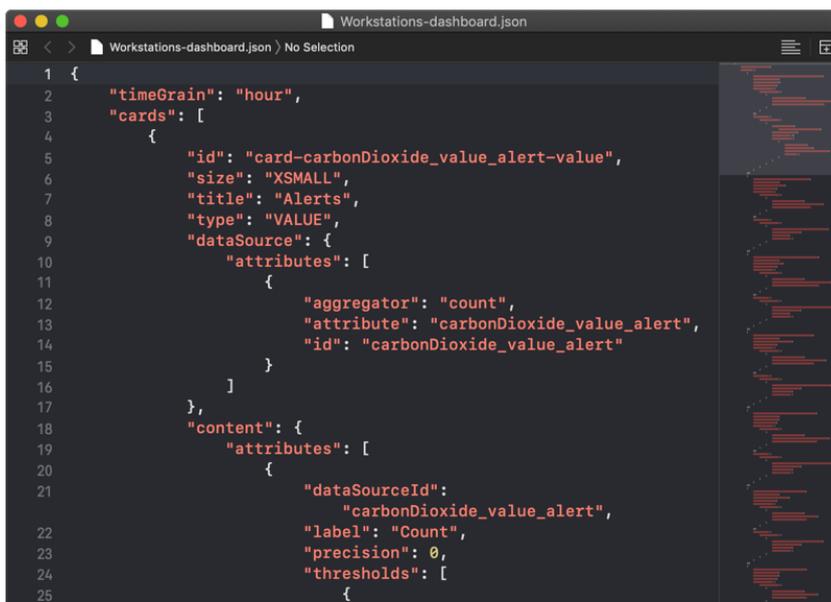
Each card type definition contains

- An “id” with a unique identifier of the cards
- A “dataSource” array with the entity data items used by the card
- A “content” array with the data sources to visualize on the card

Each card type also has specific elements in the JSON to control details. See product documentation for details.

To view JSON definition file

1. Open the downloaded Workstation-dashbaord.json file using a code or text editor.



```
1 {
2   "timeGrain": "hour",
3   "cards": [
4     {
5       "id": "card-carbonDioxide_value_alert-value",
6       "size": "XSMALL",
7       "title": "Alerts",
8       "type": "VALUE",
9       "dataSource": {
10        "attributes": [
11          {
12            "aggregator": "count",
13            "attribute": "carbonDioxide_value_alert",
14            "id": "carbonDioxide_value_alert"
15          }
16        ]
17      },
18      "content": {
19        "attributes": [
20          {
21            "dataSourceId":
22              "carbonDioxide_value_alert",
23            "label": "Count",
24            "precision": 0,
25            "thresholds": [

```

2. View the definition of a value card, for example the latest carbonDioxide\_value mean value

```
{
  "id": "card-carbonDioxide_value-value",
  "size": "XSMALL",
  "title": "Carbon Dioxide",
  "type": "VALUE",
  "dataSource": {
    "attributes": [
      {
        "aggregator": "mean",
        "attribute": "carbonDioxide_value",
        "id": "carbonDioxide_value"
      }
    ],
    "range": {
      "count": -24,
      "interval": "hour"
    }
  },
  "content": {
    "attributes": [
      {
        "dataSourceId": "carbonDioxide_value",
        "label": "Current",
        "unit": "PPM",
        "precision": 2
      }
    ]
  }
},
```

**Note:** The value card is referencing the carbonDioxide\_value data item and presenting the mean value for the last 24 hours. The “attributes” array defines display attributes like the card label, unit and data precision. Also note that the card size is set on the card. Value cards may have single or multiple values and make be of XSmall and larger sizes.

3. View the definition of a line graph card, for example the carbonDioxide\_value time series

```
{
  "id": "card-carbonDioxide_value-timeseries",
  "dataSource": {
    "attributes": [
      {
        "aggregator": "max",
        "attribute": "carbonDioxide_value_Workstations_max",
        "id": "carbonDioxide_value_Workstations_max"
      },
      {
        "aggregator": "mean",
        "attribute": "carbonDioxide_value_Workstations_mean",
        "id": "carbonDioxide_value_Workstations_mean"
      },
      {
        "aggregator": "min",
        "attribute": "carbonDioxide_value_Workstations_min",
        "id": "carbonDioxide_value_Workstations_min"
      }
    ]
  }
},
```

```

    ],
    "range": {
      "count": -24,
      "interval": "hour"
    },
    "timeGrain": "hour"
  },
  "content": {
    "series": [
      {
        "dataSourceId": "carbonDioxide_value_Workstations_max",
        "label": "Max"
      },
      {
        "dataSourceId": "carbonDioxide_value_Workstations_mean",
        "label": "Mean"
      },
      {
        "dataSourceId": "carbonDioxide_value_Workstations_min",
        "label": "Min"
      }
    ]
  },
  "xLabel": "Time",
  "yLabel": "CO2 (PPM)"
},
"size": "MEDIUM",
"title": "Carbon Dioxide",
"type": "TIMESERIES"
},

```

**Note:** A line card may plot single or multiple data sets.

#### 4. View the definition of an alert table card, for example the Carbon Dioxide alert table

```

{
  "id": "carbon-dioxide-alert",
  "dataSource": {
    "attributes": [
      {
        "aggregator": "count",
        "attribute": "carbonDioxide_value_alert",
        "id": "carbonDioxide_value_alert_count"
      },
      {
        "aggregator": "max",
        "attribute": "carbonDioxide_value",
        "id": "carbonDioxide_value_max"
      }
    ],
    "range": {
      "count": -24,
      "interval": "hour"
    },
    "timeGrain": "hour",
    "groupBy": [
      "deviceid",
      "Building",
      "Floor",
      "Zone"
    ]
  },
  "content": {
    "columns": [
      {

```

```

        "dataSourceId": "deviceid",
        "label": "Workstation"
    },
    {
        "dataSourceId": "carbonDioxide_value_alert_count",
        "label": "Alert Count"
    },
    {
        "dataSourceId": "timestamp",
        "label": "Alert Time",
        "priority": 1,
        "type": "TIMESTAMP"
    },
    {
        "dataSourceId": "Building"
    },
    {
        "dataSourceId": "Floor"
    },
    {
        "dataSourceId": "Zone"
    }
],
"thresholds": [
    {
        "dataSourceId": "carbonDioxide_value_alert_count",
        "comparison": ">",
        "value": 0,
        "showOnContent": true,
        "label": "Severity",
        "severity": 1
    }
]
},
"size": "XLARGE",
"title": "Alerts",
"type": "TABLE"
},

```

**Note:** Table cards present column data from time series data items.

We have now completed the section on Monitor Dashboards. More details on the Monitor Dashboard JSON definitions are provided in the product documentation.

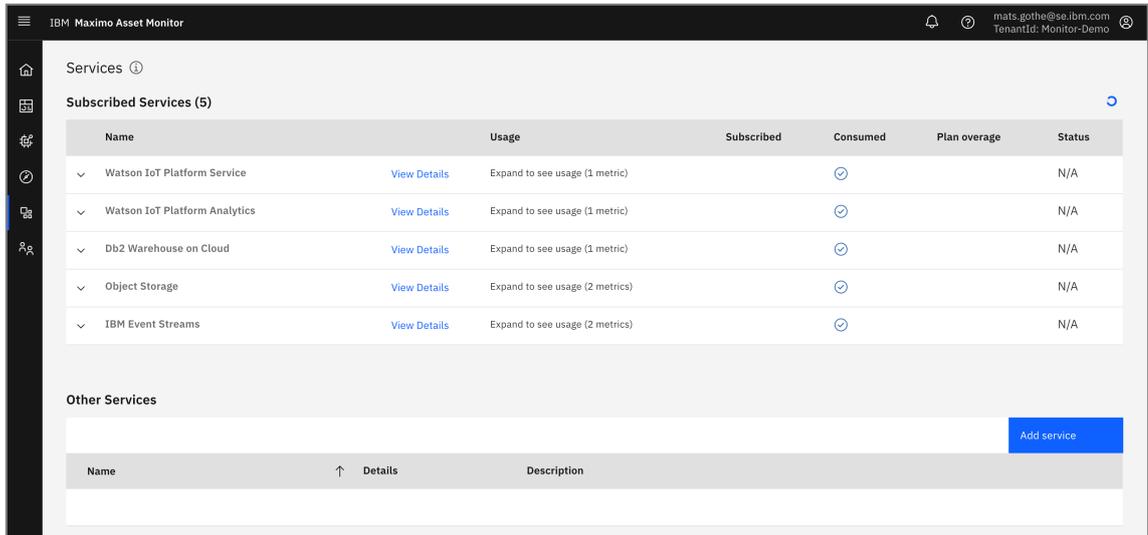
In the next final section, we will briefly explore platform administration and user management.

### 3.11 Exploring the Watson IoT Platform Administration

In this last section of the lab we will look at platform administration and user management.

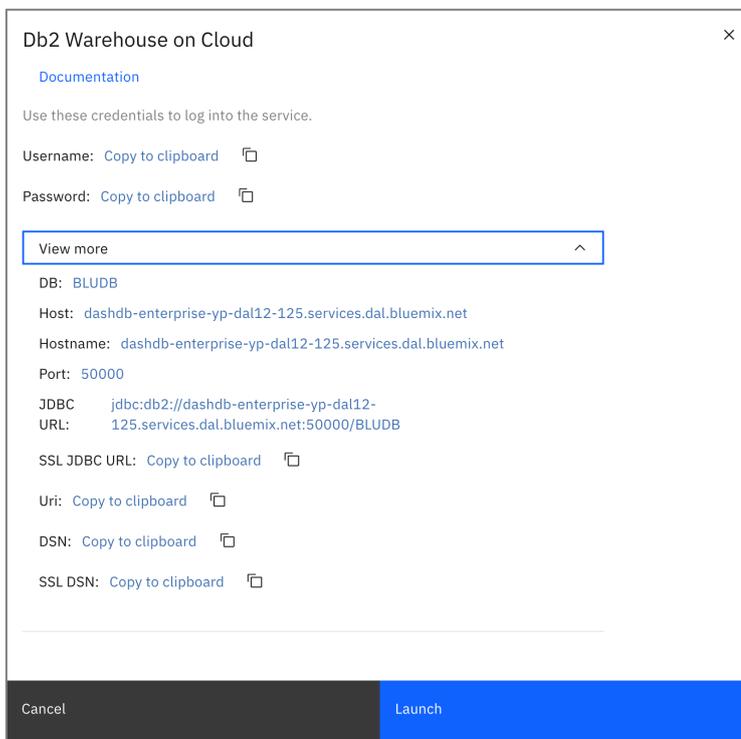
To view the configured services, their health status and connection credentials

1. Select **Manage Services** on the Home page or select **Services** from the navigator.



**Note:** View the status for the individual service preconfigured for this IoT platform tenant.

2. Click on **View Details** on Db2 Warehouse on the Cloud row in the list of services.



**Note:** The dialog shows the credential for the Db2 web administration tool and other properties on the data service.

To view the users of the IoT platform

1. Select the **Users** tab on the Watson IoT Platform banner.
2. The User page opens



**Note:** The [thinkiot@mail.com](mailto:thinkiot@mail.com) user do not have Administrator permissions and the user list cannot be modified in this lab.

You have now completed overview of administration capabilities in the Watson IoT Platform. We will now proceed to explore the Watson IoT Platform and the connected devices in the IoT Center in Munich

## 4 Conclusions from this Maximo Asset Monitor lab

You have now completed this hands-on lab on Maximo Asset Monitor 101.

During this lab you have:

- Deepened your understanding of the Watson IoT Platform Service and how Device Types and Device are declared, registered and connected to send events to the IoT platform. You have also explored the definition of Interfaces and Device State transformations.
- Deepened your understanding of the Maximo Asset Monitor and how Entity Types, Entities and Metrics are stored in the Db2 data lake.
- Deepened your understanding of Maximo Asset Monitor analytics and how to create Computed Metrics and Alerts using function in the Function Catalog.

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

### 4.1 Further reading

To learn more about the IBM Maximo Asset Monitor visit

- Maximo Asset Monitor on ibm.com  
<https://www.ibm.com/products/ibm-maximo-asset-performance-management/asset-monitor>
- Maximo Asset Monitor knowledge center  
[https://www.ibm.com/support/knowledgecenter/SSQP8H/iot/kc\\_welcome.html](https://www.ibm.com/support/knowledgecenter/SSQP8H/iot/kc_welcome.html)

## 4.2 We Value Your Feedback!

Don't forget to submit your lab survey! Your feedback is very important to us – we use it to continually improve our product design experience and our labs and workshops.

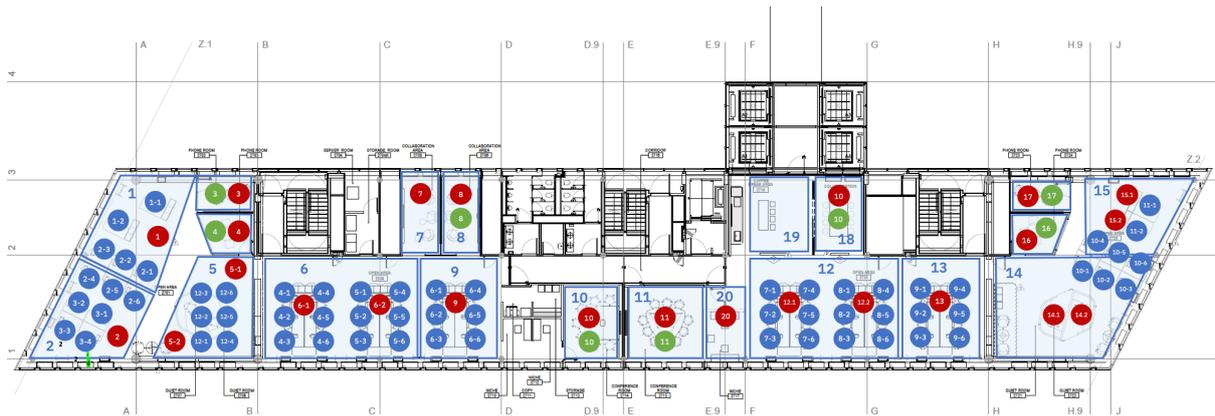
# 5 APPENDIX A

## 5.1 Device types and identities

Registered devices at 27<sup>th</sup> floor in the Munic IoT Center.

In the floor plan below

- **Zones** are indicated with numbered blue areas
- **Comfort** devices, red numbered circles
- **Motion plus** devices, green numbered circles
- **Motion** devices, blue numbered circles



As an example, Zone 1 has one Comfort device and Motion devices 1-1 , 1-2 and 2-1, 2-2, 2-3. For registered sensor id's reference the device table below.

## 5.2 Registered Sensors

In the table below, sensors are registered with an extension indicating their sensor type. For example, the device in Zone 3 with ID 3 is the Comfort device 809646\_EUI64-0080E10300045A93 is registering six sensors; with extensions -3, -4, -5, -6 and -10

The screenshot shows the 'Browse Devices' interface in the IBM Watson IoT Platform. The search bar contains the device ID 'I64-0080E10300045A93'. The table below lists the registered sensors for this device.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location
> 809646_EUI64-0080E10300045A93-4	Disconnected	pressure	Device	16 Oct 2019 21:51	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93	Disconnected	Workstation	Device	21 Oct 2019 13:29	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-10	Disconnected	soundPressureLevel	Device	7 Dec 2018 14:08	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-3	Disconnected	relativeHumidity	Device	7 Dec 2018 14:12	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-5	Disconnected	volatileOrganicCompound	Device	7 Dec 2018 14:16	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-4	Disconnected	carbonDioxide	Device	7 Dec 2018 14:16	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-6	Disconnected	pressure	Device	7 Dec 2018 14:17	FLOOR 27, ZONE 3
> 809646_EUI64-0080E10300045A93-3	Disconnected	temperatureK	Device	7 Dec 2018 14:22	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045A93-10	Disconnected	unitState	Device	13 Dec 2018 13:17	FLOOR 27, ZONE 3

Another example is the Motion+ device EUI64-0080E10300045266, also in Zone 3, registering 5 sensors with extensions -3, -4, -5, -10

The screenshot shows the 'Browse Devices' interface in the IBM Watson IoT Platform. The search bar contains the device ID 'I164-0080E10300045266'. The table below lists the registered sensors for this device.

Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location
> 809646_EUI64-0080E10300045266	Disconnected	Workstation	Device	21 Oct 2019 13:29	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-5	Disconnected	illuminance	Device	7 Dec 2018 13:49	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-10	Disconnected	soundPressureLevel	Device	7 Dec 2018 14:06	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-3	Disconnected	relativeHumidity	Device	7 Dec 2018 14:11	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-3	Disconnected	temperatureK	Device	7 Dec 2018 14:21	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-4	Disconnected	motion	Device	7 Dec 2018 20:12	Germany, MunichHQ, FLOOR 27, ZONE 3, WORKSTATION 3
> 809646_EUI64-0080E10300045266-10	Disconnected	unitState	Device	13 Dec 2018 13:17	FLOOR 27, ZONE 3

All sensors on floor 27 are listed in the table below by Zone, ID, Type and Device ID. The sensor types registered are given in the columns to the right using the following short name.

- T** temperatureK
- M** motion
- CO2** carbonDioxide
- P** pressure
- SP** soundPressureLevel
- RM** relativeHumidity
- VOC** volatileOrganicCompound
- I** illumination

For example, Comfort device EUI64-0080E10300045A93 in Zone 3 registers T, CO2, P, SP, RH, VOC sensors with the given extensions to the device name.

Use the table below to identify the devices and sensors you explore in your analytics.

ZONE	ID	YANZI	DEVICE	T	M	CO2	P	SP	RH	VOC	I
1	1	Motion Plus	EUI64-0080E10300045607	-3	-4			-10	-3		-5
1	1-1	Motion	EUI64-0080E1030005113E	-5	-4						
1	1-2	Motion	EUI64-0080E10300052476	-5	-4						
1	2-1	Motion	EUI64-0080E10300051D53	-5	-4						
1	2-2	Motion	EUI64-0080E10300052752	-5	-4						
1	2-3	Motion	EUI64-0080E103000516EC	-5	-4						
2	2	Motion Plus	EUI64-0080E103000451D3	-3	-4			-10	-3		-5
2	2-4	Motion	EUI64-0080E10300052215	-5	-4						
2	2-5	Motion	EUI64-0080E103000526DD	-5	-4						
2	2-6	Motion	EUI64-0080E1030002416E	-5	-4						
2	3-1	Motion	EUI64-0080E10300051973	-5	-4						
2	3-2	Motion	EUI64-0080E10300051B4B	-5	-4						
2	3-3	Motion	EUI64-0080E10300022634	-5	-4						
2	3-4	Motion	EUI64-0080E10300024510	-5	-4						
3	3	Comfort	EUI64-0080E10300045A93	-3		-4	-6	-10	-3	-5	
3	3	Motion Plus	EUI64-0080E10300045266	-3	-4			-10	-3		-5
4	4	Comfort	EUI64-0080E10300045C64	-3		-4	-6	-10	-3	-5	
4	4	Motion Plus	EUI64-0080E10300045264	-3	-4			-10	-3		-5
5	12-1	Motion	EUI64-0080E103000511B8	-5	-4						
5	12-2	Motion	EUI64-0080E10300051A82	-5	-4						
5	12-3	Motion	EUI64-0080E1030005241D	-5	-4						
5	12-4	Motion	EUI64-0080E103000510F6	-5	-4						
5	12-5	Motion	EUI64-0080E103000523F9	-5	-4						
5	12-6	Motion	EUI64-0080E10300051C50	-5	-4						
6	4-1	Motion	EUI64-0080E10300051735	-5	-4						
6	4-2	Motion	EUI64-0080E103000526E7	-5	-4						
6	4-3	Motion	EUI64-0080E1030005119E	-5	-4						
6	4-4	Motion	EUI64-0080E1030005112B	-5	-4						

6	4-5	Motion	EUI64-0080E103000526FB	-5	-4					
6	4-6	Motion	EUI64-0080E10300052816	-5	-4					
6	5-1	Motion	EUI64-0080E103000512F3	-5	-4					
6	5-1	Motion Plus	EUI64-0080E103000451A3	-3	-4	-10	-3		-5	
6	5-2	Motion	EUI64-0080E103000511A2	-5	-4					
6	5-2	Motion Plus	EUI64-0080E10300045420	-3	-4	-10	-3		-5	
6	5-3	Motion	EUI64-0080E10300051DF1	-5	-4					
6	5-4	Motion	EUI64-0080E10300052522	-5	-4					
6	5-5	Motion	EUI64-0080E103000516ED	-5	-4					
6	5-6	Motion	EUI64-0080E103000524B4	-5	-4					
7	7	Motion Plus	EUI64-0080E103000452B7	-3	-4	-10	-3		-5	
8	8	Motion Plus	EUI64-0080E1030004507E	-3	-4	-10	-3		-5	
9	9	Motion Plus	EUI64-0080E1030004542F	-3	-4	-10	-3		-5	
9	6-1	Motion	EUI64-0080E1030005133F	-5	-4					
9	6-1	Motion Plus	EUI64-0080E103000451A5	-3	-4	-10	-3		-5	
9	6-2	Motion	EUI64-0080E10300051301	-5	-4					
9	6-2	Motion Plus	EUI64-0080E10300045407	-3	-4	-10	-3		-5	
9	6-3	Motion	EUI64-0080E10300051776	-5	-4					
9	6-4	Motion	EUI64-0080E1030005264A	-5	-4					
9	6-5	Motion	EUI64-0080E10300051647	-5	-4					
9	6-6	Motion	EUI64-0080E103000527B7	-5	-4					
10	10	Comfort	EUI64-0080E103000478EA	-3		-4	-6	-10	-3	-5
10	10	Motion Plus	EUI64-0080E103000454E9	-3	-4			-10	-3	-5
11	11	Comfort	EUI64-0080E1030004674E	-3		-4	-6	-10	-3	-5
11	11	Motion Plus	EUI64-0080E10300045154	-3	-4			-10	-3	-5
11	11-1	Motion	N/A		[DEVI CE]-5					
12	8	Comfort	EUI64-0080E10300046CF8	-3		-4	-6	-10	-3	-5
12	12-1	Motion Plus	EUI64-0080E103000457A1	-3	-4			-10	-3	-5
12	12-2	Motion Plus	EUI64-0080E103000452CD	-3	-4			-10	-3	-5
12	7-1	Motion	EUI64-0080E10300052688	-5	-4					
12	7-2	Motion	EUI64-0080E103000519D8	-5	-4					
12	7-3	Motion	EUI64-0080E10300051B65	-5	-4					
12	7-4	Motion	EUI64-0080E10300051340	-5	-4					
12	7-5	Motion	EUI64-0080E10300051B04	-5	-4					
12	7-6	Motion	EUI64-0080E1030005146B	-5	-4					
12	8-1	Motion	EUI64-0080E10300052466	-5	-4					
12	8-2	Motion	EUI64-0080E103000511F9	-5	-4					
12	8-3	Motion	EUI64-0080E10300052789	-5	-4					
12	8-4	Motion	EUI64-0080E10300051A2F	-5	-4					
12	8-5	Motion	EUI64-0080E103000513A0	-5	-4					
12	8-6	Motion	EUI64-0080E1030005134D	-5	-4					
13	13	Motion Plus	EUI64-0080E1030004515F	-3	-4			-10	-3	-5
13	9-1	Motion	EUI64-0080E1030005171C	-5	-4					
13	9-2	Motion	EUI64-0080E103000527C8	-5	-4					

13	9-3	Motion	EUI64-0080E103000519ED	-5	-4					
13	9-4	Motion	EUI64-0080E10300051709	-5	-4					
13	9-5	Motion	EUI64-0080E10300051B3D	-5	-4					
13	9-6	Motion	EUI64-0080E103000527A8	-5	-4					
14	10-1	Motion	EUI64-0080E10300024525	-5	-4					
14	10-2	Motion	EUI64-0080E10300022551	-5	-4					
14	10-3	Motion	EUI64-0080E10300024598	-5	-4					
14	14-1	Motion Plus	EUI64-0080E103000452B9	-3	-4		-10	-3		-5
14	14-2	Motion Plus	EUI64-0080E103000457D9	-3	-4		-10	-3		-5
15	10-4	Motion	EUI64-0080E10300023C37	-5	-4					
15	10-5	Motion	EUI64-0080E10300022A58	-5	-4					
15	10-6	Motion	EUI64-0080E103000246CE	-5	-4					
15	11-2	Motion	EUI64-0080E10300022410	-5	-4					
15	15-1	Motion Plus	EUI64-0080E103000455C5	-3	-4		-10	-3		-5
15	15-2	Motion Plus	EUI64-0080E10300045424	-3	-4		-10	-3		-5
16	16	Comfort	EUI64-0080E103000476D5	-3		-4	-6	-10	-3	-5
16	16	Motion Plus	EUI64-0080E1030004553E	-3	-4		-10	-3		-5
17	17	Comfort	EUI64-0080E10300046744	-3		-4	-6	-10	-3	-5
17	17	Motion Plus	EUI64-0080E10300045452	-3	-4		-10	-3		-5
18	18	Comfort	EUI64-0080E10300046D2A	-3		-4	-6	-10	-3	-5