

# What the heck is a THING?

## Device abstractions and thing aggregation for Internet of Things



Mats Göthe

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Watson Internet of Things Platform  
Watson Content & IoT Platform*

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## About this session

Make and model of products from a single manufacturer include a lot of variability in the underlying components and sensors. When you are building IoT solutions to work with a range of connected THINGS from many suppliers, you start to realize the huge challenge you face managing the interaction with this broad and complex device ecosystem. Wouldn't it be better if the IoT application developer could just interact with a standard resource model and the underlying IoT platform managed the relationship between the model and the real-world devices? Come and learn more about the latest innovations in the Watson IoT Platform.



## About the Speaker



Mats Göthe is STSM and Design Leader of the Watson Internet of Things Platform with teams of designers in the Hursley and Toronto IBM Design Studios.

The Watson IoT Platform is part of the Watson Content & IoT Platform BU, in IBM Watson & Cloud Platform

Mats joined IBM Rational 25 years ago and have held various leadership positions in design, solution architecture, product management, development, sales and services.

# Agenda

Devices, Things and Digital Twins

Examples in Cognitive Buildings and Facility Management

Watson IoT Platform – Data Management

- Needs: Chris the IoT Application Developer
- Design: Device abstractions and data transformation
- Demo: Data Management developer experience





## About the Watson IoT Platform

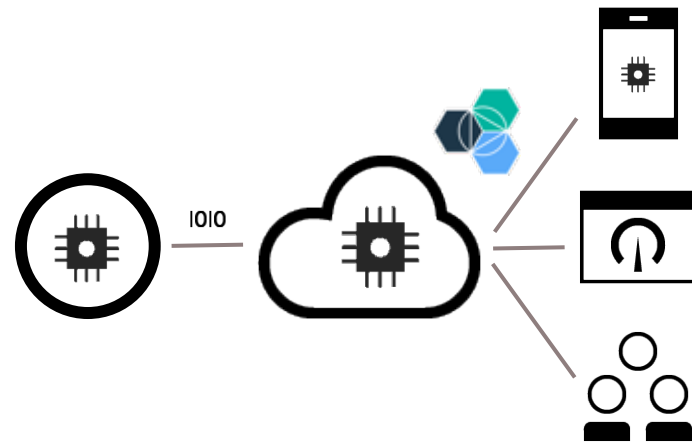
The IBM Watson Internet of Things Platform is a fully managed, cloud-hosted service available in IBM Bluemix.

Sensors and devices get connected and start sending data securely to the IBM Watson IoT Platform service using the MQTT messaging protocol.

From there, devices and things are managed using the IoT Platform UI or secure APIs, and IoT applications and solutions access real-time device state and historical data.

We compete with IoT platform offerings from Microsoft Azure, Amazon AWS and others.

<https://www.ibm.com/internet-of-things/platform/watson-iot-platform/>



# Devices, Things and Digital Twins

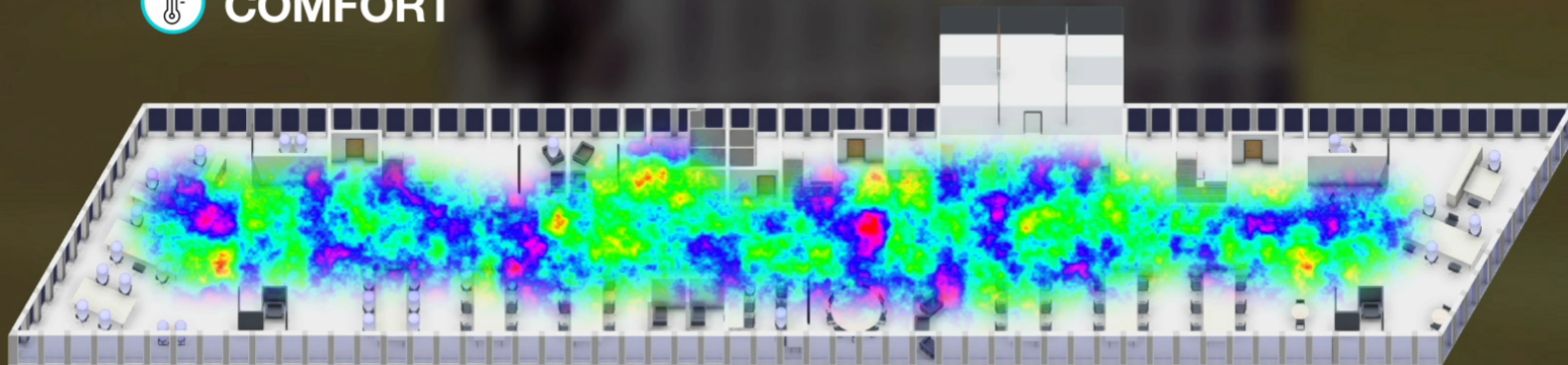
A physical, logical and virtual representation of the elements and dynamics of how an IoT system operates and works throughout its lifecycle







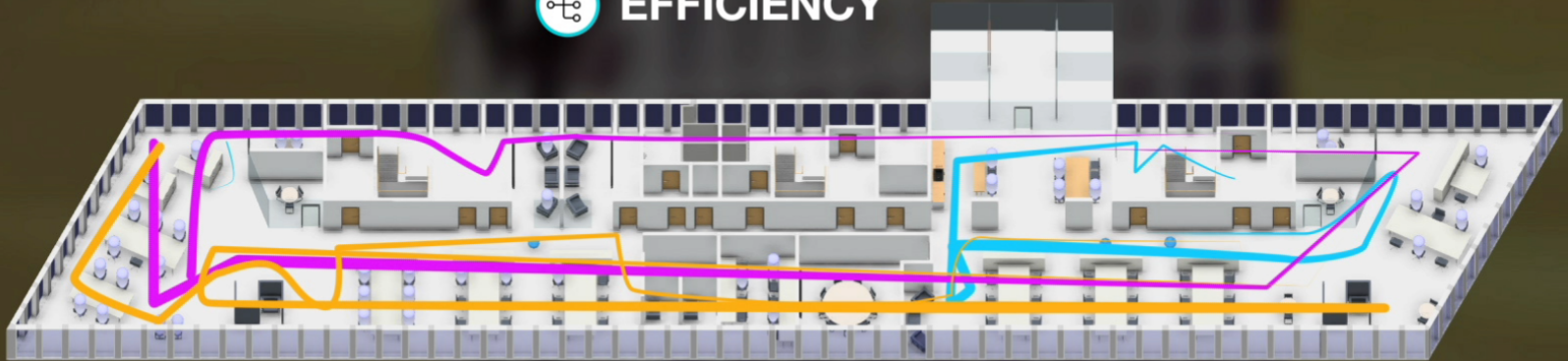
COMFORT

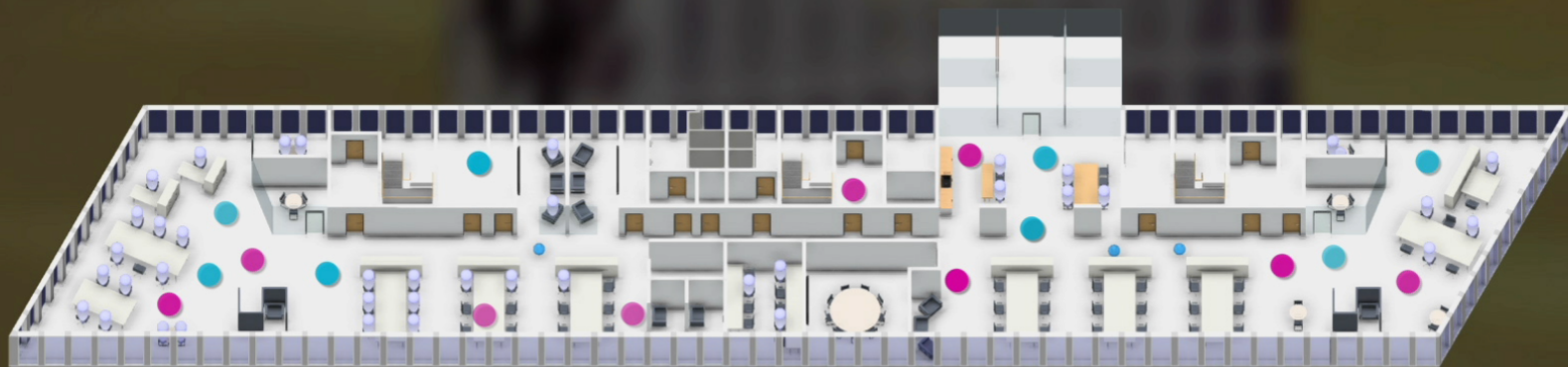






**EFFICIENCY**





**ECONOMY**



Otto, a facilities manager can  
confidently assess, act on,  
and communicate  
holistic building / floor health\* insights  
in real time, without all of the legwork\*\*

\* people, resources, assets

\*\* low level problems that take up a lot of time. Freeing  
him from these will allow him to have more  
meaningful interactions with tenants and the space

```
{
  "ts":
    "2017-10-02T08:09:34.310+0000",
  "d": {
    "value": 296.77,
    "time": 1506931831214
  }
}
```

```
{"t": 18.9, "c": 1.0}
```

```
{
  "ts":
    "2017-10-02T08:11:42.797+0000",
  "d": {
    "value": 40,
    "time": 1506931959701
  }
}
```

```
{
  "d": {
    "myName": "sensortag",
    "ambientTemp": "30.25",
    "objectTemp": "21.88",
    "humidity": "53.24178",
    "pressure": "1031.17",
    "altitude": "1.43789",
    "accelX": "-0.03",
    "accelY": "0.02",
    "accelZ": "-1.06",
    "gyroX": "-0.85",
    "gyroY": "0.28",
    "gyroZ": "1.30",
    "magX": "46.47",
    "magY": "84.69",
    "magZ": "-45.42",
    "light": "9.49"
  }
}
```





Chris  
IoT Application  
Developer

**Too much specific code required** to manage device event and command variability and custom code to manage things on top of varying devices

I need to **improve my productivity** and speed of delivery in my customer IoT deployment projects

I need a **simple programming model** and an abstract interface model for devices and things to insulate from variability

I need the **platform to take the load off me** and my code and manage relationships, behavior, state, history, simple transformations, complex enrichment, and access control into a consistent Things design

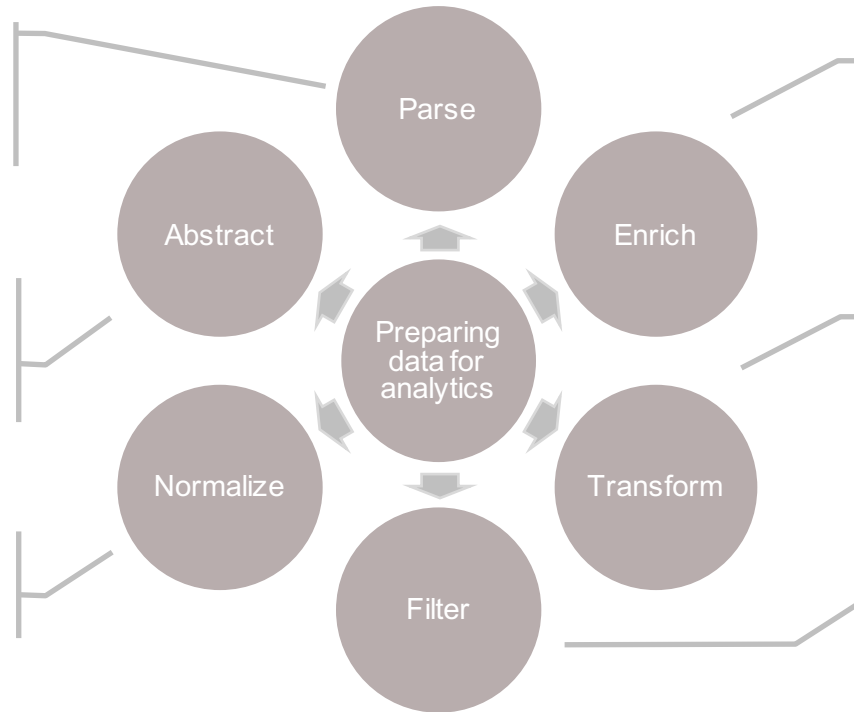


# Data Management - Ingest and Transformation

My devices send data in a binary format in order to reduce transmission costs but I need the data in JSON format for my app.

My devices operate in an event-driven manner but I need my application to be able to retrieve the current state in a REST-like manner.

I have multiple versions of devices but I need my application to interact with them all in the same way.



I need my application to combine data from my IoT devices with data from some other external data source (e.g. Weather).

My devices give me temperature in Fahrenheit but I need my application to read it in Celsius.

I just need the average temperature per hour from each device.



Chris, the application developer, who  
can reference and work with  
manageable assets what  
without being exposed to the  
individual instrumentation of them wow

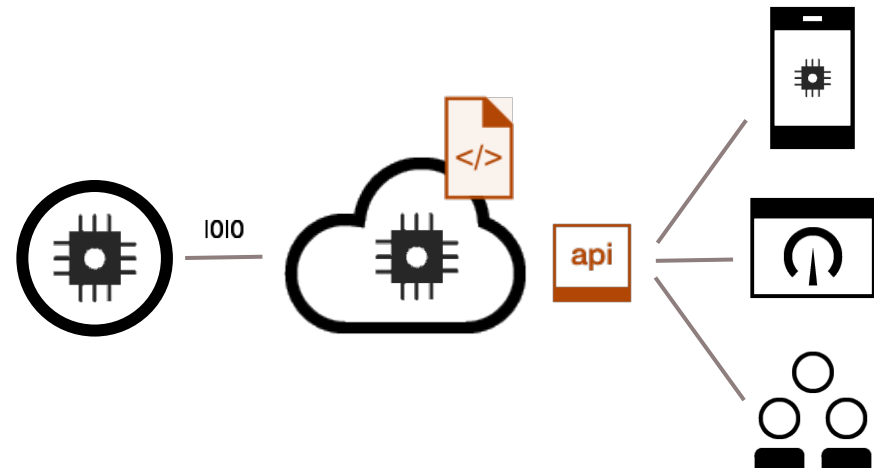
# IBM Watson IoT Platform Data Management

**IoT Platform Data Management ingests, transforms and aggregates data from your IoT devices, diverse data sources, and platforms into asset-based data structures.**

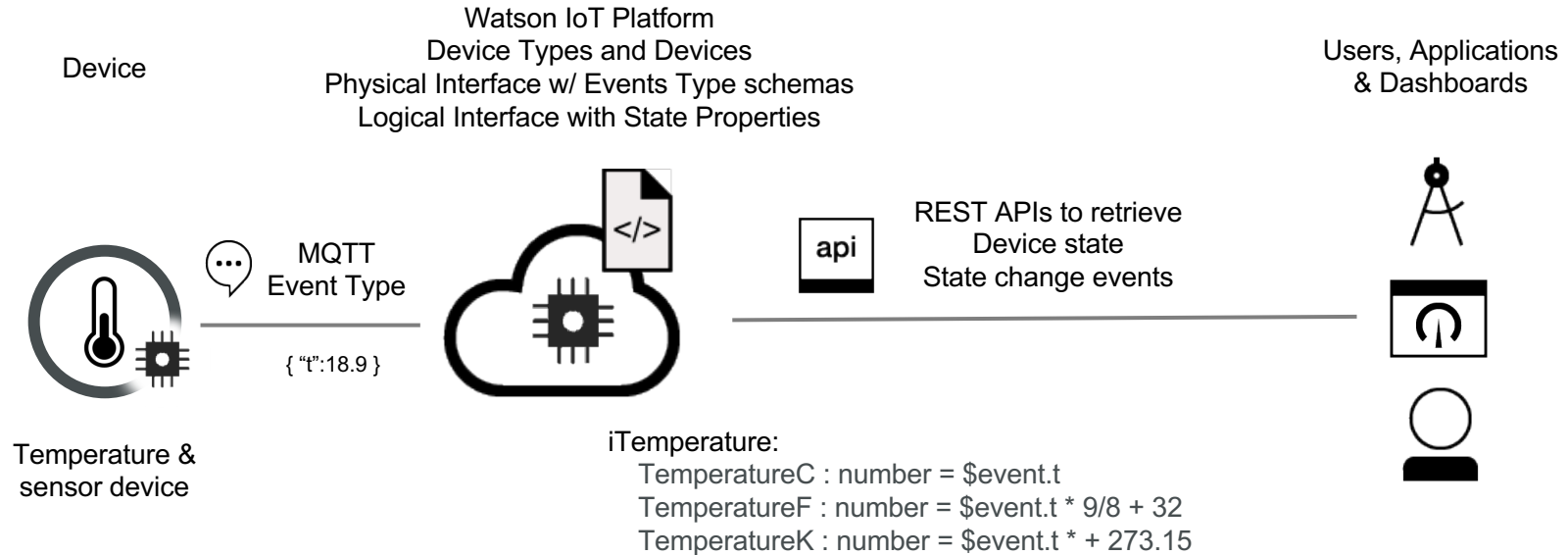
Data Management manages reusable schema abstractions of event types and device types

Data Management provides an event-based processing pipeline to transform, enrich and aggregate the state of devices

Data Management provides APIs and User Interfaces to manage the information model and interact with the state model of device and state change events



# Device Abstractions



Model custom device data events and provide a filtered information model of devices and their state to users and applications

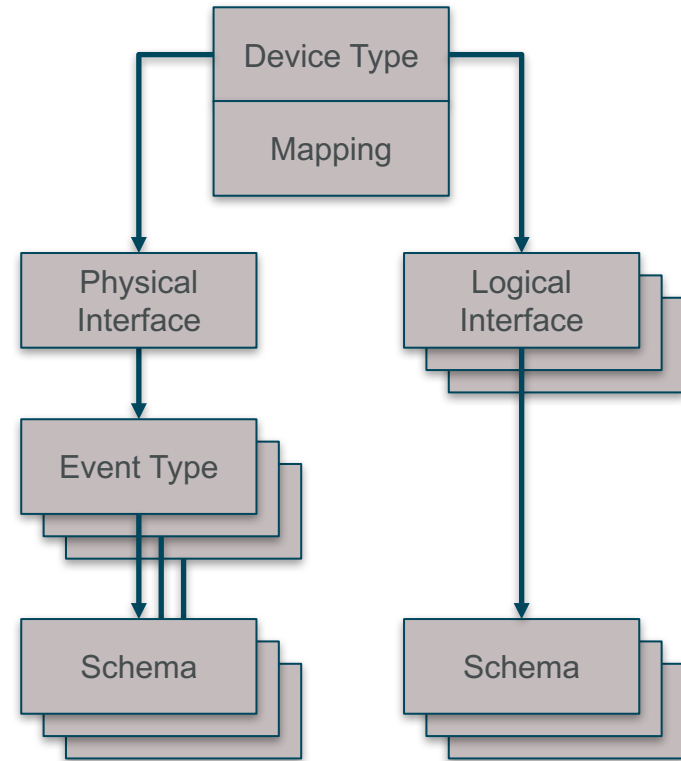


# Resources Model and REST APIs

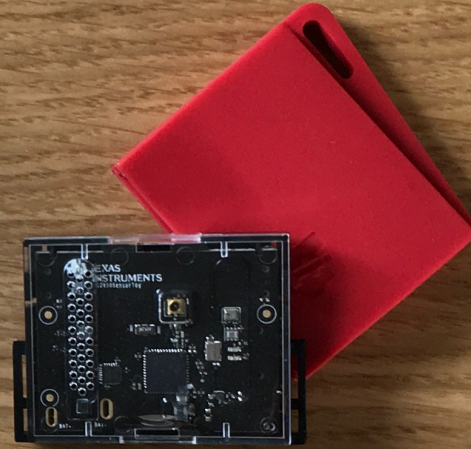
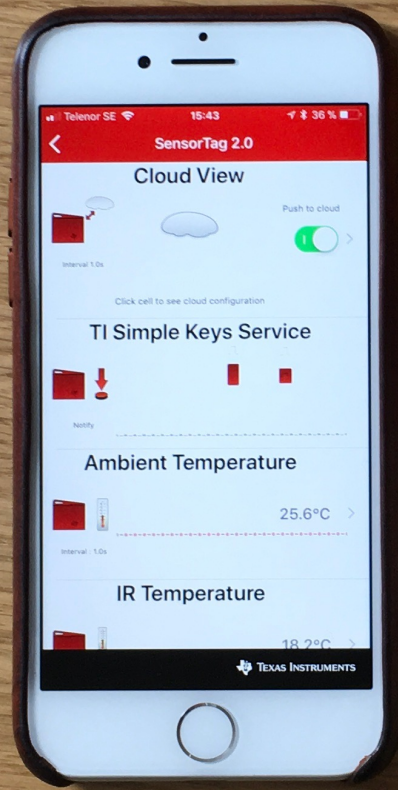
The IoT Platform REST APIs supports

- Data Management resource model in JSON
- Creating and uploading schema resources
- Validating resources and activating the processing pipeline
- Provisioning devices and things
- Discovering the resource and information model
- Retrieving device state and change events
- Calculations on real-time event data
- Error events from processing pipeline

For API details, see  
[https://console.ng.bluemix.net/docs/services/iot/information\\_management/im\\_index.html](https://console.ng.bluemix.net/docs/services/iot/information_management/im_index.html)







# DEMO

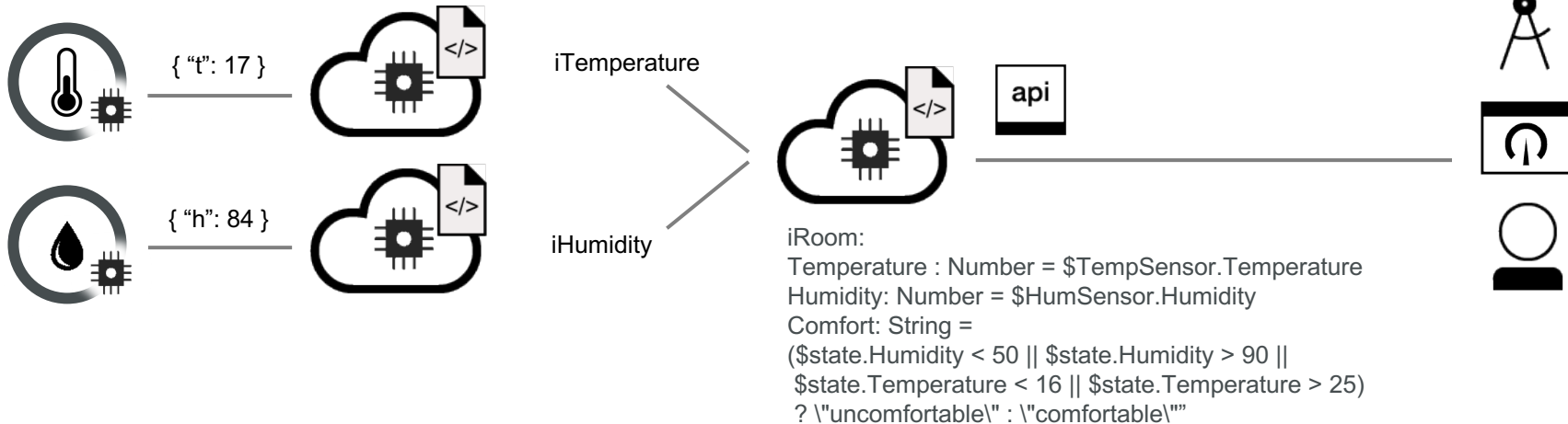
# Aggregation of Data

Temperature &  
Humidity  
Sensor devices

Watson IoT Platform  
Devices and Device Types  
w/ Application Interfaces

Thing Type  
w/ Logical Interface(s)

Users, Applications  
& Dashboards



Aggregate multiple Devices into logical / physical Things

Normalize Things using abstract logical interfaces

Manage assets without being exposed to the individual instrumentation of them



## Summary and Conclusion

### **Data Management in Watson IoT Platform provides a programming model for Devices, Things, and Digital Twins.**

- Define your own device interfaces to insulate applications from variability across device types, sensor models, variants and versions
- Decouples your IoT application from the specifics of how your devices are connected
- Aggregate multiple devices into logical objects so they can be managed as a single Thing



## For more information

- **Learn more about the Watson IoT Platform and Digital Twins**
  - [ibm.com/iot](https://ibm.com/iot)
  - [developer.ibm.com/iotplatform/blog](https://developer.ibm.com/iotplatform/blog)
  - [www.youtube.com/watch?v=gUCCnVXgYvw](https://www.youtube.com/watch?v=gUCCnVXgYvw)
  - [www.ibm.com/blogs/internet-of-things/digital-twin/](https://www.ibm.com/blogs/internet-of-things/digital-twin/)





# Demo Playbacks



# Facility Manager





# Watson IoT Experience Center

Total Occupancy: 1750  
Current: 980 | Avg: 983  
updated 3m ago

Lift Status

★L 22 ★L 25

Rain  
22°  
Munich, Germany



## Alerts

### Check Employee Sentiment

Floor 24



### Broken Projector

Floor 24 / Zone 9



### Broken Phone

Floor 22 / Zone 11

### Broken Fridge

Floor 21

### Check Air Filter

Floor 14

### Overcrowding

Floor 20

### Overcrowding

Floor 25

## 2 June 2017

### 10:00 - 12:00

Kone - 76 visitors - Floor 23 - Large Conf. Room

### 13:00 - 14:30

Siemens Meeting - 54 visitors - Floor 24 - Zone 9

### 14:00 - 16:30

IBM - 11 visitors - Floor 26 - Dining Area

## Projects

### Reconfiguring Floor 23

Floor 21, Floor 22, Floor 23

### Converting Floor 25 to Agile Space

Floor 21, Floor 24, Floor 25, Floor 26

### Updating Bathrooms

Floor 21, Floor 22, Floor 26

Sort By: 123

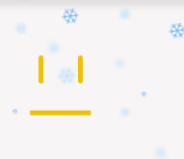
19 111/ 150  
74%



21 132/ 150  
88%



22 105/ 150  
70%



23 155/ 200  
77%



24 220/ 200  
110%

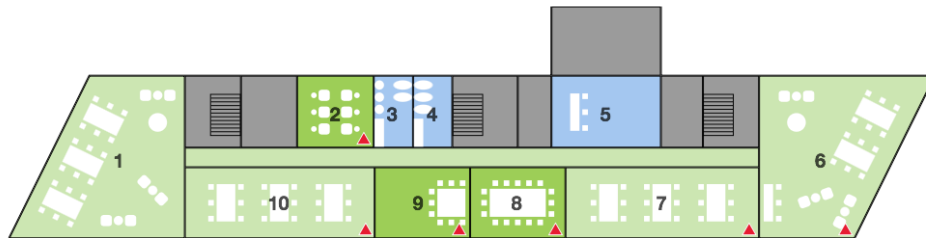


25 115/ 200  
57%





Your Input:


☒ Show Furniture


## Occupancy

Tenant Sentiment	65% Reporting	😊 55% <sup>+</sup>	😞 10% <sup>+</sup>
Occupants	220/200 tenants 5 Visitors		
Meeting Rooms	<div><div></div><div></div><div></div></div> 3 of 3 occupied since 9:00		
Team spaces	<div><div></div><div></div><div></div><div></div></div> 4 of 4 occupied since 9:45		
Collaboration Spaces	<div><div></div><div></div></div> 2 of 2 occupied 10:00		
Restrooms	Status: <span>OK</span> now		
Kitchen	Status: <span>OK</span> now		

## Work Request

Tenant Sentiment	80% Reporting	😊 70% <sup>+</sup>	😞 10% <sup>+</sup>
Zone 5	HVAC High use area 2 hours ago		
Zone 9	Broken projector High use area 8 hours ago		
Zone 9	Printer ink 1 day ago		
Zone 10	Leak 30 minutes ago		

## Temperature

Tenant Sentiment	67% Reporting	😊 45% <sup>+</sup>	😞 22% <sup>+</sup>
Zone 9	23° High use area For 30min		
Zone 7	25° For 1hr		
Zone 1	24° High use area For 1hr 5min		

## Lighting

Tenant Sentiment	77% Reporting	😊 75% <sup>+</sup>	😞 7% <sup>+</sup>
<div> <div>7:16</div> <div> </div> <div>19:34</div> <div> </div> </div> natural light 50%			
Light Composition	Current 500 lux	Target 500 lux	
Blinds	65% Reporting	55% 10%	
Overhead Lights	65% Reporting	55% 10%	



## Conference Room



Phone



Projector



Whiteboard



### Occupancy

Tenant Sentiment

55%<sup>+</sup>10%<sup>+</sup>

90% Reporting

# Occupants (10 Max)

3 12 7 5



8:00 9 10 11 12 13 14 15 16 17 18

Hours

Occupied

7/10 hours

Based on bookings

Over capacity

1 hour

12 occupants at 9:00

Under capacity

1 hour

3 occupants at 8:00

### Work Request

Tenant Sentiment

70%<sup>+</sup>10%<sup>+</sup>

80% Reporting

Current

HVAC

High use area

2 hours ago

Current

Broken projector

High use area

8 hours ago

### Temperature

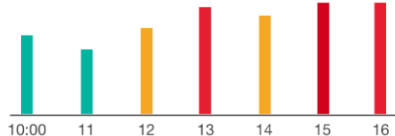
Tenant Sentiment

45%<sup>+</sup>22%<sup>+</sup>

87% Reporting

#### Hourly

Temperature

☐ Degrees

Current

Current  
24°Target  
22°

High use area

### Lighting

Tenant Sentiment

75%<sup>+</sup>7%<sup>+</sup>

77% Reporting

Light Composition

Current  
500 luxTarget  
500 lux

Blinds

50% Open

Since 8:00

Overhead Lights

75% On

Since 8:00



# Watson IoT Platform Data Management





+ Add Device

# Browse Devices

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

	Device ID ↕	Device Type ↕	Class ID ↕	Date Added
●	TiSensorTag_1	TiSensorTag	Device	Oct 3, 2017 9:4

Simulations

Import/Export ▼

1/50 Simulations Running

+ New Type

Device Type

▼ TiSensorTag

1 Event Type

1 Device

✓

S TiSensorTag\_1

✓

⋮

1 x

New Device

Use Registered Device

142 events sent

33.37 KB sent >

Browse

## Diagnose

### Action

## Device Types

## Manage Schemas

## Browse Devices

This table shows a summary of all devices that have been added to the system. You can add devices by using the Add Device button, or by using AP

Device ID 

TiSensorTag\_1

## Identity

### Device Information

## Recent Ev

 **Showing Raw Data** | This is the live stream of data

Event	Value
status	{"d":{"myName":"TiSenso
status	{"d":{"myName":"TiSenso

## Event Payload

Event Name	status
------------	--------

Time Received 2017-10-03T08:39:13.959Z

```
1 {
2   "d": {
3     "myName": "TiSensorTag",
4     "ambientTemp": 24.34,
5     "objectTemp": 19.19,
6     "humidity": 60.14496,
7     "accelX": -0.03,
8     "accelY": 0.05,
9     "accelZ": -1.05,
10    "gyroX": -0.9,
11    "gyroY": 0.3,
12    "gyroZ": 1.13,
13    "magX": 44.07,
14    "magY": 234.75,
15    "magZ": -106.28,
16    "light": 23.41
17  }
18 }
```

Import/Export

Running

+ New Type

1 Event Type

sorTag\_1

### New Device

### Use Registered Device

145 events sent

34.08 KB sent &gt;

[Browse](#) [Diagnose](#) [Action](#) [Device Types](#) [Manage Schemas](#)[+ Add Device Type](#)

## Device Types

This table shows a summary of all device types. It can be filtered, and searched on name and description. You can get started by adding device types using the Add Device Type button at the top of the page, or by using API.

<input type="checkbox"/>	Name ↕	Description ↕
<input type="checkbox"/>	TiSensorTag	

Device Type: TiSensorTag

Events 1

+ Event Type

Event Type Name status Send

Schedule

```
{
  "d": {
    "myName": "TiSensorTag",
    "ambientTemp": 24.34,
    "objectTemp": 19.19,
    "humidity": 60.14496,
    "accelX": -0.03,
  }
}
```

What functions can I do?

Cancel Save



+ Add Device Type

# Device Types

This table shows a summary of all device types. It can be filtered, and searched on name and description. You can get started by adding device types using the Add Device Type button at the top of the page, or by using API.

	Name	Description	No. Devices			
	TISensorTag		1			
	Identity	Device Information	Interface			
	Device Type	TISensorTag				
	Date Created	2017-10-03T07:43:47+00:00				
	Description					
	Number of Devices	1 Connected Device				

# Device Types

This table shows a summary of all device types. It can be filtered, and searched on name and description. You can get started by adding device types using the Add Device Type button at the top of the page, or by using API.

	Name	Description	No. Devices			
	TISensorTag		1			

IdentityDevice InformationInterface

Physical Interface ⓘ

TiSensorTag\_PI

Logical Interface 1 ⓘ

iTemperature

See Diagram



TiSensorTag1

IdentityDevice InformationInterface

Edit Physical Interface: TiSensorTag\_PI

Identity

Event Types and Payload

You can use properties to define the interface behavior and the format of the data that is presented on devices.

Define the Physical Interface

Event type

statusapplication/json

Property	Data Type	Required
d	Object	No
myName	String	No
ambientTemp	Number	No
objectTemp	Number	No
humidity	Number	No
accelX	Number	No
accelY	Number	No
accelZ	Number	No

1 Simulations running

# Device Types

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	Name	Description	No. Devices			
	TISensorTag		1			

IdentityDevice InformationInterface

Physical Interface ⓘ

TISensorTag\_PI

Logical Interface 1 ⓘ

iTemperature

See Diagram

1 Simulations running





# Device Types

This table shows a summary of all device types. It can be filtered, and searched on name and description. You can get started by adding device types using the Add Device Type button at the top of the page, or by using API.

NameDescriptionNo. Devices

TISensorTag1

IdentityDevice InformationInterface

Edit Logical Interface: iTemperature

IdentityState ModelNotification Preference

Define the Interface

Property	Mapped Payload(s)	Data Type
TemperatureC	ambientTemp [status]	Number
TemperatureF	ambientTemp x 9 ÷ 5 + 32	Number
TemperatureK	ambientTemp + 273.15	Number

1 Simulations running



NameDescriptionNo. Devices

TISensorTag1

IdentityDevice InformationInterface

Edit Logical Interface: iTemperature

IdentityState ModelNotification Preference

No Event Notifiers

Notifications are not sent. In order to retrieve the state of a device you must use the REST API.

On State Change

Notifications are only sent if the state actually changes as a result of processing an inbound event.

On Every Event

Notifications are sent every time the platform processes an event for that device, even if it does not result in a change to the state.

<Done



Browse Diagnose Action Device Types Manage Schemas

+ Add Device

# Browse Devices

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

	Device ID ↕	Device Type ↕	Class ID ↕	Date Added	Descriptive Location ↕			
●	■	TiSensorTag_1	TiSensorTag	Device	Oct 3, 2017 9:44 AM			
Identity						Device Information Recent Events State Logs		
Device ID		TiSensorTag_1						
Device Type		TiSensorTag						
Date Added		2017-10-03T07:44:21.183Z						
Added By		mats.gothe@se.ibm.com						
		Connected						
Connection Status		Connection Time: 03 Oct, 2017 10:04:26 AM Client Address: 77.218.245.162 (SecureToken)						

# Browse Devices

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

Device IDDevice TypeClass IDDate Added

TiSensorTag\_1TiSensorTagDeviceOct 3, 2017 9:4

IdentityDevice InformationRecent EventsStateLogs

Showing Raw Data | This is the live stream of data that is coming and going from this device.

Event	Value	Format	Last Received
status	{ "d": { "myName": "TiSensorTag", "ambientT...	json	a few seconds ago
status	{ "d": { "myName": "TiSensorTag", "ambientT...	json	a few seconds ago
status	{ "d": { "myName": "TiSensorTag", "ambientT...	json	a few seconds ago
status	{ "d": { "myName": "TiSensorTag", "ambientT...	json	a few seconds ago
status	{ "d": { "myName": "TiSensorTag", "ambientT...	json	a few seconds ago

Device Type: TiSensorTag

Events1+ Event Type

Event Type NamestatusSend

Schedule{ "d": { "myName": "TiSensorTag", "ambientTemp": 24.34, "objectTemp": 19.19, "humidity": 60.14496, "accelX": -0.03

What functions can I do?

CancelSave

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

Device Type: TiSensorTag

▼

Events 1

+ Event Type

▼

Event Type Name

status

Send

🗑

Schedule 🕒

```
{
  "d": {
    "myName": "TiSensorTag",
    "ambientTemp": 24.34,
    "objectTemp": 19.19,
    "humidity": 60.14496,
    "accelX": -0.03,
  }
}
```

What functions can I do?

Cancel

Save

```
1 {
2   "timestamp": "2017-10-03T08:26:20Z",
3   "updated": "2017-10-03T07:58:10Z",
4   "state": {
5     "TemperatureC": 24.34,
6     "TemperatureF": 75.812,
7     "TemperatureK": 297.48999999999995
8   }
9 }
```