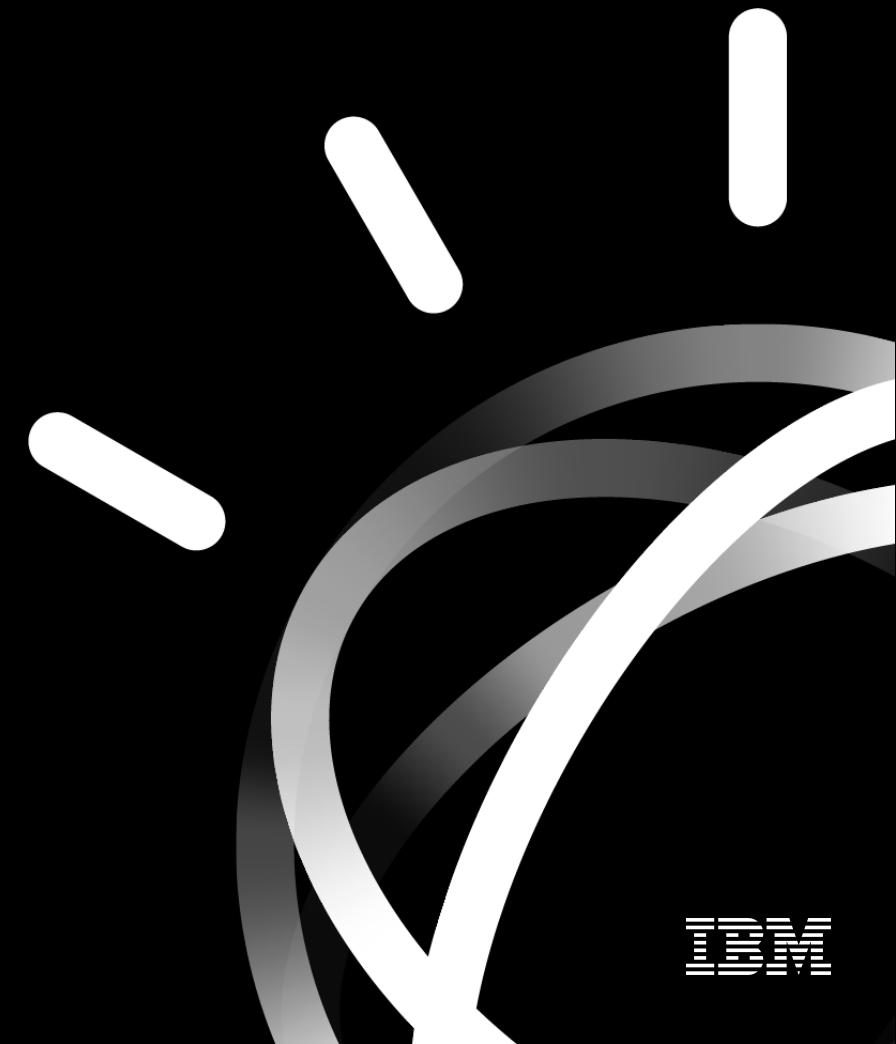


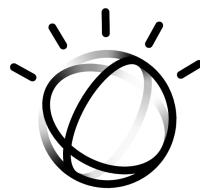
ST Microelectronics Technology Tour 2019

From Sensors to Insights with Watson IoT

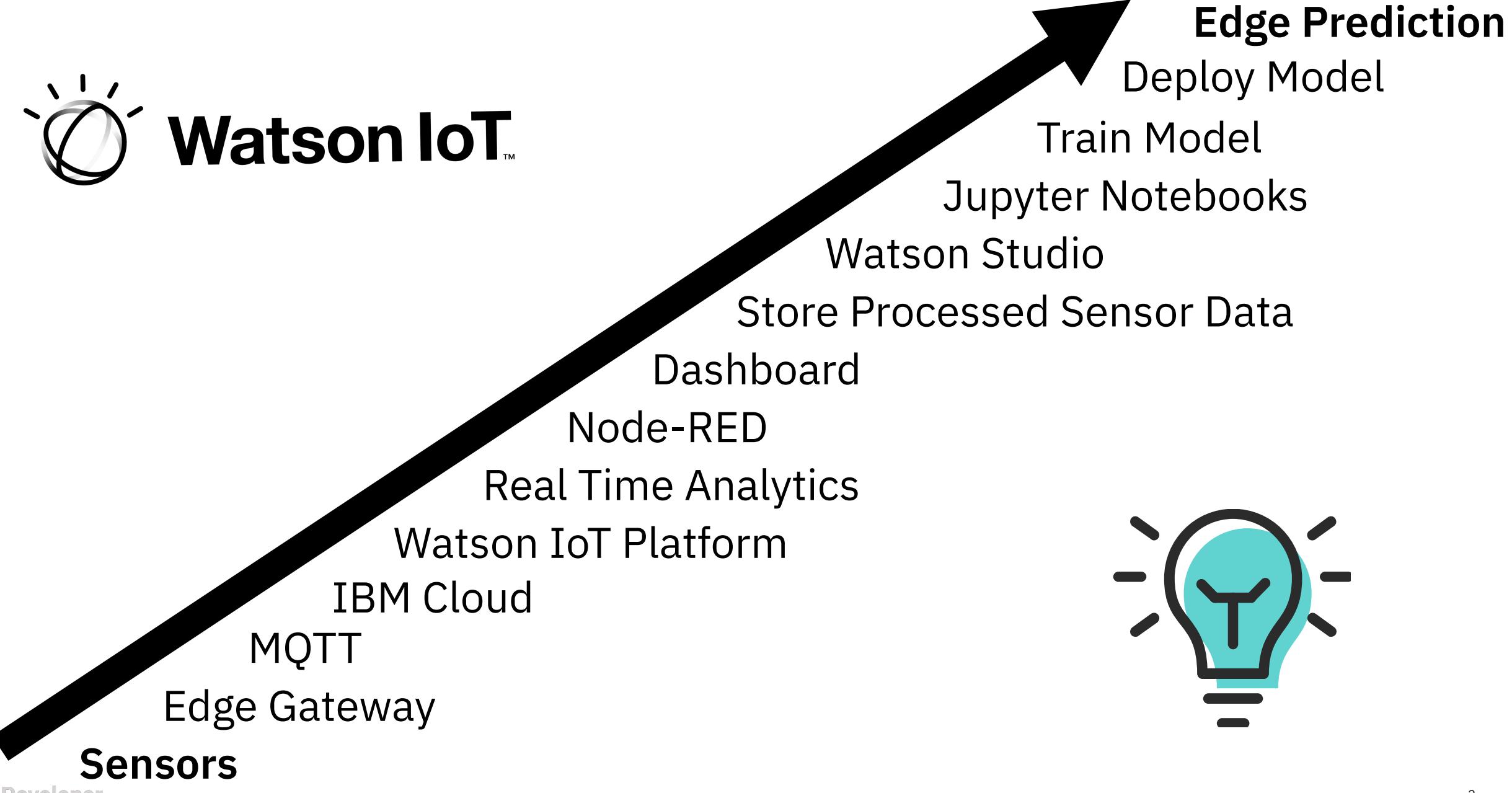
Applying AI to IoT Data

John Walicki
IBM IoT Developer Advocate
@johnwalicki





Watson IoT™



No Slides!

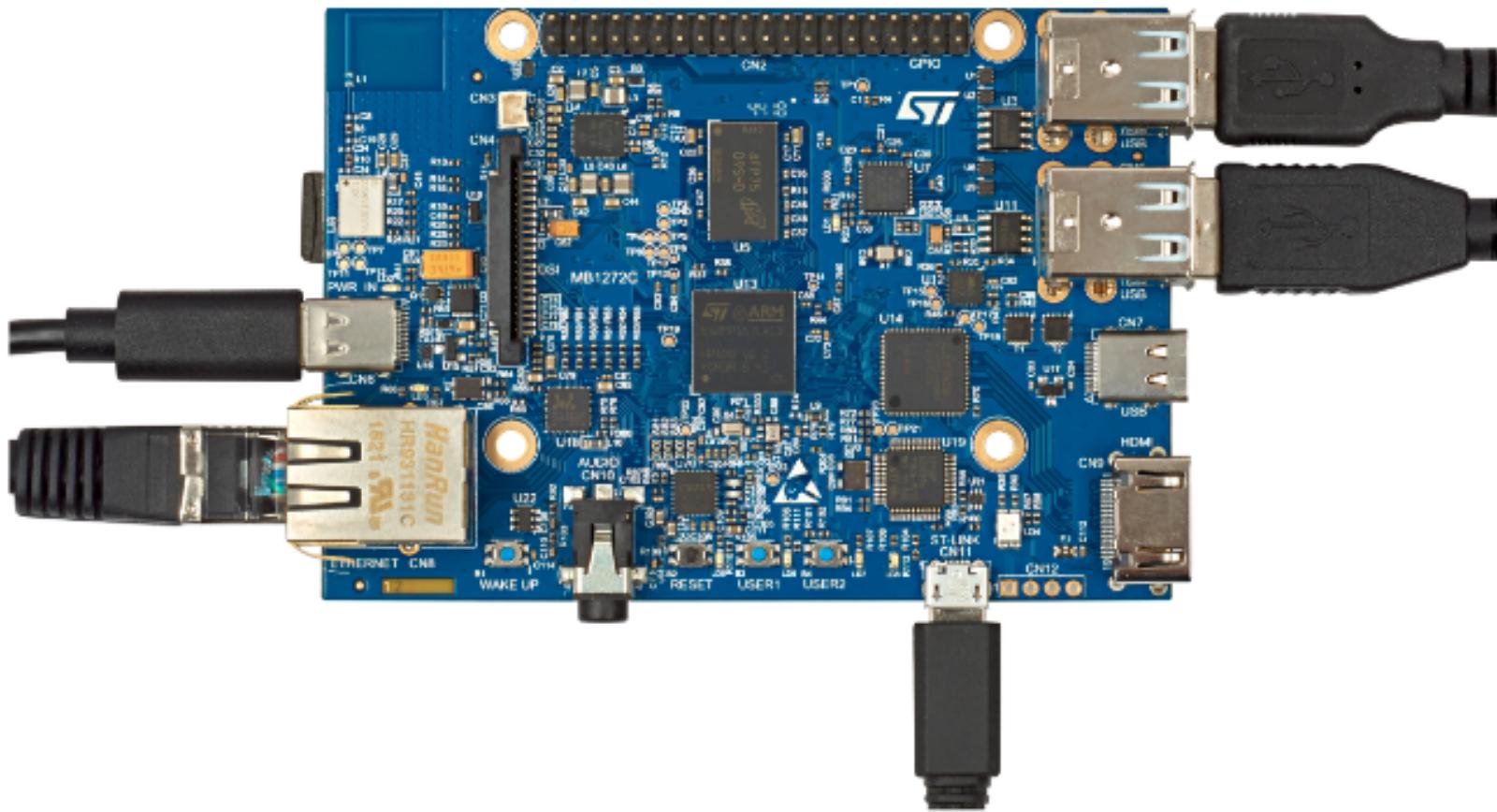
All live code!

Get the Code:

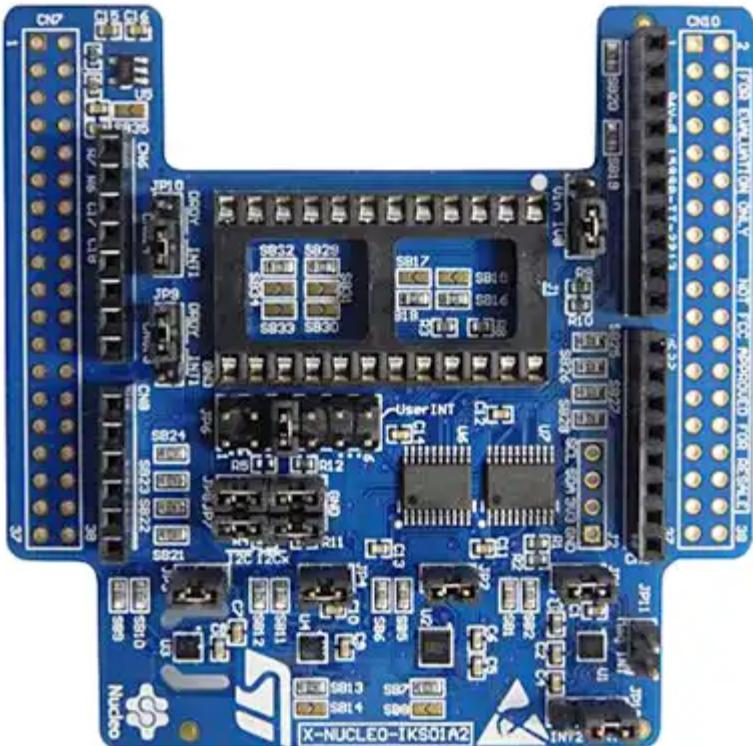
<https://github.com/johnwalicki/STM32MP1-Edge-WatsonIoT-Workshop>

But first... A demo!

DISCOVERY STM32MP157C

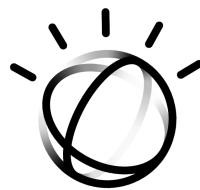


X-NUCLEO-IKS01A2 - motion MEMS / environmental sensor expansion board

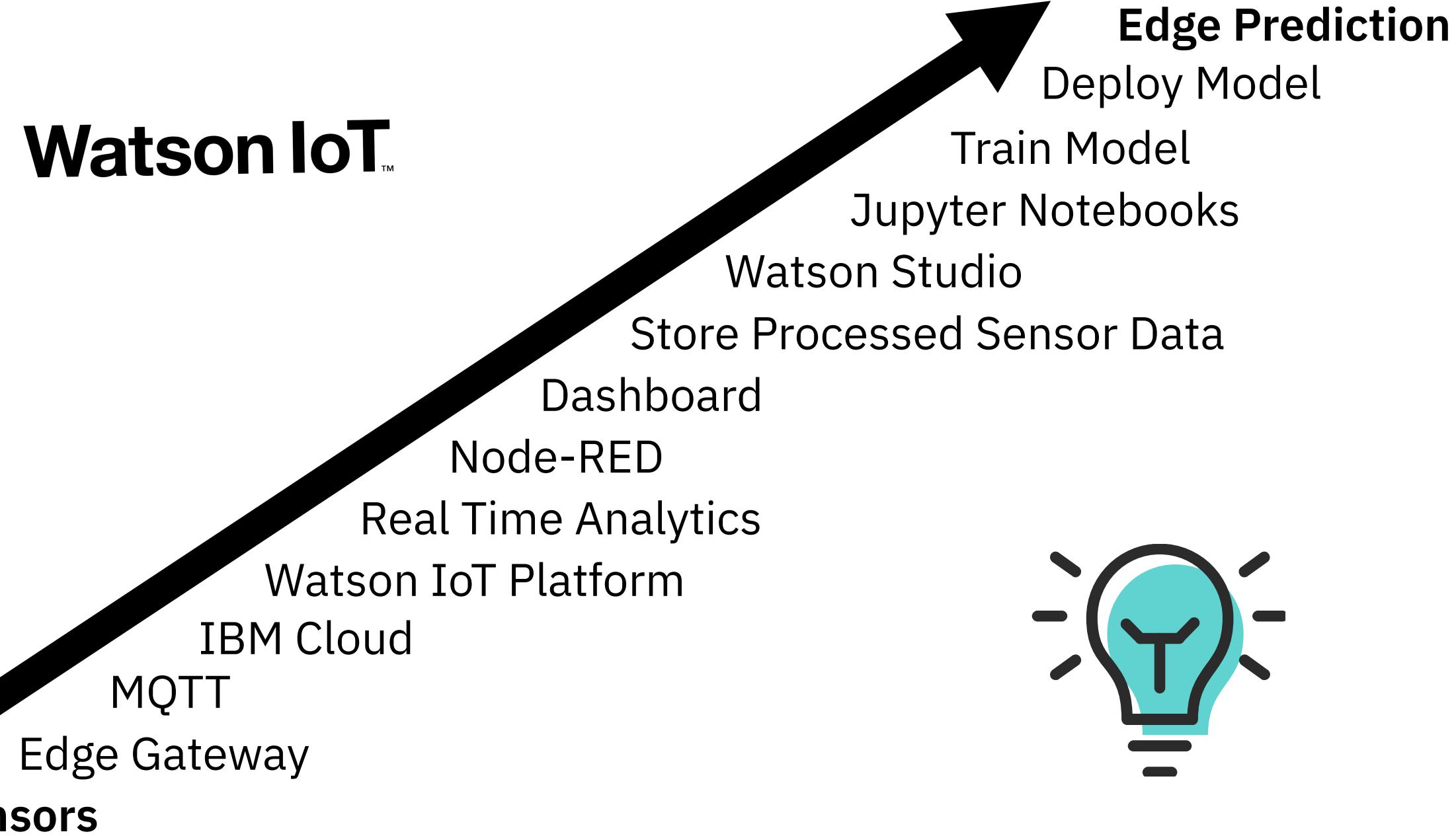


Key Features

- LSM6DSL MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g) and 3D gyroscope ($\pm 125/\pm 245/\pm 500/\pm 1000/\pm 2000$ dps)
- LSM303AGR MEMS 3D accelerometer ($\pm 2/\pm 4/\pm 8/\pm 16$ g) and MEMS3D magnetometer (± 50 gauss)
- LPS22HB MEMS pressure sensor, 260-1260 hPa absolute digital output barometer
- HTS221: capacitive digital relative humidity and temperature



Watson IoT™



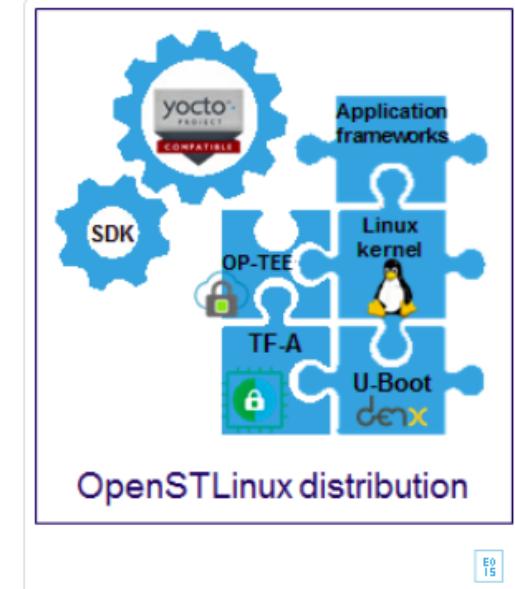
1 What is the OpenSTLinux distribution?

The OpenSTLinux distribution, running on the Arm® Cortex®-A processor(s), is a sub-part of the [STM32MPU Embedded Software distribution](#).

OpenSTLinux is a Linux® distribution based on the [OpenEmbedded](#) build framework.

It includes the following collection of software components:

- [OpenSTLinux BSP](#) (OP-TEE secure OS, boot chain and Linux kernel)
- Application frameworks such as the following Linux application frameworks (non-exhaustive list):
 - [Wayland-Weston](#) as a display/graphic framework
 - [Gstreamer](#) as a multimedia framework
 - [Advanced Linux Sound Architecture \(ALSA\)](#) libraries



As explained in the [OpenEmbedded](#) article, the files used to build an image are stored in layers that come from different sources, and that are configured for this image.

Only layers specific to the OpenSTLinux distribution (for example the OpenSTLinux Board Support



File Edit View Search Terminal Help

```
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ uname -a  
Linux stm32mp1 4.19.9 #1 SMP PREEMPT Fri Aug 30 22:41:43 EDT 2019 armv7l armv7l armv7l GNU/Linux  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ ./sensors_iks01a2.py  
{"temperature":23.15,"humidity":48.25,"acc_x":-4,"acc_y":-1,"acc_z":-257,"gyr_x":5,"gyr_y":-3,"gyr_z":-3}  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ ./sensors_iks01a2.py  
{"temperature":23.20,"humidity":48.24,"acc_x":-5,"acc_y":-1,"acc_z":-257,"gyr_x":5,"gyr_y":1,"gyr_z":-2}  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ ./sensors_iks01a2.py  
{"temperature":23.18,"humidity":48.41,"acc_x":-5,"acc_y":-1,"acc_z":-257,"gyr_x":5,"gyr_y":-4,"gyr_z":-4}  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ node -v  
v8.12.0  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $  
root@192.168.7.2 ~ $ node-red  
21 Oct 11:36:56 - [info]
```

Welcome to Node-RED

=====

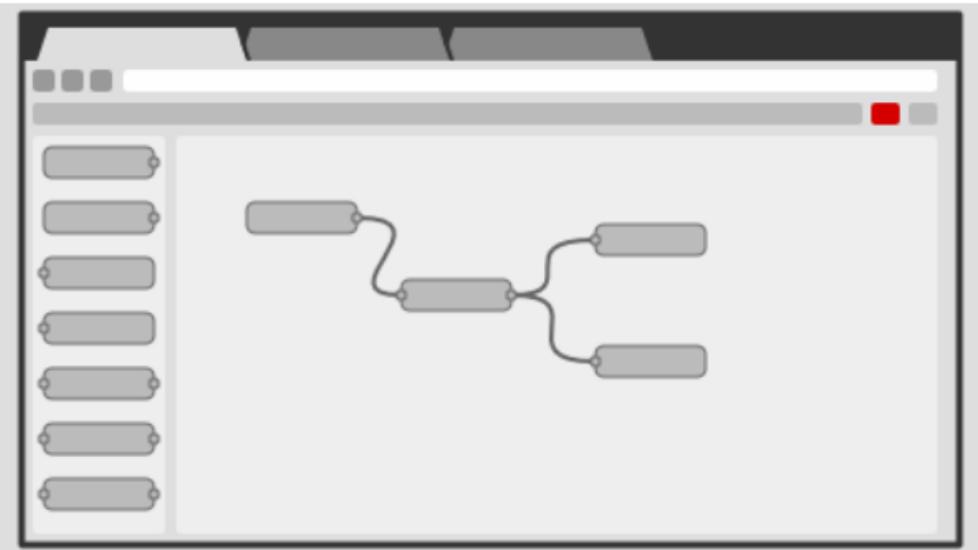
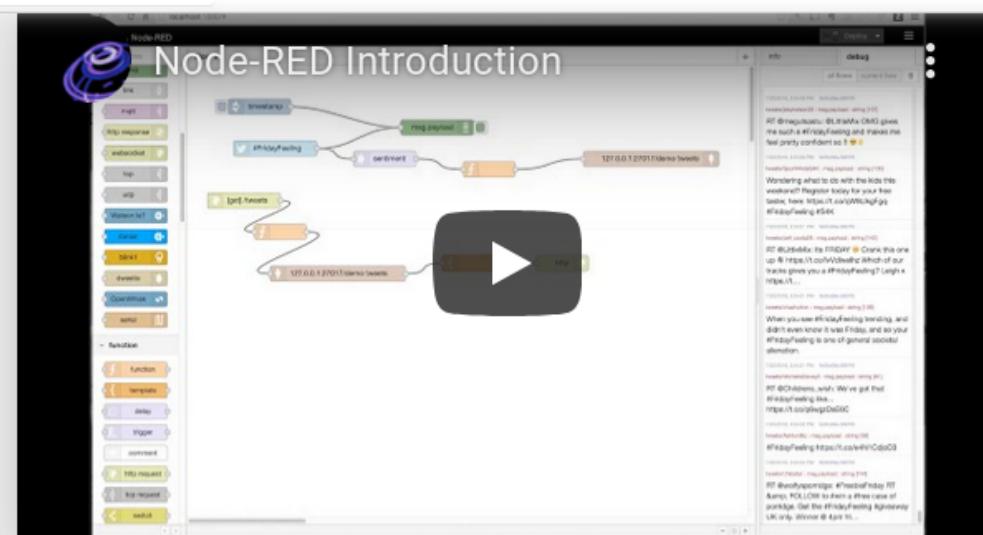
Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.

It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click.

[Features](#)

[Get Started](#)

[Community](#)



Browser-based flow editing

Node-RED provides a browser-based flow editor that makes it easy to wire together flows using the wide range of nodes in the palette. Flows can be then deployed to the runtime in a single-click.

JavaScript functions can be created within the editor using a rich text editor.

A built-in library allows you to save useful functions, templates or flows for re-use.

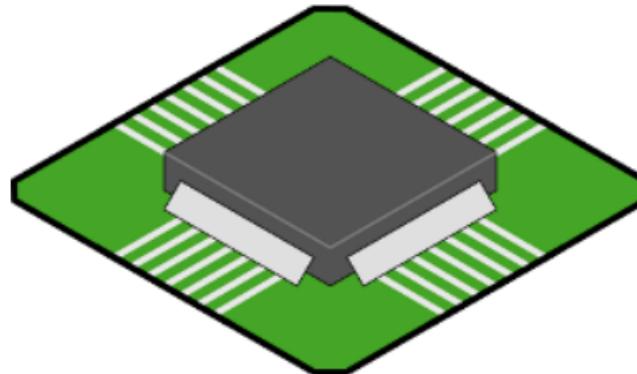
Get Started

Node-RED is built on Node.js, taking full advantage of its event-driven, non-blocking model. This makes it ideal to run at the edge of the network on low-cost hardware such as the Raspberry Pi as well as in the cloud.



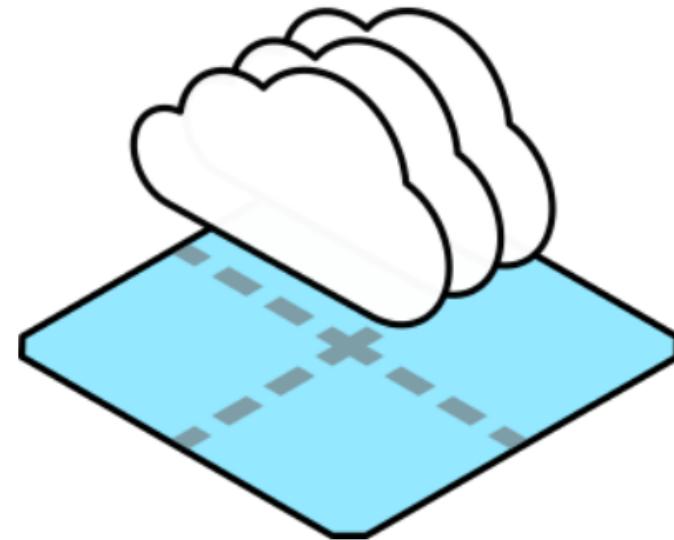
Run locally

- Getting started
- Docker



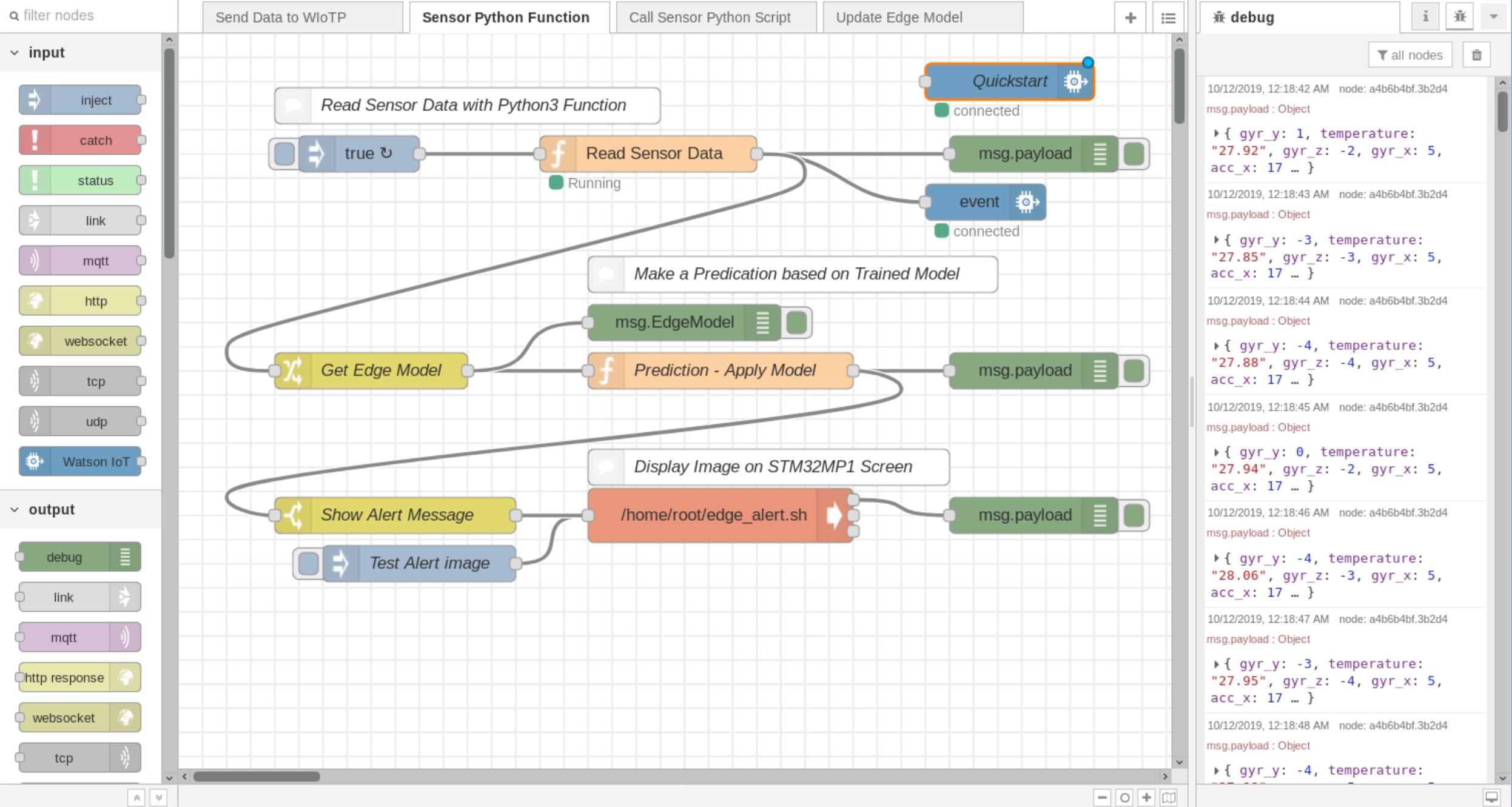
On a device

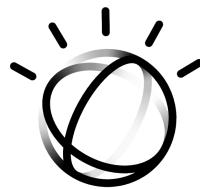
- Raspberry Pi
- BeagleBone Black
- Interacting with Arduino
- Android



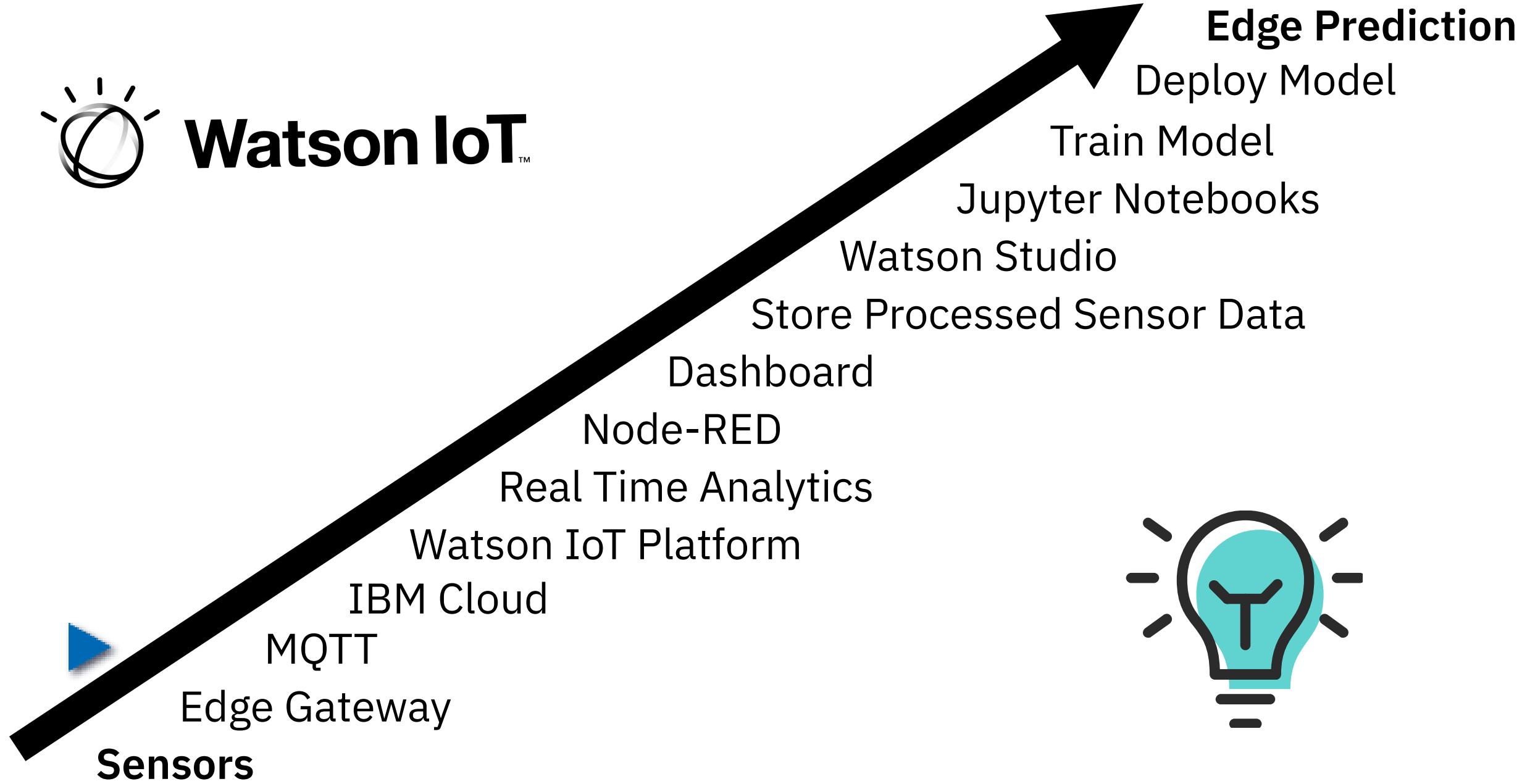
In the cloud

- IBM Cloud
- SenseTecnic FRED
- Amazon Web Services
- Microsoft Azure





Watson IoT™



THE BLOG

BLOG

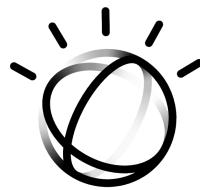
MQTT is the leading protocol for connecting IoT devices

[IoT](#) [Messaging](#)

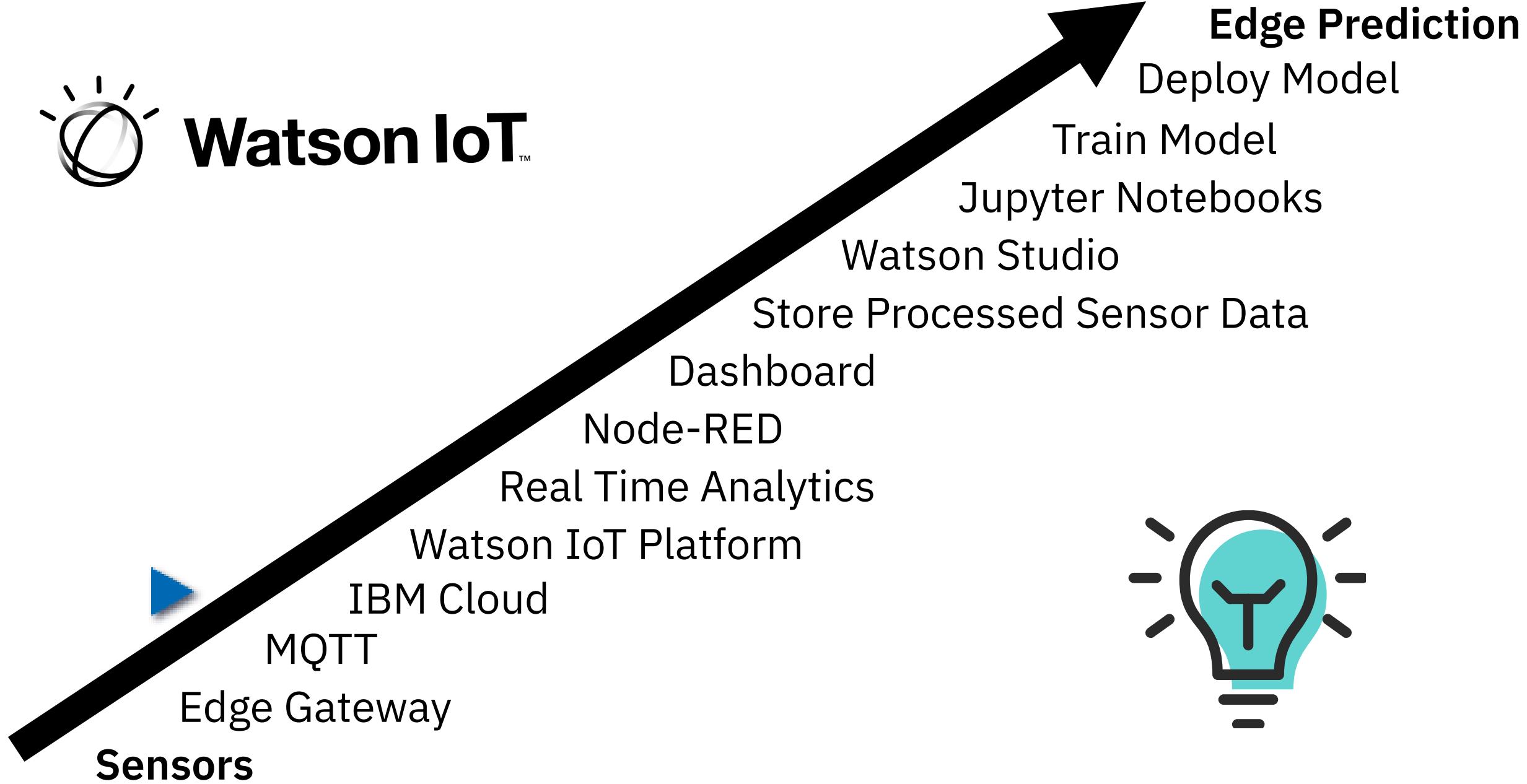
by Andy Stanford-Clark Published January 3, 2019

 [f](#) [t](#) [in](#)

Before the Internet of Things was a thing, or really back around the time that the term *Internet of Things* was first mentioned in print (late 90s), I was collaborating with Arlen Nipper (now of CirrusLink) on devising a protocol to communicate with [SCADA systems](#) in the oil and gas industry. What started out as a highly niche protocol for a specific industry quickly



Watson IoT™



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ID

IBMid ▾

walicki@us.ibm.com

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[Continue](#)

Catalog

 node-red[All Categories \(3\)](#) [VPC Infrastructure](#)[Compute](#)[Containers](#)[Networking](#)[Storage](#)[AI](#)[Analytics](#)[Databases](#)[Developer Tools](#)[Integration](#)[Internet of Things](#)[Security and Identity](#)[Starter Kits \(3\)](#)

Starter Kits



Internet of Things Platform Starter

IBM

Get started with IBM Watson IoT platform using the [Node-RED Node.js sample application](#). With the Starter, you can quickly simulate an Internet of Things device, create cards, generate data, and begin analyzing and displaying data in the Watson Io...

[Starter kits](#)

Node-Red-Starter

IBM

A starter to run the [Node-RED open-source project](#) on IBM Cloud.

FEEDBACK





Create a Cloud Foundry App

Lite

IBM

Boilerplate

Need Help?

[Contact Support](#)[View docs](#)

Version: 0.7.1 • Location: Frankfurt, London, Washington DC, Dallas

[Create](#)[About](#)

Select a region

Dallas

Select a pricing plan

SDK for Node.js™



Cloudant



Internet of Things
Platform

[Create](#)

Summary

Cloud Foundry App

Region: Dallas

SDK for Node.js™ - Default Plan

Cloudant - Lite Plan

Internet of Things Platform - Lite Plan

App name: fromsensors2insights

Host name: fromsensors2insights

Domain: mybluemix.net

Org: walicki@us.ibm.com

Space: AssetTracking

FEEDBACK

Dashboard

Customize

Upgrade account

Create resource

Resource summary

[View resources](#)

Cloud Foundry Apps

21 4

Cloud Foundry Services

61

Services

29

Storage

1

Apps

1

Developer Tools

12

[Add more resources](#)

FEEDBACK

Planned maintenance

[View events](#)

Location status

[View status](#)

Next event: Sat, Oct 12, 2019 11:00 AM

Asia Pacific

[Collapse all](#) | [Expand all](#)

Name	Group	Location	Status	
<input type="text" value="stmicro"/>	<input type="text" value="Filter by group or org..."/>	<input type="text" value="Filter..."/>	<input type="text" value="Filter..."/>	
Devices (0 / 0)				
VPC Infrastructure (0 / 0)				
Clusters (0 / 0)				
Cloud Foundry Apps (1 / 25)				
stmicro-discovery-kit-iot-node	walicki@us.ibm.com / dev	Dallas	Running	
Cloud Foundry Services (2 / 58)				
stmicro-discovery-kit-iot-node-cloudan...	walicki@us.ibm.com / dev	Dallas	Provisioned	
stmicro-discovery-kit-iot-node-iot...	walicki@us.ibm.com / dev	Dallas	Provisioned	
Services (0 / 29)				
Storage (0 / 1)				

FEEDBACK

Getting started

Overview

Runtime

Connections

Logs

API Management

Autoscaling

Monitoring

Resource list /



stmicro-discovery-kit-iot-node

 Running [Visit App URL](#)

Routes



Org: walicki@us.ibm.com

Location: Dallas

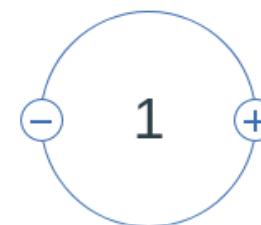
Space: dev

[Add Tags](#)

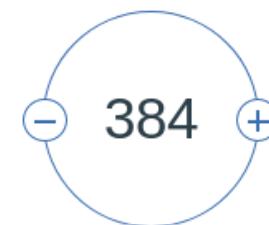
Runtime

**BUILDPACK**

Internet of Things Platform Starter

**INSTANCES**

All instances are running
Health is 100%

**MB MEMORY PER INSTANCE**

384

**TOTAL MB ALLOCATION**

14.125 GB still available

Connections (2)



stmicro-discovery-kit-iot-node-cloudantNoSQLDB



stmicro-discovery-kit-iot-node-iotf-service

[Create connection](#)

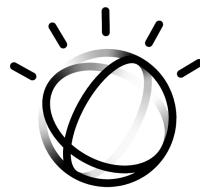
Runtime cost

\$0.00

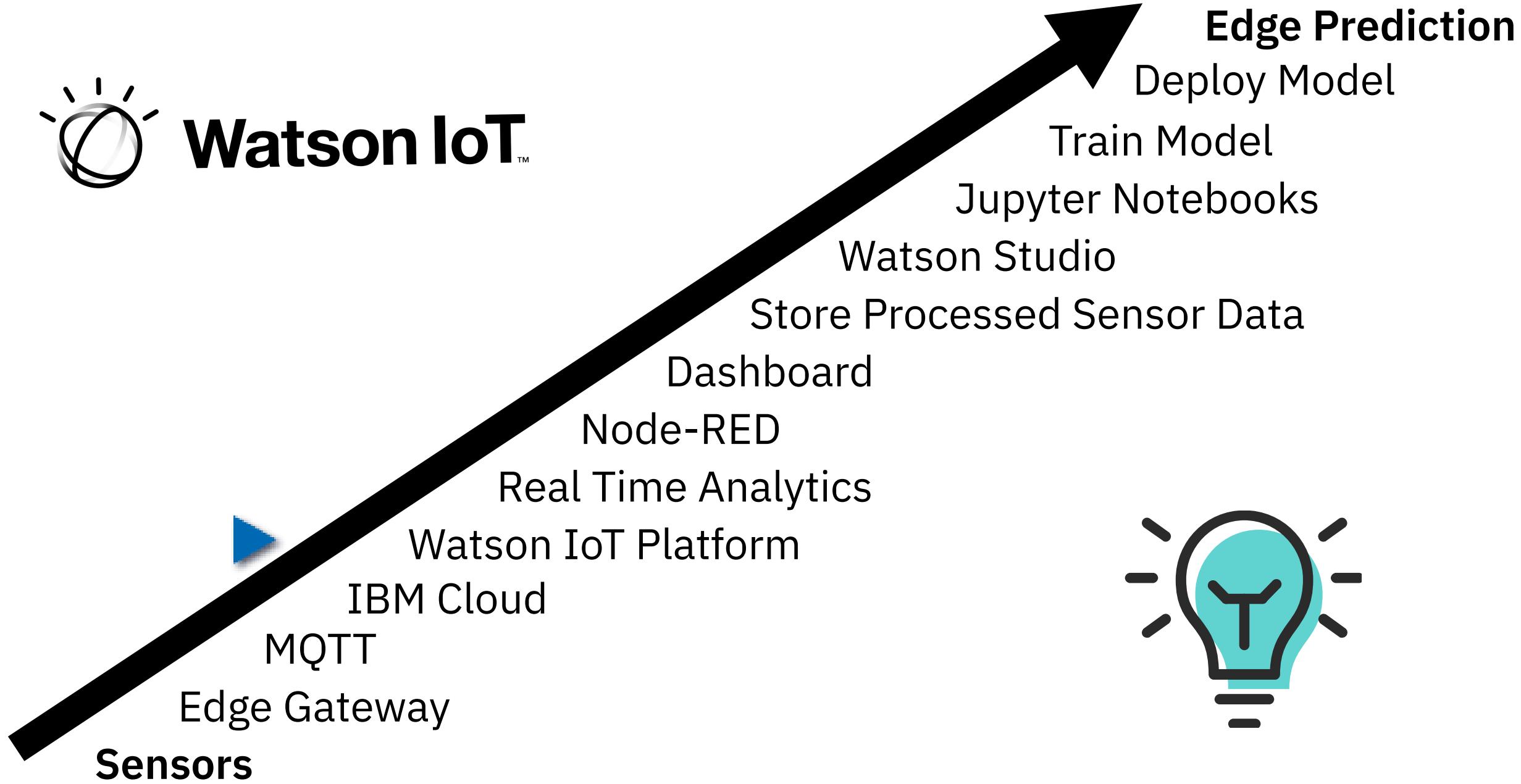
Current charges for billing period

\$0.00

Estimated total for billing period
(Oct 1, 2019 - Oct 31, 2019)Current and estimated cost excludes [connected services](#).



Watson IoT™



Manage

Plan

Connections

Resource list /



stmicro-discovery-kit-iot-node-iotf-service

2.76%

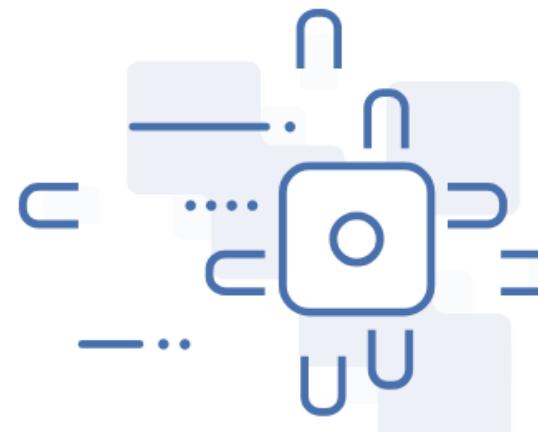
Used

| 194.48 Megabyte exchanged
available[Details](#)

Location: Dallas

Org: walicki@us.ibm.com

Space: dev



Let's get started with IBM Watson IoT Platform

Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world.

[Launch](#)[Docs](#)

Ready for the next level?

IBM Watson IoT Platform Journey



Lite

The Lite service plan provides a lightweight development environment to get you started with the connectivity capabilities of Watson IoT Platform.



Non-Production

The Non-Production service plan is a full-featured, fully-integrated offering that enables you to explore Watson IoT Platform to see how the service can fit into your IoT environment.



Production

The Production service is a fully managed SaaS offering that enables you to manage and analyze enterprise IoT data.



Browse Action Device Types Interfaces

Add Device Type

>	<input type="checkbox"/>	DiscoveryKit	19	Device	2018-09-03T20:18:27+00:00
---	--------------------------	--------------	----	--------	---------------------------

▼	<input type="checkbox"/>	STM32MP1	1	Device	2019-09-11T01:13:06.590Z	...
---	--------------------------	----------	---	--------	--------------------------	-----

Identity Device Information Interface

Edit

Device Type STM32MP1

Date Created Sep 10, 2019 9:13 PM

Description

Number of Devices 1 Registered Device

Items per page **10** | 1–2 of 2 items1 of 1 pages < **1** <= >

Cookie Preferences

[Browse](#) [Action](#) [Device Types](#) [Interfaces](#)

Add Device

**Identity**

Device Information



Security



Summary



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

Device Type

STM32MP1

Device ID

STM32MP1-Edge007

[Cancel](#)[Next](#)

Browse Devices

[All Devices](#)[Diagnose](#)[Cookie Preferences](#)

[Browse](#) [Action](#) [Device Types](#) [Interfaces](#)[Add Device](#)

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](#) 

<input type="checkbox"/>	Device ID	Status	Device Type	Class ID	Date Added	Descriptive Location
>	<input type="checkbox"/> STM32MP1-Edge001	Connected	STM32MP1	Device	Sep 21, 2019 2:00 PM	
>	<input type="checkbox"/> IoTNode2	Disconnected	DiscoveryKit	Device	Sep 3, 2018 7:28 PM	EGL C
>	<input type="checkbox"/> IoTNode1	Disconnected	DiscoveryKit	Device	Sep 3, 2018 8:55 PM	EGL C
>	<input type="checkbox"/> IoTNode4	Disconnected	DiscoveryKit	Device	Sep 3, 2018 9:41 PM	EGL C
>	<input type="checkbox"/> IoTNode5	Disconnected	DiscoveryKit	Device	Sep 3, 2018 9:44 PM	EGL C

[Cookie Preferences](#)

[Browse](#)[Action](#)[Device Types](#)[Interfaces](#)[Add Device](#) 

Device ID

Status

Device Type

Class ID

Date Added

Descriptive Location

STM32MP1-
Edge001

Connected

STM32MP1

Device

Sep 21, 2019 2:00
PM[Identity](#)[Device Information](#)[Recent Events](#)[State](#)[Logs](#)

The recent events listed show the live stream of data that is coming and going from this device.

Event

Value

Format

Last Received

event

{ "d": { "gyr_y": -5, "temperature": "27.12", "gyr_z": -3... }

json

a few seconds ago

event

{ "d": { "gyr_y": -3, "temperature": "27.05", "gyr_z": 0, ... }

json

a few seconds ago

event

{ "d": { "gyr_y": -4, "temperature": "27.01", "gyr_z": -3, ... }

json

a few seconds ago

event

{ "d": { "gyr_y": -5, "temperature": "27.07", "gyr_z": -2, ... }

json

a few seconds ago

event

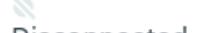
{ "d": { "gyr_y": -3, "temperature": "27.07", "gyr_z": -2, ... }

json

a few seconds ago



IoTNode2



DiscoveryKit

Device

Sep 3, 2018 7:28 PM

EGL C

[Cookie Preferences](#)

[Browse](#) Action Device[Add Device](#)

Event Payload

Event Name event

Time Received Oct 12, 2019 1:01 AM

```
1 | {  
2 |   "d": {  
3 |     "gyr_y": -3,  
4 |     "temperature": "27.12",  
5 |     "gyr_z": -4,  
6 |     "gyr_x": 5,  
7 |     "acc_x": -17,  
8 |     "acc_z": 257,  
9 |     "acc_y": -7,  
10 |     "humidity": "39.55"  
11 |   }  
12 | }
```



IoTNode2

Connected

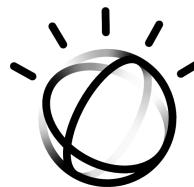
DiscoveryKit

Device

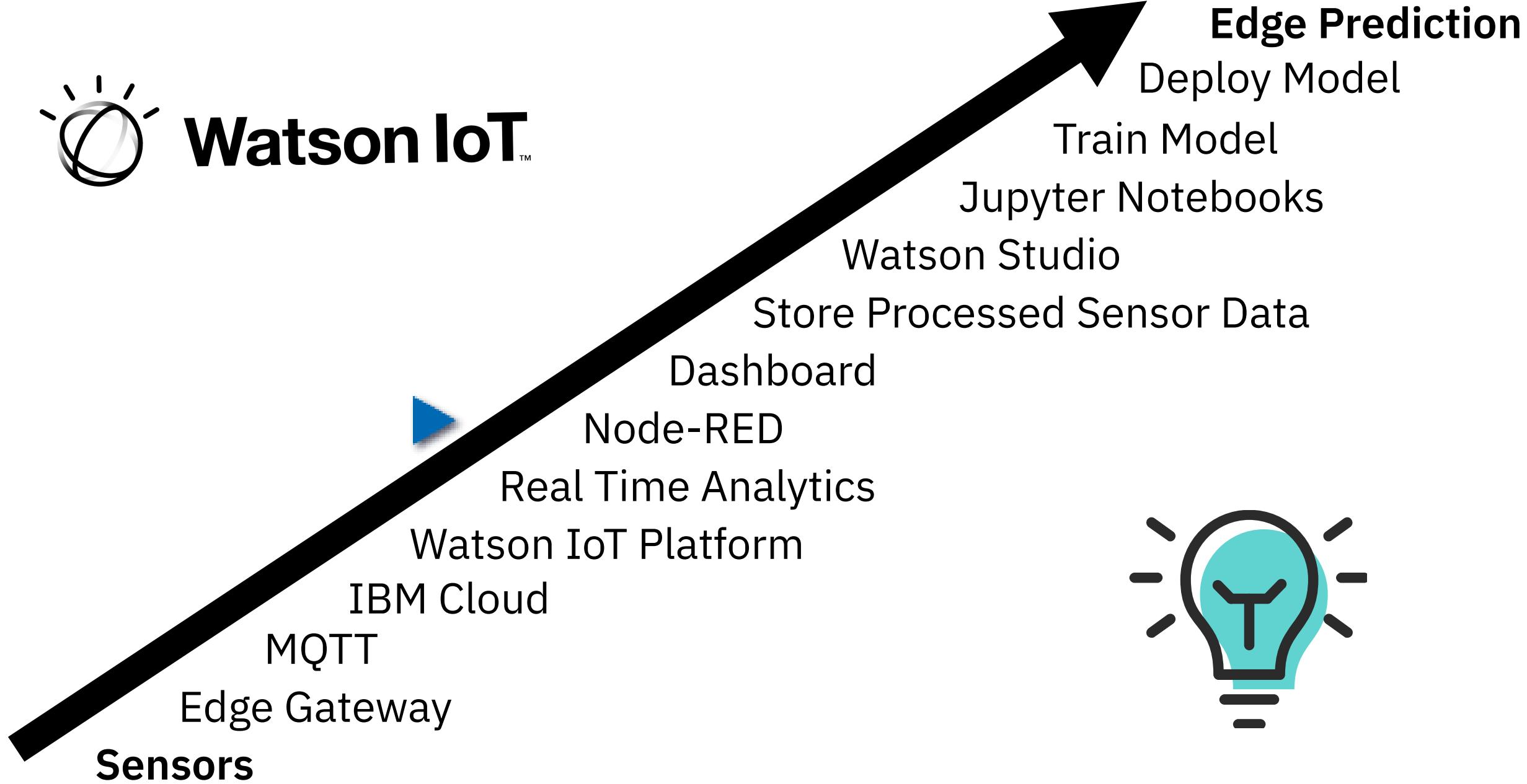
Sep 3, 2018 7:28 PM

EGL C

Cookie Preferences



Watson IoT™



Node-RED

Flow-based programming for the Internet of Things

Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.

The version running here has been customized for the IBM Watson IoT Platform.

More information about Node-RED, including documentation, can be found at nodered.org.

[Go to your Node-RED flow editor](#)

[Learn how to customise Node-RED](#)

filter nodes

Plot STM Sensor Data

Store Sensor Data

Historical Chart

STM32MP1

Send Edge Model



dashboard

level

button

dropdown

switch

slider

numeric

text input

date picker

colour picker

form

text abc

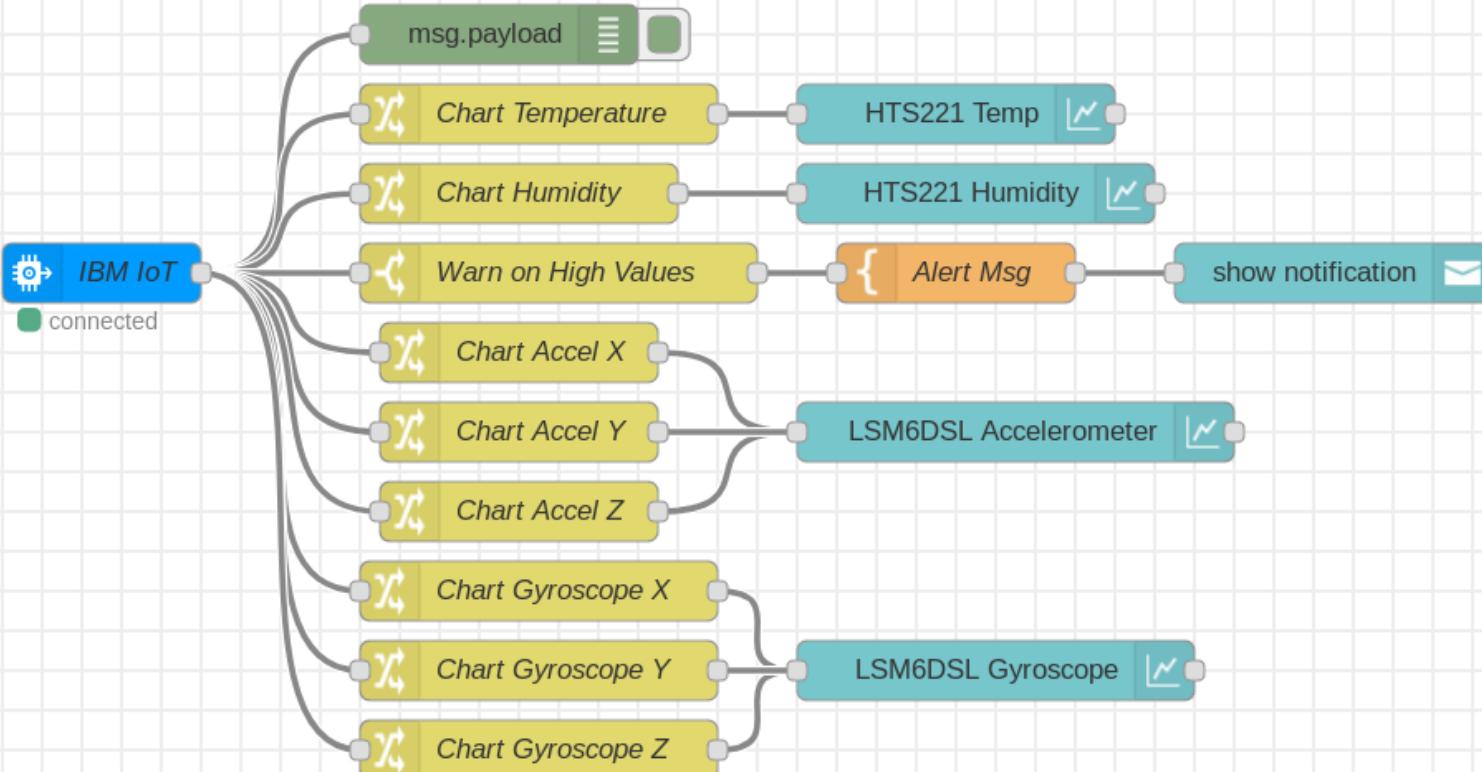
gauge

chart

audio out

notification

ui control



debug



all nodes



10/12/2019, 1:03:13 AM node: 6e48cbde.2e7504
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

object

time: 1570856485847
temp: "27.12"
humidity: "39.56"
class: 0

10/12/2019, 1:03:14 AM node: 208f5af6.1e8f76
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg : Object

object

topic: "iot-2/type/STM32MP1/
/id/STM32MP1-Edge001/evt/event
/fmt/json"
payload: object
deviceId: "STM32MP1-Edge001"
deviceType: "STM32MP1"
eventType: "event"
format: "json"
msgid: "3112c9d0.96df96"

10/12/2019, 1:03:15 AM node: 8214a6f2.7b864
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

{ d: object }

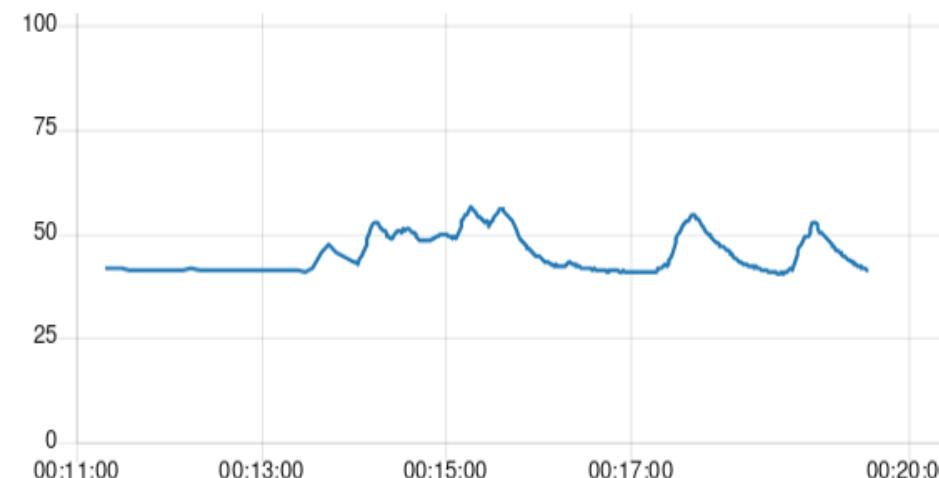
10/12/2019, 1:03:16 AM node: 6e48cbde.2e7504
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

STM32MP1 Sensors

HTS221 Temp

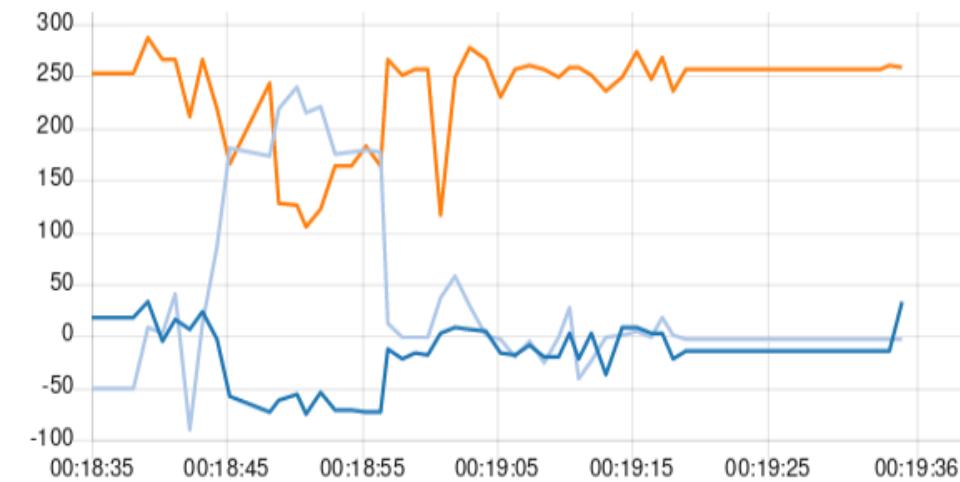


HTS221 Humidity

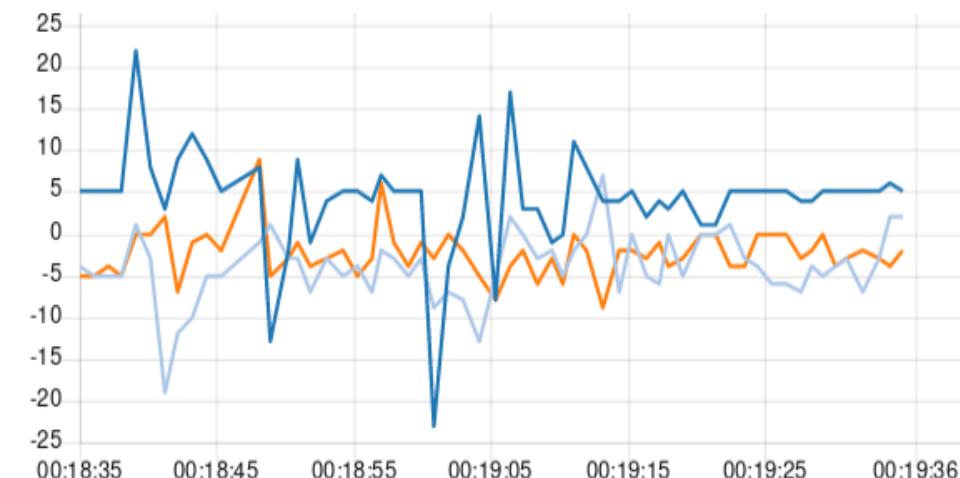


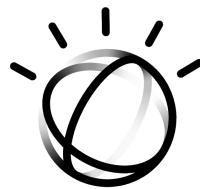
Motion

LSM6DSL Accelerometer

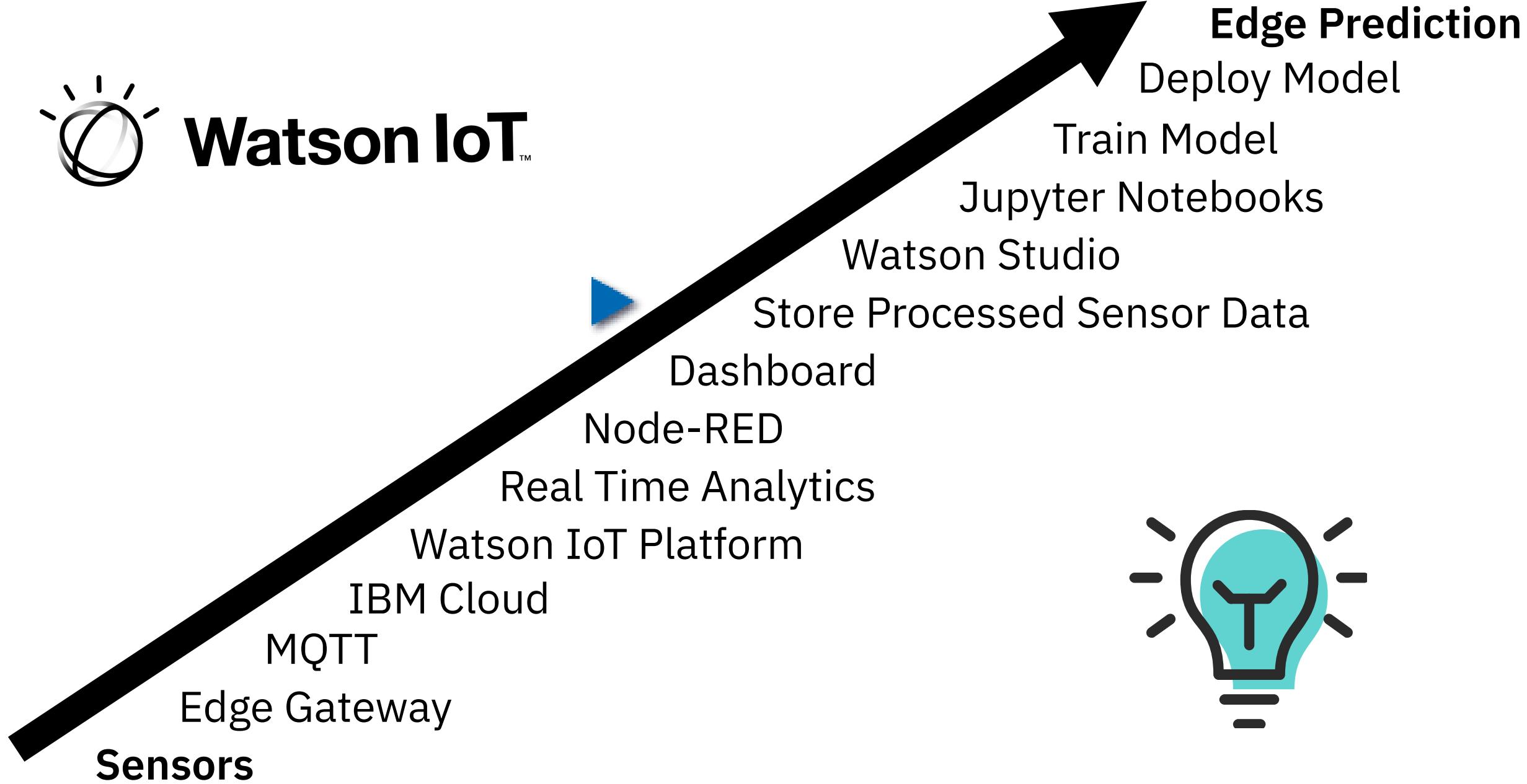


LSM6DSL Gyroscope





Watson IoT™



Q cloudar|



Plot STM Sensor Data

Store Sensor Data

Historical Chart

STM32MP1

Send Edge Model



> input

> output

> function

> social

storage



> analysis

> advanced

> weather

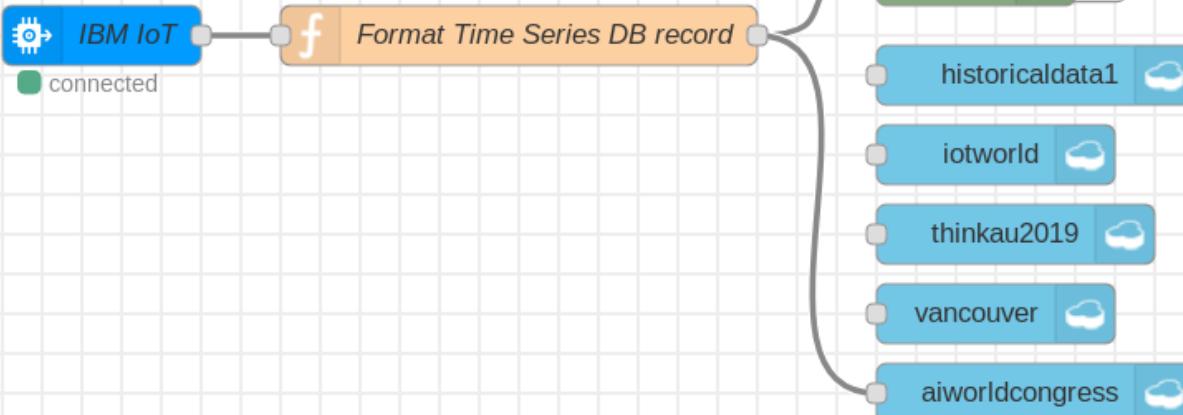
> Smarter Process

> Watson IoT

> Virtual IoT Device

> dashboard

> IBM Watson



debug



all nodes



10/12/2019, 1:03:13 AM node: 6e48cbde.2e7504
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

object

time: 1570856485847
temp: "27.12"
humidity: "39.56"
class: 0

10/12/2019, 1:03:14 AM node: 208f5af6.1e8f76
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg : Object

object

topic: "iot-2/type/STM32MP1
/id/STM32MP1-Edge001/evt/event
/fmt/json"

payload: object
deviceId: "STM32MP1-Edge001"
deviceType: "STM32MP1"
eventType: "event"
format: "json"
msgid: "3112c9d0.96df96"

10/12/2019, 1:03:15 AM node: 8214a6f2.7b864
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

d: object

10/12/2019, 1:03:16 AM node: 6e48cbde.2e7504
iot-2/type/STM32MP1/id/STM32MP1-Edge001/evt/event
/fmt/json : msg.payload : Object

Manage

Service credentials

Plan

Connections

Resource list /



Resource group: default

Location: Dallas

[Add Tags](#)[Overview](#)[Dashboard](#)[Capacity](#)[Docs](#)[Launch Cloudant Dashboard](#)

Deployment details

CRN

crn:v1:bluemix:public:cloudantnosqldb:us-south:a/6ab49fb655a1e47b62d33e71014dcba
1:8c8883f4-4487-4fa9-8f9f-3aa2cfcc1144::

Location

Dallas

External Endpoint

<https://b5b4fa53-a408-4d47-8ffe-b9420072195d-bluemix.cloudant.com>

Authentication methods

[IBM Cloud IAM](#) and [Cloudant credentials](#)

Disk encryption

Yes

Capacity details



Databases

Database name



Create Database

{ } JSON



Your Databases

Name	Size	# of Docs	Partitioned	Actions
aiworldcongress	130.8 KB	0	No	
historicaldata1	150.8 KB	515	No	
iotworld	0.8 MB	3576	No	
nodered	313.3 KB	3	No	
think	237.5 KB	819	No	
thinkau2019	1.4 MB	6342	No	
training	46.1 KB	100	No	
vancouver	130.8 KB	0	No	

Log Out

Showing 1–8 of 8 databases.

Databases per page

20



1





All Documents



Table

Metadata

{ } JSON



Create Document

Query

Permissions

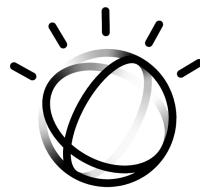
Changes

Design Documents

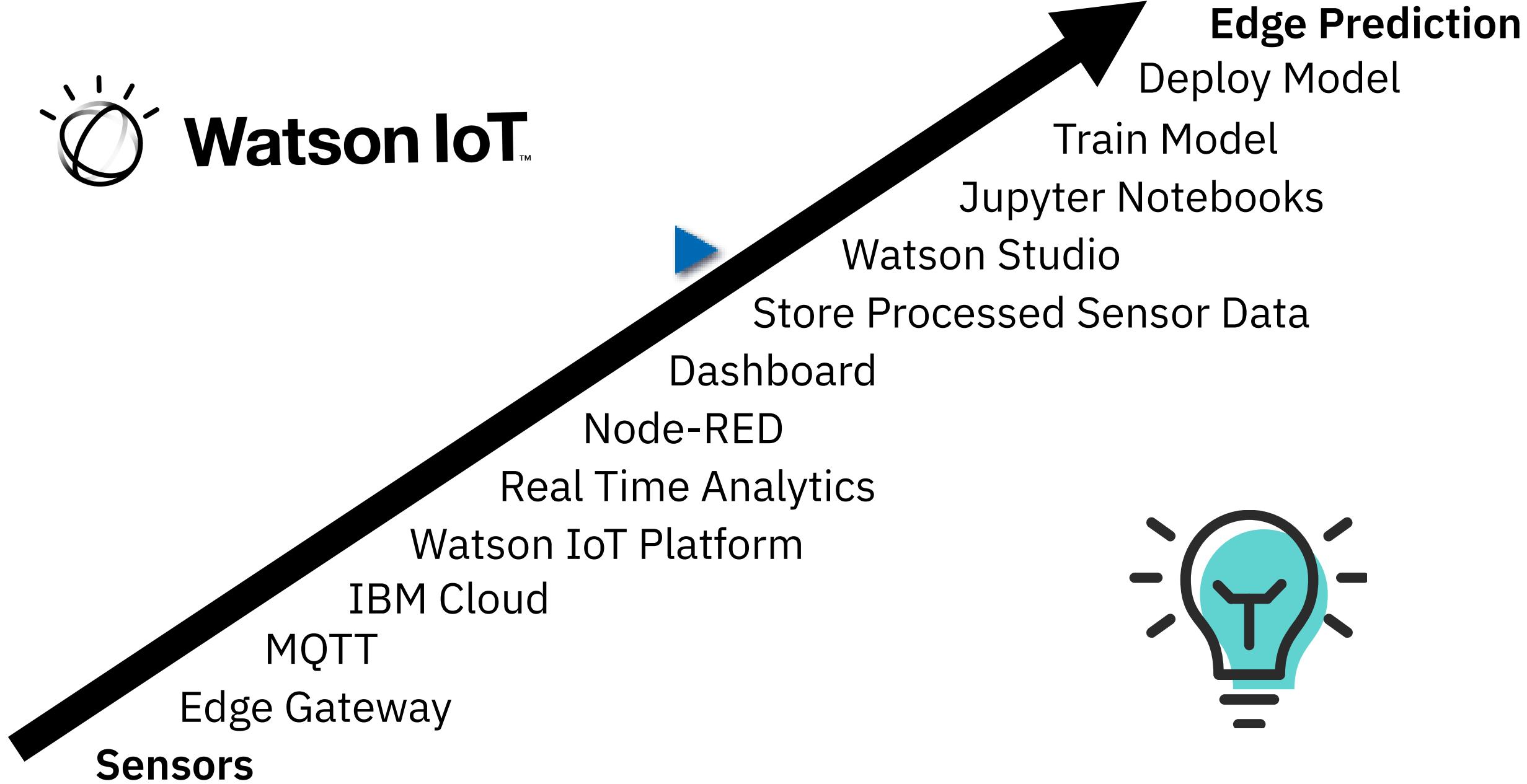


	_id	humidity	temp	time
<input type="checkbox"/>	3a5078f5ca82eb...	37.03	31.01	1537881430139
<input type="checkbox"/>	3a5078f5ca82eb...	35.89	34.31	1537881503059
<input type="checkbox"/>	3a5078f5ca82eb...	35.4	34.41	1537881507716
<input type="checkbox"/>	3a5078f5ca82eb...	34.44	34.85	1537881523232
<input type="checkbox"/>	3a5078f5ca82eb...	32.91	35.76	1537881560468
<input type="checkbox"/>	3a5078f5ca82eb...	32.53	35.99	1537881582195
<input type="checkbox"/>	3a5078f5ca82eb...	32.27	36.26	1537881596157
<input type="checkbox"/>	3a5078f5ca82eb...	32.08	36.39	1537881610129
<input type="checkbox"/>	3a5078f5ca82eb...	31.99	36.35	1537881617900
<input type="checkbox"/>	3a5078f5ca82eb...	31.91	36.43	1537881625650
<input type="checkbox"/>	3a5078f5ca82eb...	31.55	36.79	1537881662881





Watson IoT™



Catalog



Search the catalog...

[All Categories](#)[VPC Infrastructure](#)[Compute](#)[Containers](#)[Networking](#)[Storage](#)[AI](#) [Analytics](#)[Databases](#)[Developer Tools](#)[Integration](#)[Internet of Things](#)[Security and Identity](#)[Starter Kits](#)[Web and Mobile](#)[Web and Application](#)**AI****Watson Assistant**

IBM

Watson Assistant lets you build conversational interfaces into any application, device, or channel.

APIs and services

**Watson Studio**

IBM

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APIs and services

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APIs and services

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IBM

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APIs and services

FEEDBACK

IBM Watson

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[Learn more](#)



IBM Watson Knowledge Catalog

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[Learn more](#)

[← Back](#)

Create a project

Choose whether to create an empty project or to preload your project with data and analytical assets. Add collaborators and data, and then choose the right tools to accomplish your goals. Add services as necessary.



Create an empty project

Add the data you want to prepare, analyze, or model. Choose tools based on how you want to work: write code, create a flow on a graphical canvas, or automatically build models.

NEW

AutoAI experiment tool: Fully automated approach to building a classification or reg...

USE TO

Prepare and visualize data

Analyze data in notebooks

Train models



Create a project from a sample or file

Get started fast by loading existing assets. Choose a project file from your system, or choose a curated sample project.

USE TO

Learn by example

Build on existing work

Run tutorials





My Projects / IoT Sensor Analytics - Singapore

Launch IDE 

+ Add to project



Overview

Assets

Environments

Jobs

Deployments

Access Control

Sel.



Load

Files

Catalog

🔍 What assets are you looking for?

▼ Data assets

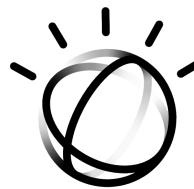
NAME	TYPE	CREATED BY	LAST MODIFIED	ACTIONS
You don't have any Data assets yet.				

▼ Notebooks

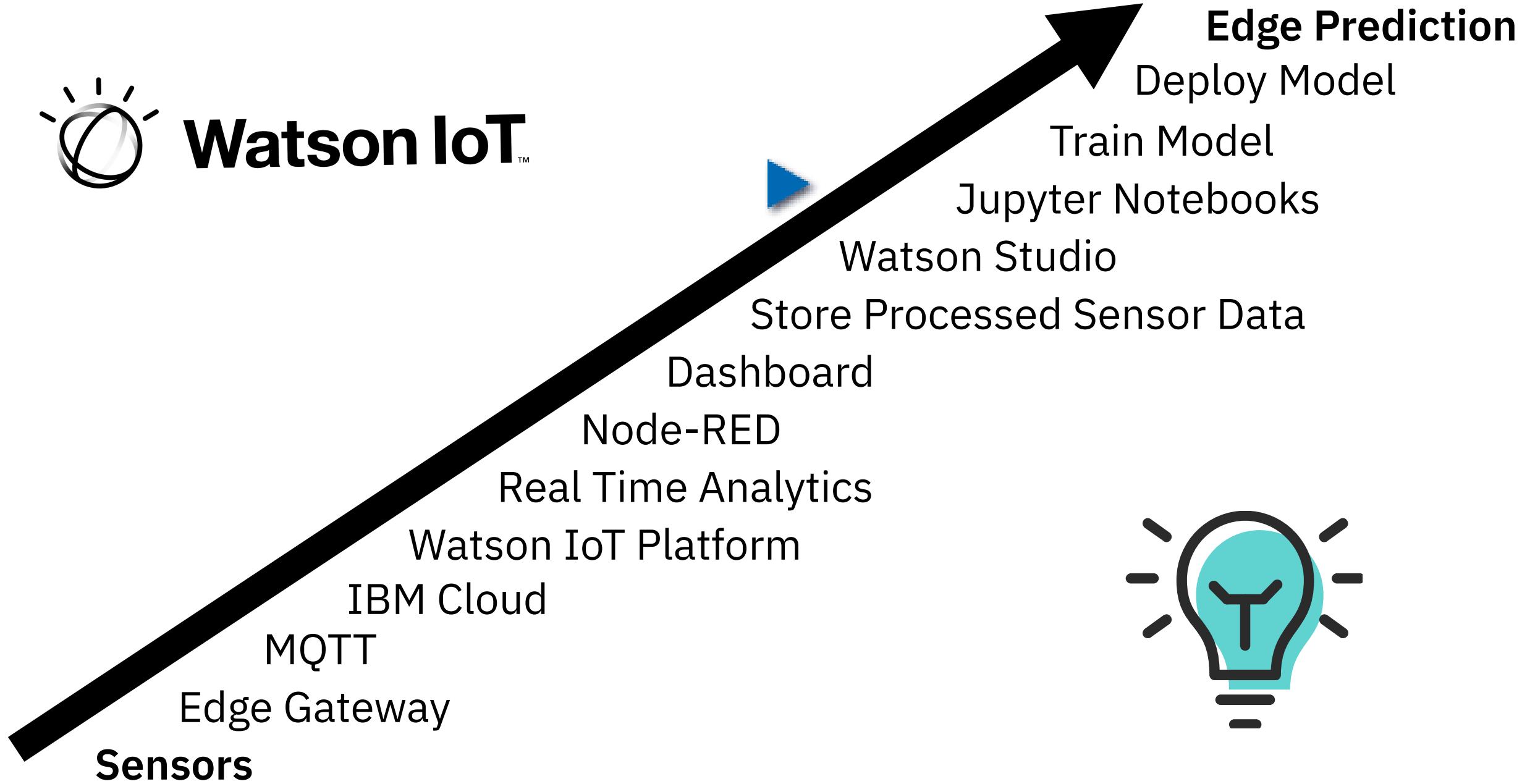
New notebook 

NAME	SHARED	SCHEDULED	STATUS	LANGUAGE	LAST EDITOR	LAST MODIFIED	ACTION
IoT Sensor Analytics - Singapore				Python 3.6 With Spark	John Walicki	2 Oct 2019 	





Watson IoT™





My Projects

Overview

What's new

Data

NAME

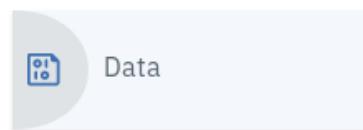
Notebooks

NAME

Streams

Choose asset type

AVAILABLE ASSET TYPES



Data



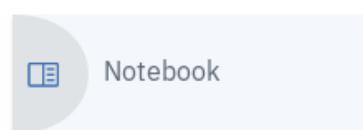
Connection



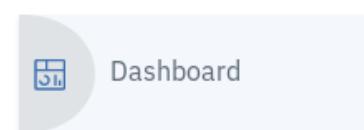
Connected data



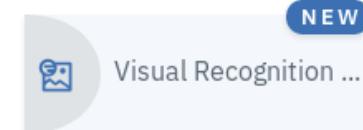
AutoAI experiment



Notebook



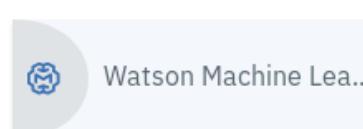
Dashboard



Visual Recognition ...



Natural Language Cl...



Watson Machine Lea...



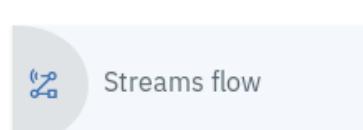
Deep learning experi...



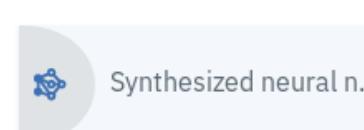
Modeler flow



Data Refinery flow



Streams flow



Synthesized neural n...



Decision Optimizatio...

Close



Catalog

Browse

Id.



New notebook

[Blank](#)[From file](#)[From URL](#)**Name**

IoT Sensor Analytics #3

17 characters remaining

Description (optional)

Edge Analytics

486 characters remaining

Select runtime

Default Spark Python 3.6 XS (Driver with 1 vCPU and 4 GB RAM, 2 exec



The selected runtime uses 1 driver with 1 vCPU and 4 GB RAM, and 2 executors each with 1 vCPU and 4 GB RAM.

This runtime consumes 1.5 capacity units per hour.

[Learn more](#) about capacity unit hours and Watson Studio pricing plans.

Notebook URL

hubusercontent.com/johnwalicki/STM32MP1-Edge-WatsonIoT-Workshop/

[Cancel](#)[Create Notebook](#)


32%

Instantiating Runtime for IoT Sensor Analytics - Singapore

The selected runtime uses one driver with 1 vCPU and 4 GB RAM, and 2 executors each with 1 vCPU and 4 GB RAM.

This runtime consumes 1.5 capacity units per hour.





```
In [1]: # !pip install --upgrade pixiedust
import pixiedust
pixiedust.installPackage("org.apache.bahir:spark-sql-cloudant_2.11:0")
```

```
Waiting for a Spark session to start...
Spark Initialization Done! ApplicationId = app-20191002060451-0000
KERNEL_ID = 65425e04-9e3c-4efe-958c-6bdb729f4792
Pixiedust database opened successfully
Table VERSION_TRACKER created successfully
Table METRICS_TRACKER created successfully
```

Share anonymous install statistics? (opt-out instructions)

PixieDust will record metadata on its environment the next time the package is installed or updated. The data is anonymized and aggregated to help plan for future releases, and records only the following values:

```
{
  "data_sent": currentDate,
  "runtime": "python",
  "application_version": currentPixiedustVersion,
  "space_id": nonIdentifyingUniqueId,
  "config": {
    "repository_id": "https://github.com/ibm-watson-data-lab/pixiedust",
    "target_runtimes": ["Data Science Experience"],
    "event_id": "web",
    "event_organizer": "dev_journeys"
}
```





```
In [2]: from pyspark.sql import SparkSession
```

```
In [3]: spark = SparkSession.builder.getOrCreate()
```

```
In [5]: ### TODO Please provide your Cloudant credentials in this cell
def readDataFrameFromCloudant(database):
```

```
    cloudantdata = spark.read.format("org.apache.bahir.cloudant")\
        .option("cloudant.host", '0.0.0.0')\
        .option("cloudant.username", '0.0.0.0')\
        .option("cloudant.password", '0.0.0.0')\
        .load(database)
```

```
    return cloudantdata
```

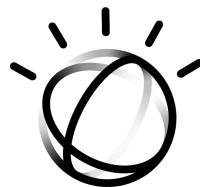
```
In [6]: df=readDataFrameFromCloudant('training2')
```

```
In [7]: # Enable SQL on the data frame
df.createOrReplaceTempView('df')
```

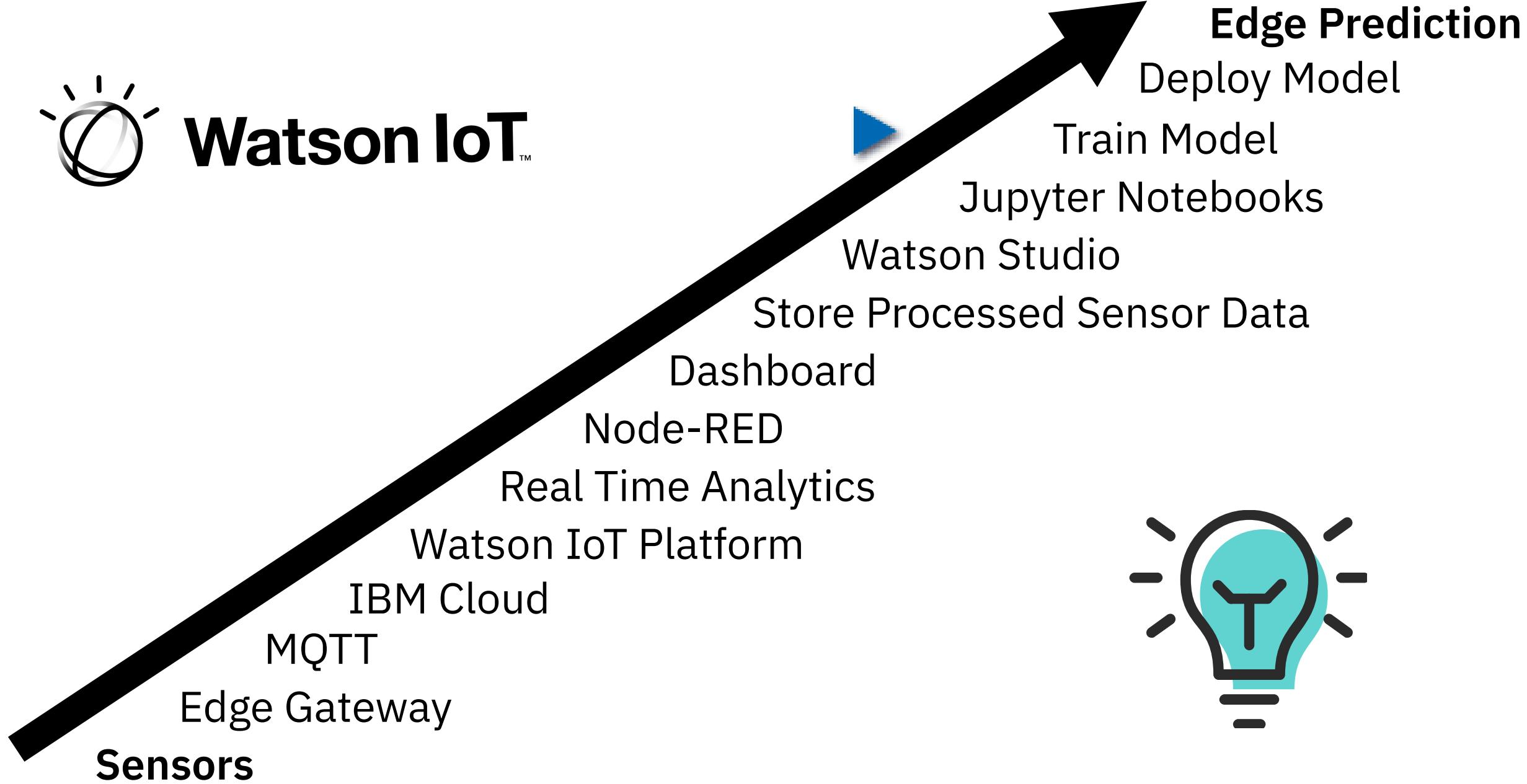
```
In [8]: from pyspark.sql.functions import translate, col
```

```
df_cleaned = df \
    .withColumn("temp", df.temp.cast("double"))
```





Watson IoT™





Node-RED

Deploy ▾



ibmiot



STM32MP1

Send Edge Model

Training Data

Plot Random



debug



input



output



function

social

storage

analysis

advanced

weather

Smarter Process

Watson IoT

Virtual IoT Device



10/12/2019, 1:03:13 AM node: 6e48cbde.2e7504

iot-2/type/STM32MP1/id/STM32MP1-Edge001

/evt/event/fmt/json : msg.payload : Object

object

time: 1570856485847

temp: "27.12"

humidity: "39.56"

class: 0

10/12/2019, 1:03:14 AM node: 208f5af6.1e8f76

iot-2/type/STM32MP1/id/STM32MP1-Edge001

/evt/event/fmt/json : msg : Object

object

topic: "iot-2/type/STM32MP1 /id/STM32MP1-Edge001/evt/event /fmt/json"

payload: object

deviceId: "STM32MP1-Edge001"

deviceType: "STM32MP1"

eventType: "event"

format: "json"

_msgid: "3112c9d0.96df96"

10/12/2019, 1:03:15 AM node: 8214a6f2.7b864



All Documents



Table

Metadata

{ } JSON



Create Document

Query

Permissions

Changes

Design Documents



		_id	class	humidity	temp	time
<input type="checkbox"/>		018c1d3b08...	1	69.35	31.08	1569089742...
<input type="checkbox"/>		018c1d3b08...	1	70.86	31.06	1569089762...
<input type="checkbox"/>		018c1d3b08...	1	70.58	30.97	1569089766...
<input type="checkbox"/>		018c1d3b08...	1	70.76	31.06	1569089772...
<input type="checkbox"/>		018c1d3b08...	1	71.11	30.99	1569089775...
<input type="checkbox"/>		018c1d3b08...	1	71.41	30.99	1569089776...
<input type="checkbox"/>		018c1d3b08...	1	72.73	30.76	1569089809...
<input type="checkbox"/>		018c1d3b08...	1	74.58	30.58	1569089869...
<input type="checkbox"/>		12413768ac...	0	53.71	24.59	1569089479...
<input type="checkbox"/>		12413768ac...	0	53.90	24.68	1569089495...
<input type="checkbox"/>		12413768ac...	0	53.67	24.68	1569089496...



```
In [15]: # Imports for modelling
from pyspark.ml.feature import StringIndexer, OneHotEncoder
from pyspark.ml.linalg import Vectors
from pyspark.ml.feature import VectorAssembler
from pyspark.ml.feature import Normalizer
from pyspark.ml import Pipeline
from pyspark.ml.classification import LogisticRegression
from pyspark.ml.evaluation import MulticlassClassificationEvaluator
```

```
In [16]: # create binary classifier model
vectorAssembler = VectorAssembler(inputCols=["humidity", "temp"],
                                  outputCol="features")
lr = LogisticRegression(maxIter=1000).setLabelCol("class")
pipeline = Pipeline(stages=[vectorAssembler, lr])
model = pipeline.fit(df_cleaned)
result = model.transform(df_cleaned)
```

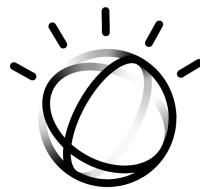
```
In [17]: model.stages[1].coefficients
```

```
Out[17]: DenseVector([11.3076, -18.5898])
```

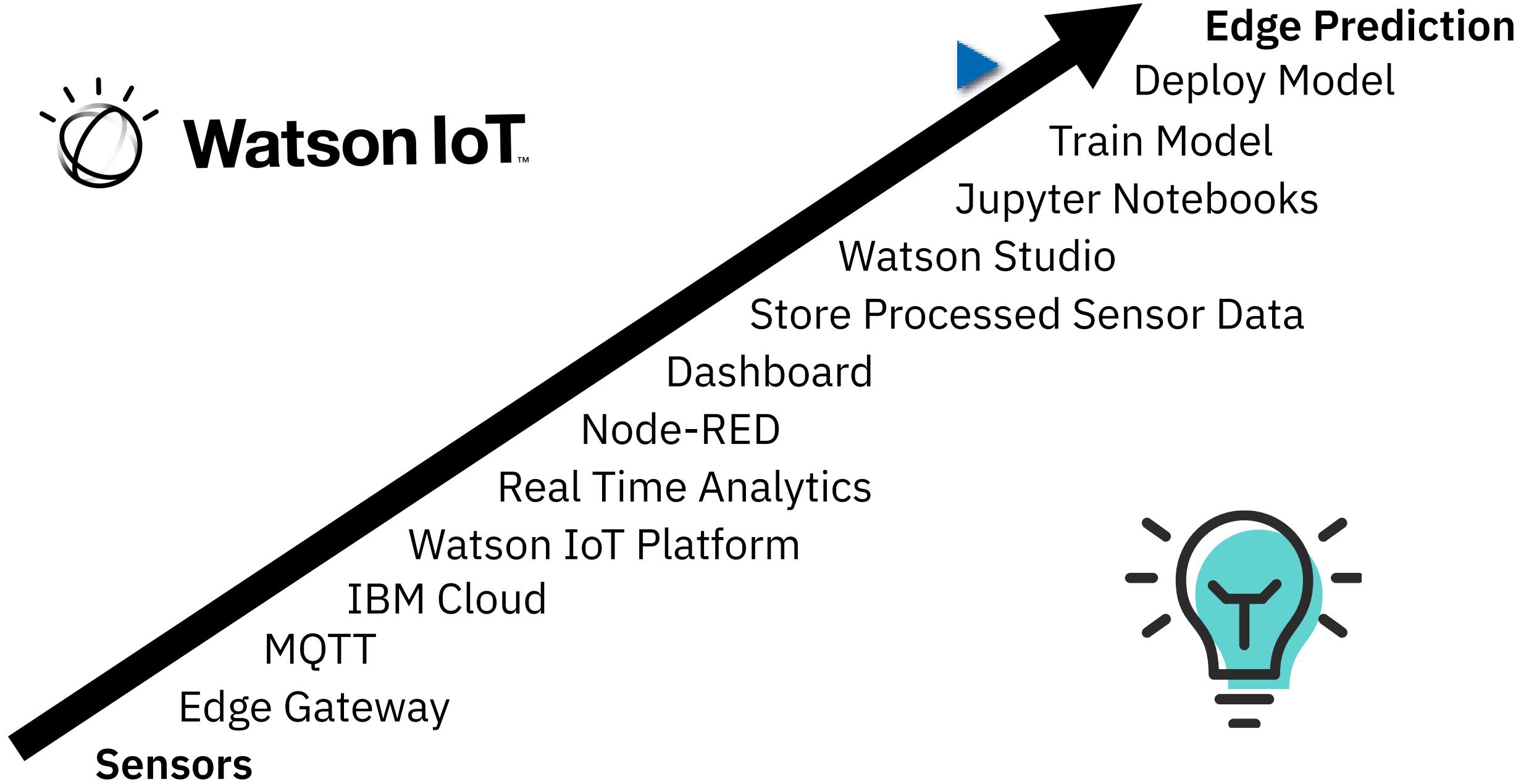
```
In [18]: model.stages[1].intercept
```

```
Out[18]: -78.89924771667654
```





Watson IoT™





Node-RED

Deploy ▾



ibmiot



MP1

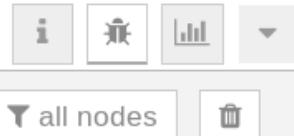
Send Edge Model

Training Data

Plot Random



debug



input



output



function

social

storage

analysis

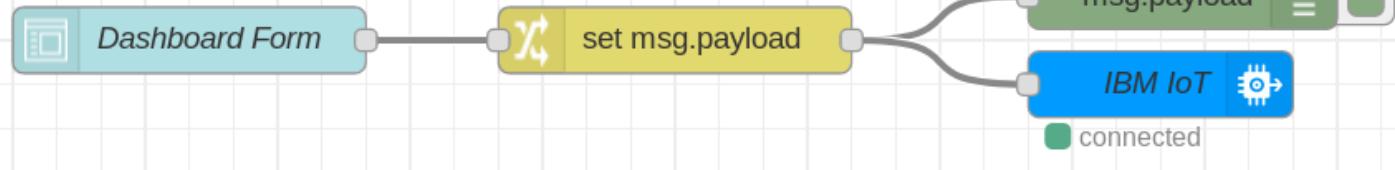
advanced

weather

Smarter Process

Watson IoT

Virtual IoT Device



msg.payload

IBM IoT

connected

10/12/2019, 1:03:13 AM node: 6e48cbde.2e7504

iot-2/type/STM32MP1/id/STM32MP1-Edge001

/evt/event/fmt/json : msg.payload : Object

object

time: 1570856485847

temp: "27.12"

humidity: "39.56"

class: 0

10/12/2019, 1:03:14 AM node: 208f5af6.1e8f76

iot-2/type/STM32MP1/id/STM32MP1-Edge001

/evt/event/fmt/json : msg : Object

object

topic: "iot-2/type/STM32MP1 /id/STM32MP1-Edge001/evt/event /fmt/json"

payload: object

deviceId: "STM32MP1-Edge001"

deviceType: "STM32MP1"

eventType: "event"

format: "json"

_msgid: "3112c9d0.96df96"

10/12/2019, 1:03:15 AM node: 8214a6f2.7b864

Change STM32MP1 Edge Scoring

Send Model Coefficients

MODEL_INTERCEPT *



MODEL_TEMP_COEF *



MODEL_HUM_COEF *



SUBMIT

CANCEL

filter nodes

Send Data to WIoTP

Sensor Python Function

Call Sensor Python Script

Update Edge Model



input

inject

catch

status

link

mqtt

http

websocket

tcp

udp

Watson IoT

output

debug

link

mqtt

http response

websocket

tcp

Receive Model Coefficients from Watson Studio Analytics



10/12/2019, 12:19:38 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -3, temperature: "28.32", gyr_z: -6, gyr_x: 3, acc_x: -21 ... }

10/12/2019, 12:19:39 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -2, temperature: "28.23", gyr_z: -3, gyr_x: -1, acc_x: -21 ... }

10/12/2019, 12:19:40 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -5, temperature: "28.30", gyr_z: -6, gyr_x: 0, acc_x: 2 ... }

10/12/2019, 12:19:41 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -2, temperature: "28.28", gyr_z: 0, gyr_x: 11, acc_x: -23 ... }

10/12/2019, 12:19:42 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: 0, temperature: "28.21", gyr_z: -2, gyr_x: 8, acc_x: 3 ... }

10/12/2019, 12:19:43 AM node: a4b6b4bf.3b2d4

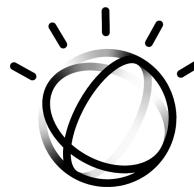
msg.payload : Object

▶ { gyr_y: 7, temperature: "28.28", gyr_z: -9, gyr_x: 4, acc_x: -37 ... }

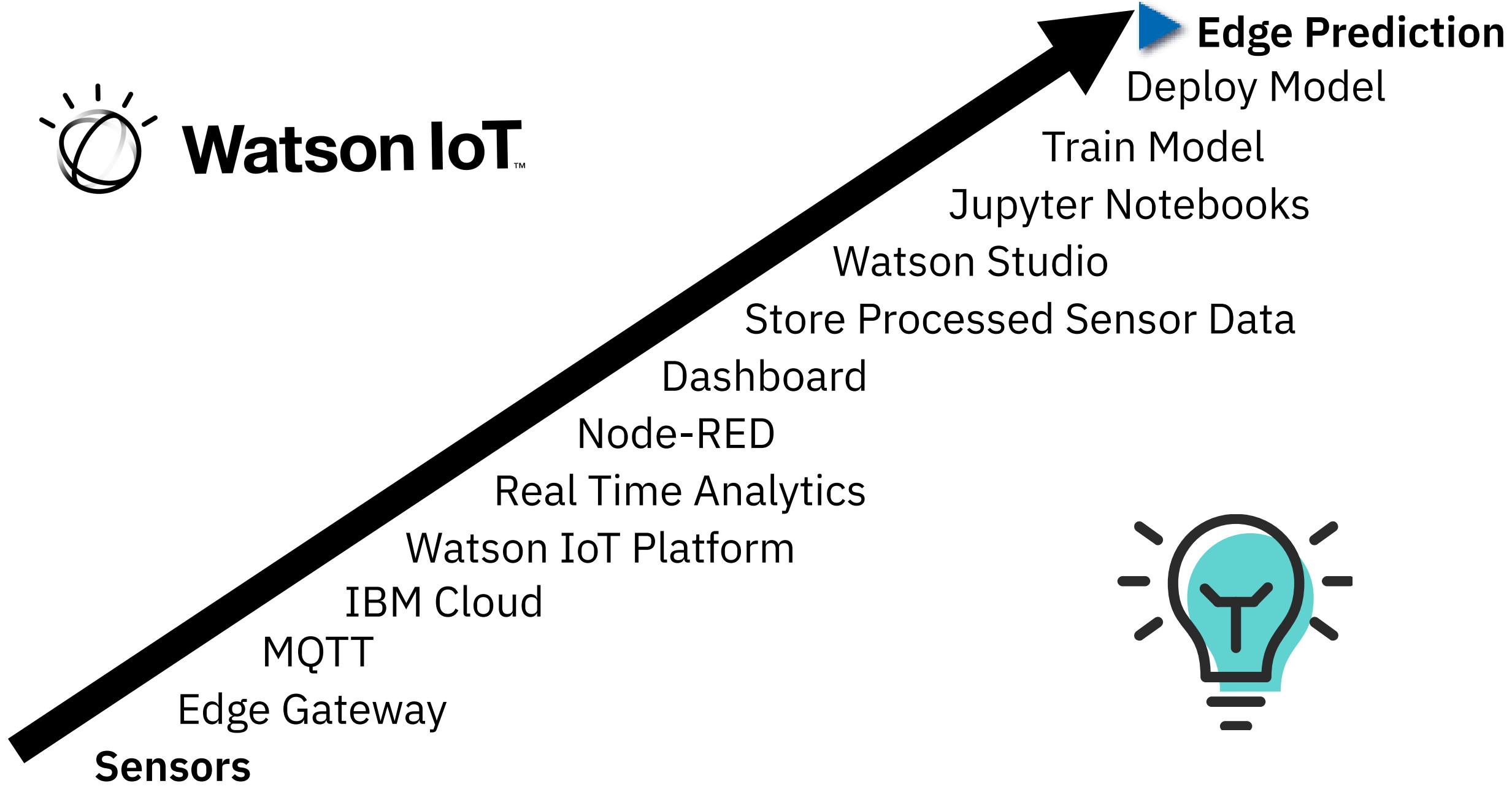
10/12/2019, 12:19:44 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -7, temperature:



Watson IoT™



filter nodes

Send Data to WIoTP

Sensor Python Function

Call Sensor Python Script

Update Edge Model

+

≡

debug

all nodes

✖

input

inject

catch

status

link

mqtt

http

websocket

tcp

udp

Watson IoT

output

debug

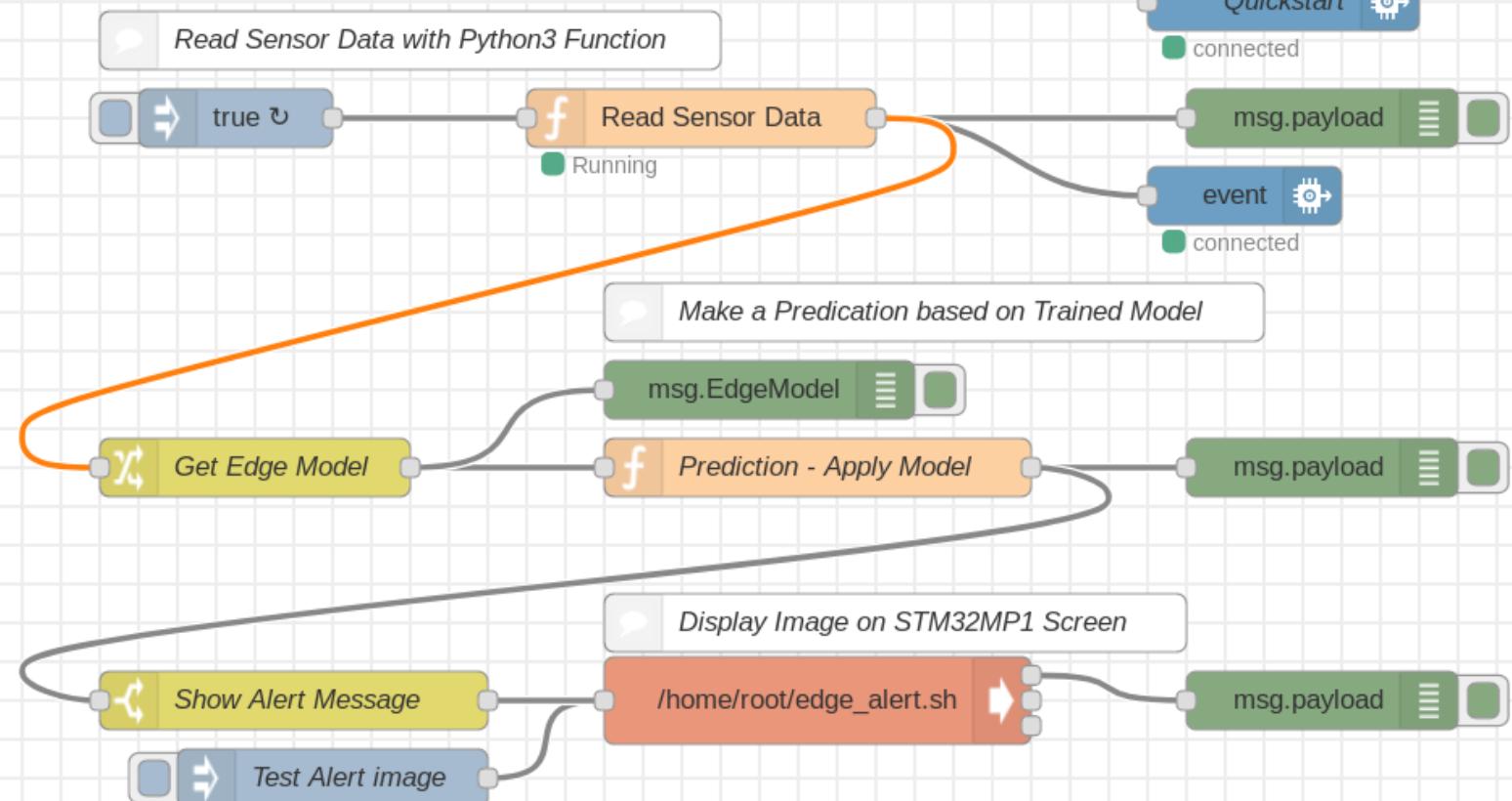
link

mqtt

http response

websocket

tcp



10/12/2019, 12:19:38 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -3, temperature: "28.32", gyr_z: -6, gyr_x: 3, acc_x: -21 ... }

10/12/2019, 12:19:39 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -2, temperature: "28.23", gyr_z: -3, gyr_x: -1, acc_x: -21 ... }

10/12/2019, 12:19:40 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -5, temperature: "28.30", gyr_z: -6, gyr_x: 0, acc_x: 2 ... }

10/12/2019, 12:19:41 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -2, temperature: "28.28", gyr_z: 0, gyr_x: 11, acc_x: -23 ... }

10/12/2019, 12:19:42 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: 0, temperature: "28.21", gyr_z: -2, gyr_x: 8, acc_x: 3 ... }

10/12/2019, 12:19:43 AM node: a4b6b4bf.3b2d4

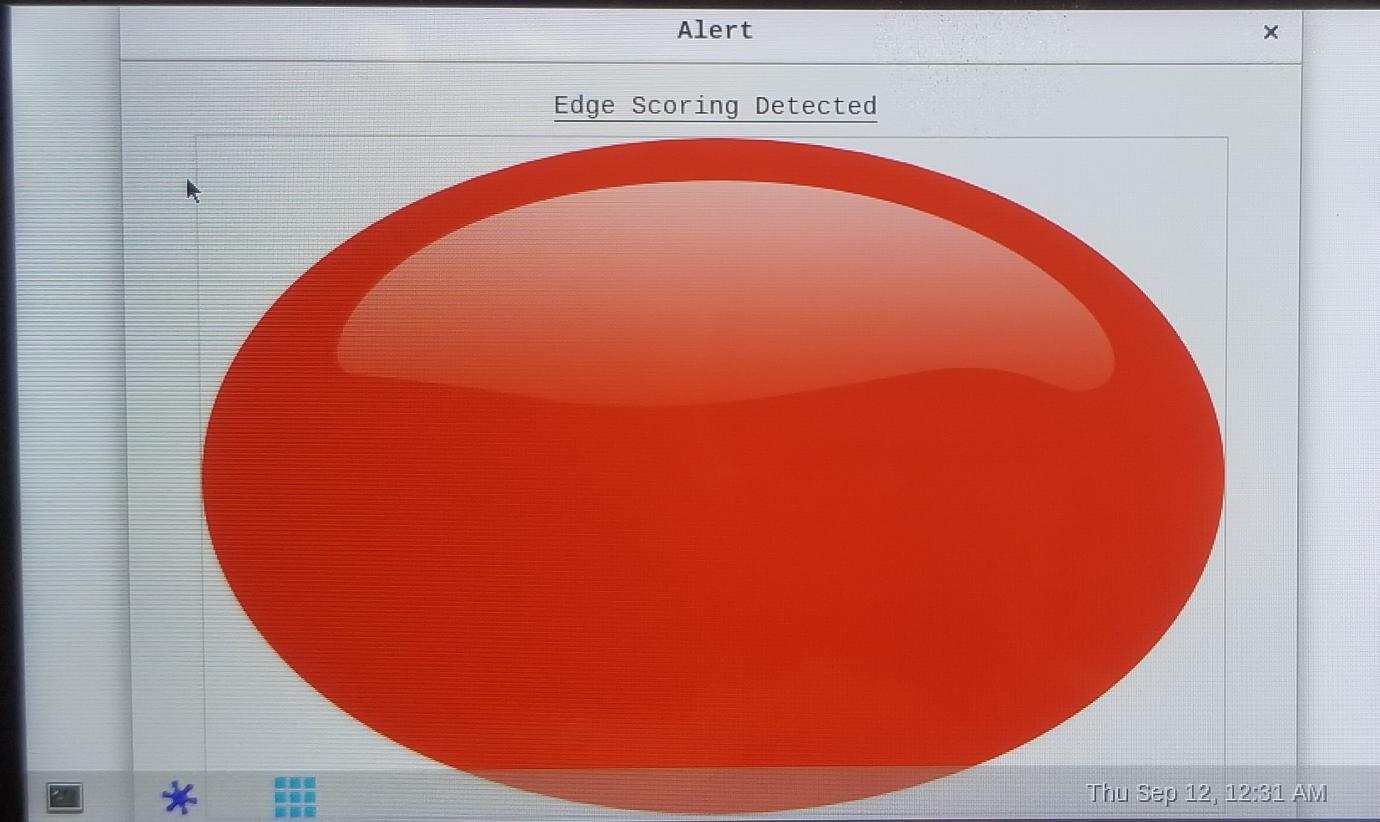
msg.payload : Object

▶ { gyr_y: 7, temperature: "28.28", gyr_z: -9, gyr_x: 4, acc_x: -37 ... }

10/12/2019, 12:19:44 AM node: a4b6b4bf.3b2d4

msg.payload : Object

▶ { gyr_y: -7, temperature:



Get the Code:

<https://github.com/johnwalicki/STM32MP1-Edge-WatsonIoT-Workshop>

Thank you



twitter.com/johnwalicki



github.com/johnwalicki



developer.ibm.com/profiles/walicki



linkedin.com/in/jowalicki



John Walicki

CTO, IoT / Edge Developer Advocacy

IBM Academy of Technology
Leadership Team



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