



# Developer Week



Building an Azure IoT Controlled Device  
That Costs Less Than 10 USD

## Introduction to the Internet of Things



Your Road to Magical Debugging



Inspiring Code, Creating Value.



Alon Fliess

Chief Software Architect

<http://alonfliess.me>



Microsoft  
Regional Director

# Traffic Light History Facts



1868  
London



1912  
SLC



1914  
Cleveland



1920  
Detroit



1922  
Automatic timer  
controlled



1950s  
Computer  
Detection

*light*TRAFFIC



# About Me

## ► Alon Fliess:

- Chief Software Architect & Co-Founder at CodeValue Ltd.
- Over 25 years of hands-on experience
- Microsoft Regional Director
- Microsoft Azure MVP
- Renowned speaker at both international and domestic events





# About CodeValue



Cloud Computing



Advanced Mobile Technologies



UI/UX & Graphic Design



Advanced Web Technologies



Cross Platform Development



ALM & DevOps



Software Architecture



IOT & Embedded Software



Training & Mentoring



Development Management & Methodology



Microsoft  
Regional Director



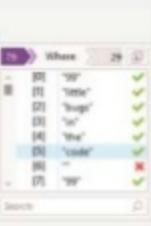
# Debug like a wizard

Quit debugging, spend more time writing brilliant software



## LINQ Debugging / Know the flow of your LINQ queries

```
mostFrequentWord = beautifulPoem
    .Split(' ', '.', ',') (6/79)
    .Where(i => i != "") (6/29)
        .code
    .GroupBy( i => i ) (6/19)
        3
    .OrderBy(i => i.Count()) (19/19)
    .Last() (1/1);
```



## Search / Find that needle in a haystack of data

```
foreach (var customer in customers)
```

The screenshot shows a search interface for 'customers' with 20 items. One item is highlighted: Michael Ford, with FirstName: "Michael" and Id: 21. The search bar at the bottom contains 'michael'.

## Magic Glance / Figure out complex expressions

```
float CalculateCost(Customer customer, string restaurant)
{
    float courseCost = GetCourseCost(restaurant);
    false
    bool shouldTip = walter.IsNice && courseCost > COSTLY_MEAL;
}
```

## Reveal / Focus on data that actually matter

The screenshot shows a detailed view of a customer object with properties: FirstName: "Darren", Firstname: "Stephen", FirstName: "Carla". It highlights the FirstName property of the third customer. The sidebar shows other properties: [17], [18], [19]. The bottom has a search bar.

With our Visual Studio extension for C#, follow the road to a bug-free world  
oz-code.com | @oz\_code



# Agenda

- Introduction
- About
- The Device
- The Cloud - Azure IoT
- The IoT Hub
- An affordable IoT controlled device
- Real world scenarios
- Going Deeper
- Summary



# IoT System Basic Components



```
var sensorData = await _bmp180.GetSensorDataAsync(Bmp180.UltraHighResolution);
var messageString = JsonConvert.SerializeObject(sensorData);
var message = new
    Microsoft.Azure.Devices.Client.Message(Encoding.ASCII.GetBytes(messageString));
await deviceClient.SendEventAsync(message);
```





# The Device

- There are many System on a Chip (SoC) devices to choose from
- Raspberry Pi family
- Arduino Compatible Family
  - ESP 8266 & ESP 32 based devices
- Microsoft Azure Sphere
- ...



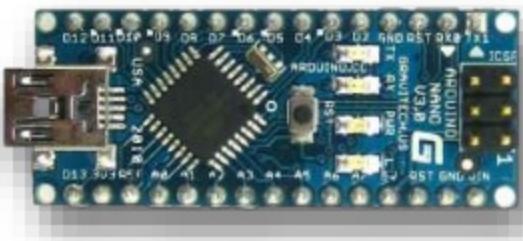
Azure Sphere



Raspberry Pi 3



Raspberry Pi 3 Kit  
Windows 10 and Raspbian  
Samples in C and C#

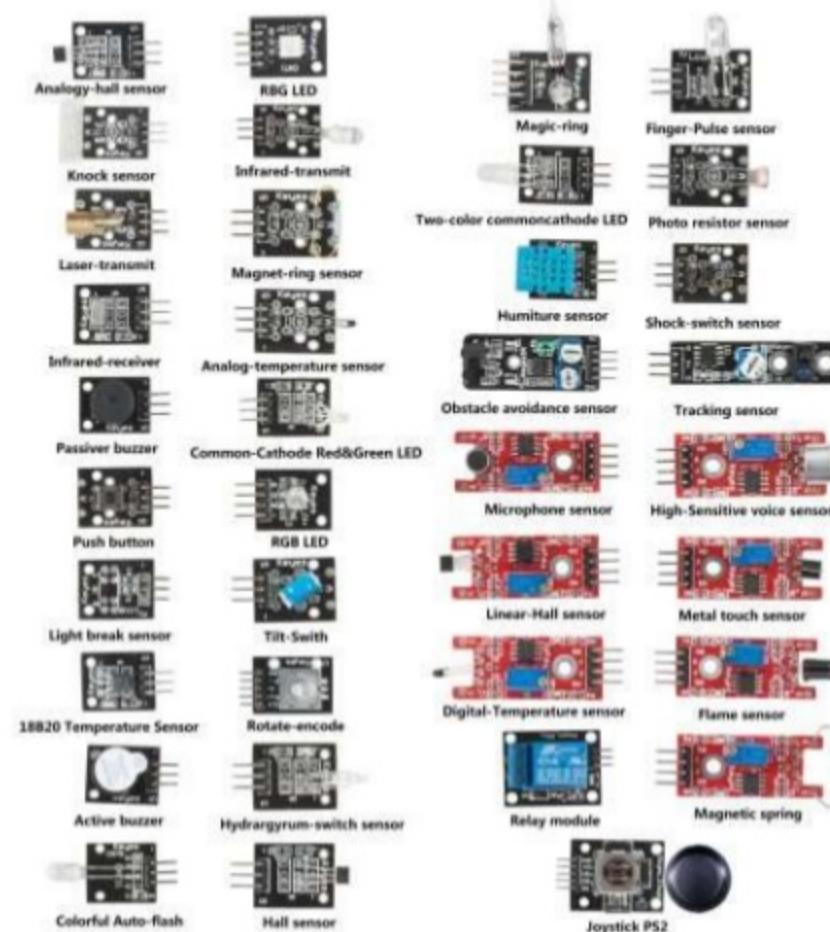
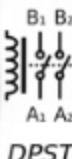
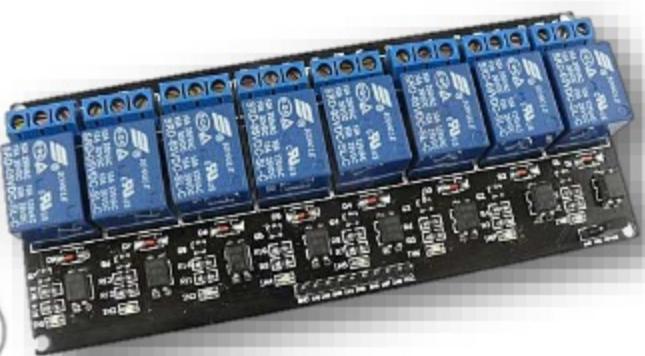


Feather Huzzah ESP8266 Kit  
RTOS  
Samples in Arduino IDE and C



# Sensors, Actuators, Motors

► There are plenty of them





# How do I play with it?

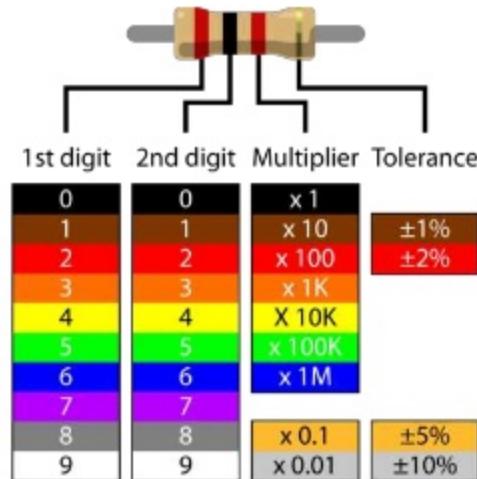
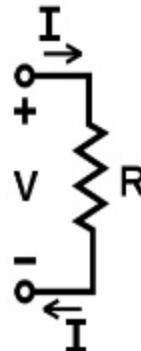
- Pick your weapon
  - A prototype board that has networking capabilities
    - [Raspberry Pi](#), [WeMos](#), [Tessel](#), [NetDuino](#)
    - The complete list – [Azure IoT hardware catalog](#)
- Some Electronics & Hardware Programming
  - Understand how to connect sensors and communicate with them
- Pick your Cloud Services and technologies
  - Microsoft Azure, AWS
  - Do something with the (Big) data





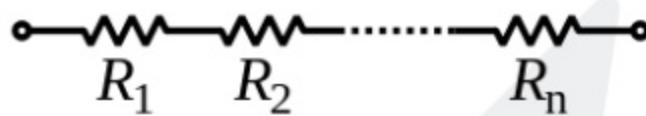
# Electronics 101

- Ohm's law:  $V = R \cdot I$ 
  - $V \rightarrow$  Volt (V, mV)
  - $I \rightarrow$  Ampere (A, mA)
  - $R \rightarrow$  Ohm ( $\Omega$ )

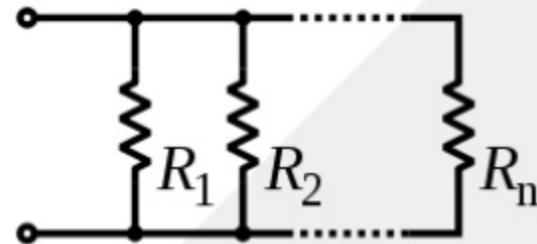


## ➤ Series and Parallel Resistors

➤ Series:  $R_{EQ} = R_1 + R_2 + \dots + R_n$



➤ Parallel:  $\frac{1}{R_{EQ}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$



## Resistive divider, LED current limiter

► Voltage divider:  $V_{OUT} = V_{IN} * (R_2 / (R_1 + R_2))$

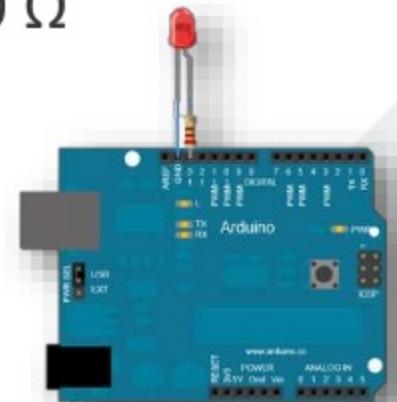
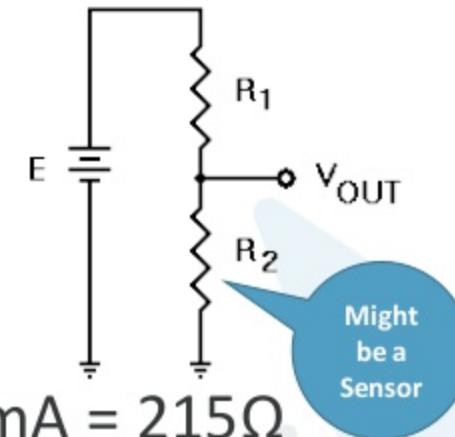
► 3.3V supply,  $R_1 = 5\text{k}\Omega$ ,  $R_2 = 10\text{k}\Omega$

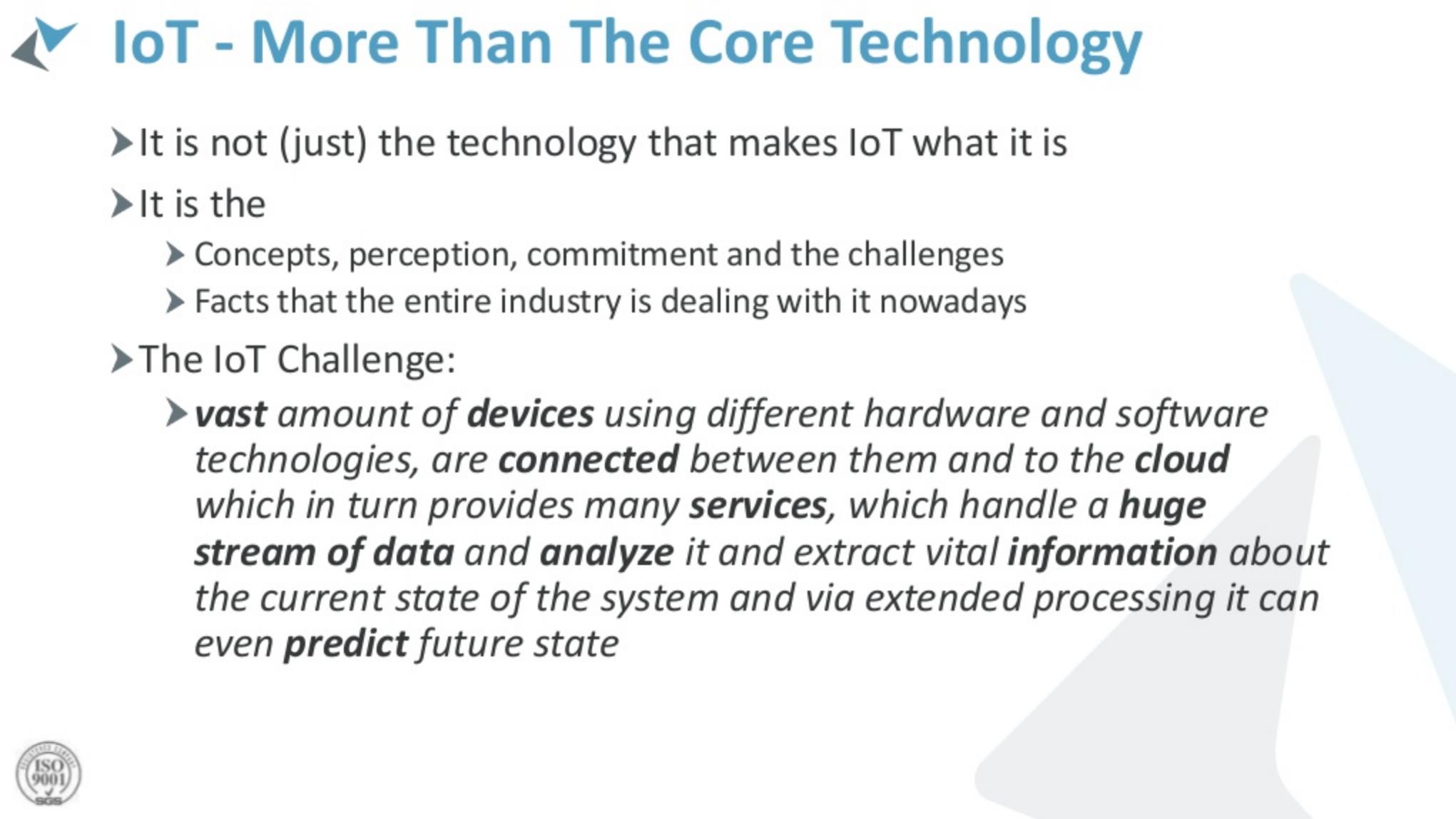
$$V_{OUT} = 3.3V * (10\text{k}\Omega / (10\text{k}\Omega + 5\text{k}\Omega)) = 2.2V$$

► LED resistor:  $R = (V_{SUPPLY} - V_{LED}) / I_{LED}$

► 5V supply, 0.7V 20mA LED:  $R = (5V - 0.7V) / 20\text{mA} = 215\Omega$

→ Nearest higher rated resistor 220  $\Omega$





# IoT - More Than The Core Technology

- It is not (just) the technology that makes IoT what it is
- It is the
  - Concepts, perception, commitment and the challenges
  - Facts that the entire industry is dealing with it nowadays
- The IoT Challenge:
  - *vast amount of devices using different hardware and software technologies, are connected between them and to the cloud which in turn provides many services, which handle a huge stream of data and analyze it and extract vital information about the current state of the system and via extended processing it can even predict future state*



# ← The IoT Challenge - Pets Vs Cattle – Pettle?



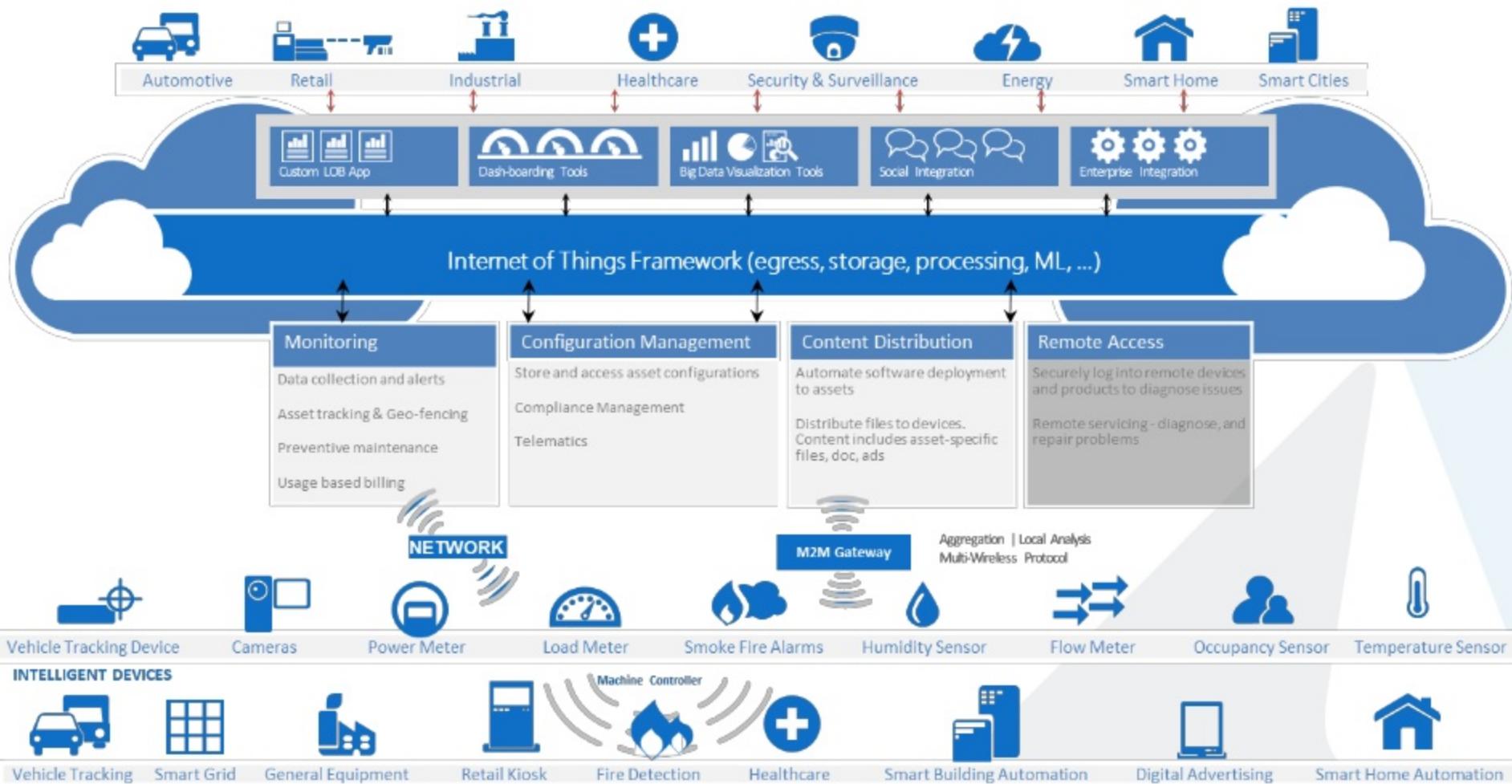


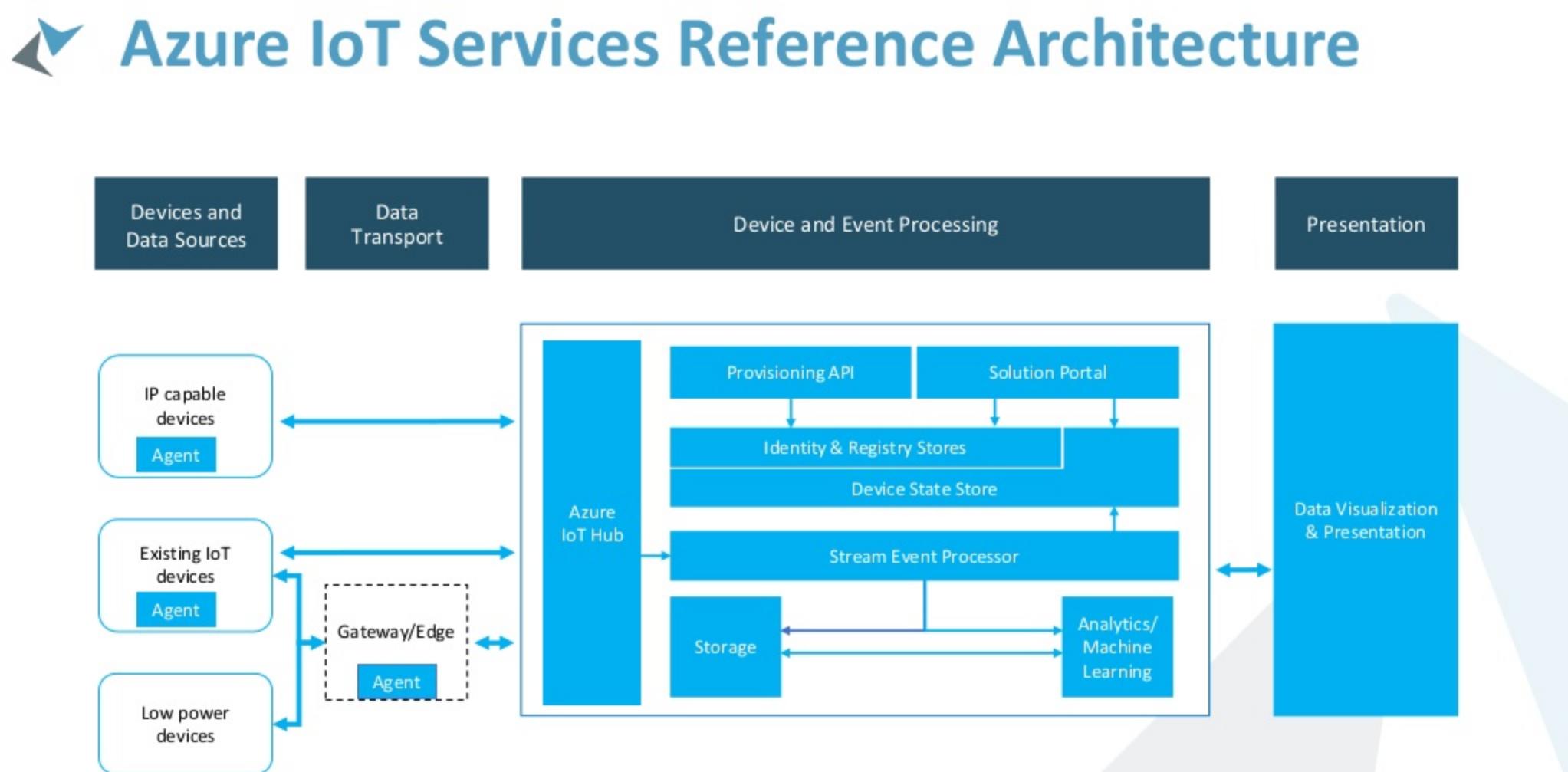
# The Modern IoT System

- Most large IoT systems include one or more of the following:
  - Many different end **devices** with **sensors** and **actuators**
  - Local **gateways**
  - A collection of **cloud services** that enables:
    - **Registration** of end devices
    - **Management** of end devices
    - **Controlling** of end devices
    - Different **communication protocols** that provide reliability and security
    - The ability to **collect a vast amount** of data in a very **high rate**
    - The ability to **analyze** the **stream** of information in **close to real-time** manner
    - The ability to **analyze** the **current** and **historical** collected information
    - The ability to **show** the resulted **conclusion** and the **collected data**



# High Level Architecture





# Microsoft Azure



## Application innovation

Accelerate innovation with the cloud



## Data and intelligence

Power decisions & apps with insights



## Openness and flexibility

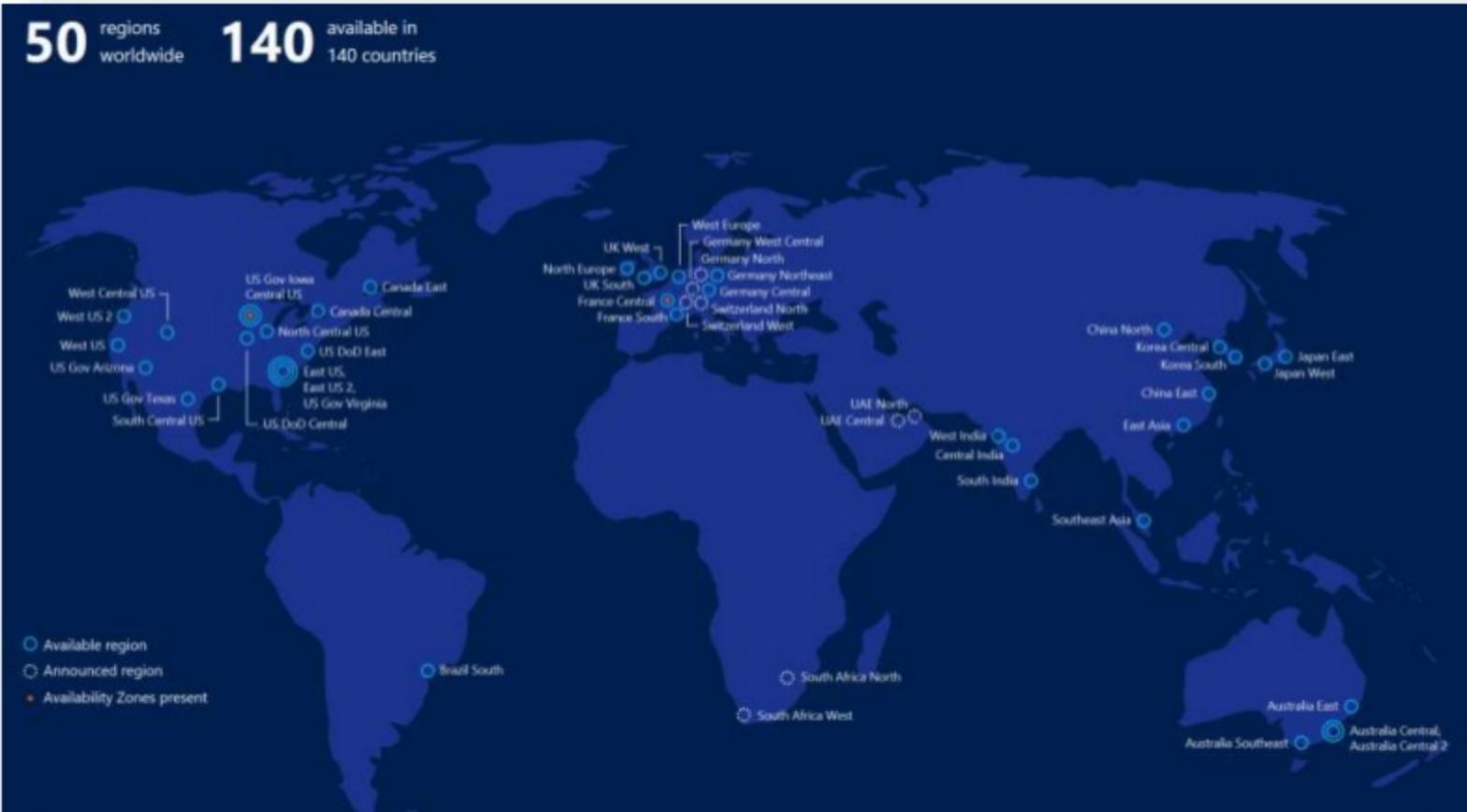
Build freely, deploy anywhere



## Trust

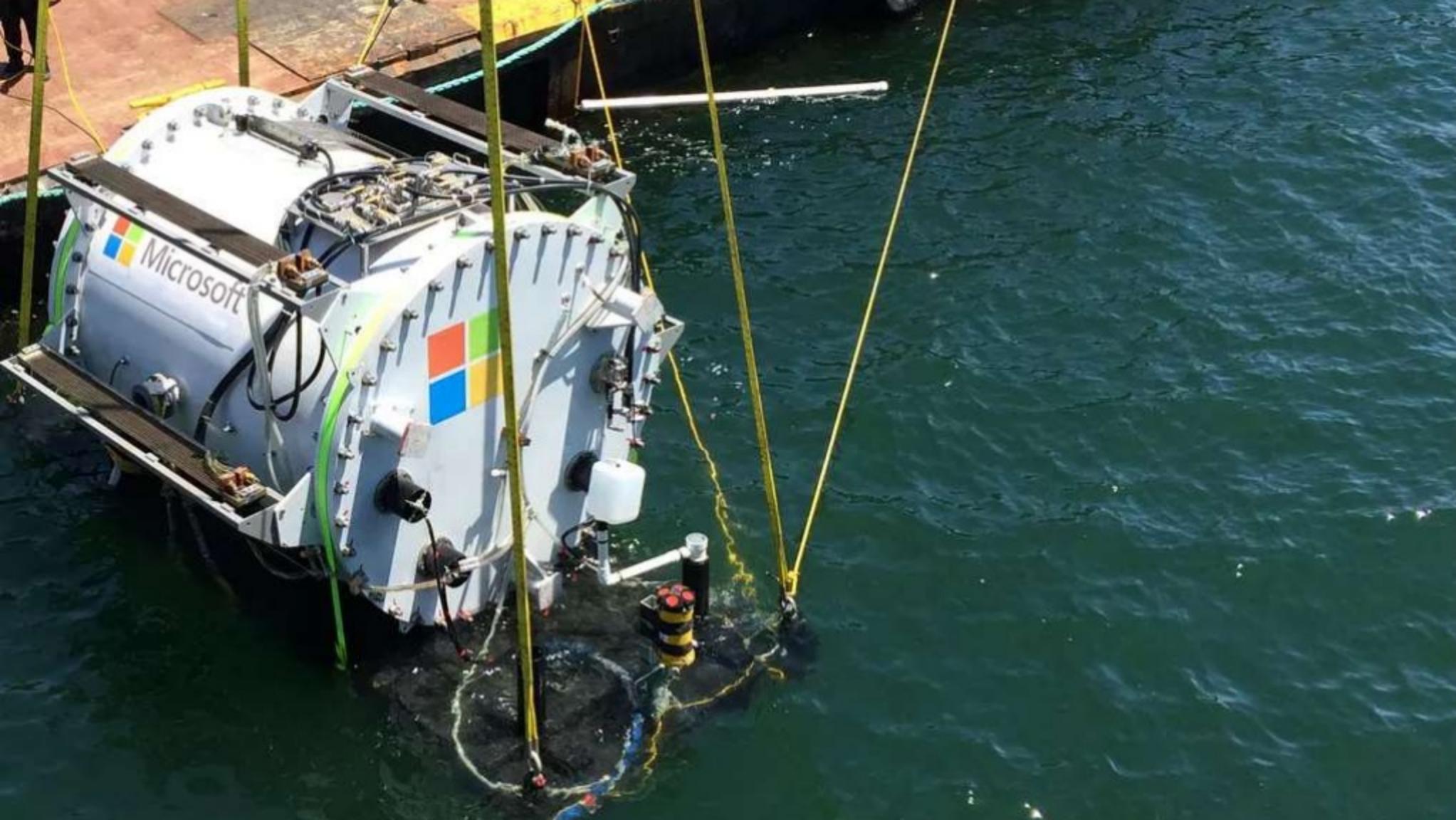
Protect your business

# Azure Regions



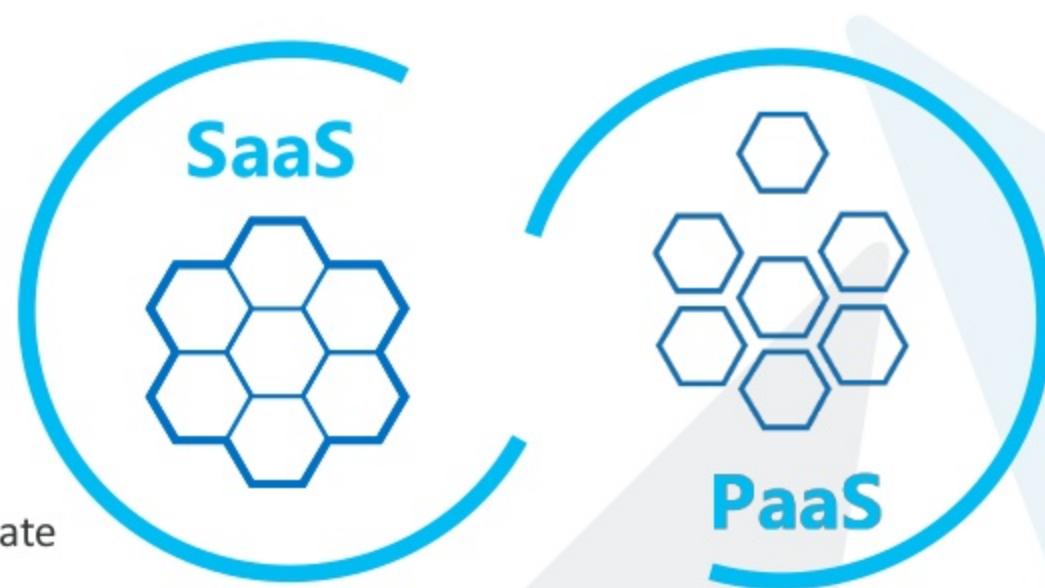
<https://azure.microsoft.com/en-us/regions>





# Azure IoT solutions approach

- SaaS – Microsoft IoT Central
  - Fully managed IoT SaaS
  - No cloud solution development expertise required
  - Configurable to your needs
  - Ideal for straightforward IoT needs
- PaaS – IoT Solution Accelerators
  - Preconfigured solutions
  - Deploy in minutes
  - Accelerate time to value
  - Ideal for solutions that require ultimate control





ISO  
9001  
CERTIFIED

## Create Application

We just need a few things from you, so we can create your application

Application Name \* ⓘ

URL \* ⓘ  
 .microsoftiotcentral-ppe.com

Directory \* ⓘ

Azure Subscription \* ⓘ  
Don't have a subscription? [Create subscription](#)

Resource Group \* ⓘ

Region \* ⓘ

Application Template

Custom Application  
Start with a blank template and define your application from scratch.

Sample Contoso  
Get started with a predefined application for a connected device.

Sample Devkits  
Want to connect a Raspberry Pi or M0 Chip IoT Devkit? Start with this predefined app and get them connected in minutes.

Payment plan

Free 30 Day Trial Application

Paid Application  
500 USD per application per month (includes 100 devices)  
0.50 USD per additional device per month after that  
30 USD per additional GB of data

By clicking create, you agree to the Microsoft IoT Central [Terms of use](#) and [Privacy Statement](#).

[Create](#)

Refrigerated Vending Machine (1.0.0)

# Refrigerated Vending Machine-1

Measurements Settings Properties **Rules** Dashboard

SIMULATED

+ New Rule

Save Cancel

### Configure Telemetry Rule

Name \*

Enable rule for all devices of this template On

Conditions +  
Temperature is greater than 15

Actions +

**Select Action**

Email	Coming Soon	Coming Soon	Coming Soon
Webhook Invoke a webhook to trigger external custom workflows.	SMS Send SMS to one or more recipients to notify about alert.	SAP Create service case automatically in your existing SAP instance.	Logic Apps Invoke Azure Logic Apps to simplify and implement scalable integrations and workflows in the cloud.
Azure Functions Invoke serverless code that enables you to run code on-demand in response to rule events.	Coming Soon	Coming Soon	Microsoft Dynamics 365 Integrate with Microsoft Dynamics 365 to automatically create service tickets and schedule proactive maintenance.
Salesforce Create service case automatically in your existing Salesforce instance.	Coming Soon	Coming Soon	Coming Soon



Refrigerated Vending Machine (1.0.0)

## Refrigerated Vending Machine - SN01255

[Connect this device](#)
[Measurements](#) [Settings](#) [Properties](#) [Rules](#) [Dashboard](#)

## Machine Info

Installation Address: 11/8/2017 7:38:42 AM Model: Double Zone

Serial Number:  
SN00001

## Maintenance Info

Installation Address: 11/8/2017 7:38:42 AM Maintenance Contract: true

Tampering Threshold: 0 Temperature Alert Thresh.: 0

## Customer Info

Customer Address: Customer Contact Email: Customer Contact Name:

Customer Contact Phone: Customer Name: \_\_\_\_\_

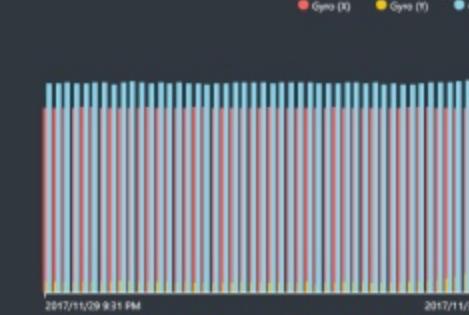
Max Temperature (degC): 22.7 Max Humidity (%): 58 Average Pressure (hPa): 1K

Past 1 week Past 1 week Past 1 week

## Internal Temperature



## Machine Orientation (X,Y,Z Axis)



## Internal Temperature Trend



## Tampering Monitor (X,Y,Z Axis)



## Environmental Data Trend



## Min Temperature (degC)



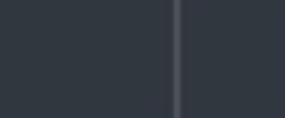
## Average Temperature (degC)



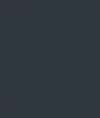
## Mag Field (X Axis) (mG)



## Mag Field (Y Axis) (mG)



## Mag Field (Z Axis) (mG)



# Microsoft IoT Central - Simplified predictable pricing

**FREE**

Trial for 30 days

Includes 10 devices  
and 100MB data traffic

**\$0.50 USD**

Per device, per month

\$500 fixed fee per month *includes first 100 devices and 1000 MB data traffic*

Additional devices \$0.50 USD  
includes 10 MB data traffic

Additional data traffic \$30 per 1 GB



# Azure IoT Solution Accelerators

A screenshot of a Microsoft Edge browser window displaying the Microsoft Azure IoT Solution Accelerators website at <https://www.azureiotsolutions.com/Accelerators>. The page features a dark header with the title and a light-colored main content area.

## Get started

A solution accelerator helps you speed up the development and deployment of your IoT solution. It's open source, so you can customize it to fit your business. Use it as a reference for your own solution, or as a demo to see how a finished solution can work for you.

Which solution is right for you?



### Remote Monitoring

Connect and monitor your devices to analyze untapped data and improve business outcomes by automating processes.

[Overview](#)   [Demo](#)   [Deployment guide](#)

### Connected Factory

Accelerate your journey to Industrie 4.0 – connect, monitor and control industrial devices for insights using OPC UA to drive operational productivity and profitability.

[Overview](#)   [Demo](#)   [Deployment guide](#)

### Predictive Maintenance

Anticipate maintenance needs and avoid unscheduled downtime by connecting and monitoring your devices for predictive maintenance.

[Overview](#)   [Demo](#)   [Deployment guide](#)

### Device Simulation

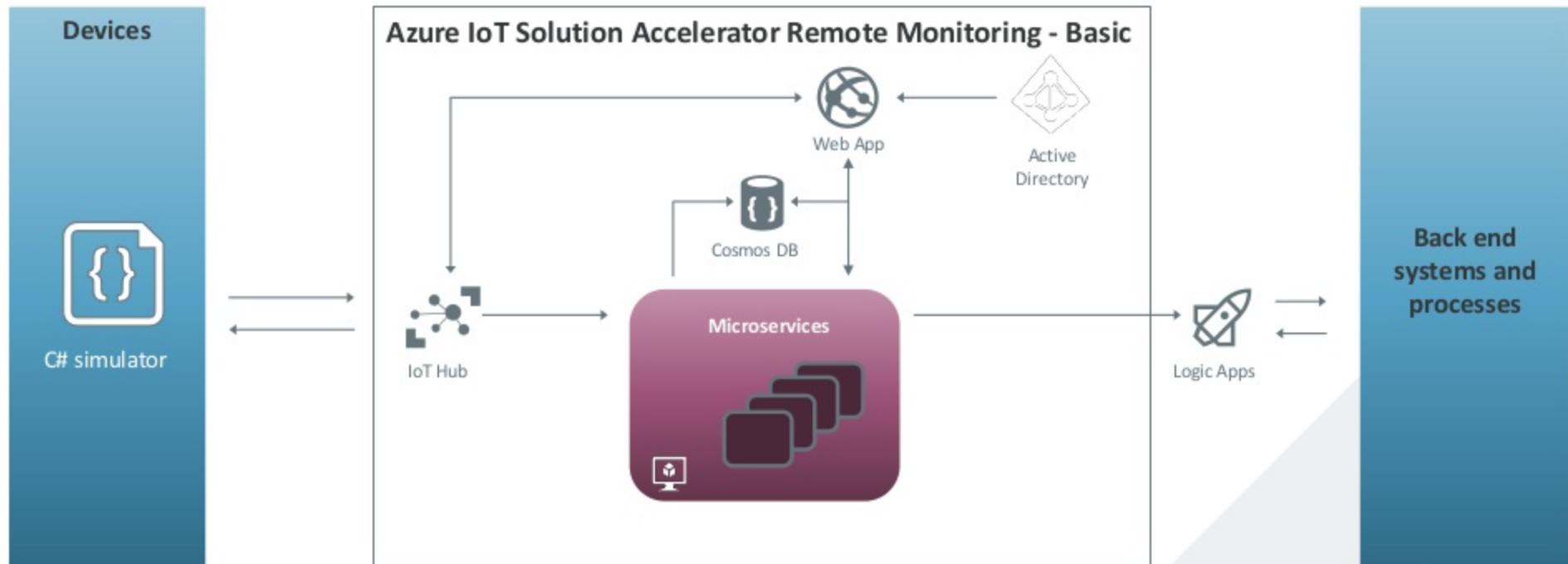
Streamline your IoT solution development by using simulated IoT devices to both build and test your solution throughout the software development lifecycle.

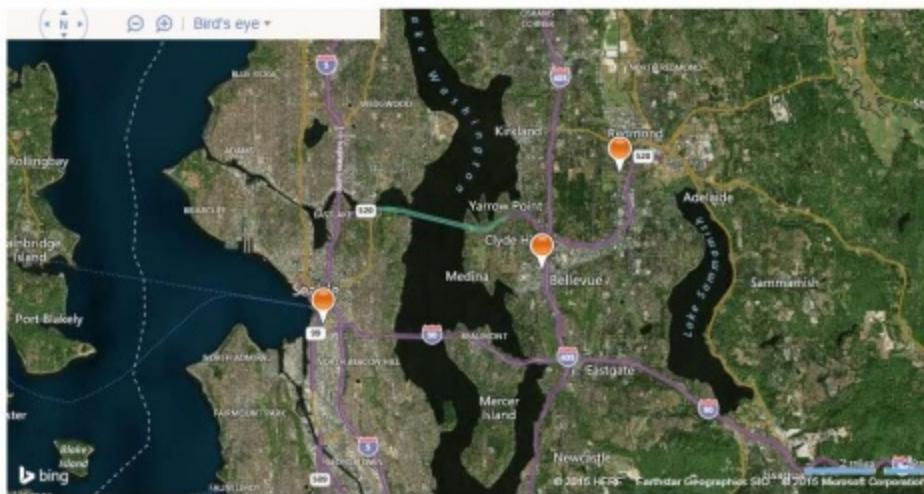
[Overview](#)   [Deployment guide](#)

[Feedback](#)



# Azure IoT Solution Accelerator – PaaS (almost) like a SaaS



DASHBOARDDEVICESRULESACTIONS

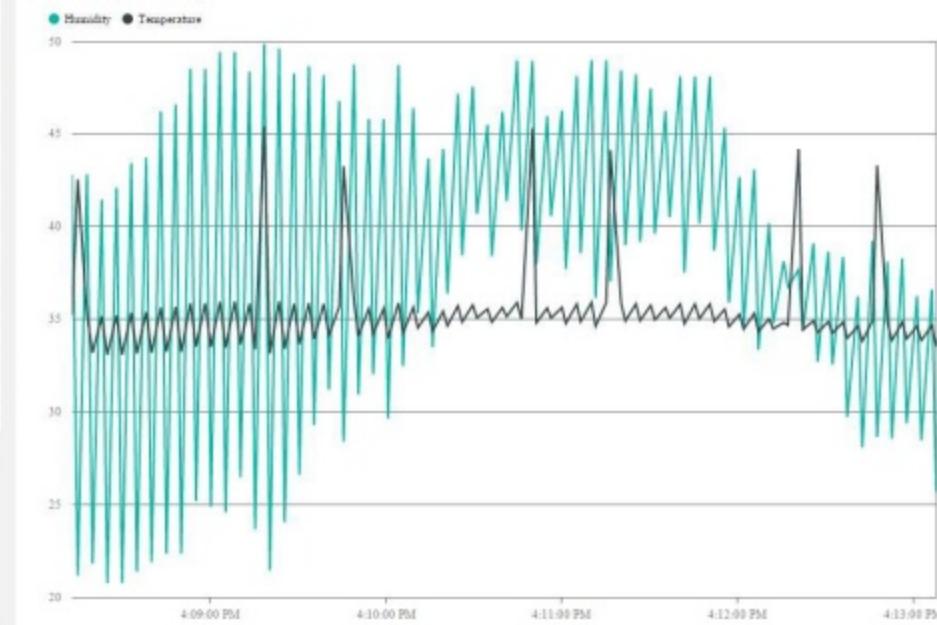
### Alarm History

TIME	DEVICE ID	RULE OUTPUT	VALUE
10/23/2015 4:12:47 PM	SampleDevice001_249	AlarmTemp	43.284
10/23/2015 4:12:47 PM	SampleDevice001_249	AlarmHumidity	28.637
10/23/2015 4:12:20 PM	SampleDevice001_249	AlarmTemp	44.188
10/23/2015 4:12:20 PM	SampleDevice001_249	AlarmHumidity	37.678
10/23/2015 4:11:50 PM	SampleDevice001_249	AlarmTemp	35.810
10/23/2015 4:11:50 PM	SampleDevice001_249	AlarmHumidity	48.104
10/23/2015 4:11:45 PM	SampleDevice001_249	AlarmTemp	35.810

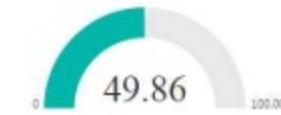
ADD A DEVICE

Device to View: SampleDevice001\_249 ▾

### Telemetry History



Max of device humidity



Min of device humidity



Average of device humidity



## Introducing Microsoft Azure IoT Hub

- IoT Hub is available as a stand-alone service or as one of the services used in the new Azure IoT Suite
- Azure IoT Hub is designed to connect your devices to Azure. It supports:
  - Millions of simultaneously connected devices
  - Per-device authentication
  - High throughput data ingestion
  - Scale device management
  - Reliable command and control





# IoT Hub Price & Capabilities

FEATURE	BASIC	STANDARD
Device-to-cloud telemetry	✓	✓
Per-device identity	✓	✓
Message Routing, Event Grid Integration	✓	✓
HTTP, AMQP, MQTT Protocols	✓	✓
DPS Support	✓	✓
Monitoring and diagnostics		✓
Cloud-to-device messaging		✓
Device Management, Device Twin		✓
IoT Edge		✓





# Price & Capabilities

BASIC TIER	PRICE PER UNIT (PER MONTH)	TOTAL NUMBER OF MESSAGES/DAY PER UNIT	MESSAGE METER SIZE	MAX # OF UNITS
B1	\$10	400,000	4 KB	200
B2	\$50	6,000,000	4 KB	200
B3	\$500	300,000,000	4 KB	10

STANDARD TIER	PRICE PER UNIT (PER MONTH)	TOTAL NUMBER OF MESSAGES/DAY PER UNIT	MESSAGE METER SIZE	MAX # OF UNITS
FREE	FREE	8,000	0.5 KB	1
S1	\$25	400,000	4 KB	200
S2	\$250	6,000,000	4 KB	200
S3	\$2,500	300,000,000	4 KB	10

Operation throttles & Other Limits:

<https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-devguide-quotas-throttling>



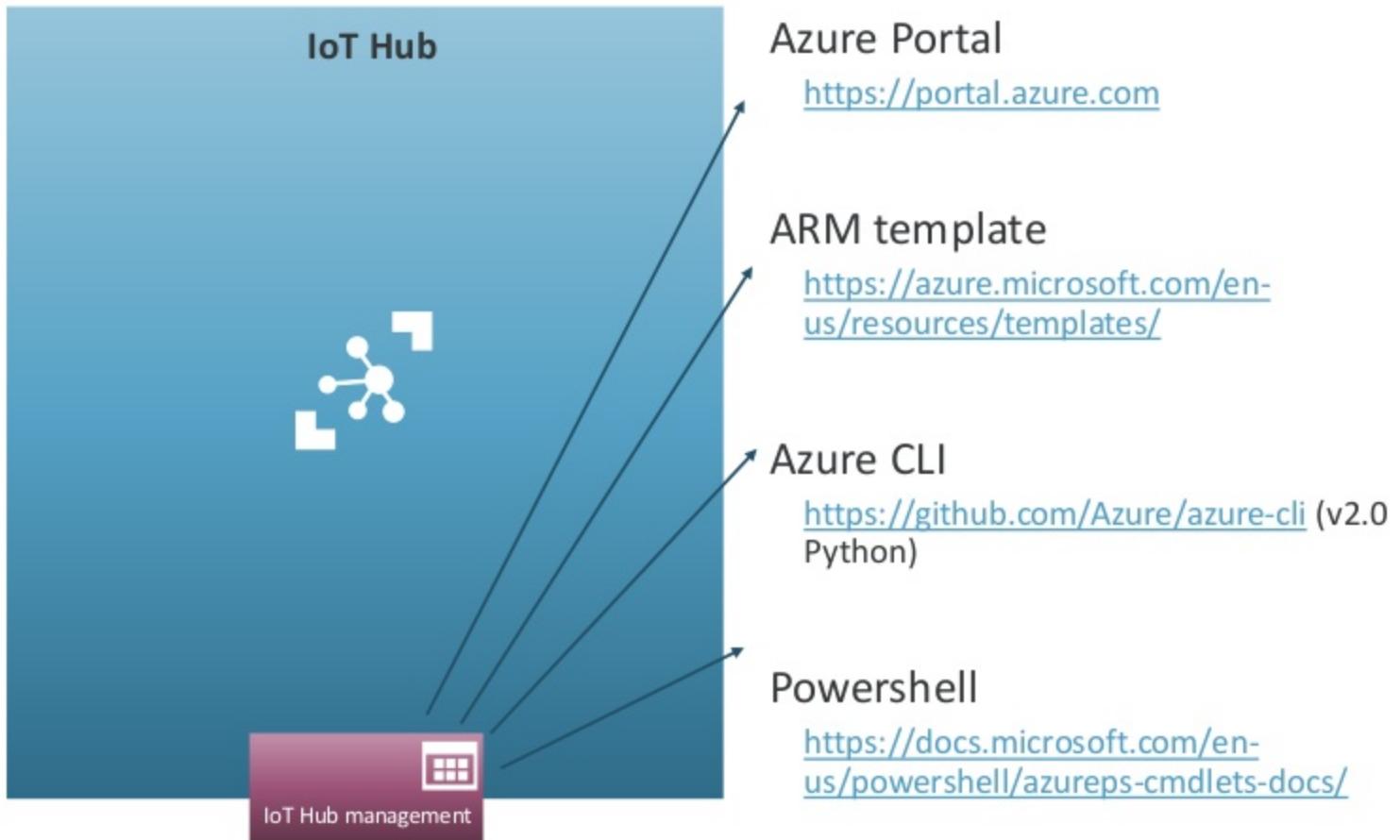


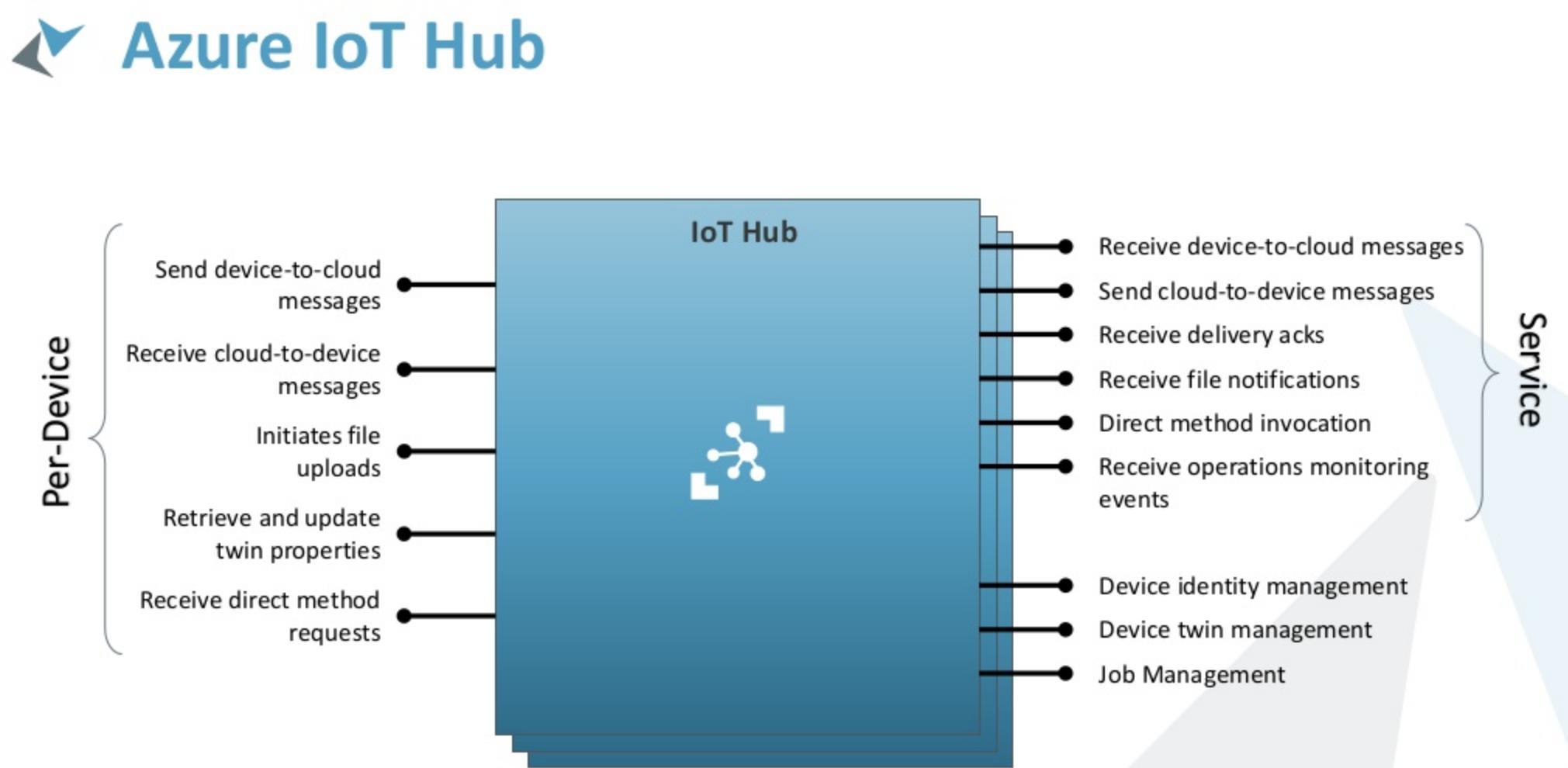
# Limits, Quota & Throttling

TIER	SUSTAINED THROUGHPUT	SUSTAINED SEND RATE
B1, S1	Up to 1111 KB/minute per unit (1.5 GB/day/unit)	Average of 278 messages/minute per unit (400,000 messages/day per unit)
B2, S2	Up to 16 MB/minute per unit (22.8 GB/day/unit)	Average of 4,167 messages/minute per unit (6 million messages/day per unit)
B3, S3	Up to 814 MB/minute per unit (1144.4 GB/day/unit)	Average of 208,333 messages/minute per unit (300 million messages/day per unit)



# Pick your favorite to create a hub





# Azure IoT Hub SDKs

## ➤ Device-facing

- For devices and field gateways

## ➤ Platforms

- [Many devices](#)
- RTOS (FreeRTOS)
- Linux  
(Ubuntu, Debian, Fedora, Raspbian, Angstrom)
- Windows 7/8/10
- ARM mbed
- Android
- iOS

## ➤ Device SKD by programming language

- For device side development
- [Azure IoT device SDK for C](#)
- [Azure IoT device SDK for .NET](#)
- [Azure IoT device SDK for Java](#)
- [Azure IoT device SDK for Node.js](#)
- [Azure IoT device SDK for Python](#)

## ➤ Service-facing SDK by programming language

- For back-ends and cloud gateways
- [Azure IoT service SDK for .NET](#)
- [Azure IoT service SDK for Node.js](#)
- [Azure IoT service SDK for Java](#)
- [Azure IoT service SDK for Python](#)

## ➤ [Azure IoT Gateway SDK](#)

- Infrastructure and modules to create IoT gateway solutions

## ➤ [Azure IoT Hub REST API](#)

- For all the rest...

## ➤ [Advance IoT Hub topics](#)

- [IoT Hub endpoints](#)
- [IoT Hub query language for device twins and jobs](#)
- [Quotas and throttling](#)
- [IoT Hub MQTT support](#)



# C Language Device SDK

- Many low price, low energy, SoC can be only developed using the C language
- The IoT team has built a full-blown C SDK to connect and communicate with the IoT Hub
  - It supports all IoT Hub Device capabilities, including:
    - Secure connection and communication using three protocols (HTTP, AMQP, MQTT)
    - Sending telemetry messages using JSON serialization and set of macros to provide message serialization
    - Receiving messages from the cloud
    - Handling device twin synchronization
    - Invoke a function with request-reply message exchange pattern when the IoT Hub calls
    - Upload files
- There are two levels of functions:
  - With \*\_LL\_\* - low level API – for device that has no threading capabilities
  - With no \*\_LL\_\* - support background message processing using threads
- Follow this intro to understand the various functions



C  
Language



# ◀ Connecting and Defining A Model (C SDK)

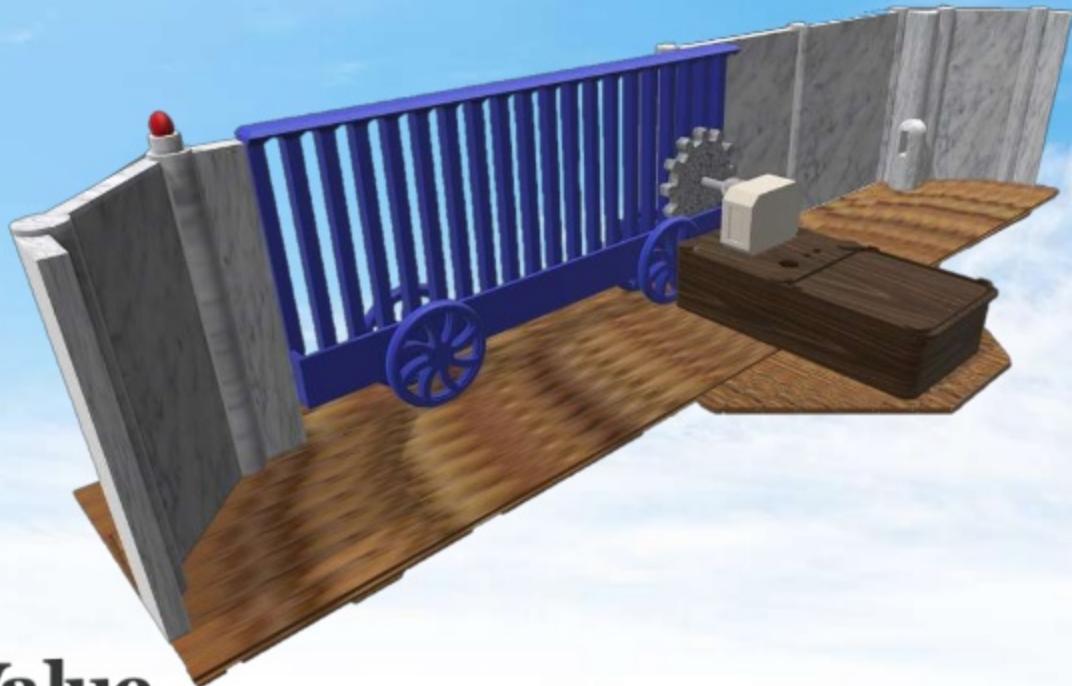
```
if ((iotHubClientHandle = IoTHubClient_LL_CreateFromConnectionString(connectionString, MQTT_Protocol)) ==  
{  
    (void)printf("ERROR: iotHubClientHandle is NULL!\r\n");  
}  
else  
{
```

```
BEGIN_NAMESPACE(WeatherStation);  
  
DECLARE_MODEL(ContosoAnemometer,  
WITH_DATA(ascii_char_ptr, DeviceId),  
WITH_DATA(int, WindSpeed),  
WITH_ACTION(TurnFanOn),  
WITH_ACTION(TurnFanOff),  
WITH_ACTION(SetAirResistance, int, Position)  
);  
  
END_NAMESPACE(WeatherStation);
```

```
ContosoAnemometer* myWeather = CREATE_MODEL_INSTANCE(WeatherStation, ContosoAnemometer);  
if (myWeather == NULL)  
{  
    (void)printf("Failed on CREATE_MODEL_INSTANCE\r\n");  
}  
else  
{
```



# Building an Azure IoT controlled device



Inspiring Code, Creating Value.

# ESP8266 – The Right Device for the Job



Free shipping 1pcs/lot **ESP8266 ESP-01** remote serial Port WiFi wireless module through walls Wang

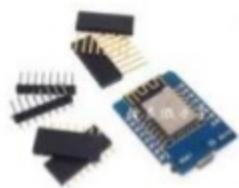
5.0 BEST CHOICE ELECTRONICS CO.,LTD

Offline

US \$1.68 / piece  
Free Shipping

★★★★★ Feedback(220) | Orders (244)

Add to Wish List



D1 mini - Mini NodeMcu 4M bytes Lua WiFi Internet of Things development board based ESP8266 by WeMos

5.0 BEST CHOICE ELECTRONICS CO.,LTD

Offline

US \$2.85 / piece  
Free Shipping

★★★★★ Feedback(31) | Orders (66)

Add to Wish List



CH340G NodeMcu V3 Lua Wireless Internet Of Things Development Board 3.3V Network WIFI Connector Module Based ESP8266 ESP-12E

5.0 Worldchips

Chat now!

US \$2.98 / piece  
Free Shipping

Orders (68)

Add to Wish List

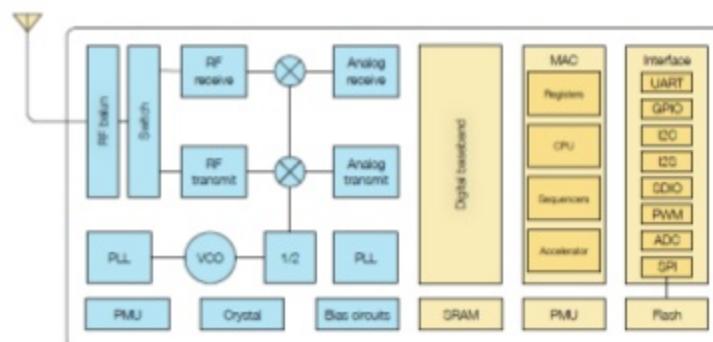


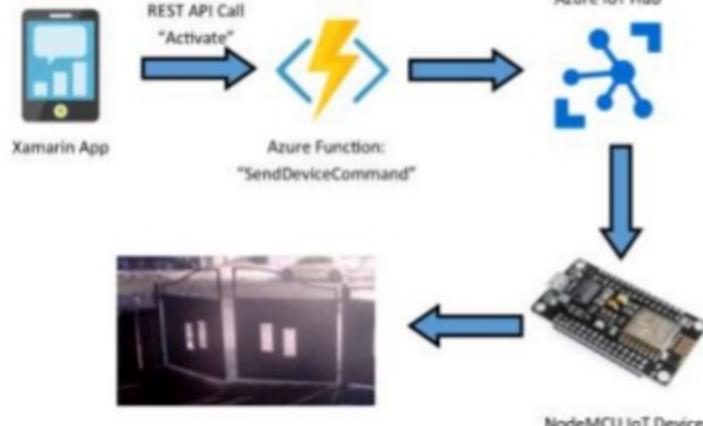
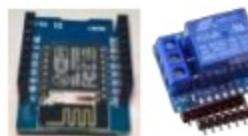
Figure 1-1: ESP8266EX Block Diagram





# The Basic System

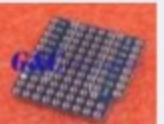
- WeMos D1 Mini Pro + Relay Shilled
- Azure IoT Hub
- Xamarin App with One Button
- Azure IoT Hub Device SDK C App
- Building it



- Create an IoT Hub using Azure Portal
- Connect The Relay Shield to the WeMos D1
- Connect the WeMos D1 to the computer
- Write simple Arduino app that trigger the relay on Azure IoT Hub Command
  - Create and use the device connection string
- Compile and download the Arduino code
- Test using Device Explorer
- Create Azure Function that sends commands to devices
- Write a simple Xamarin App that sends the command using the Azure Function

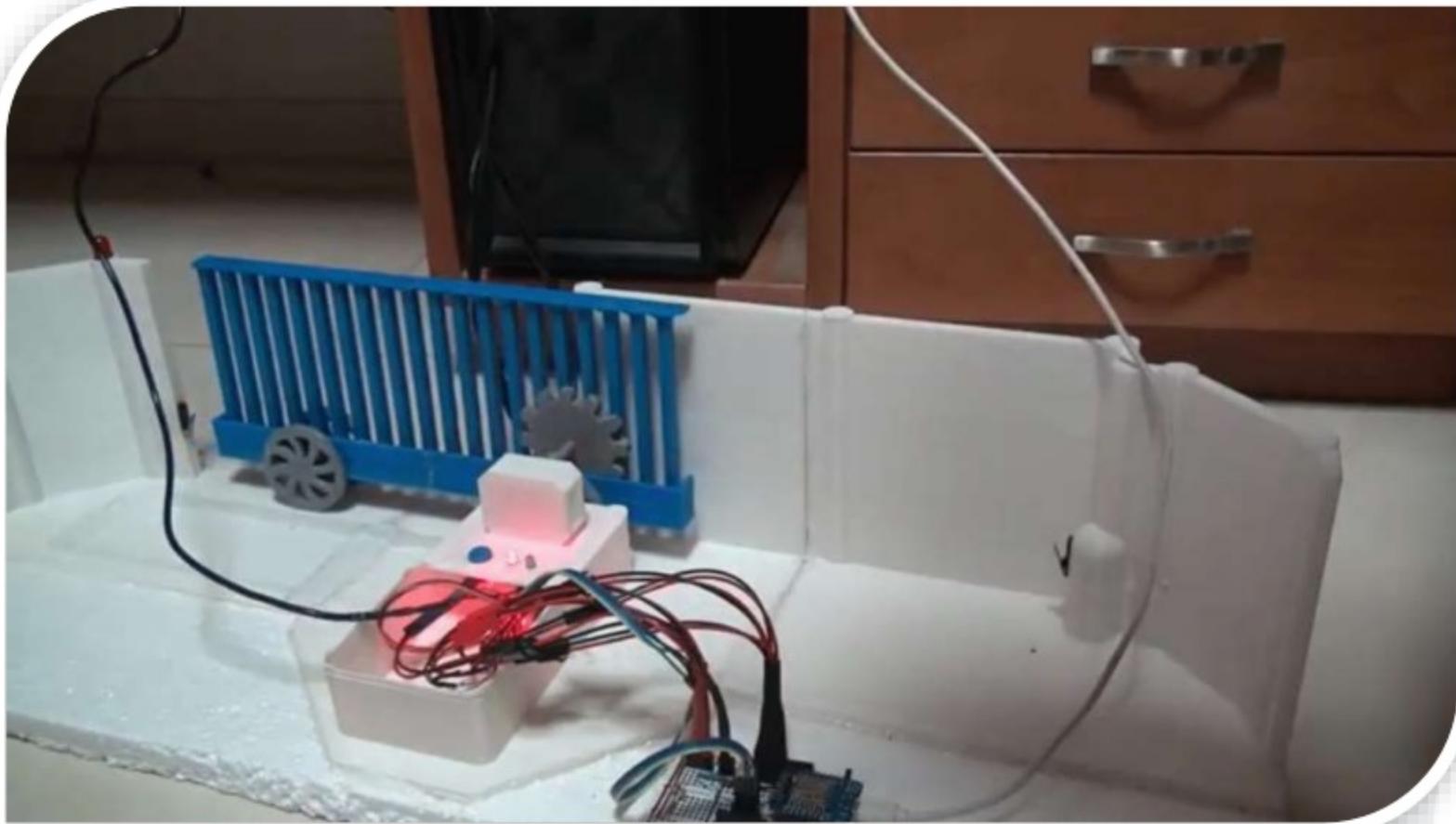


# Our Cloud Gate Controller BOM < \$10

Device	Picture	Price
<a href="#"><u>WeMos D1 Mini</u></a>		\$2.85
<a href="#"><u>WeMos ProtoBoard Shield</u></a>		\$0.68
<a href="#"><u>WeMos Relay Shield</u></a>		\$1.00
<a href="#"><u>Button</u></a>		0.0143
5 mm <a href="#"><u>Led</u></a> X 2 (Red & Green) + 330Ω <a href="#"><u>Resistor</u></a> X 2		\$0.0089 X 2 \$0.0059 X 2
Power Supply <a href="#"><u>Module</u></a> + AC 110C-240V <a href="#"><u>Converter</u></a>		\$0.58 \$2.08



# Demo



# The V1 System Problem

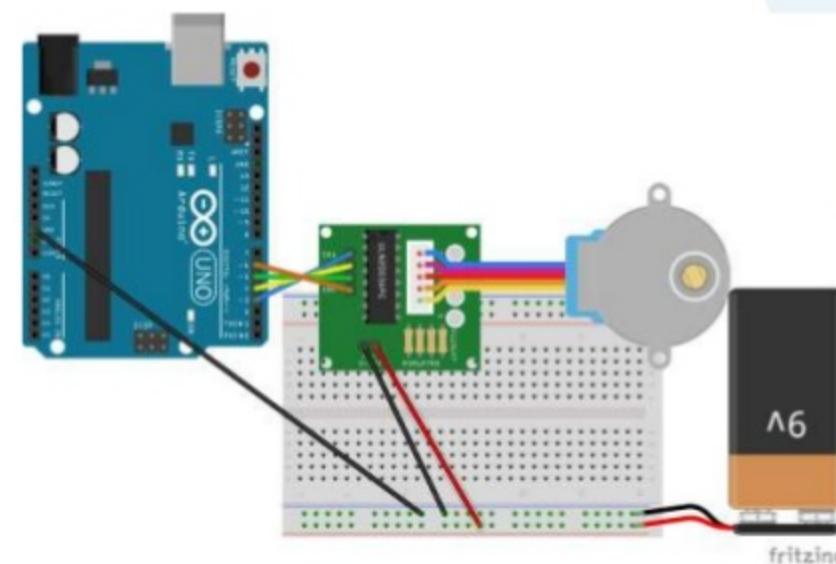
- The Gate model system uses a stepper motor
  - The stepper motor requires a smooth sequence of
- To have a smooth movement, the sequence has to keep the same frequency
  - Azure IoT Client SDK, does a polling from time to time, and delays this sequence!

Alternate Full Step Sequence  
(Provides more torque)

Index	1a	1b	2a	2b
1	1	0	0	1
2	1	1	0	0
3	0	1	1	0
4	0	0	1	1
5	1	0	0	1
6	1	1	0	0
7	0	1	1	0
8	0	0	1	1

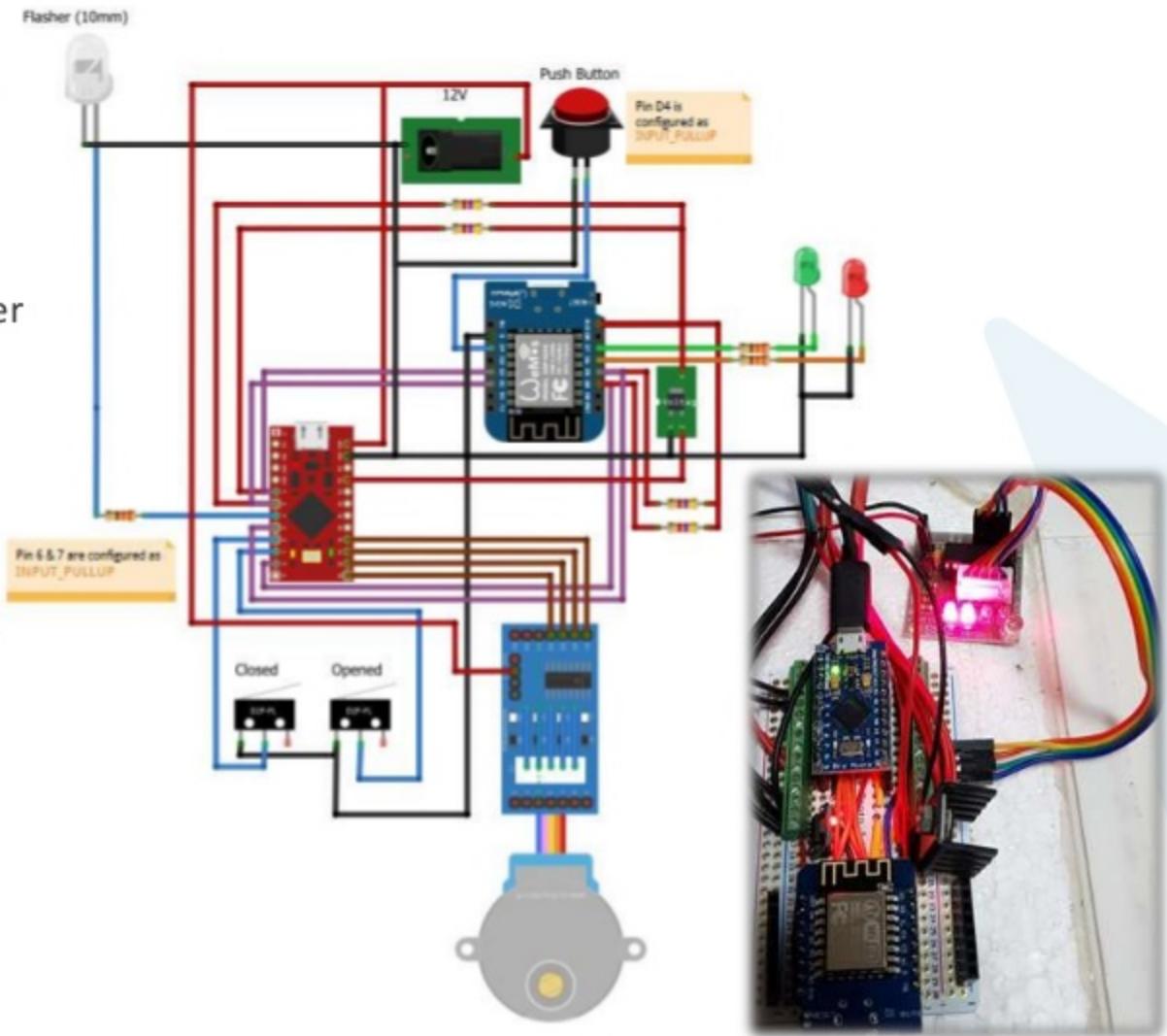
Half Step Sequence

Index	1a	1b	2a	2b
1	1	0	0	0
2	1	1	0	0
3	0	1	0	0
4	0	1	1	0
5	0	0	1	0
6	0	0	1	1
7	0	0	0	1
8	1	0	0	1
9	1	0	0	0
10	1	1	0	0
11	0	1	0	0
12	0	1	1	0
13	0	0	1	0
14	0	0	1	1
15	0	0	0	1
16	1	0	0	1



## The V2 Solution: Have Two Arduinos

- The WeMod D1 – The Cloud Controller Smooth connectivity
- The Pro Micro – The Gate Controller
  - Smooth gate operation
- Communication, can be:
  - I<sup>2</sup>C, Serial, SPI, Custom
- Since there is a conflict of voltage 3.3V to 5V, I choose to use pullup resistors, and implement a custom communication protocol



# The Gate System

► A complete solution:

- Provides HTTP web interface for setup and operation
- Access point mode to enables device settings and secure registration via a dedicated web page
- Once registered to an IoT hub, all communication is secured and done only with the cloud
  - Send the command “web” or reset the device to get back the web interface

► Communication:

- Accept the commands Open, Close, Stop, Web
- Provides Status: Open, Opening, Stopped, Closing & Close

These values will be saved in the device eeprom. esprom reset: press the button for 20 seconds.

Router Settings

On submit the device will reboot and will try to connect to the chosen network. The green Led light will blink the IP Address.

Choose WiFi Network:

- ESP\_1723D4 Signal:-64 \*
- Alonet Signal:-58
- AlonetGuest Signal:-56
- alimini Signal:-93
- GIPSY Signal:-92

WiFi Password

Microsoft Azure IoT Hub Configuration

Enter the Azure IoT Hub device connection string. For more information: [here](#) and [here](#).

Azure IoT Hub Connection String:

Device Id Name

Use Azure IoT Hub or Web Server for issuing commands

- ESP8266 Web Server
- Azure IoT Hub

Push Button settings

Long press period

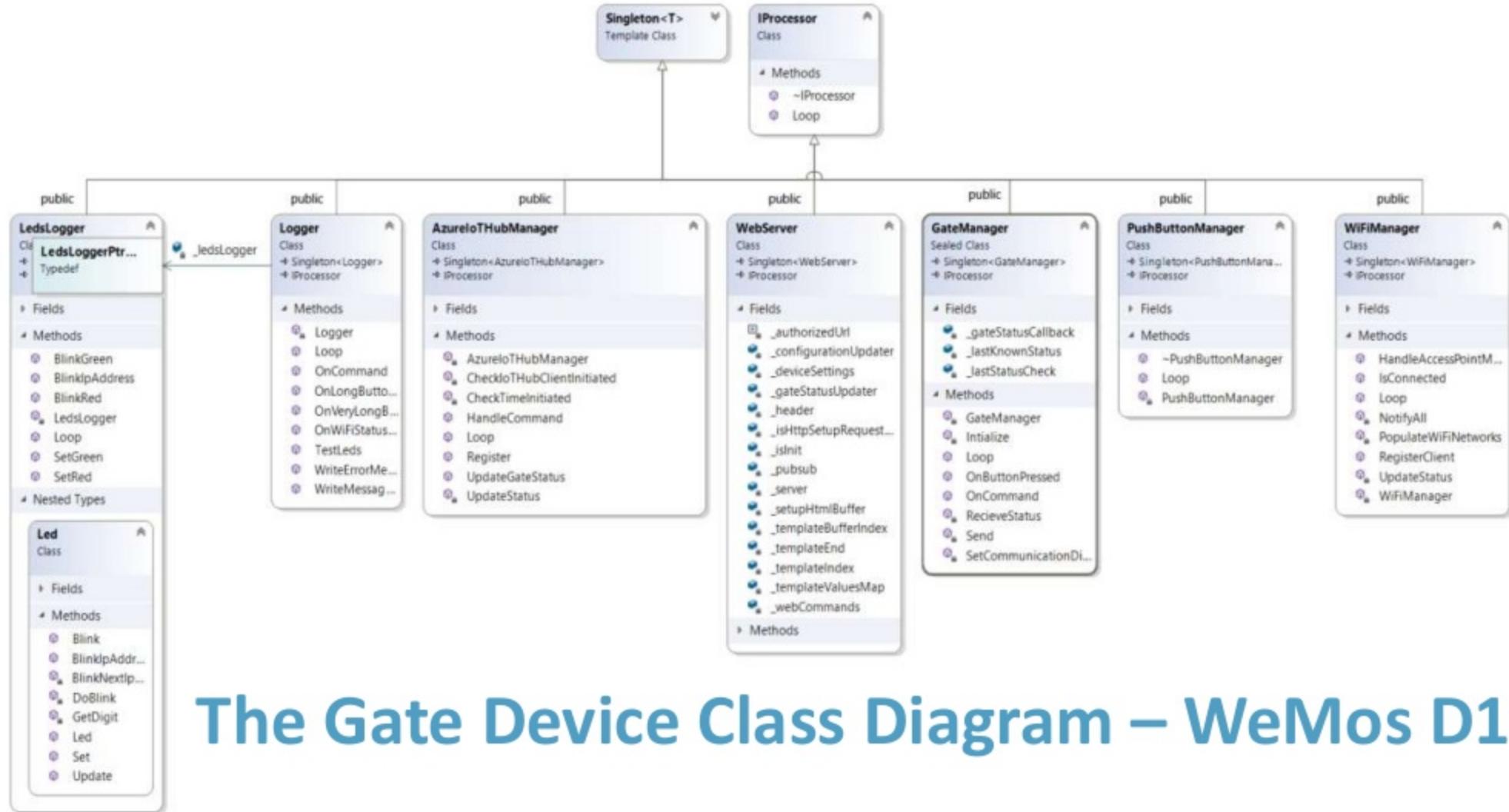
Very long press period

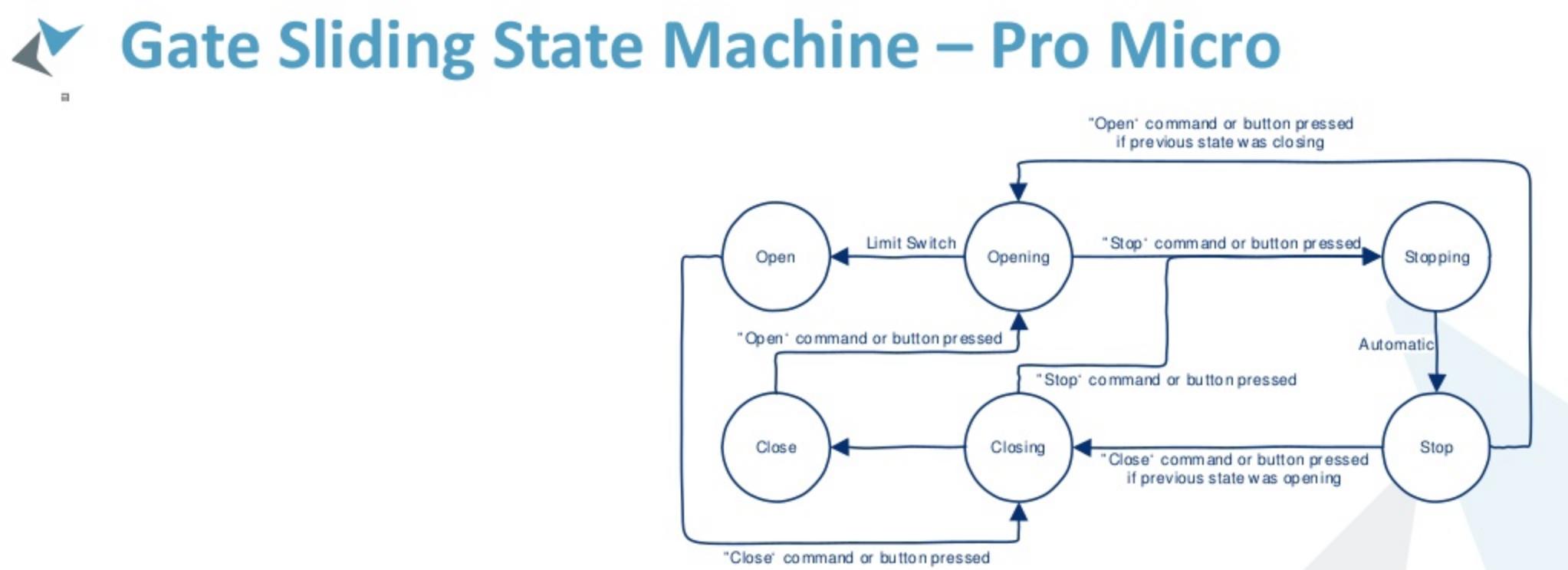
Push Button Behaviour

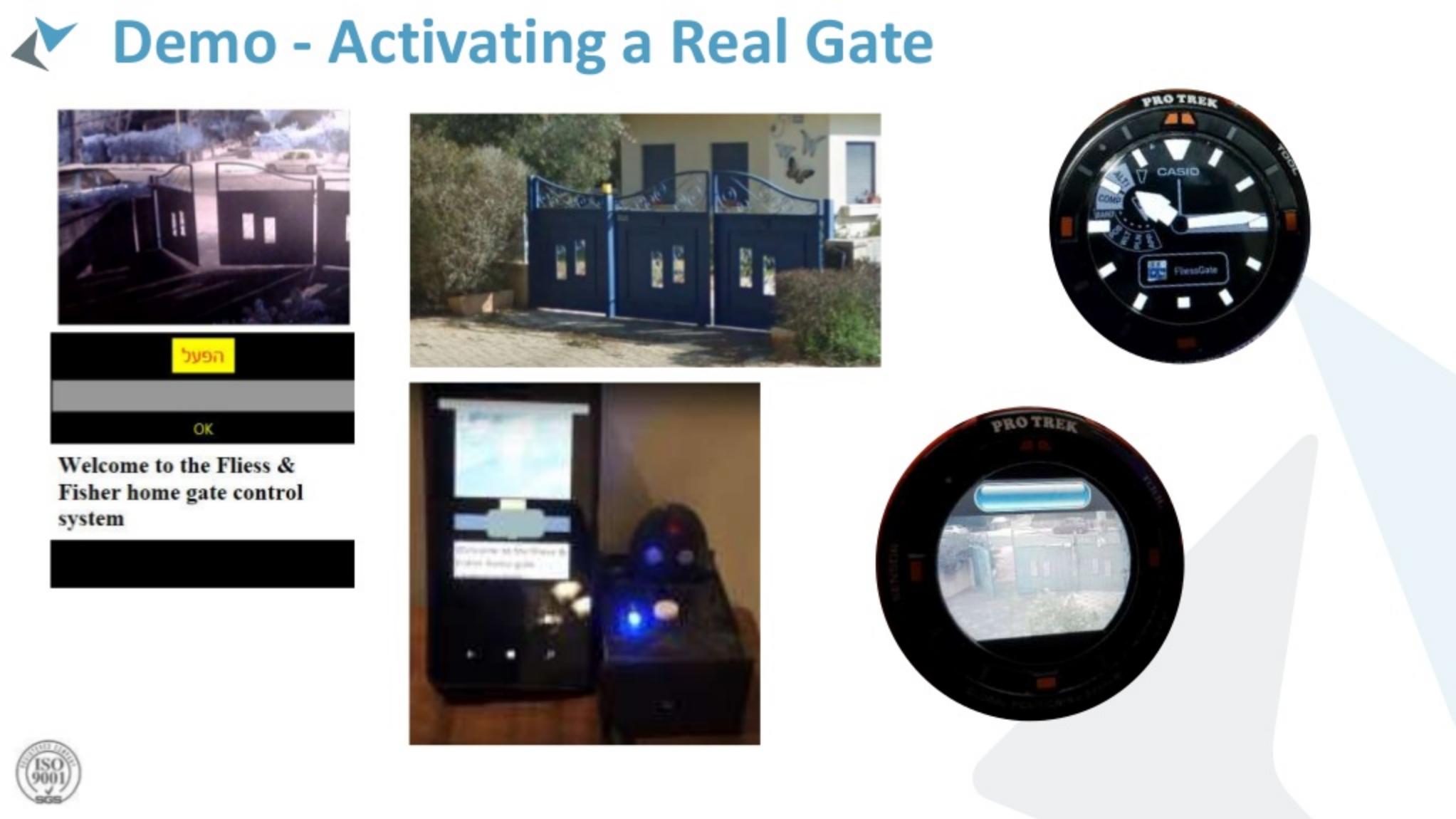
- Toggle (On/Off)
- Pulse (On and then Off)

Push button and Activate command "On" period

Submit







# Demo - Activating a Real Gate



Welcome to the Fliess &  
Fisher home gate control  
system



# ◀ Safety & Automation

## ➤ Alexa – Open Gate

- Gate control with a single signal – How does Alexa know the current gate state?
- Is it safe to operate the gate?

## ➤ Automatically closed a left opened gate

- Same issues



# Custom Vision – Azure Cognitive Services

Custom Vision Read-Only

FliessGateStatus

TRAINING IMAGES PERFORMANCE PREDICTIONS Train Quick Test ?

Refine Add images Delete Tag images Select all

Iteration

Iteration 27

Tags

Showing:

CarEntering X

Search for

CarAfterExiting  
 CarBeforeEntering  
 CarEntering  
 CarExiting  
 Closed  
 Middle  
 Opened

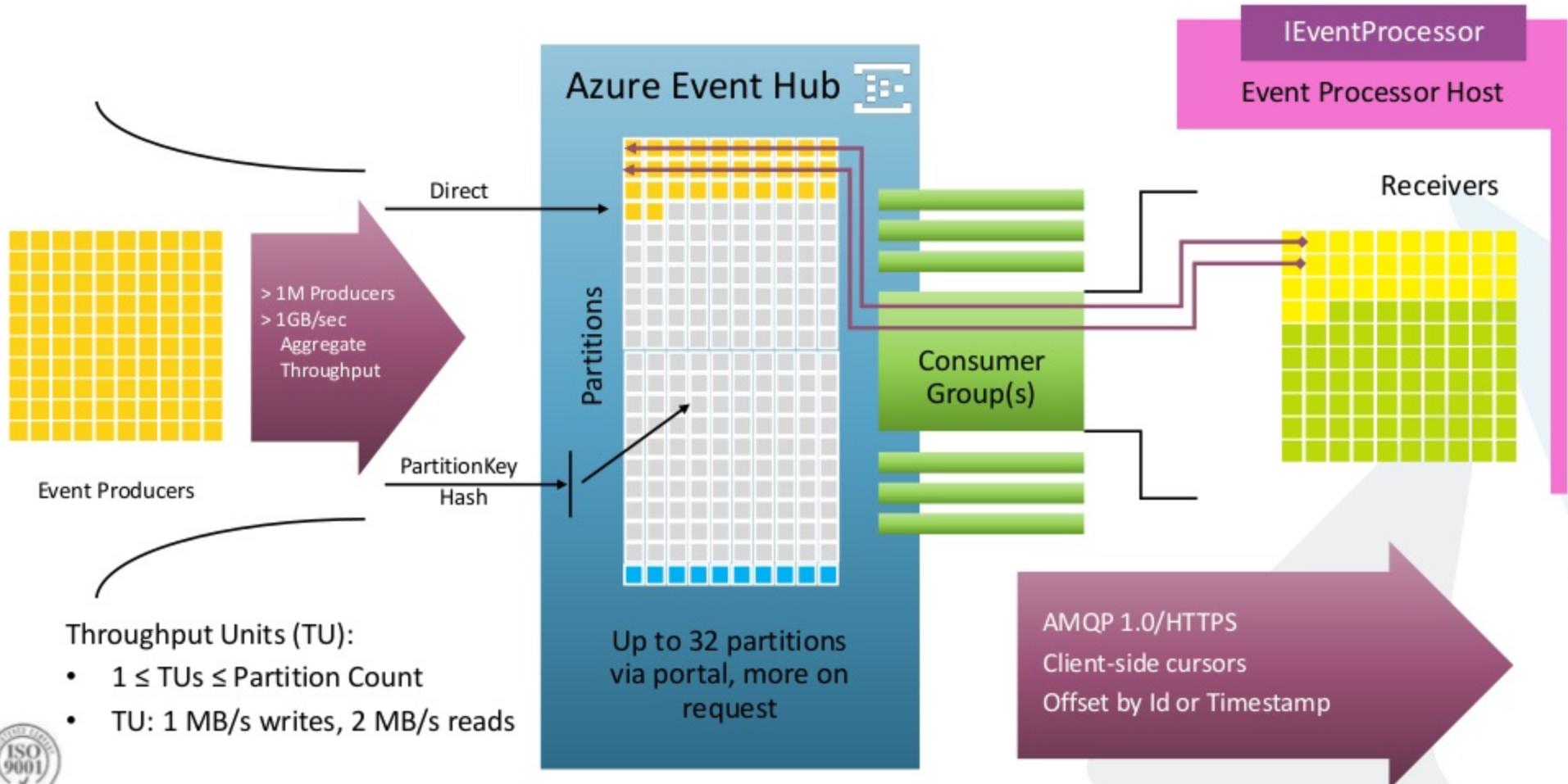




The background of the image is a lush, diverse coral reef ecosystem. It features several large, yellowish-green brain corals with distinct lobes. Interspersed among them are smaller, more delicate-looking coral species, possibly soft corals or certain types of polyps. A few small, colorful fish are visible, swimming gracefully between the coral structures. The overall lighting is bright and natural, suggesting a sunny day at sea.

Going Deeper...

# Processing the IoT Hub Messages – Event Hub

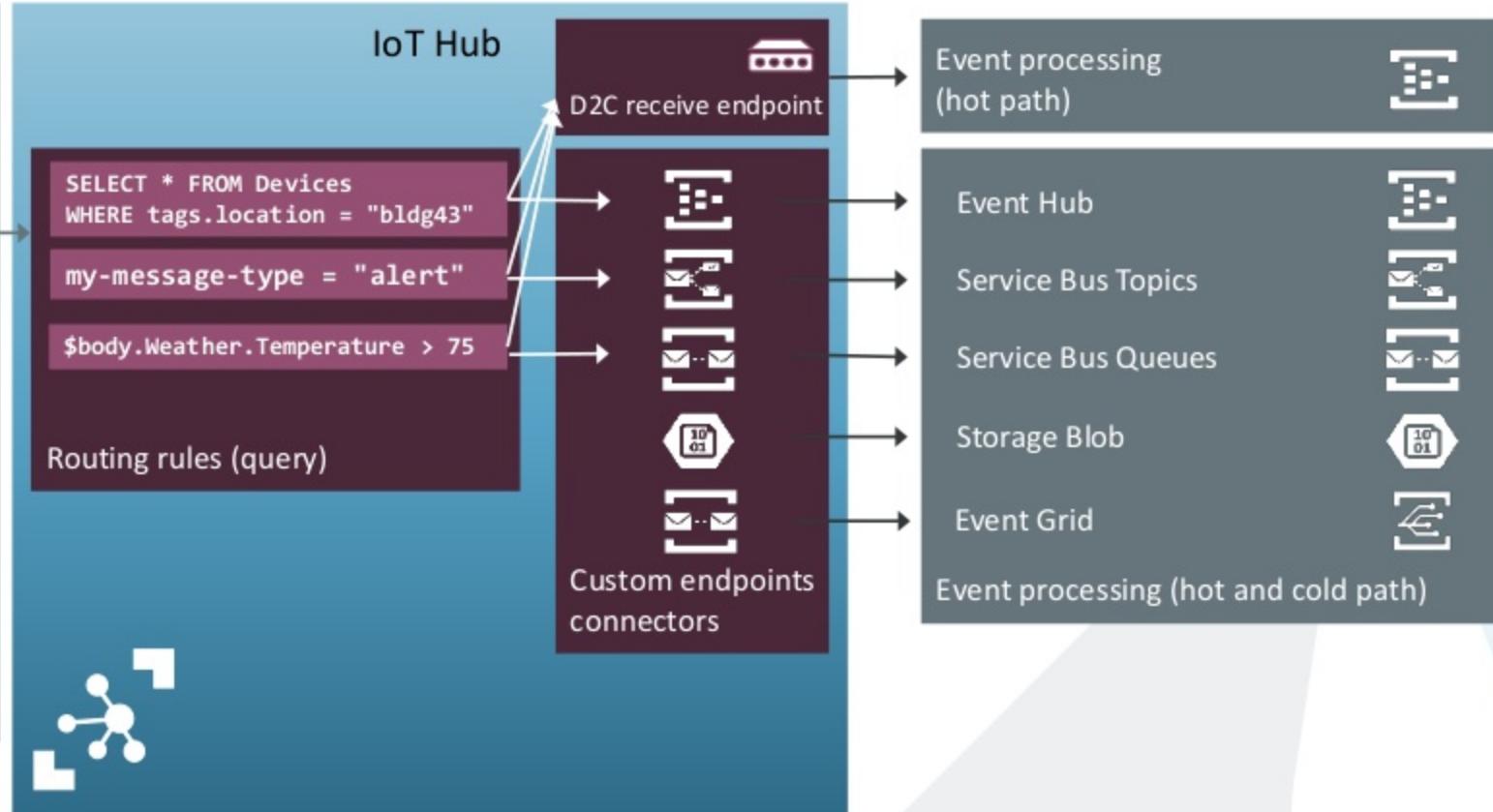


# Routing telemetry data

Header:  
\$content-encoding="utf-8"  
\$content-type =  
"application/json"  
my-message-type = "alert"

Body  
{  
    "Weather":{  
        "Temperature":50,  
        "Time":"01:23:12Z"  
    }  
}

Device 



# ↗ ESP32 – Give Me Some Power!



Lileytech



ESP32 ESP-32 ESP-32S Development Board WiFi Bluetooth Ultra-Low Power Consumption Dual Cores ESP32 Board LuaNode ESP 8266

☆☆☆☆☆ 0.0 (1 votas) | 5 orders

Price: US \$8.00 /piece

Discount Price: **US \$7.60** /piece -5% 2 days left

QR Get our app to see exclusive prices

Shipping: Free Shipping to Israel via China Post Registered Air Mail ⓘ

Estimated Delivery Time: 25-41 days ⓘ

Quantity:    piece (19930 pieces available)

Total Price: **US \$7.60**

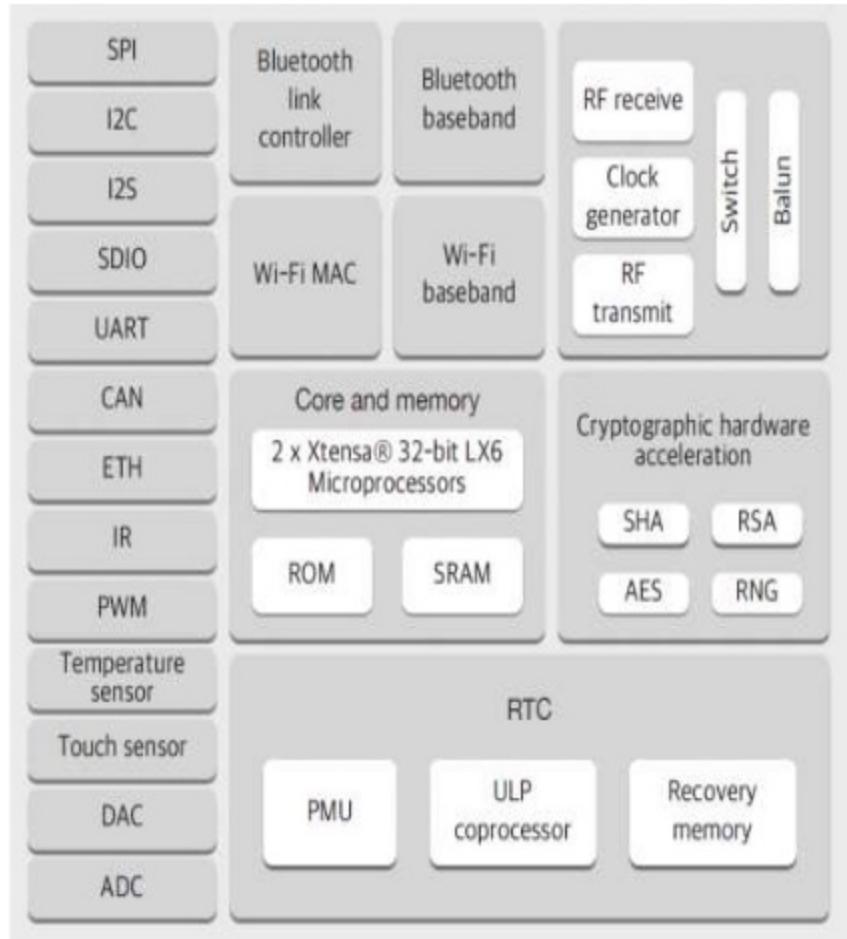
Buy Now

Add to Cart

Heart Add to Wish List (17 Adds) ⓘ



# Some ESP32 Features

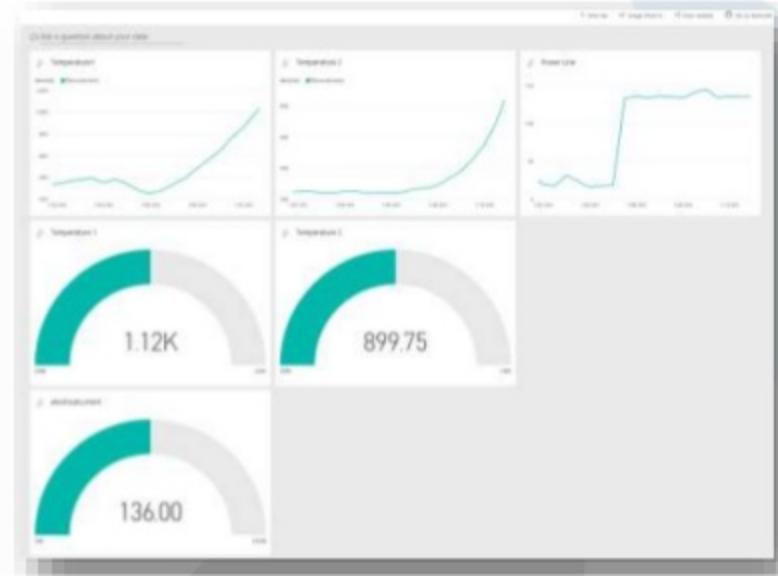
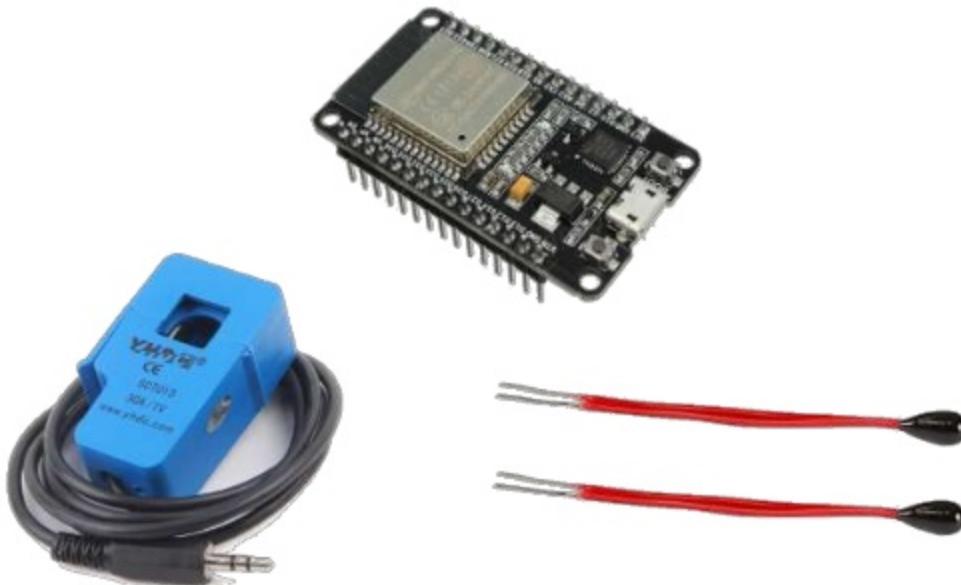


- Twin-core CPU (200 MIPS)
- Wifi and Bluetooth
- Crypto acceleration
- A-to-D and D-to-A
- Many GPIOs
- Many Communication Interfaces



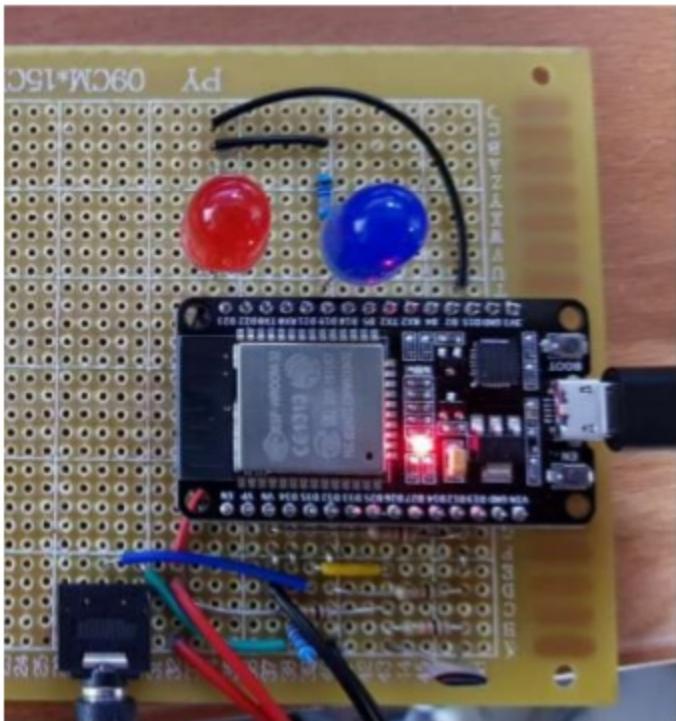
# ➤ Demo - The Water-Tank Boiler System

- Based on ESP32 + 2 NTC Thermistors + Current Sensor
- Hot water, when needed while saving energy!
- Over the air firmware update



# ← Demo – a Smart Boiler System

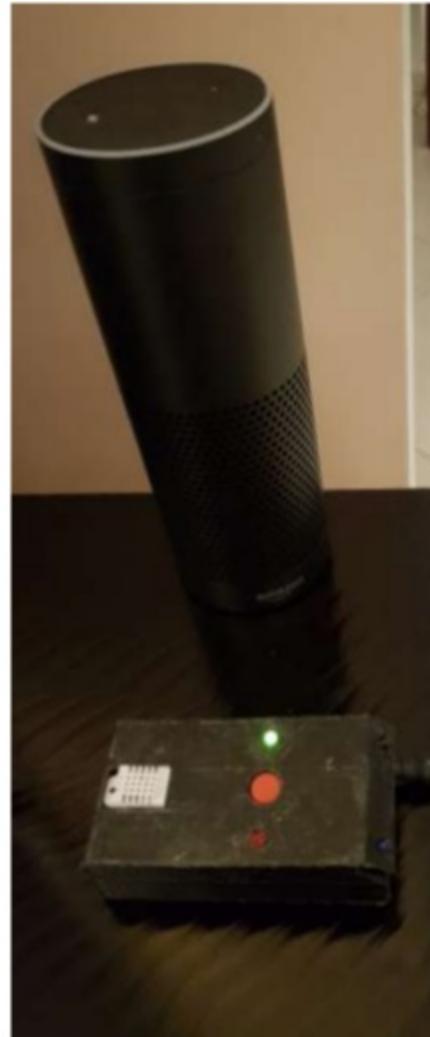
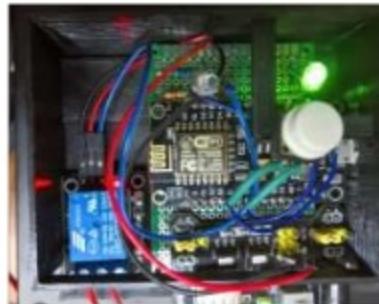
IoT Hub + Routing to ServiceBus Queue + Stream Analytics + Azure Function + PowerBI + Stream Insight



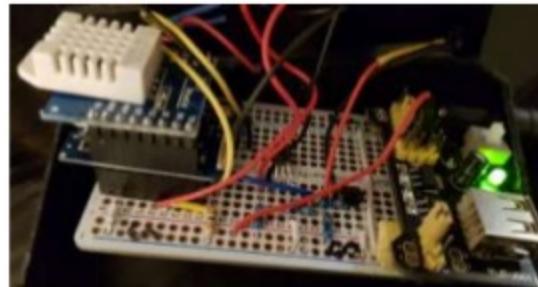


## Other Usage

- My 3D Printer LED light



- Alexa: Turn on ground level AC
- Alexa set ground level AC to 20 degrees





# The Citizen App

- Make any citizen a sensor(s)
  - Text, picture, video, audio, location
- Large city scale – 10s Millions
- Server-less Architecture:
  - IoT Hub per city
  - Stream Analytics
  - CosmosDB
  - Azure Functions
  - File uploads
- Small team: 2-3 developers, 6-8 months

**Amazing!**



# Waves of Innovation

## The smart cloud & Intelligent Edge

### Cloud

Globally available, unlimited compute resources

### IoT

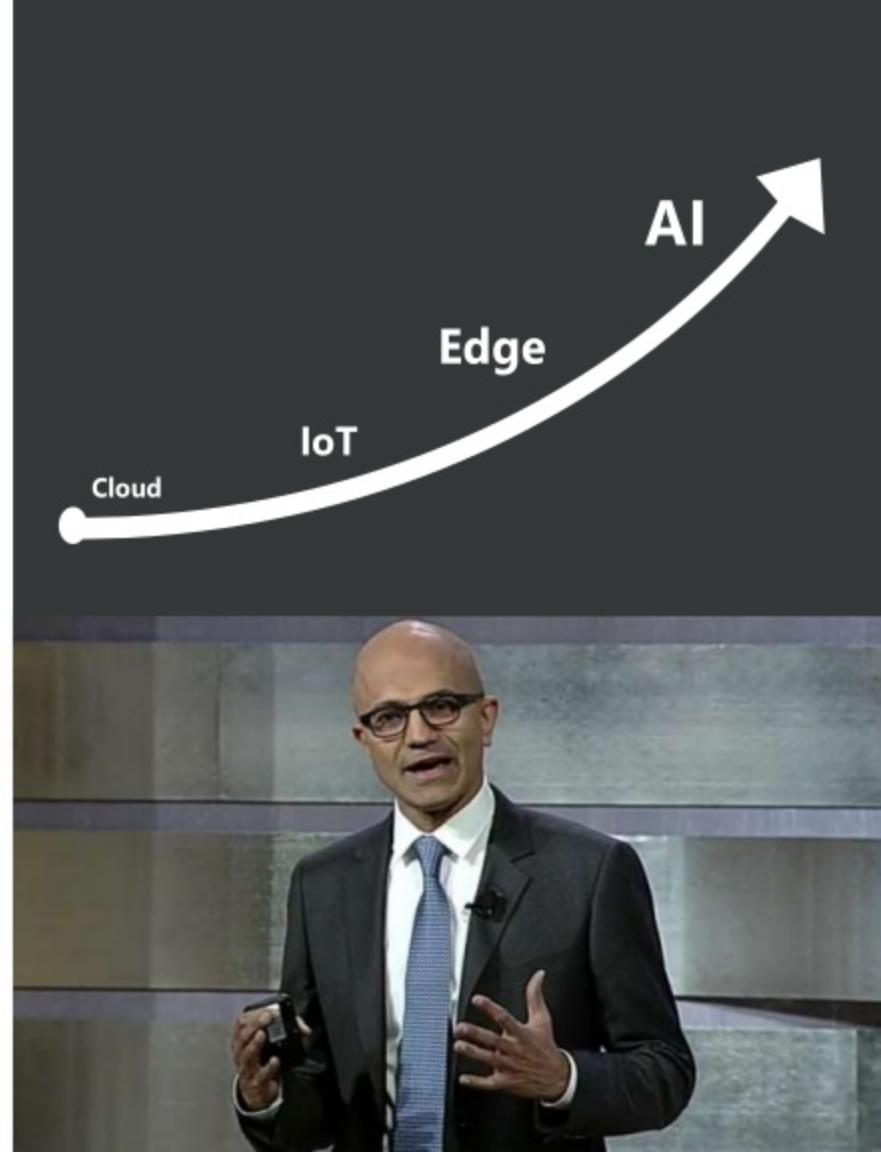
Harnessing signals from sensors and devices, managed centrally by the cloud

### Edge

Intelligence offloaded from the cloud to IoT devices

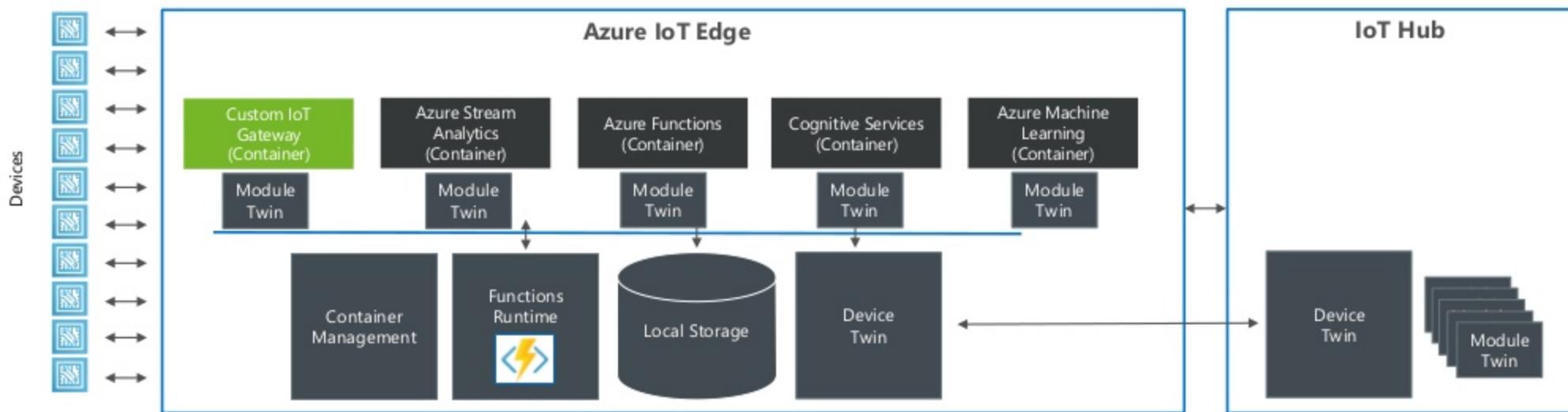
### AI

Breakthrough intelligence capabilities



# Azure IoT Edge

- Container based modules
- Azure Functions
- Azure Stream Analytics
- Azure Machine Learning
- Cognitive Services
- Offline / Synchronized Device Twins
- Local Storage
- Cloud Management & Deployment
- High Availability / Fault Tolerance
- Cloud Dev/Test Support





# Azure Sphere Device

## ► Azure Sphere MCU

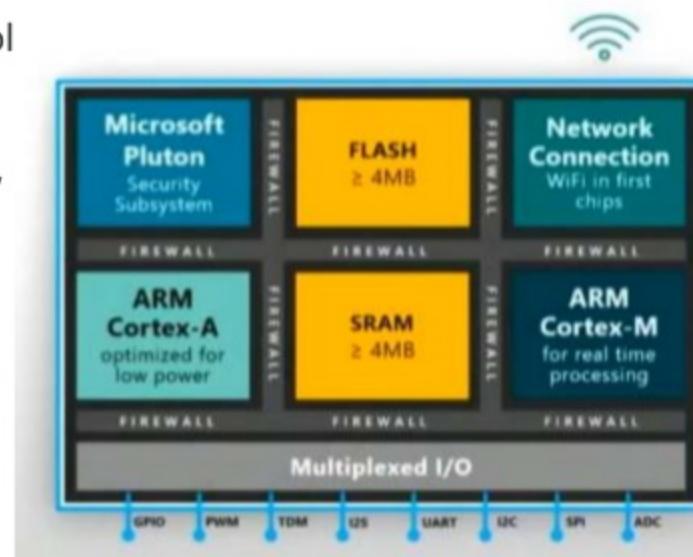
- First SoC by [MediaTek](#)
- ARM Cortex-A for low power
- ARM Cortex-M for real time processing
- Built-in Wi-Fi
- Built-in firewall everywhere
  - Secure with built-in silicon technol



## ► Azure Sphere Linux based OS

- An OS purpose built for security and agility

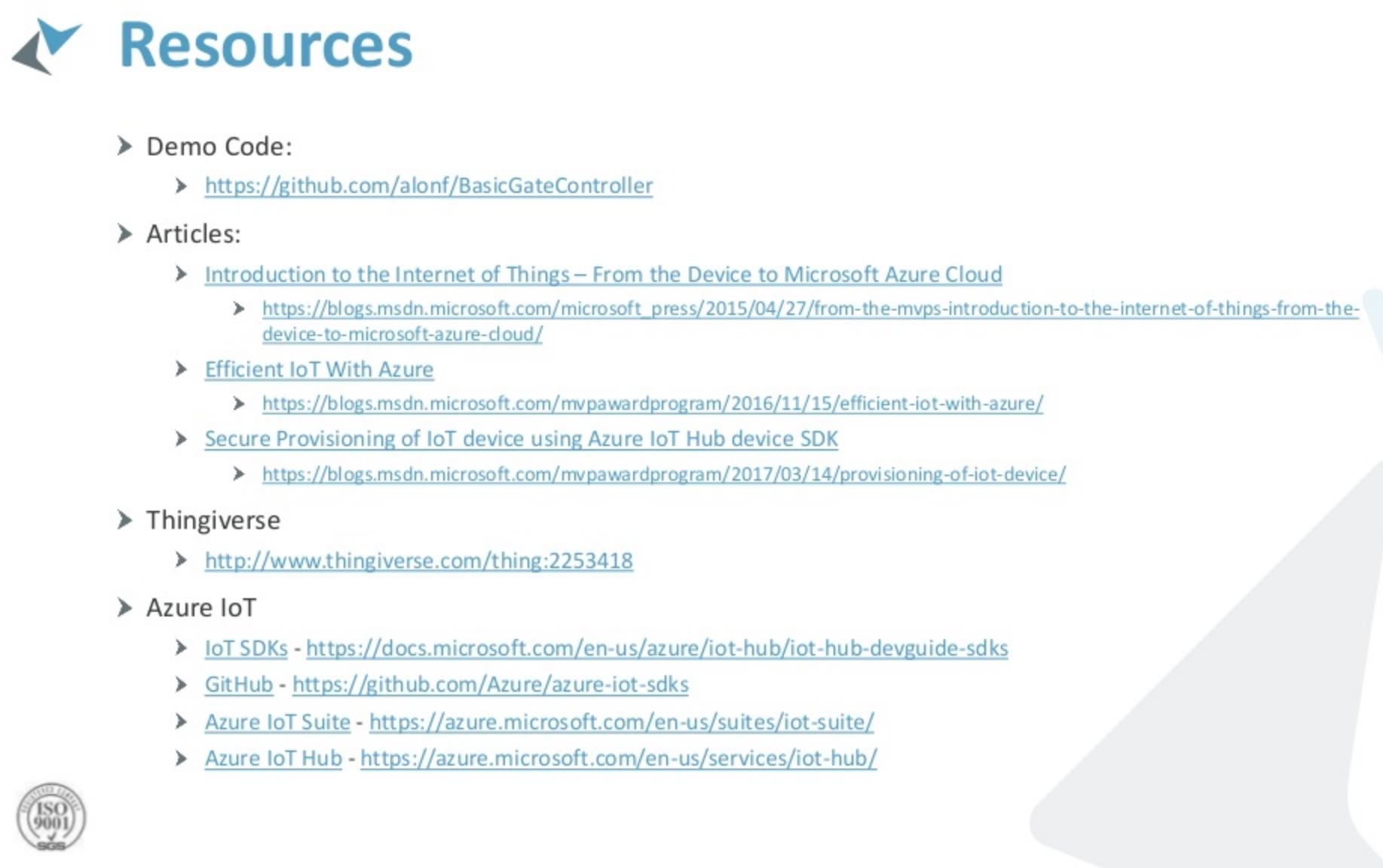
## ► Available Q3 of 2018



# Summary



- We have seen:
  - All about Azure IoT Hub
  - Building a water tank boiler system
  - Controlling a gate





*Thank you!*