Internet of Things

Fundamentals of Azure IoT

Justin Grammens

Cofounder, Lab651

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What We'll Cover

- About Me & Lab651
- History and Future of IoT
- What is Microsoft Azure IoT
- Setting up a Development Environment
- Applications & Code Demo
- Questions

About Me - Justin Grammens

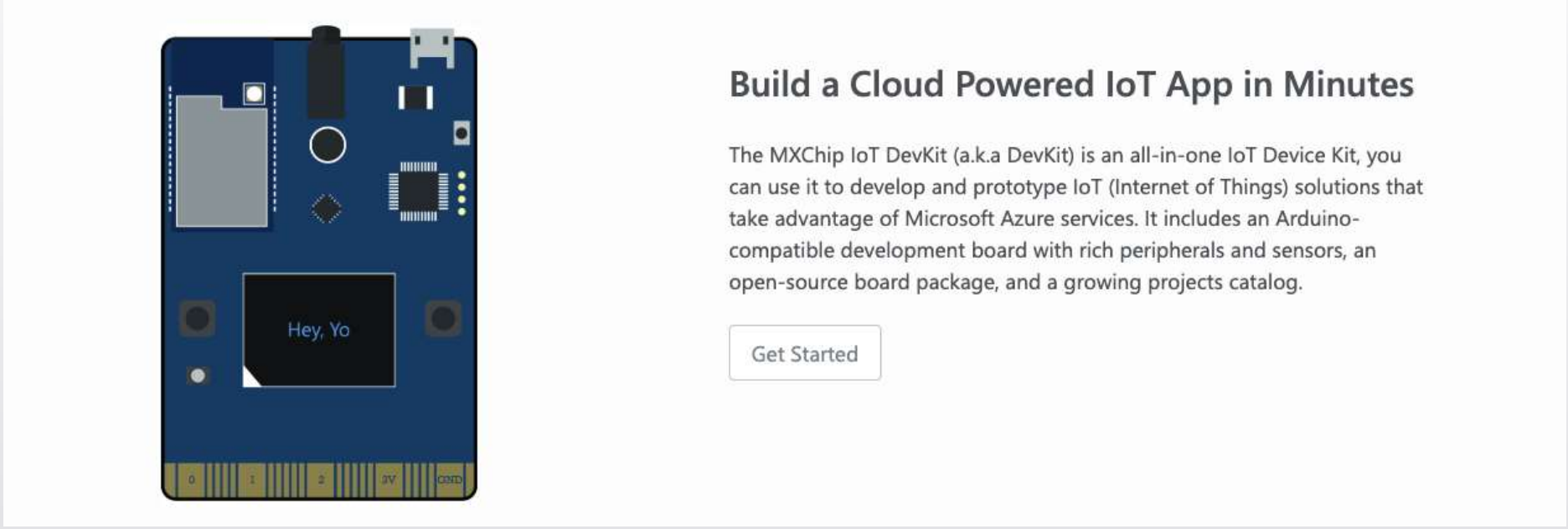
- Serial Entrepreneur working in Emerging / Disruptive Technologies
- Building communities around next generation technology
  - Web Applications (Ruby on Rails)
  - Mobile Applications (Android & iOS)
  - Internet of Things (Arduino, Particle, Azure, AWS, etc)
- University of Saint Thomas Professor in Graduate Software Engineering
- Owner & Publisher - IoT Weekly News
- Cofounder – Lab651 & IoT Fuse

Who is Lab651?

Decades of Experience Building “Smart” Products

• Physical Product Design • User Experience & Feel	**Mechanical Engineering**
• Electrical Hardware & Firmware • Connectivity / Wireless Design • Power Optimization	**Electrical Engineering**
• Mobile Applications • Cloud / Web Applications • Machine Learning / AI	**Software Engineering & Data Science**

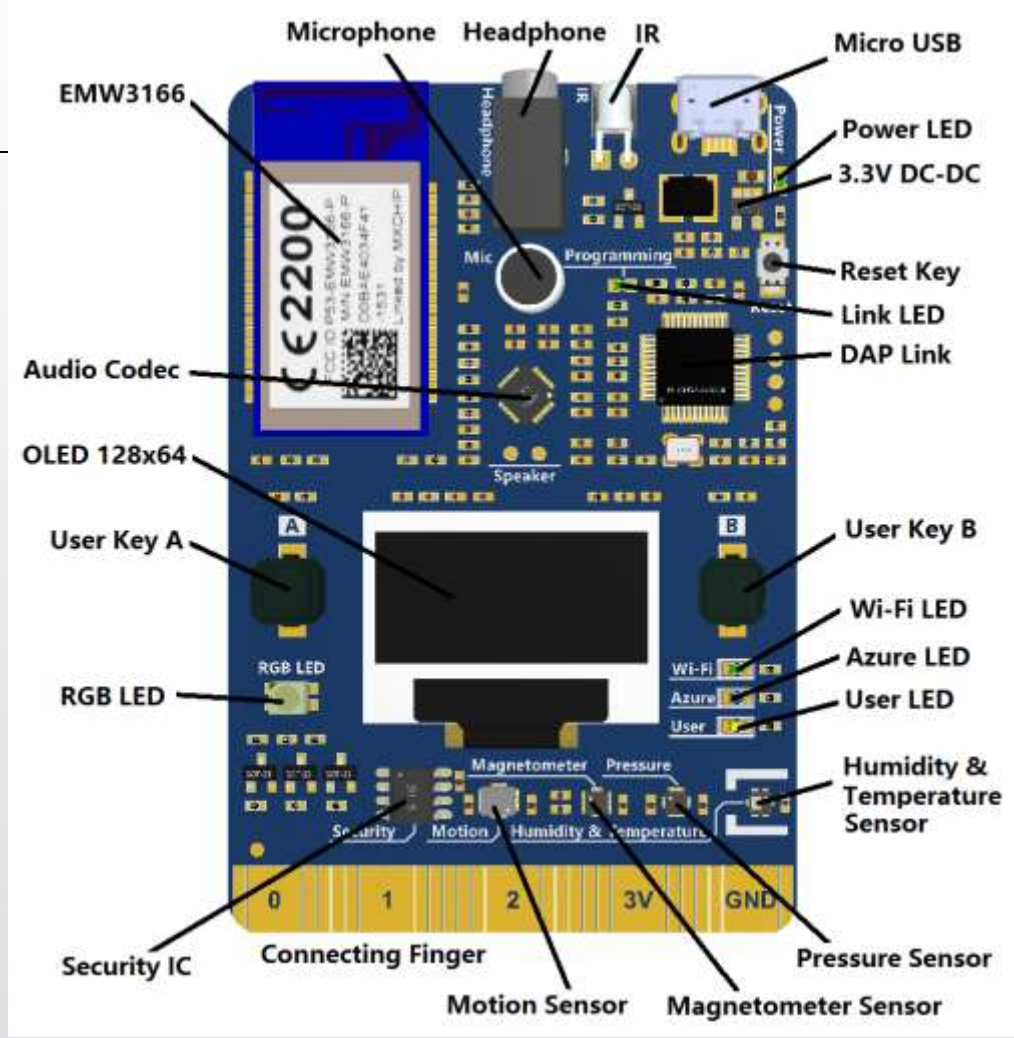
Setup Environment



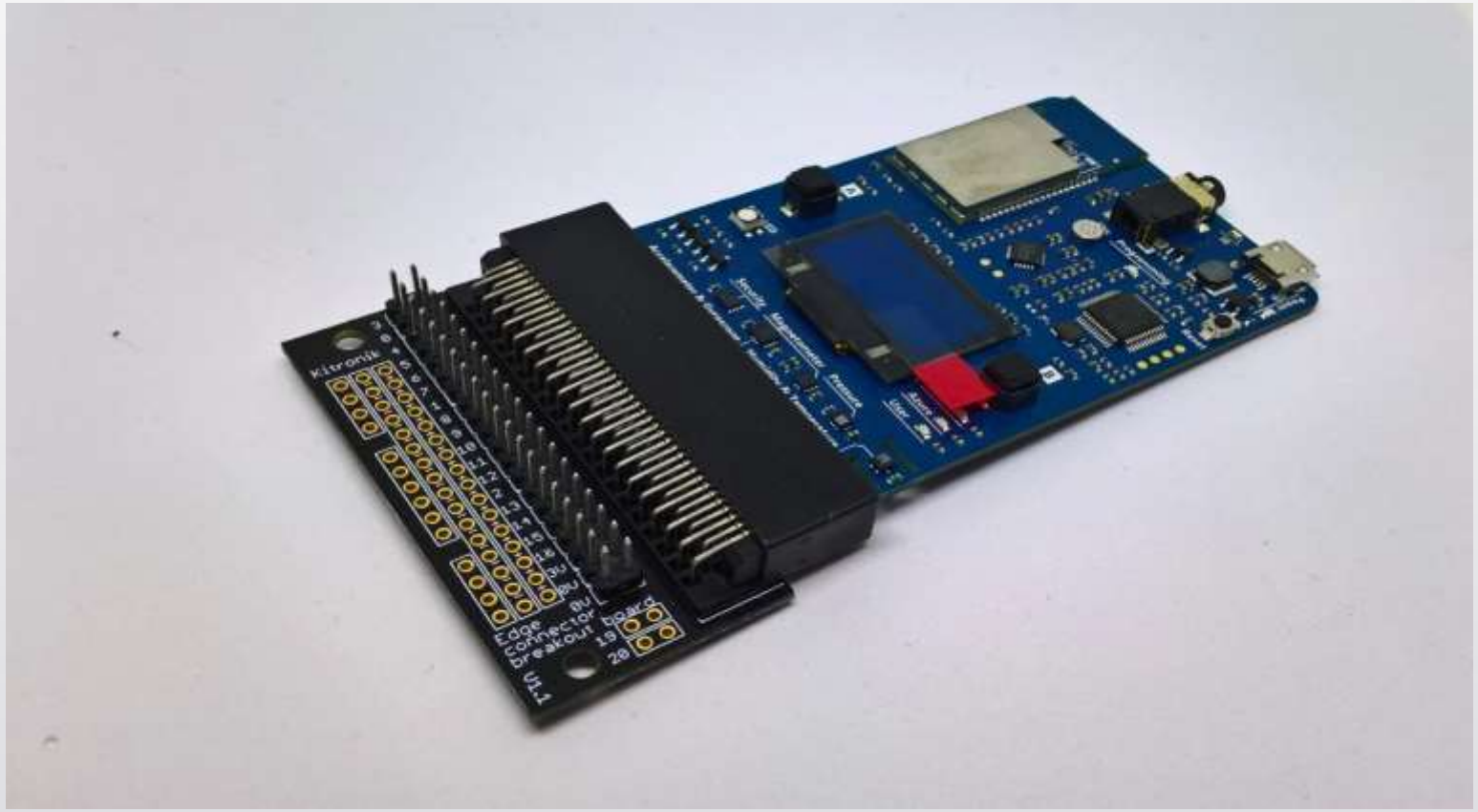
https://microsoft.github.io/azure-iot-developer-kit/v1/

IoT Dev Kit by MXChip

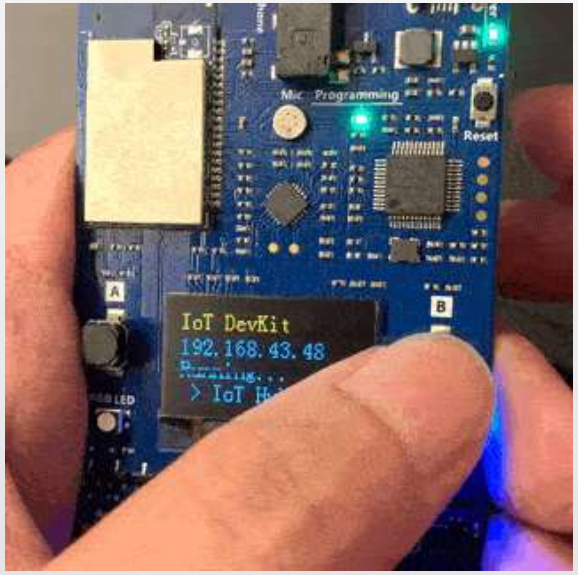
- Prototype development board using an Arduino microcontroller
- Includes sensors, buttons and outputs (screen, microphone & headphone)
- Cost around $40
- Lots of examples and tutorials



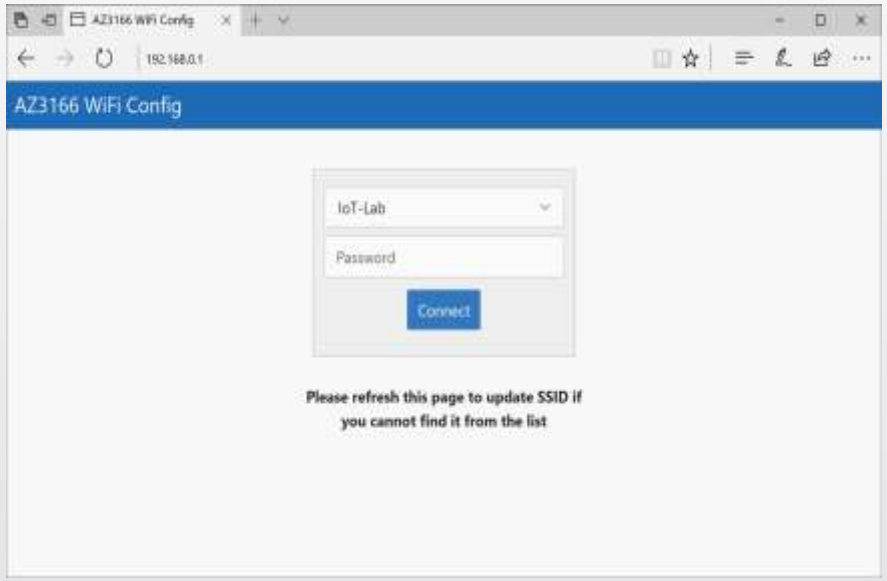
Additional I/O Pins



Configure WiFi



Put in to access point (AP) mode (B+reset)



Connect to AP, set SSID and password

Ta-da! Connected.

Azure IoT – What Is It

- A collection of Microsoft-managed cloud services that connect, monitor, and control billions of IoT assets
- IoT Devices
  - Circuit board with sensors
  - Gateway
  - Raspberry Pi & MX Chip IoT Devkit frequently used for prototyping
- IoT Device SDKs to integrate any hardware with Azure IoT

Browse Devices

Certified devices and starter kits

Microsoft Azure

Certified

Tell us what you are looking for

Become a Partner

Learn More

- Microsoft Azure IoT Starter Kit
- Azure IoT Edge
- Chip Manufacturers
- Cloud Protocol
- Connectivity
- Device Security Services
- Device Type
- Geo Availability
- I/O Hardware Interfaces
- Industrial Protocols

TELUS LTE-M IoT Starter Kit

By: Avnet

The TELUS LTE-M IoT Starter Kit (AES-BG96-IOT-SK2-G) enables designers to easily develop and prototype cellula...

CEC1x02DevBoard

By: Microchip Technology

The CEC1x02 Development Board is an evaluation board that can be used for development, customer evaluation and...

Industrial IoT Starter Kit

By: Softing Industrial Automation GmbH

Drive productivity with data insights. We believe that the Industrial IoT Starter Kit (IISK) is the fastest an...

Grove Starter Kit for Azure IoT Edge

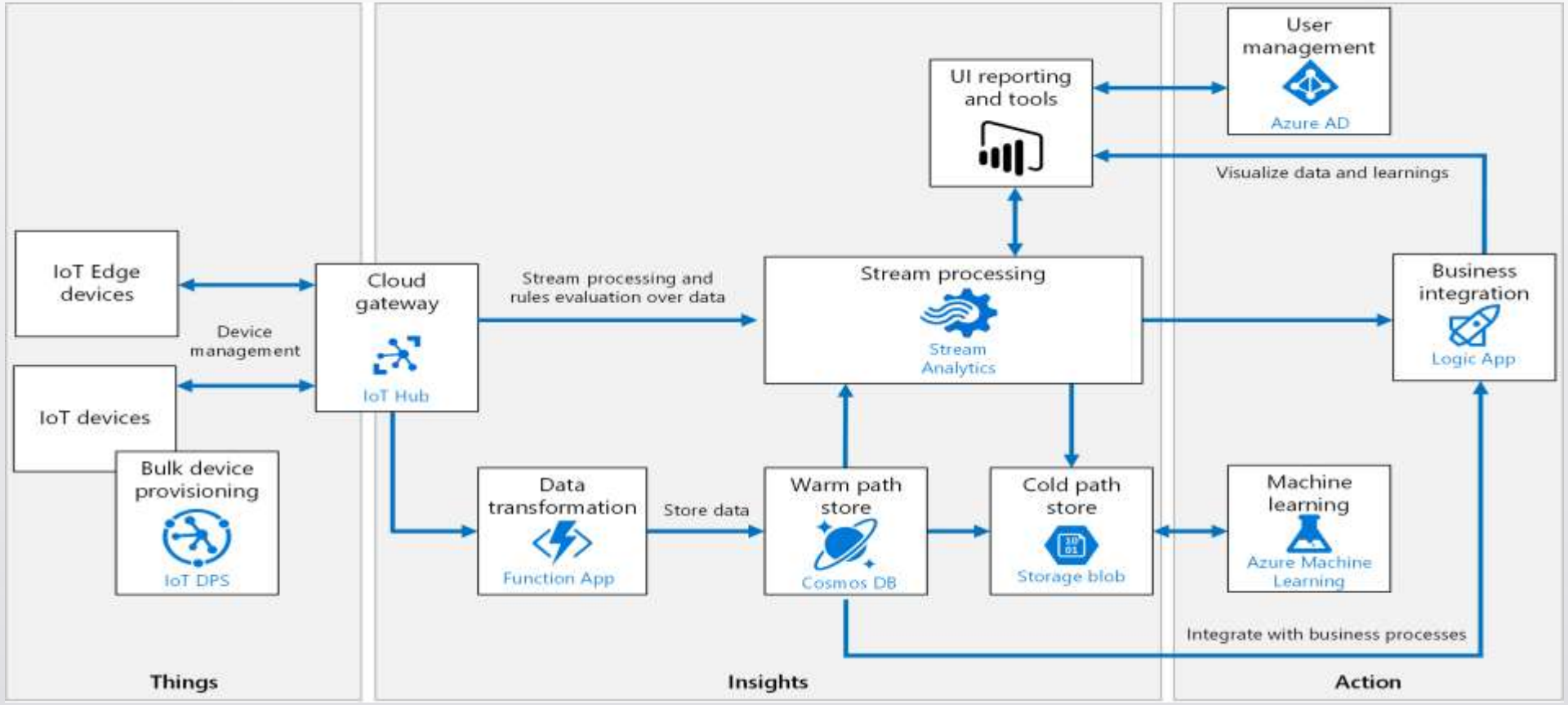
By: Seeed

The Grove Starter kit for Azure IoT Edge is a joint-effort developed by Microsoft and Seeed Studio.The kit int...

Azure IoT – What Is It

- Communication
  - Ethernet, WiFi, LoRa, Cellular, etc.
- Cloud Services
  - Data ingestion at scale
  - Device provisioning
  - Data visualization
  - Data analytics & machine learning

Azure IoT Architecture



Azure IoT Technologies and Solutions

(PaaS) Solutions

Azure IoT solution accelerators (PaaS)

Preconfigured solutions for common IoT scenarios

(SaaS) Solutions

Azure IoT Central (SaaS)

Microsoft Dynamics Connected Field Service (SaaS)

(PaaS) Technologies

Device support

- Azure IoT Device SDK
- Azure IoT certified devices
- Security Program for Azure IoT
- Windows 10 IoT

IoT

- Azure IoT Hub
- Azure Maps
- Azure IoT Edge
- IoT Hub Device Provisioning Service
- Azure Time Series Insights
- Azure Sphere
- Azure Functions
- Azure Digital Twins
- Azure Machine Learning

Data and Analytics

- Azure HD Insight
- Azure Data Lake
- Azure Cosmos DB

Visualization and Integration

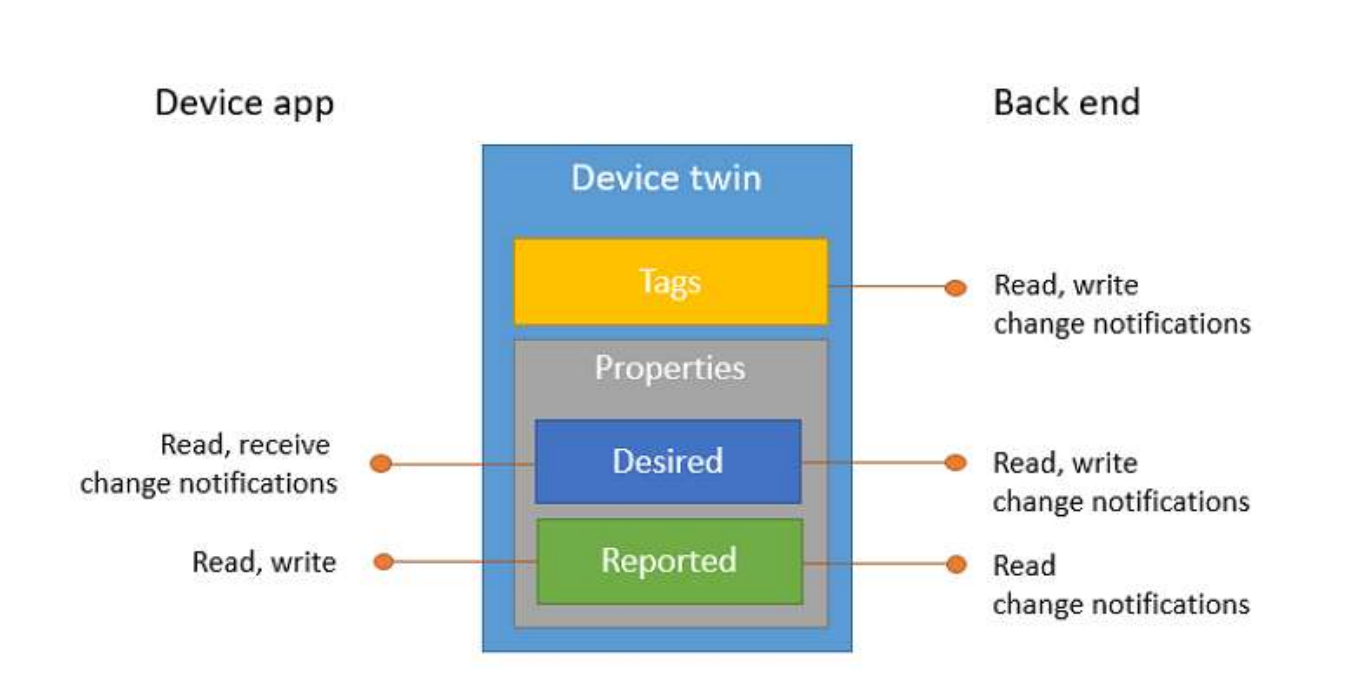
- Microsoft Flow
- Azure Active Directory
- Azure Logic Apps
- Microsoft Power BI
- Azure Web App
- Azure Monitor
- Notification Hubs

Azure Logic Apps

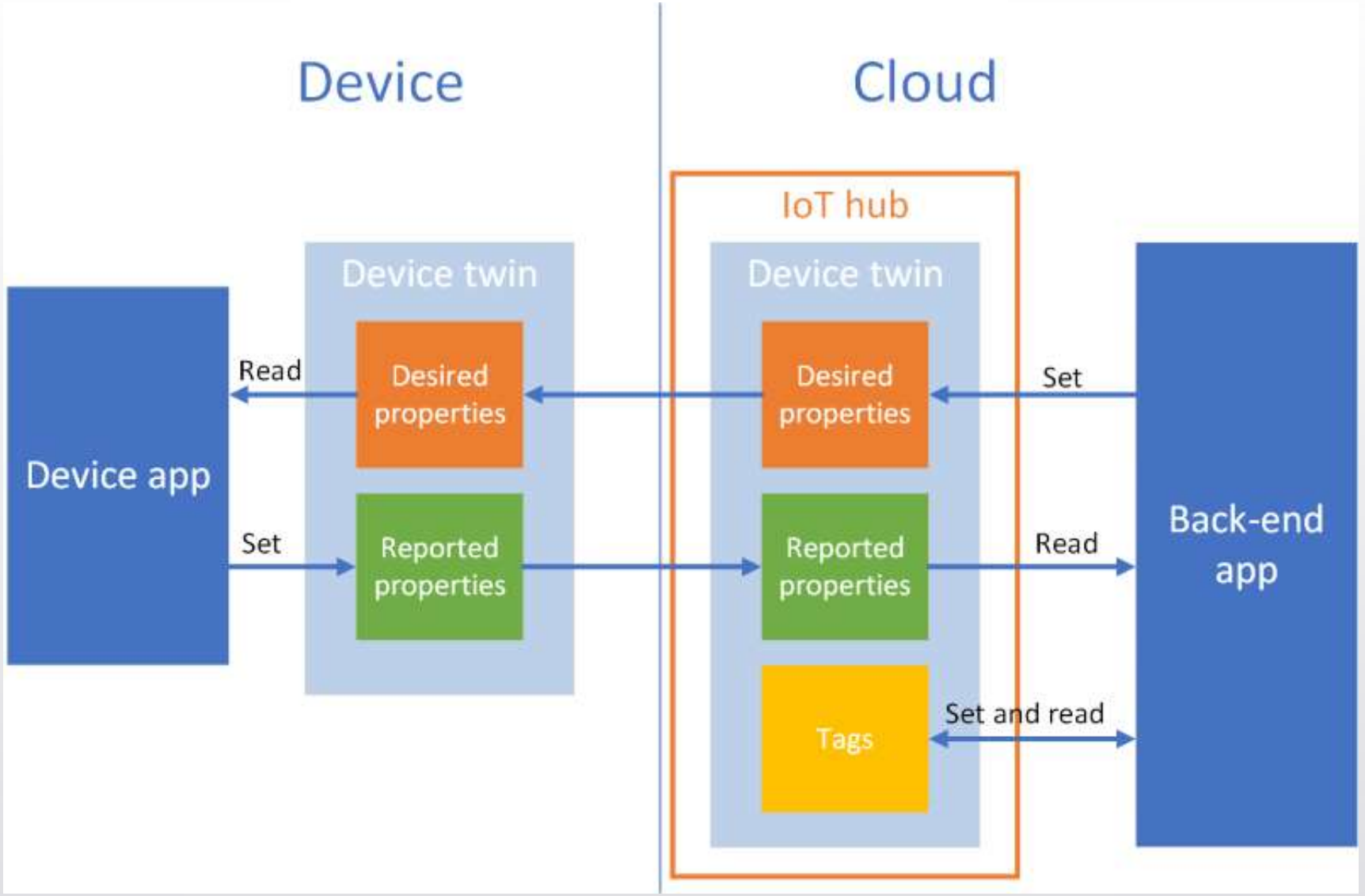
- Out of the box integrations
  - Salesforce, Office 365, Twitter, Dropbox, Google Service, etc
- No coding is needed
- Write your own connectors to add to the marketplace
- Drag/drop WYSIWYG interface
- Released in 2016

Device Twins

- JSON document, associated with a specific device and stored IoT Hub
- Tags: What the back end can read/write to
- Desired: The values to be set
- Reported: Current values



Device Twin


Device
Cloud
IoT hub
Device twin
Device twin
Device app
Read
Desired properties
Desired properties
Set
Set
Reported properties
Reported properties
Read
Back-end app
Tags
Set and read

Azure Functions

- Severless compute (ala Aws Lambda)
  - Short lived
  - Typically stateless, but Azure does offer extensions for “Durable Functions”
- Event based
  - HTTP, Timer, Blob, Queue
- Deploy from Visual Studio or Visual Studio Code
- C#, Javascript, Java, Python

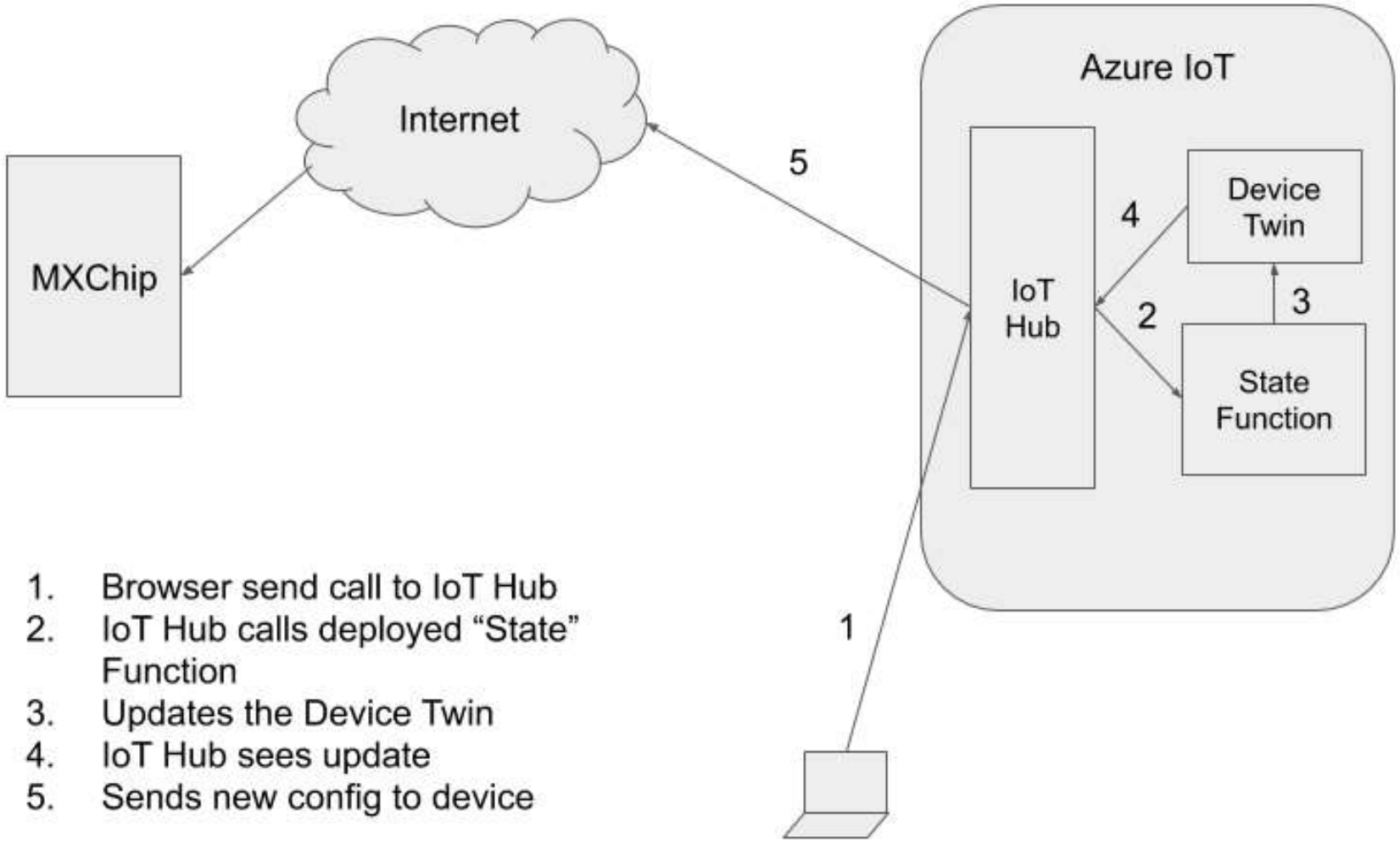
Azure IoT Edge

- Standalone deployment
  - Works with Linux or Windows containers
- Moves logic & intelligence to edge devices
  - React in real-time
  - Handle offline actions/states
- Deploy and mange from IoT Hub
- Supports many languages: C, Java, Javascript and Python

Examples

- Getting Started
  - https://github.com/Microsoft/vscode-iot-workbench/blob/master/docs/iot-devkit/devkit-get-started.md
- Verify JSON data is being set to Azure IoT
  - Temperature
  - Humidity

Azure MXChip State Monitor & Update

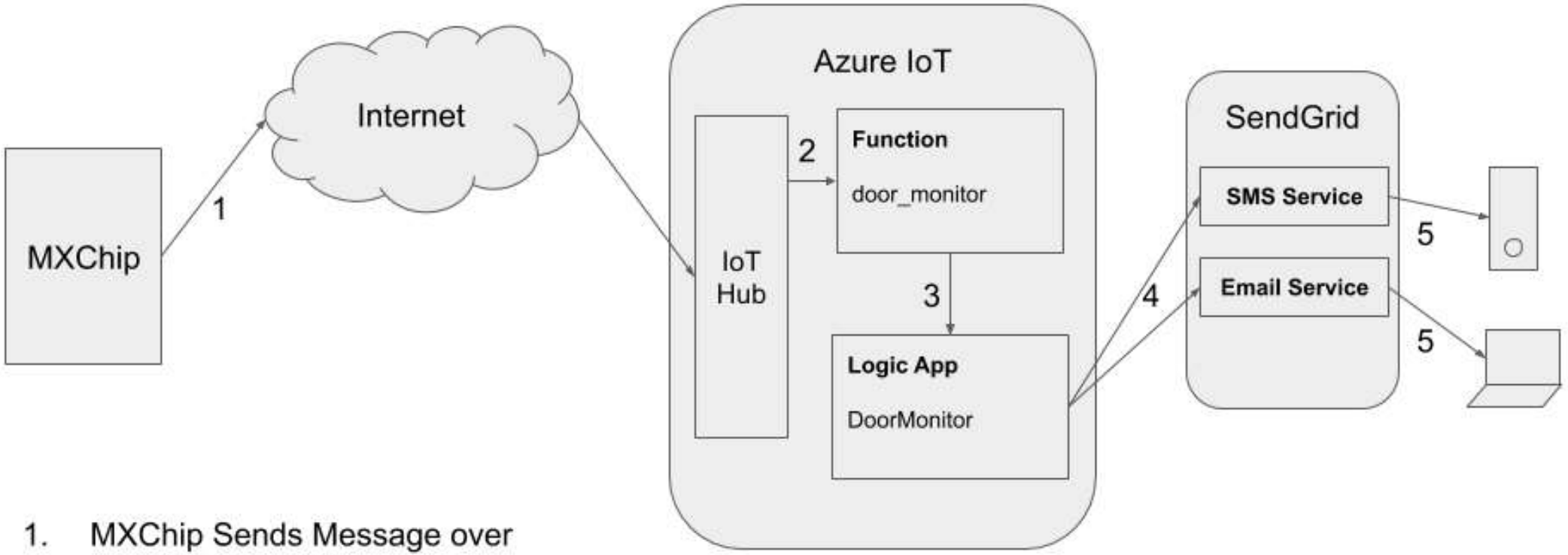


1. Browser send call to IoT Hub
2. IoT Hub calls deployed “State” Function
3. Updates the Device Twin
4. IoT Hub sees update
5. Sends new config to device

Examples

- State Updates
  - https://github.com/Microsoft/vscode-iot-workbench/blob/master/docs/iot-devkit/devkit-state.md
- Load a browser interface that calls an Azure function
  - Updates Device Twin – show updating in Azure Portal
- Device Twin
  - JSON documents that store device state information including metadata, configurations, and conditions

Azure MXChip Door Monitor



1. MXChip Sends Message over MQTT to IoT Hub
2. IoT Hub calls door_monitor Azure Function
3. Function POSTs to LogicApp
4. LogicApp POSTs to SendGrid
5. Service Send Email and SMS

Examples

- Door Monitor
  - https://github.com/Microsoft/vscode-iot-workbench/blob/master/docs/iot-devkit/devkit_door_monitor.md
- Magnetometer Sensor
  - Sense changes in the magnetic field (door opening)
  - Send SMS & email to alert of state change

Thank You

Justin Grammens

justin@lab651.com

https://lab651.com