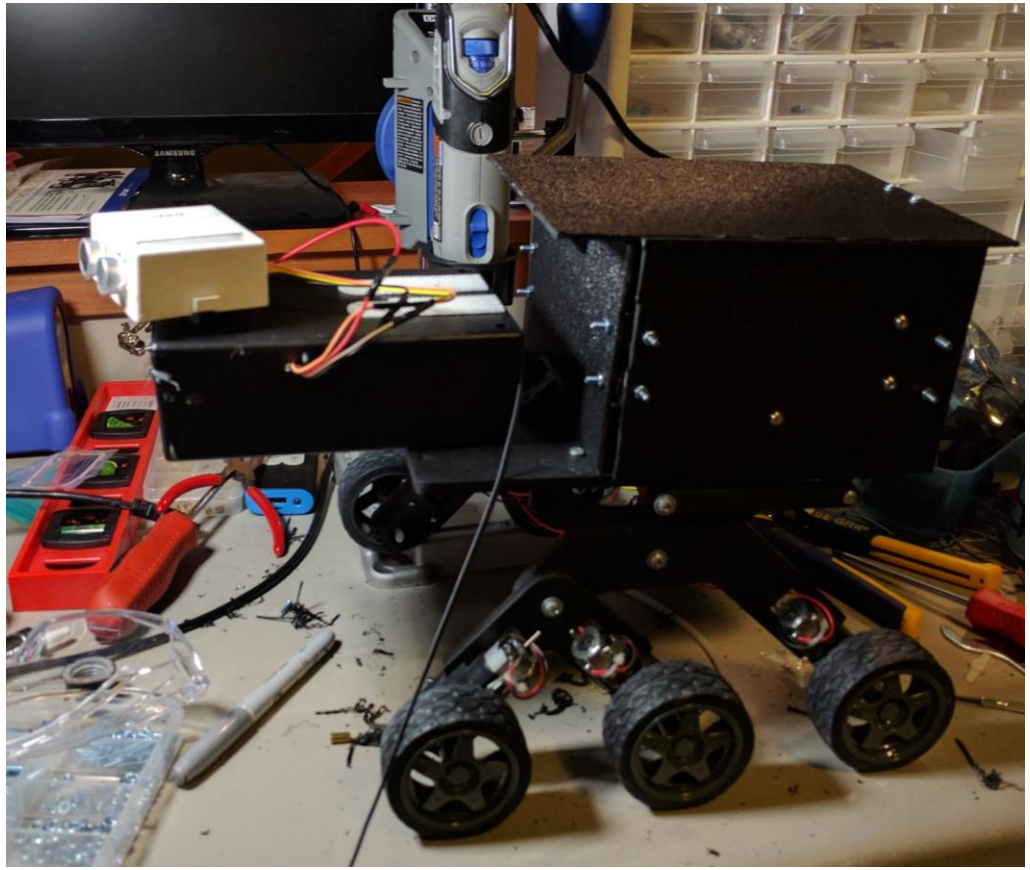
IoT real world applications and an overview of end to end solutions

Ian Macnichol



About me

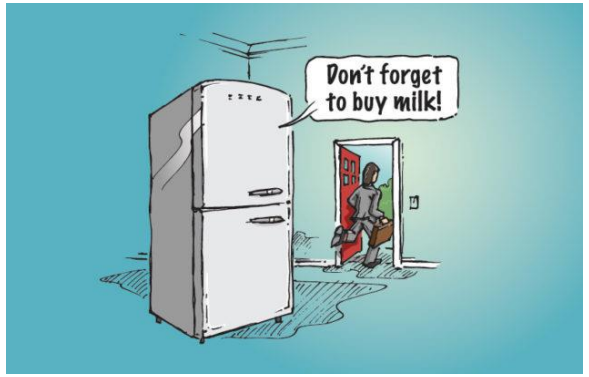
- Consultant in the business Solutions Group at HMB
- SharePoint developer for about 8 years
- IoT has been a hobby

IoT Devices


INSIGNIA · Roku TV
12:40 pm
Options
12 Items
Home
My Feed
Movie Store
TV Store
News
Search
Streaming Channels
Settings
Cable TV
Game console
Blu-ray player
NETFLIX
YouTube
hulu
WATCH ESPN
HBO NOW
Google Play


nest
70


ring


Don't forget to buy milk!

IoT Growth

Growth in cloud availability

Increased of community and ease of use of development tools

You can connect from anywhere

HUGE drop in hardware cost, and availability

What is IoT about

- Monitoring
- Analysis
- Prediction

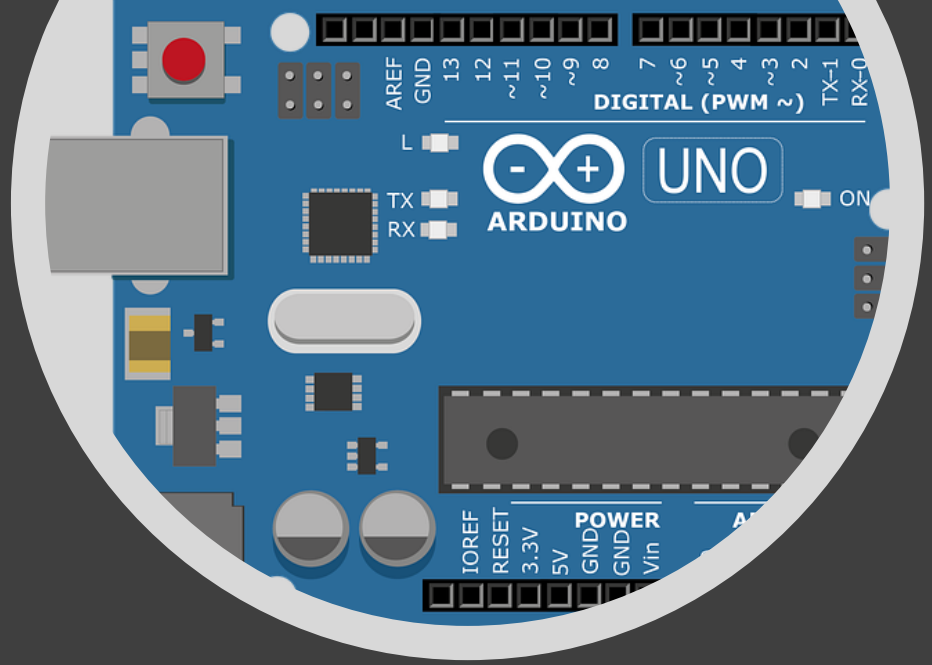
- Insight into the real world
- Decisions based on more data

Business cases

- Inventory tracking
- Machine preventative maintenance
- Connected factories

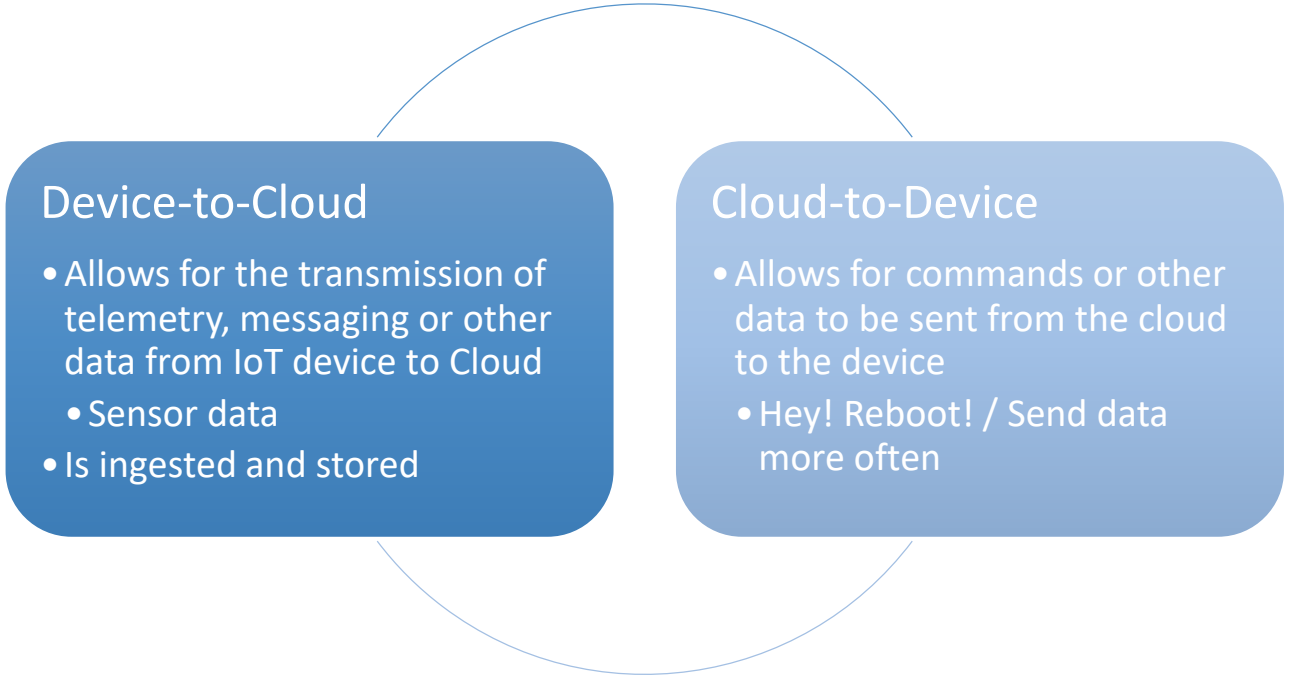
Agenda

- IoT Architecture
- Raspberry Pi
- Arduino
- Windows IoT Core
- Microsoft Azure IoT services

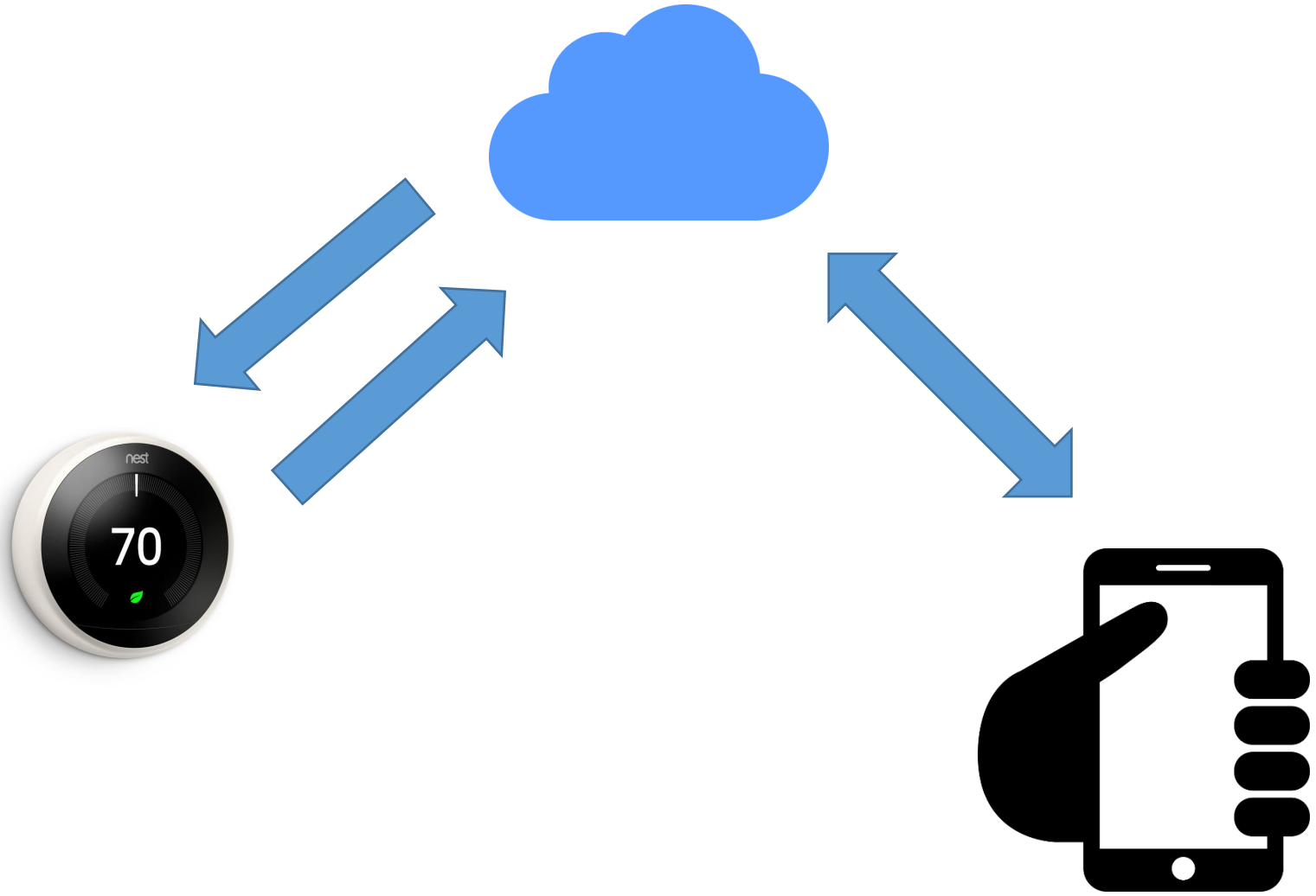


IoT Architecture

IoT Messaging



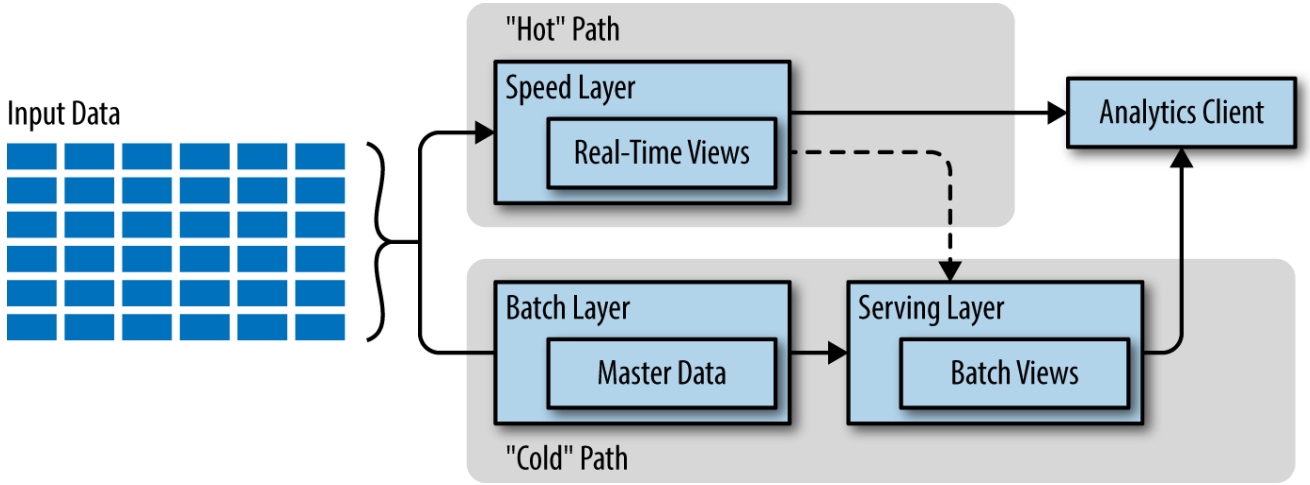
IoT 2-way Messaging



Lambda Architecture

- Hot path
  - FAST
  - Real time data
  - Real time actions

- Cold path
  - SLOW
  - Batching
  - Storing



IoT gateways

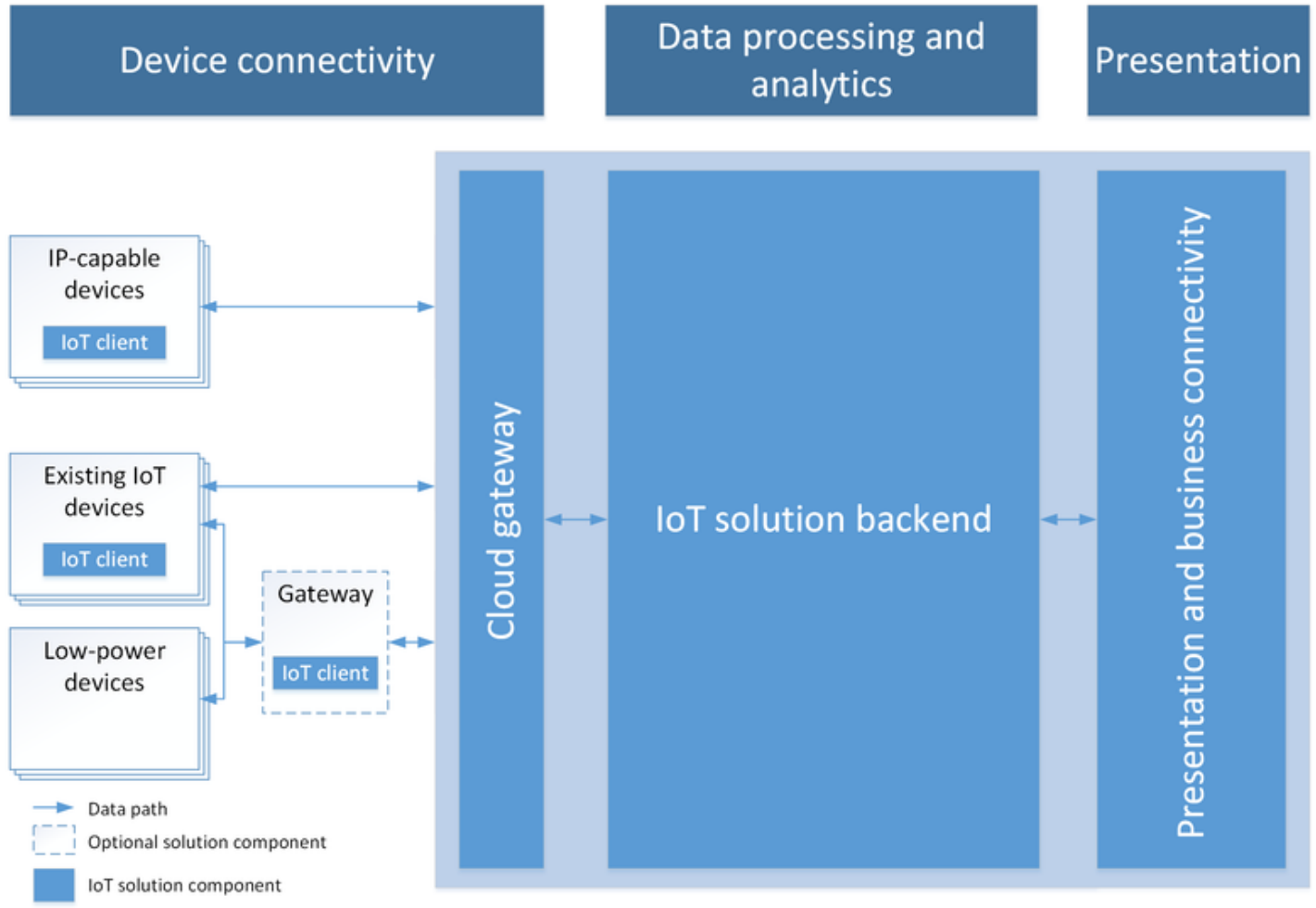
Telemetry aggregation point

- Message brokers
- Message Queues

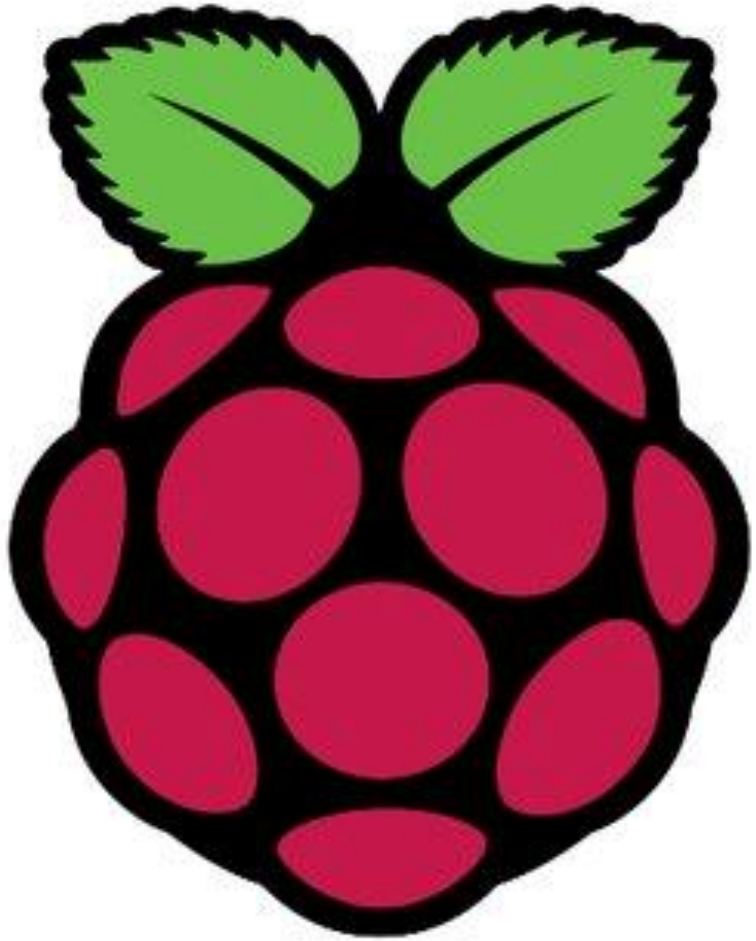
Two primary types of gateways

- Field Gateway
  - Low powered devices, maybe no encryption supported on device
- Protocol Gateway
  - Protocol adaptation

IoT Architecture



Yum, Pi



Raspberry Pi

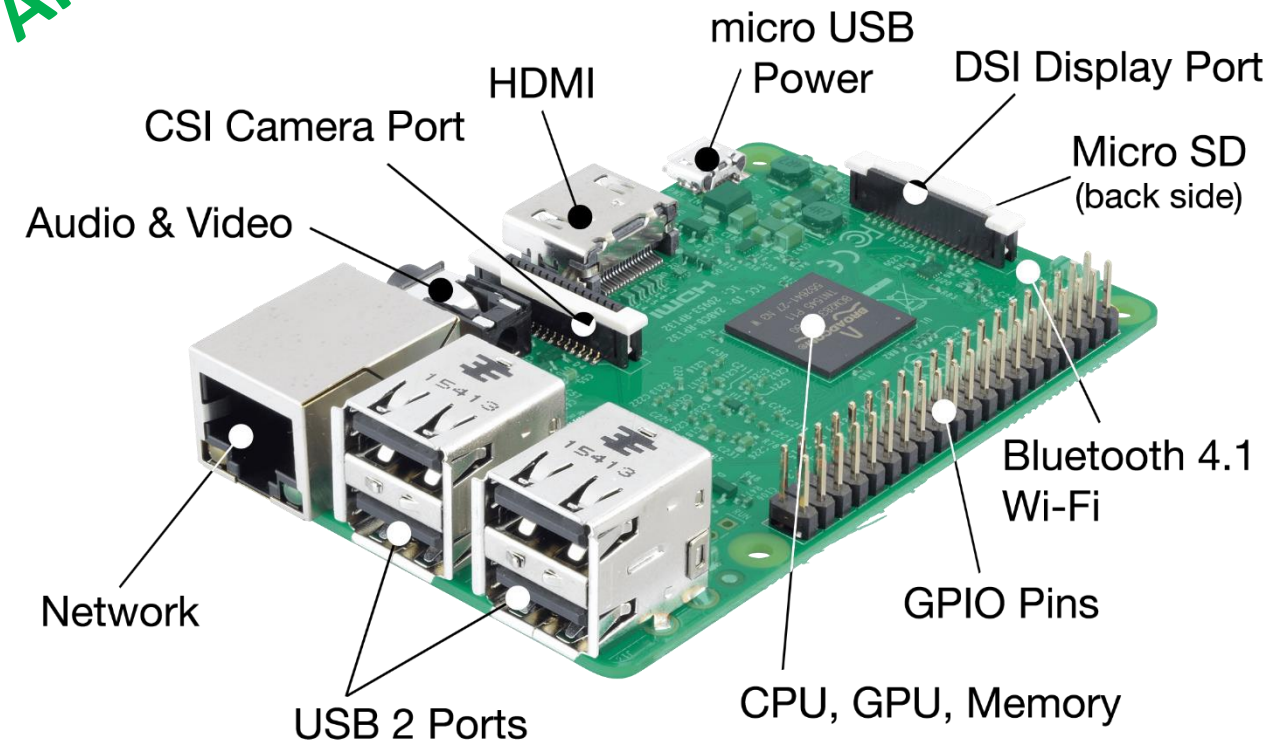
- Designed originally to help teach basic computer science in schools
- Very active community

http://www.raspberrypi.org

Raspberry Pi 3 Model B+

- 1.4GHz 64-bit quad-core ARM Cortex-A53 CPU
- 1GB RAM
- Integrated:
  - WIFI 802.11n
  - Bluetooth 4.1 w/BLE

Around $35!



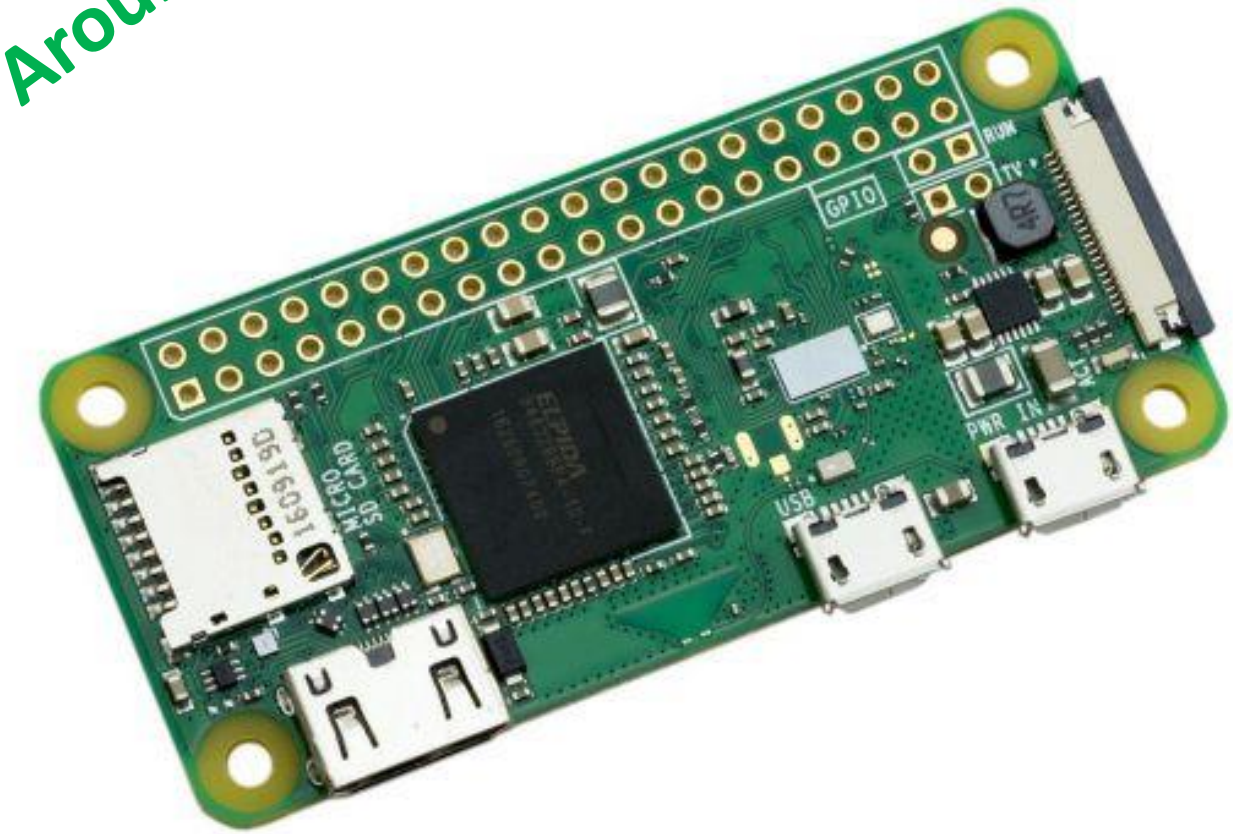
https://elinux.org/RPi_HardwareHistory#Raspberry_Pi_3_Model_B.2B

Raspberry pi zero W

- About half the size of the Raspberry Pi
- Released 2017
- WIFI 802.11n built in

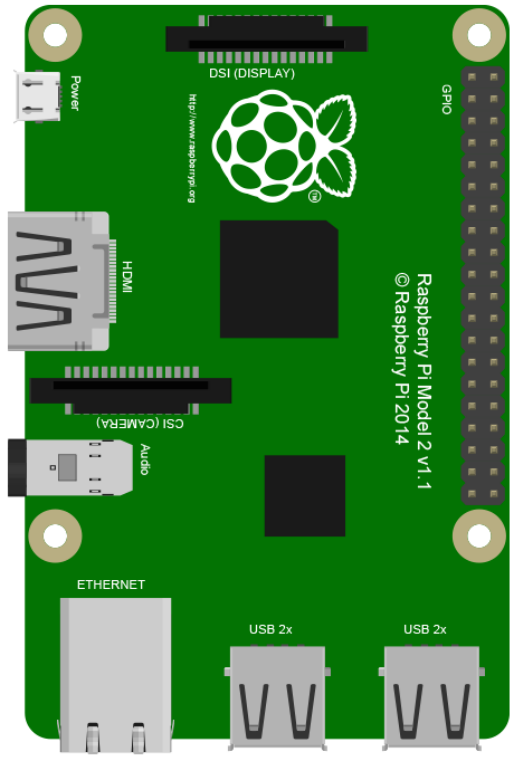
- Not as powerful as full Pi
- Can’t run Windows IoT Core
- Does run Raspbian

Around $10!



Raspberry Pi GPIO pins

- 40 GPIO Pins
- 5V and 3.3V
- I2C
- SPI
- UART



Raspberry Pi 2 Model B (J8 Header) pinout

WiringPi	BCM(Name)	Physical		Physical	BCM(Name)	WiringPi
	3v3 Power	1	2		5v Power	
8	BCM 2 (SDA)	3	4		5v Power	
9	BCM 3 (SCL)	5	6		Ground	
7	BCM 4 (GPCLK0)	7	8		BCM 14 (TXD)	15
	Ground	9	10		BCM 15 (RXD)	16
0	BCM 17	11	12		BCM 18 (PCM_C)	1
2	BCM 27 (PCM_D)	13	14		Ground	
3	BCM 22	15	16		BCM 23	4
	3v3 Power	17	18		BCM 24	5
12	BCM 10 (MOSI)	19	20		Ground	
13	BCM 9 (MISO)	21	22		BCM 25	6
14	BCM 11 (SCLK)	23	24		BCM 8 (CE0)	10
	Ground	25	26		BCM 7 (CE1)	11
	BCM 0 (ID_SD)	27	28		BCM 1 (ID_SC)	
21	BCM 5	29	30		Ground	
22	BCM 6	31	32		BCM 12	26
23	BCM 13	33	34		Ground	
24	BCM 19 (MISO)	35	36		BCM 16	27
25	BCM 26	37	38		BCM 20 (MOSI)	28
	Ground	39	40		BCM 21 (SCLK)	29

Programming languages

Raspbian / Linux

- C, C++, Pyton, Java, Javascript
- Very open to IDE

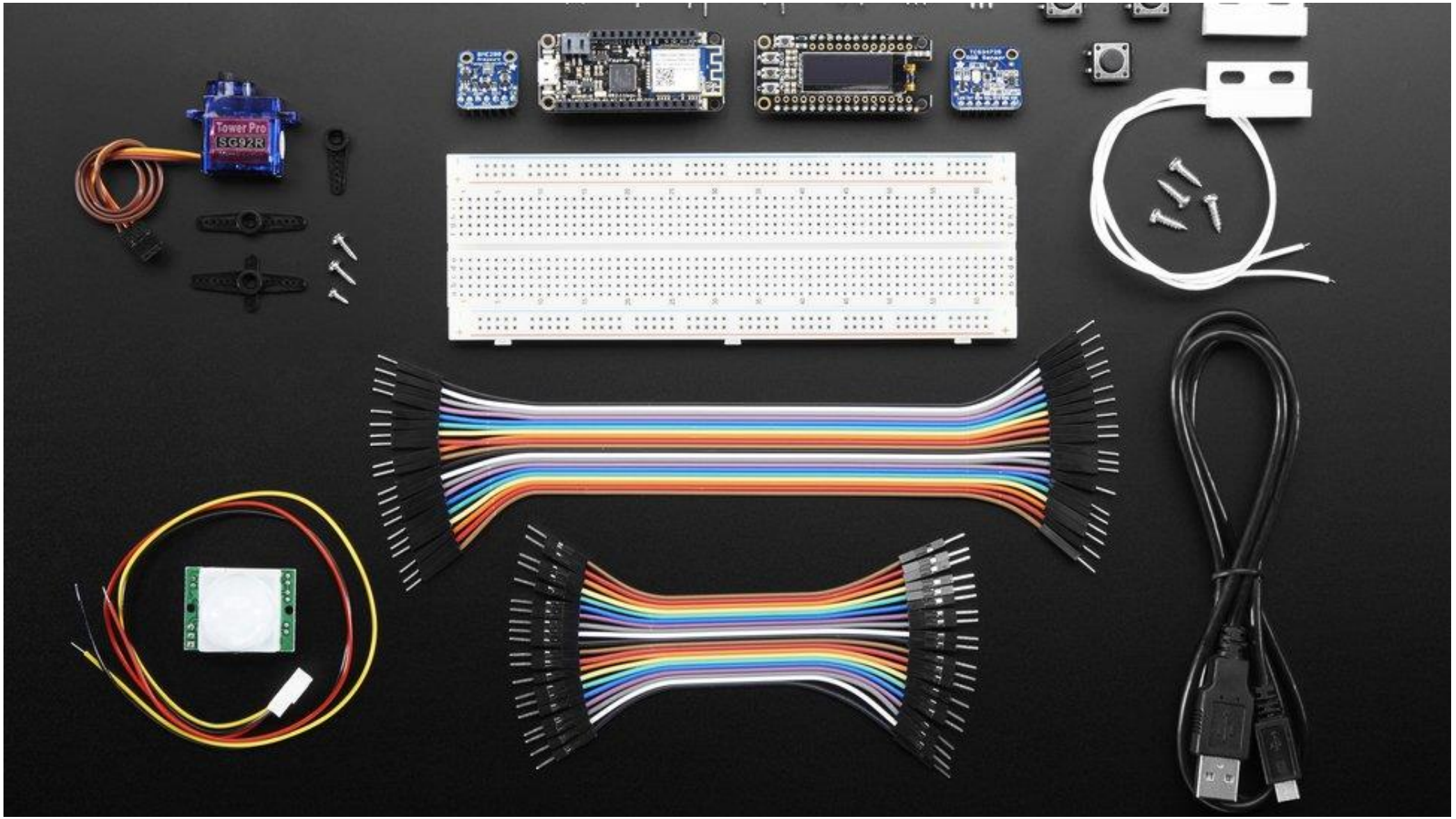
Windows IoT Core

- Familiar experience for many of us
- Visual Studio
- Windows Universal Platform (UWP) Apps

Azure Certified for IoT starter Kit

This kit includes:
1x Assembled Adafruit Feather M0 WiFi w/ Feather Stacking Headers
1x FeatherWing OLED - 128x32 OLED Add-on
1x Assembled BME280 I2C or SPI Temperature/Humidity/Pressure Sensor
1x Micro Servo
1x PIR (motion) Sensor
1x Fast Vibration Switch
1x Magnetic Contact Switch (door sensor)
1x Full-sized Breadboard
1x Assembled TCS34725 RGB Color Sensor
1x Premium Male/Male Jumper Wires - 20 x 6"
1x Premium Male/Male Jumper Wires - 20 x 3"
1x USB Cable - A/Micro B

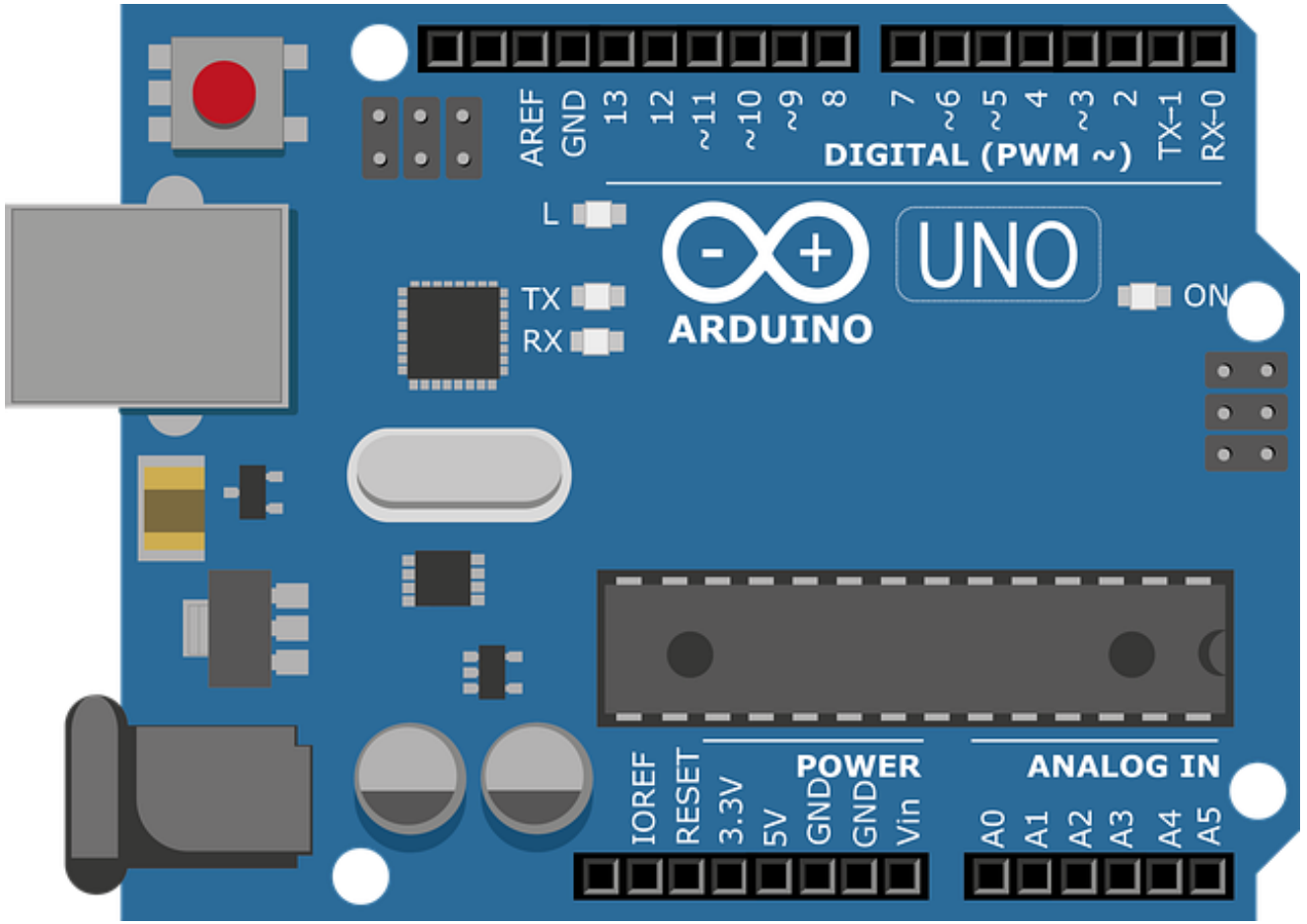
https://www.adafruit.com/product/3031


Tower Pro
SG92R

Arduino

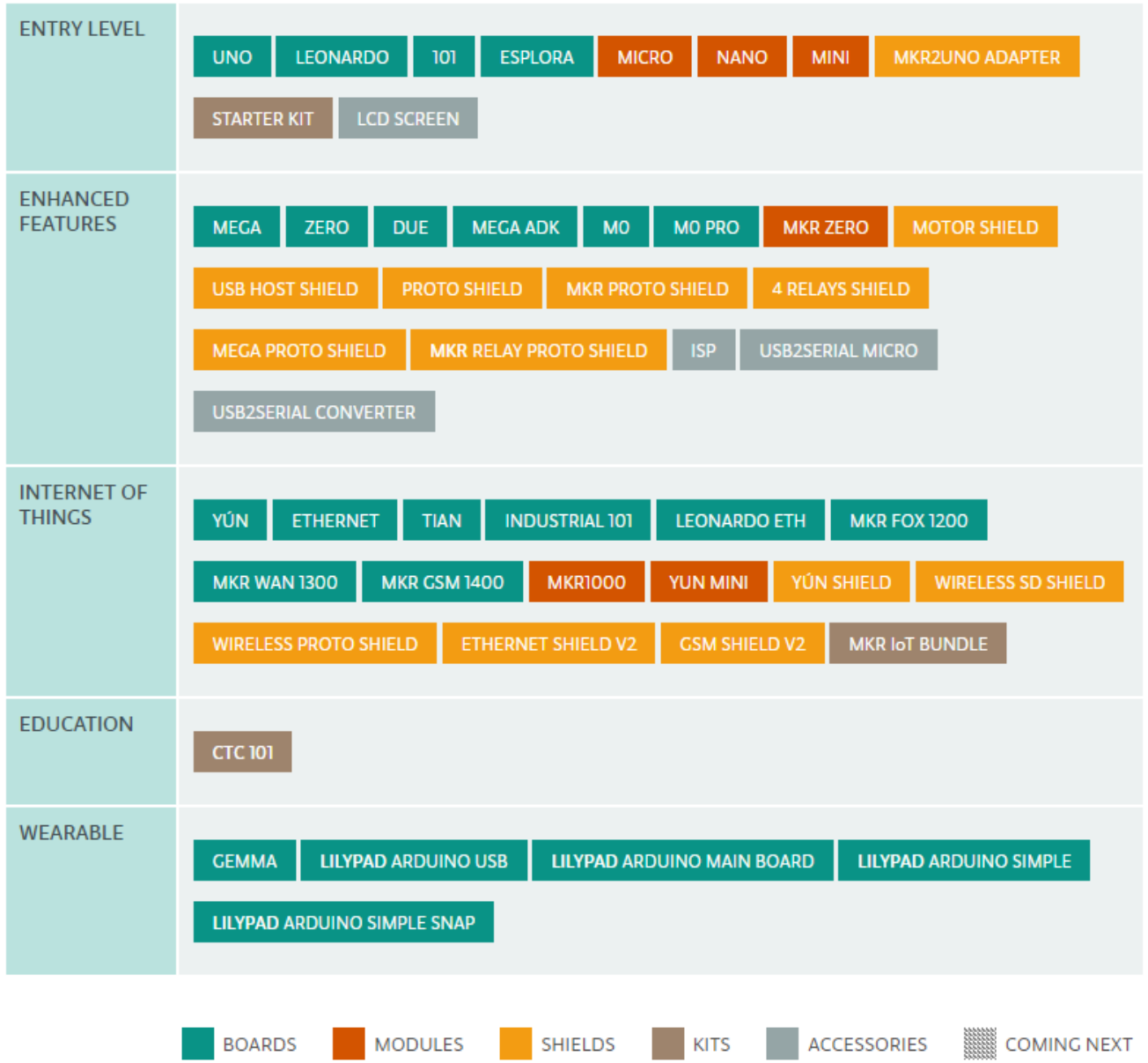
Arduino specs

- Open Source electronics prototyping platform
- First released 2005
- Many different boards and in various sizes / features
- Microcontroller
- Many shields available

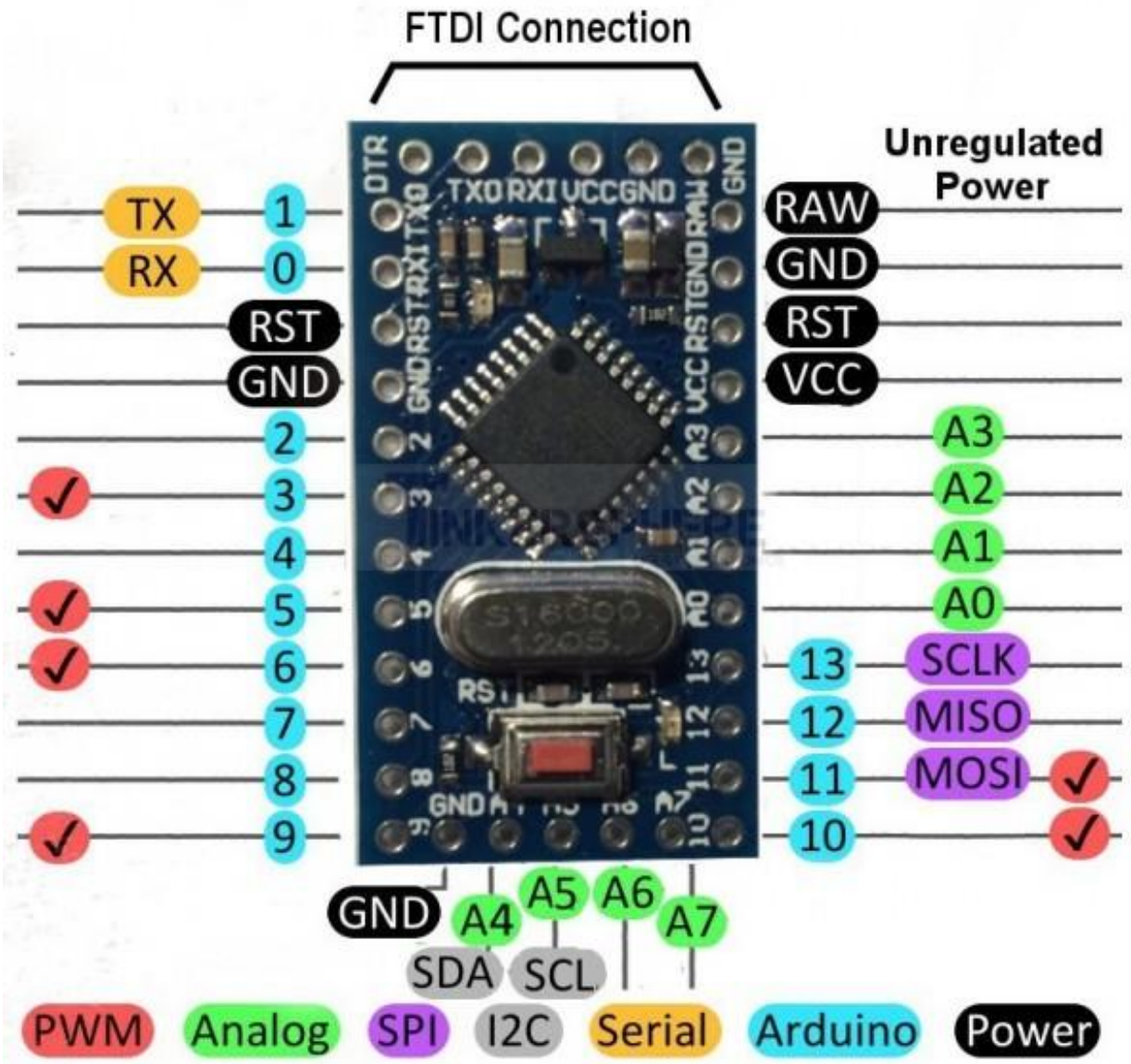


https://Arduino.cc

Boards overview

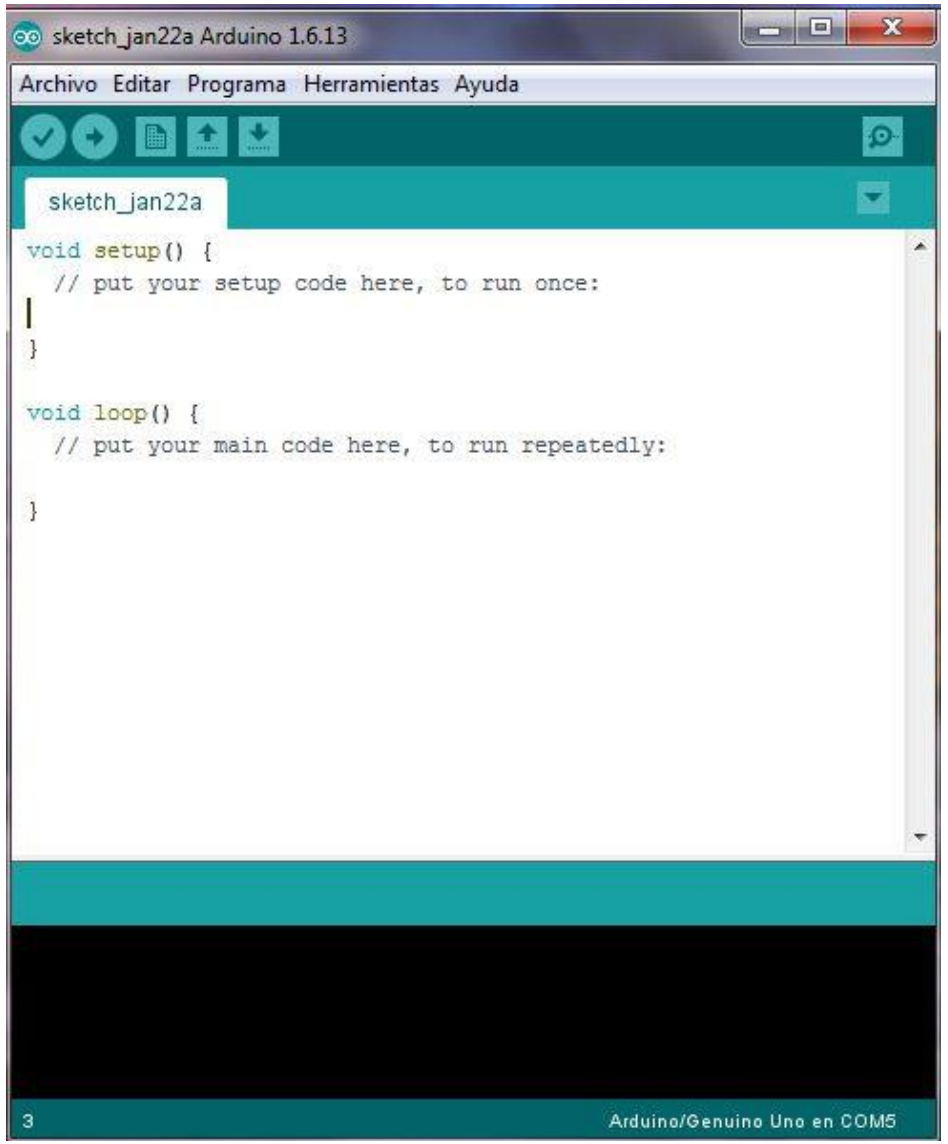


GPIO for Arduino



How to program an Arduino

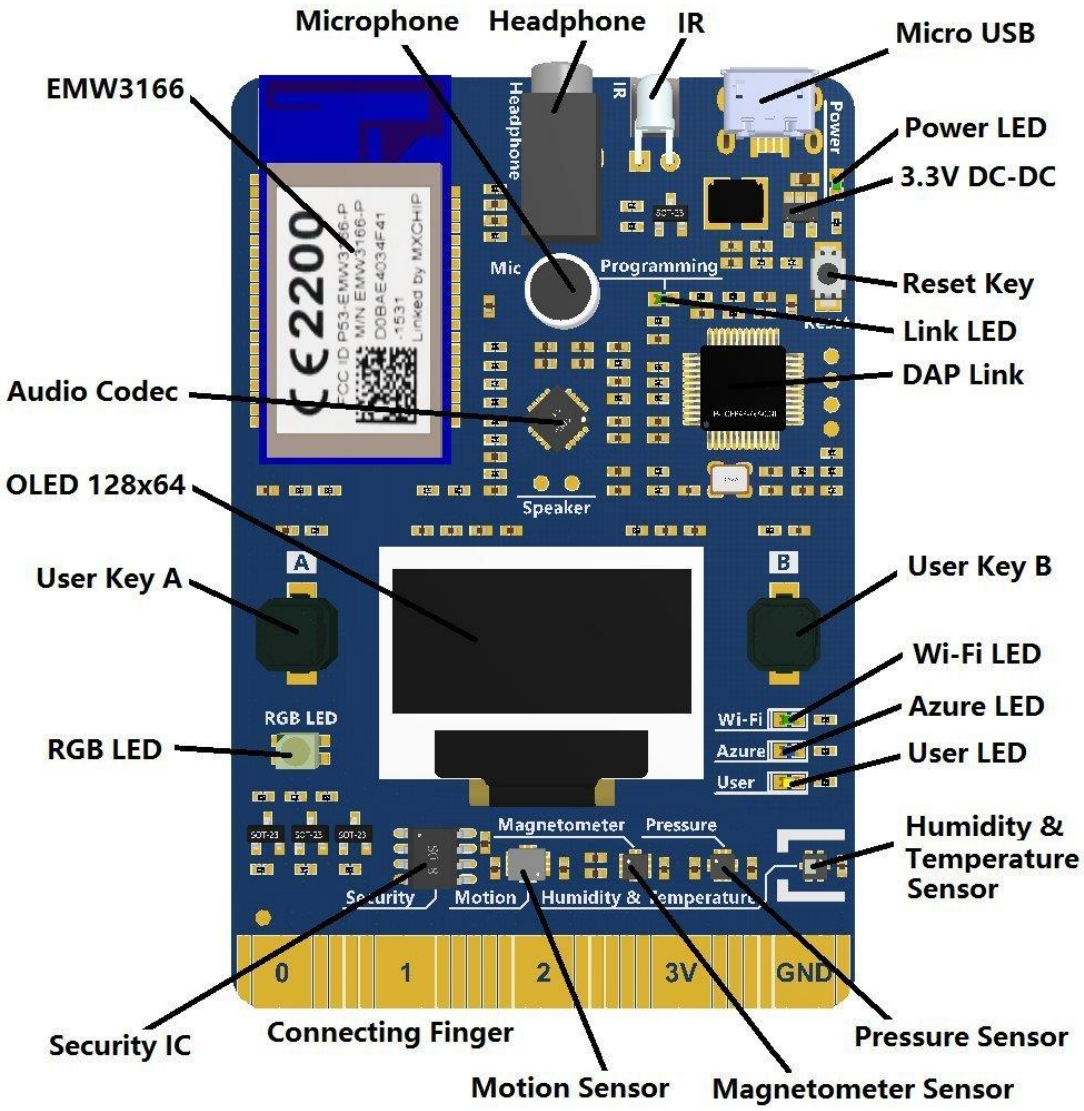
- Arduino IDE
  - Open source IDE
    - Released under GPL v2
  - Cross-Platform
- Use VSCode as well



Additional Arduino Hardware

Microsoft Azure IoT Developer Kit

- Arduino compatible
- Integrated hardware
  - Sensors
  - OLED display
  - Buttons
  - WIFI
- About $45



Microsoft

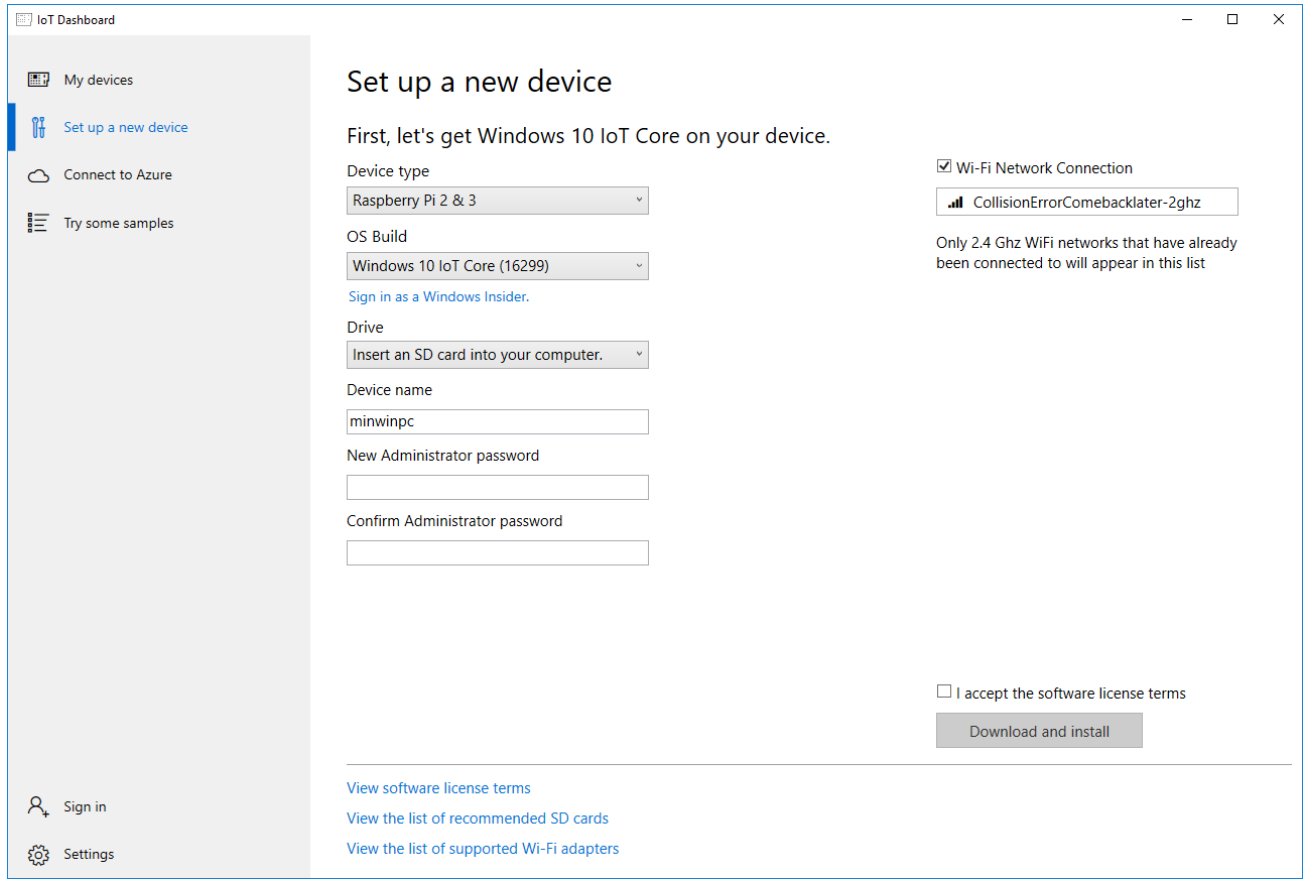
Windows 10 IoT Core

Windows IoT Core

- Runs with or without a display
- Supports Auto-update over windows update
- Is mainly supported by the larger boards, but you still have options
- IS FREE to use

Windows IoT core Dashboard

- Assists in flashing SD card
- Configures device settings
  - Device name
  - Administrator Password
  - WIFI network



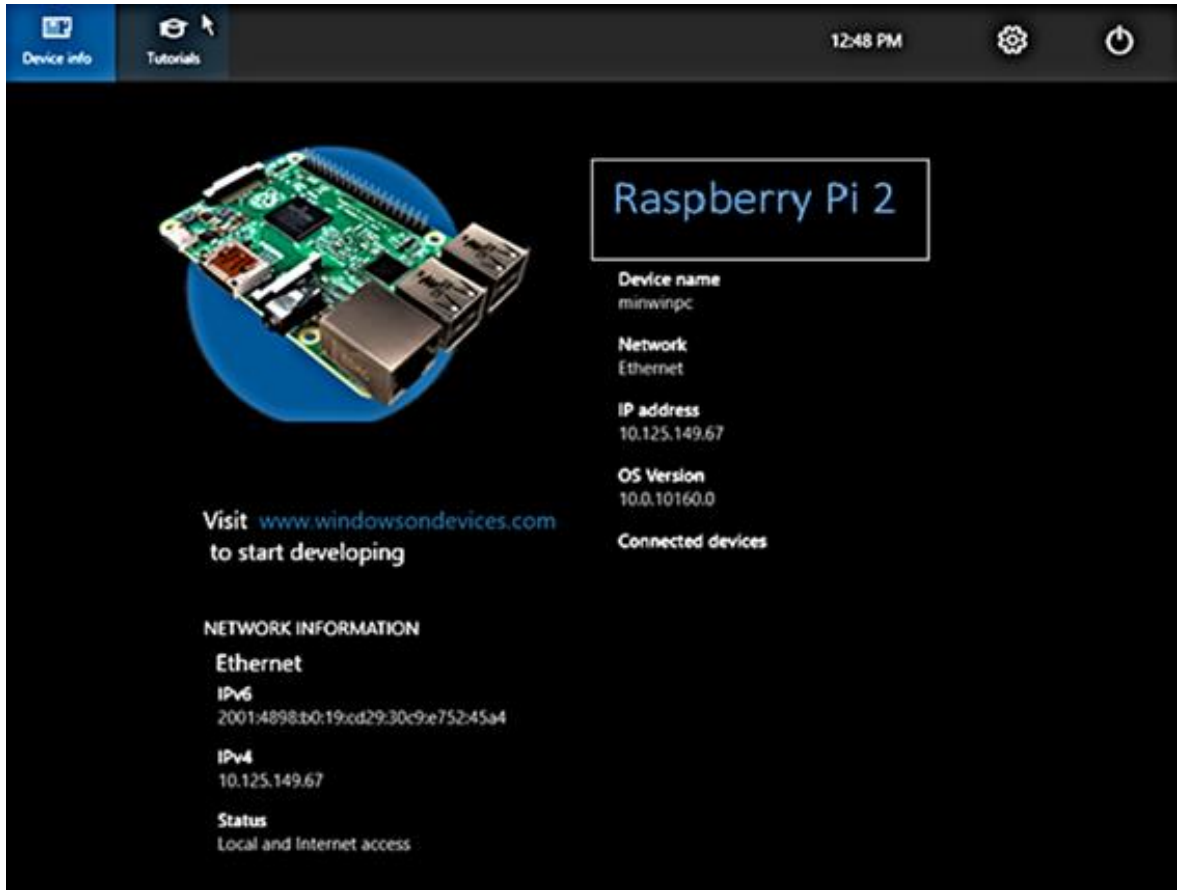
https://developer.microsoft.com/en-us/windows/iot/downloads

Working with the device

- Windows Device Portal
- Remote Display
- Command-Line Utilities (PowerShell)
- Device web portal

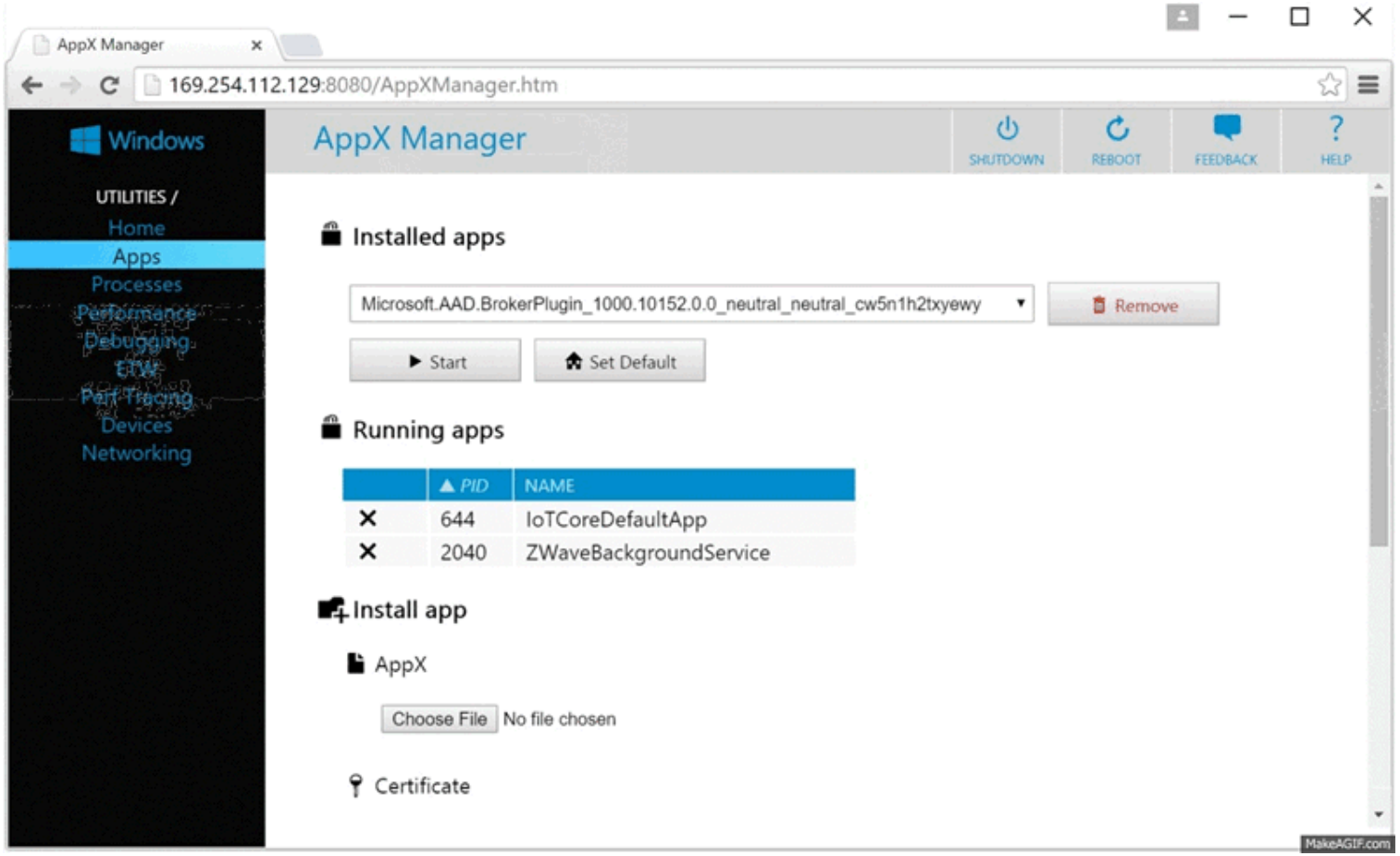
Device interface

- Device name
- Netowork and IP address
- Windows Version
- Command line access
- Settings



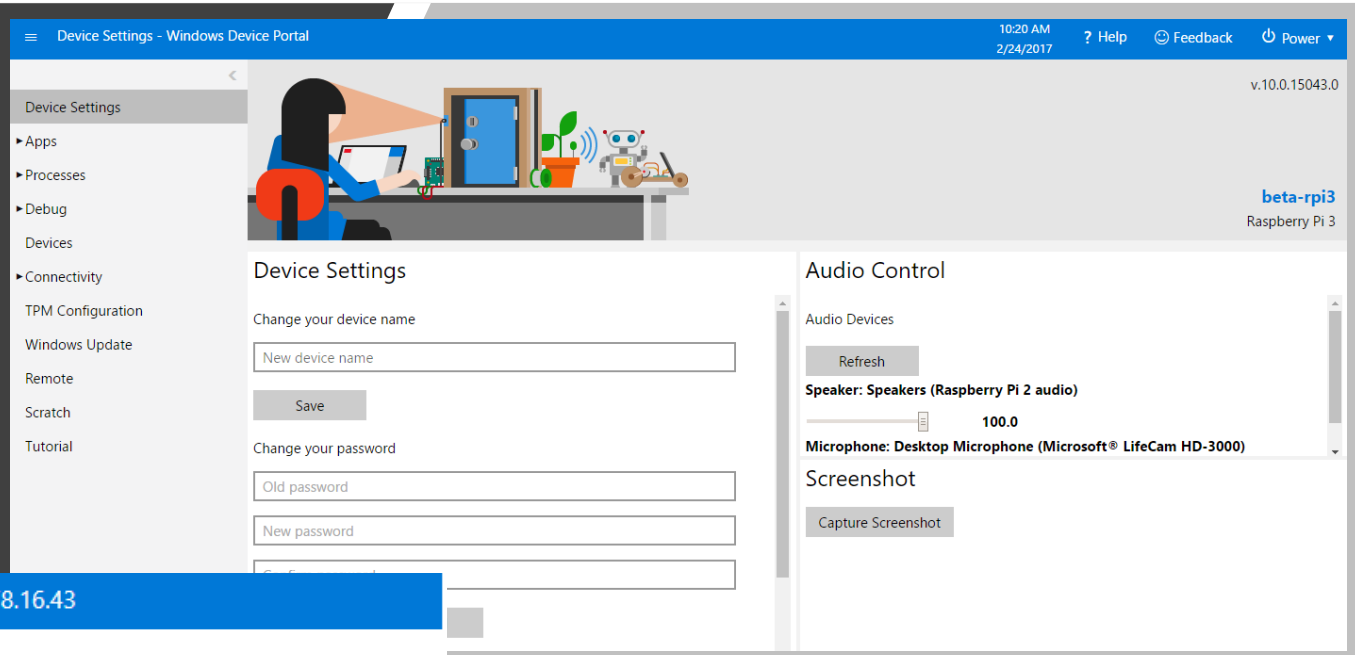
Device web portal with the windows device portal

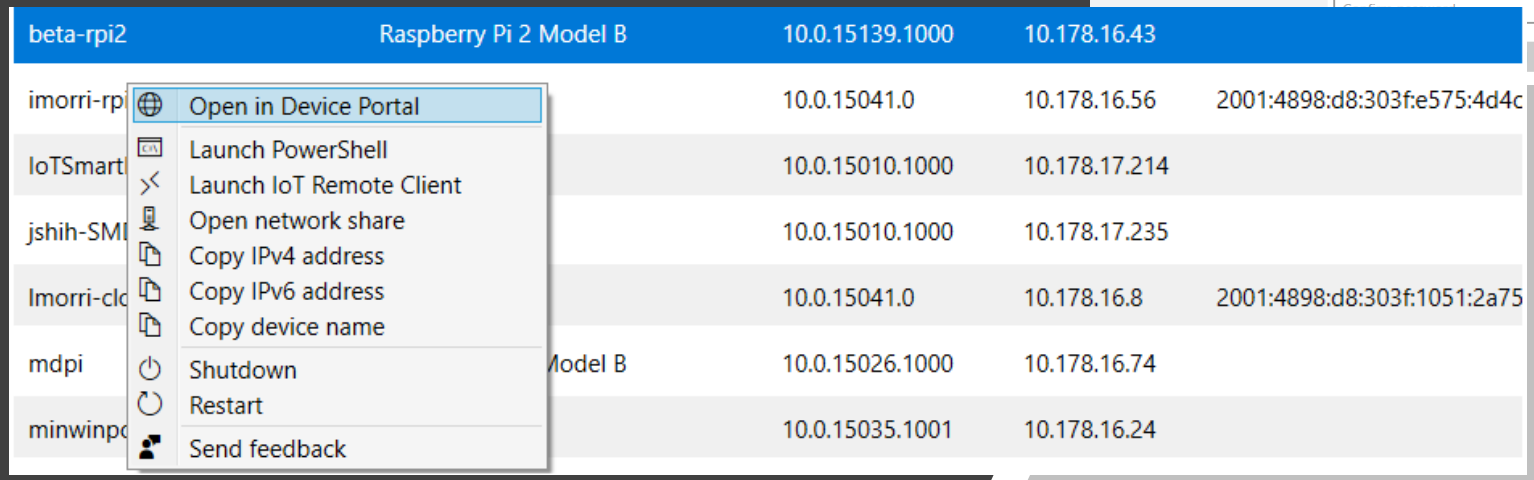
- Headless management
- http://{IP}:8080
- Login: Administrator
- Password when you flashed it



Windows Device Portal

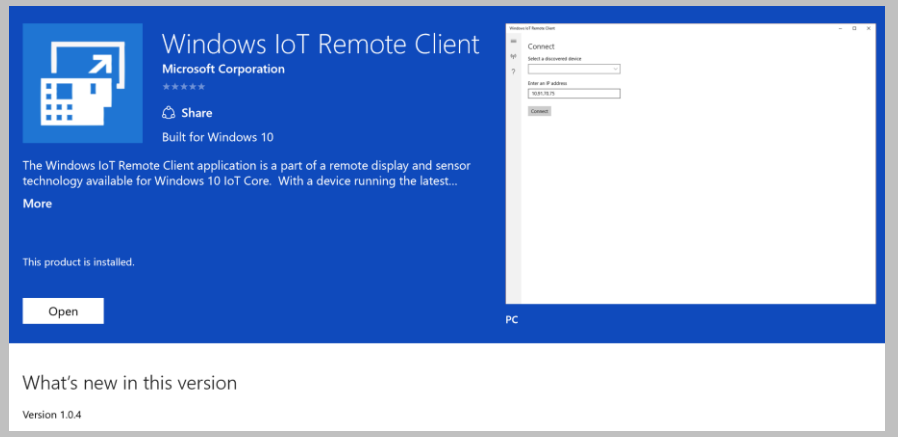
- Launch right from the device dashboard
- Configure and manage your device remotely

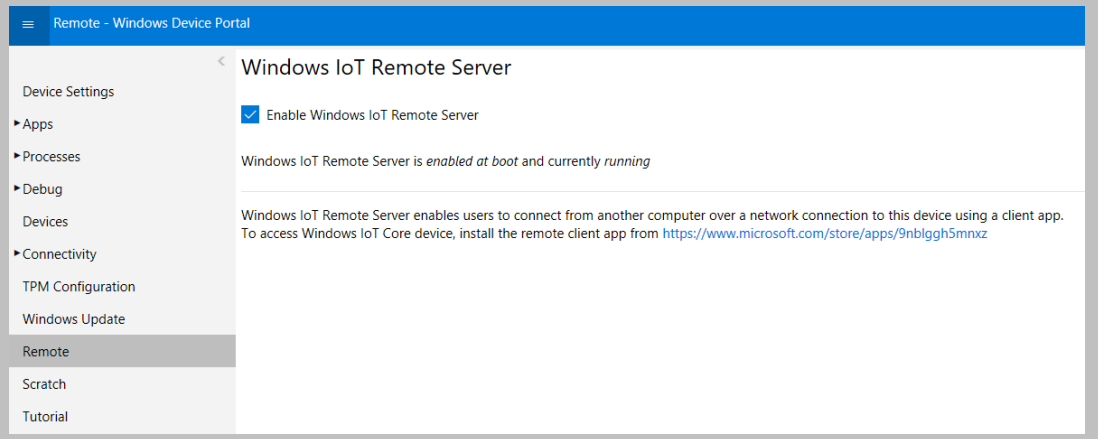




Windows IoT remote client

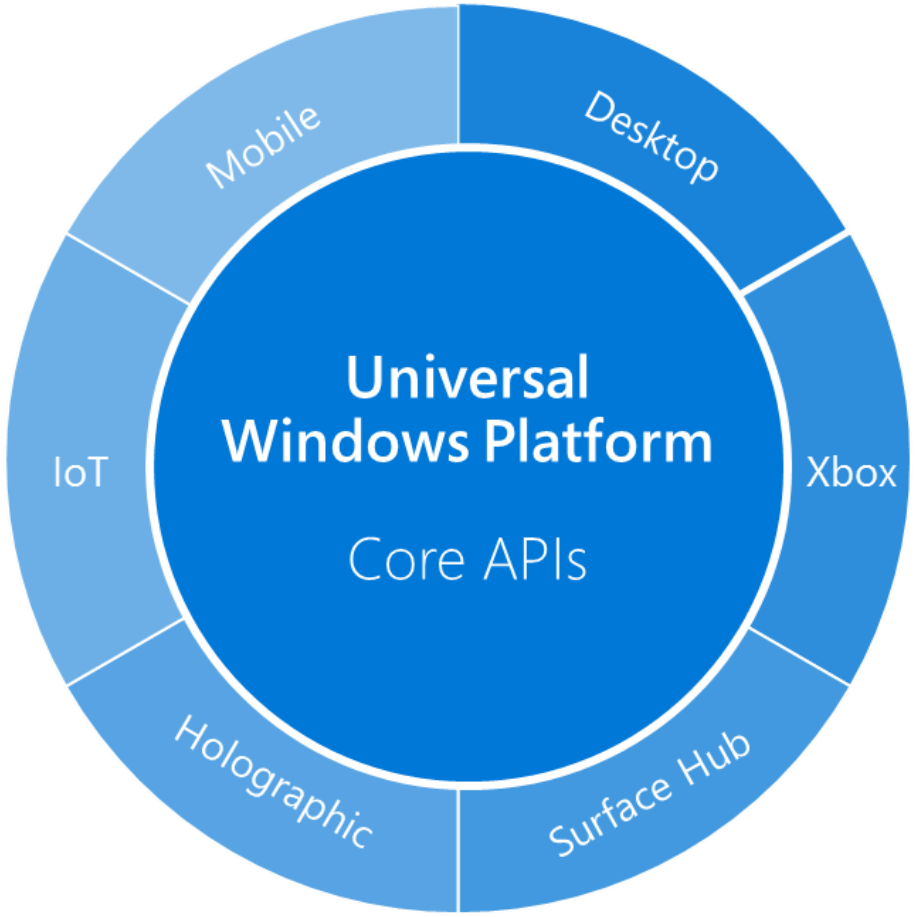
- Required to enable the Windows IoT Remote Server
- Connect and see running UWP apps on the device





IoT Development with IoT core

- Universal Windows Apps (UWP) API
  - Not install from the store
  - Same development tools as:
    - Windows 10
    - HoloLens
    - Etc
  - Visual studio



Windows 10 IoT Editions

Windows 10 IoT for industry devices

Desktop Shell, Win32 apps, Universal apps and drivers

Minimum: 1 GB RAM, 16 GB storage

X86/x64

Windows 10 IoT for mobile devices

Modern Shell, Mobile apps, Universal apps and drivers

Minimum: 512 MB RAM, 4 GB storage

ARM

Windows 10 IoT Core

Universal Apps and Drivers

No shell or MS apps

Minimum: 256MB RAM, 2GB storage

X86/x64 or ARM

+

Windows Updates

Visual Studio & UWP

New User Interfaces

Security & Identity

AllJoyn

Integrated Device Connectivity

Microsoft Azure IoT

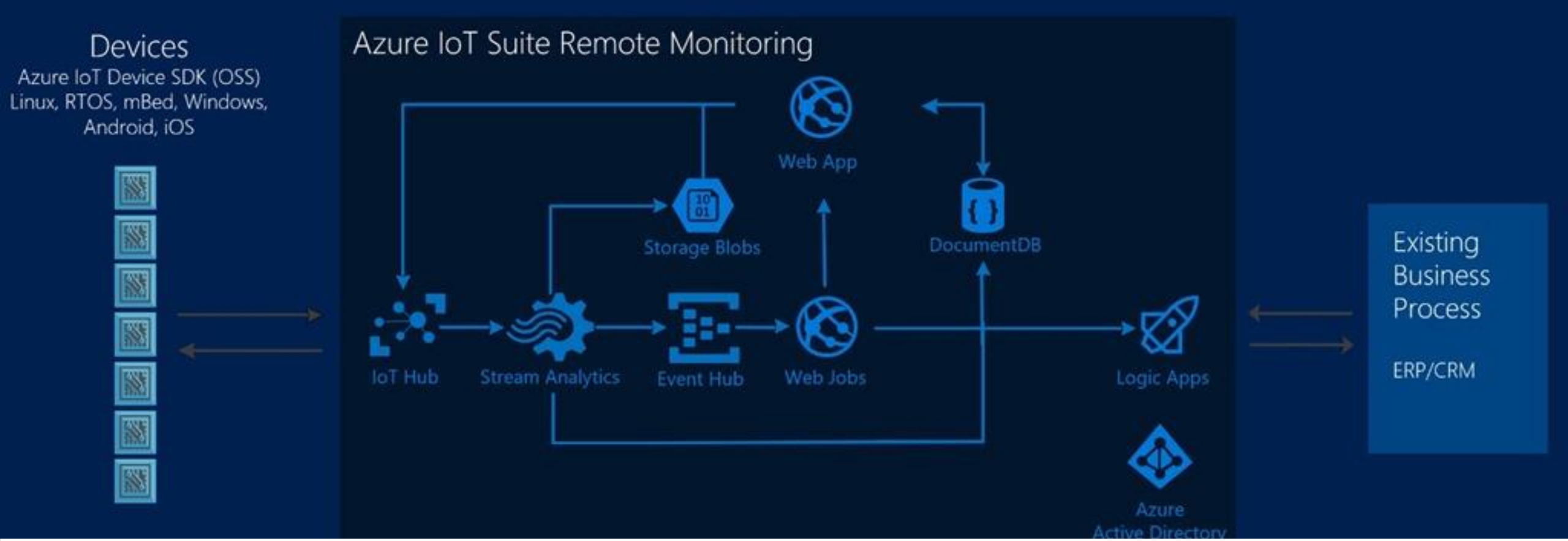
IoT core Enterrise

Windows 10 IoT Enterprise

Windows 10 IoT Enterprise is a full version of Windows 10 that delivers enterprise manageability and security to IoT solutions. It is designed for powerful industry devices used in retail, manufacturing, healthcare, and other industries. Note: Windows 10 IoT Enterprise is a binary equivalent to Windows 10 Enterprise.

	Windows 10 IoT Core	Windows 10 IoT Enterprise
User experience	Single UWP app running at startup with supporting background apps and services.	Traditional Windows Shell with Advanced Lockdown Features
Headless supported	Yes	Yes
App architecture supported	UWP only	UWP and Win32
Cortana	*Cortana SDK*	Yes
Domain join	AAD only	AAD and Traditional Domain
Management	MDM	MDM
Device Security Technologies	TPM, Secure Boot, BitLocker, Device Health Attestation, and Device Guard for IoT	TPM, Secure Boot, BitLocker, Device Guard, Defender ATP, and Device Health Attestation
CPU Architecture support	x86, x64, and ARM	x86 and x64
Licensing	Online Licensing Agreement and Embedded OEM Agreements, Royalty-free	Direct and Indirect Embedded OEM Agreements
Usage scenarios	Digital Signage, Smart Building, IoT Gateway, HMI, Smart Home, Wearables	Industry Tablets, POS, Kiosk, Digital Signage, ATM, Medical Devices, Manufacturing Devices, Thin Client

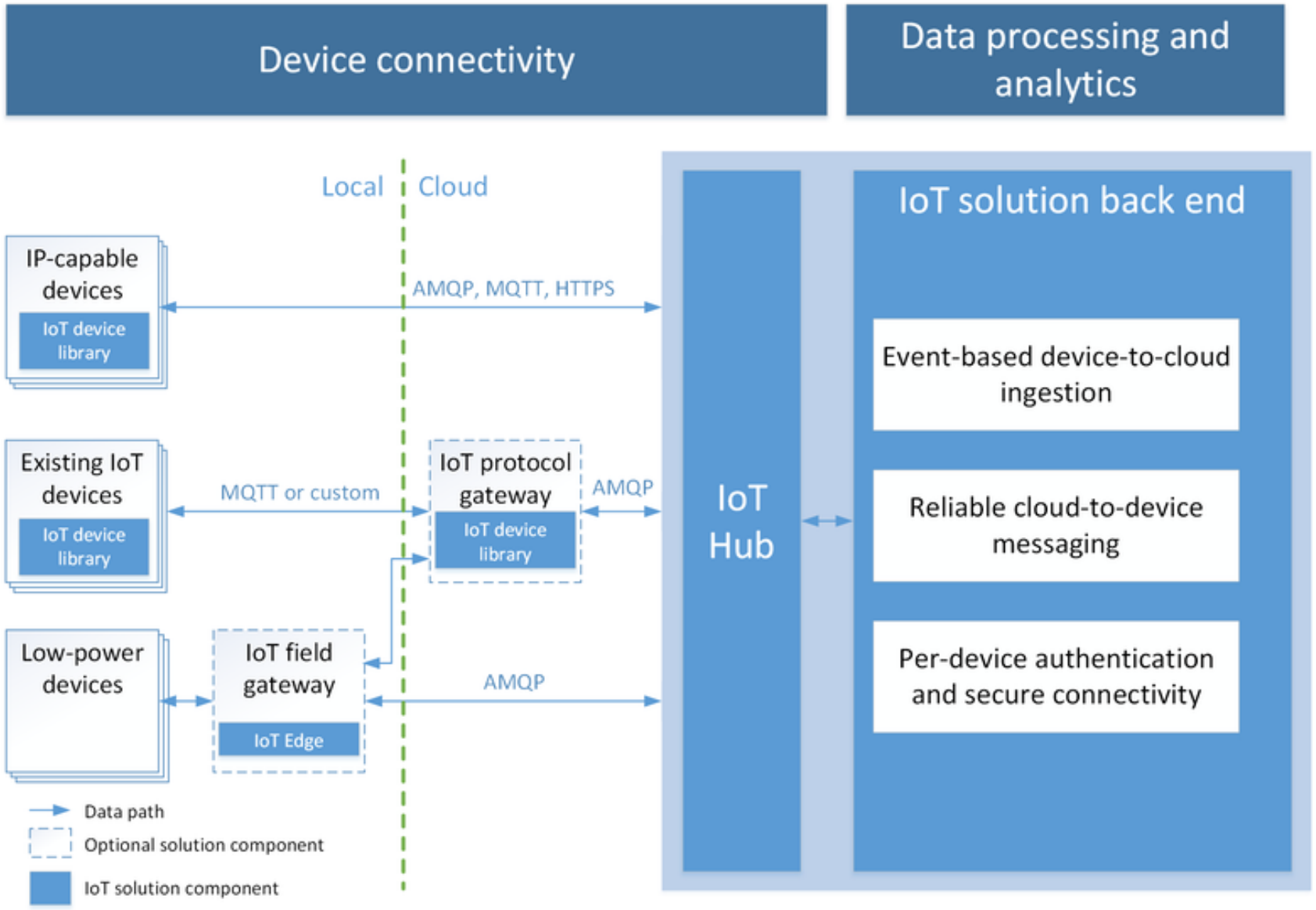

Microsoft Azure

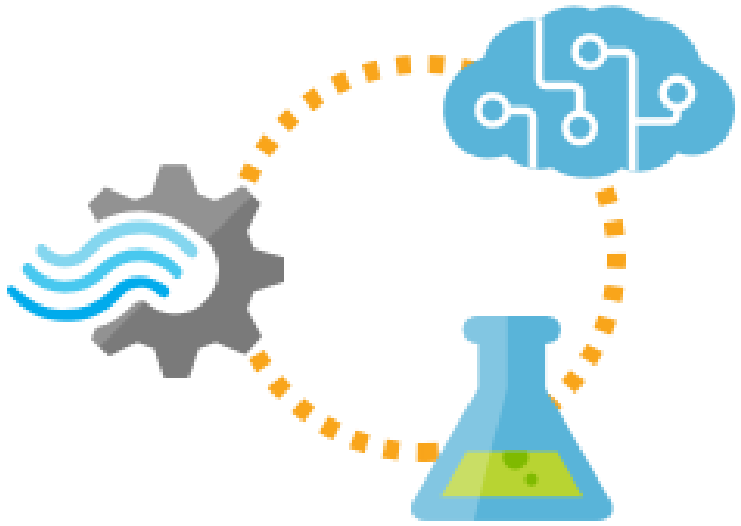


Azure IoT Suite

IoT hub

- Device-2-cloud messaging
  - Supports AMQP, MQTT, HTTP/1
- Cloud-2-Device messaging
- Massively scalable
- Ability to manage individual devices / secure devices
- Azure IoT Gateway SDK
  - Open source SDK for building IoT gateways


Device connectivity
Data processing and analytics
Local
Cloud
IP-capable devices
IoT device library
AMQP, MQTT, HTTPS
Existing IoT devices
IoT device library
MQTT or custom
IoT protocol gateway
IoT device library
AMQP
Low-power devices
IoT field gateway
IoT Edge
AMQP
IoT Hub
IoT solution back end
Event-based device-to-cloud ingestion
Reliable cloud-to-device messaging
Per-device authentication and secure connectivity
Data path
Optional solution component
IoT solution component



- Enable AI and advanced analytics at the edge
- Reduce IoT solution Cost
- Store and forward
- Protect your data

IoT Edge

Notification Hub

- Send push notifications to any platform
- Supports all major platforms
  - iOS, Android, Kindle, etc
- Highly scalable
  - Millions of mobile devices and billions of notifications

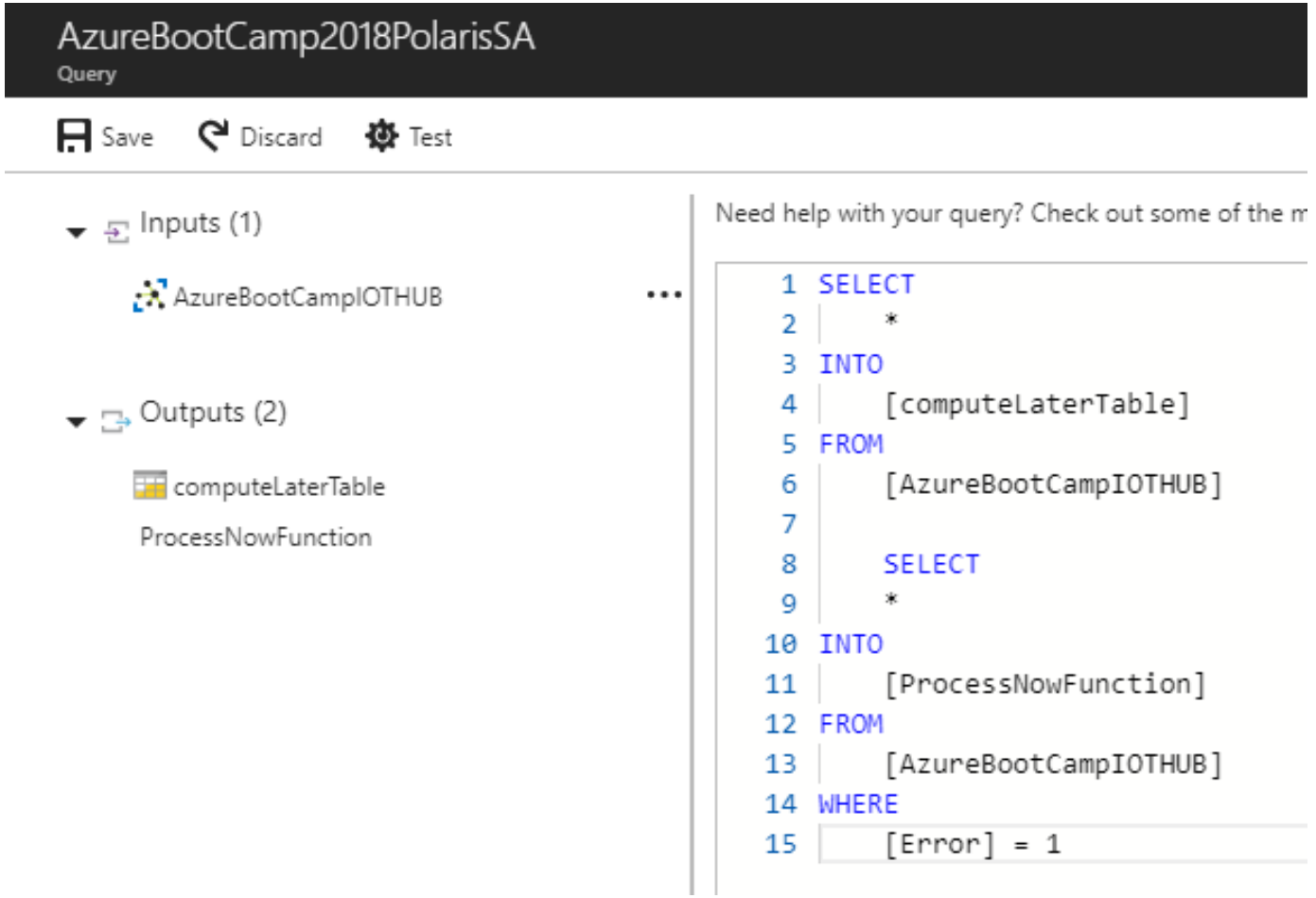
Event Hub

- Less concurrent connection
- One way communication
- No device level security

Stream analytics

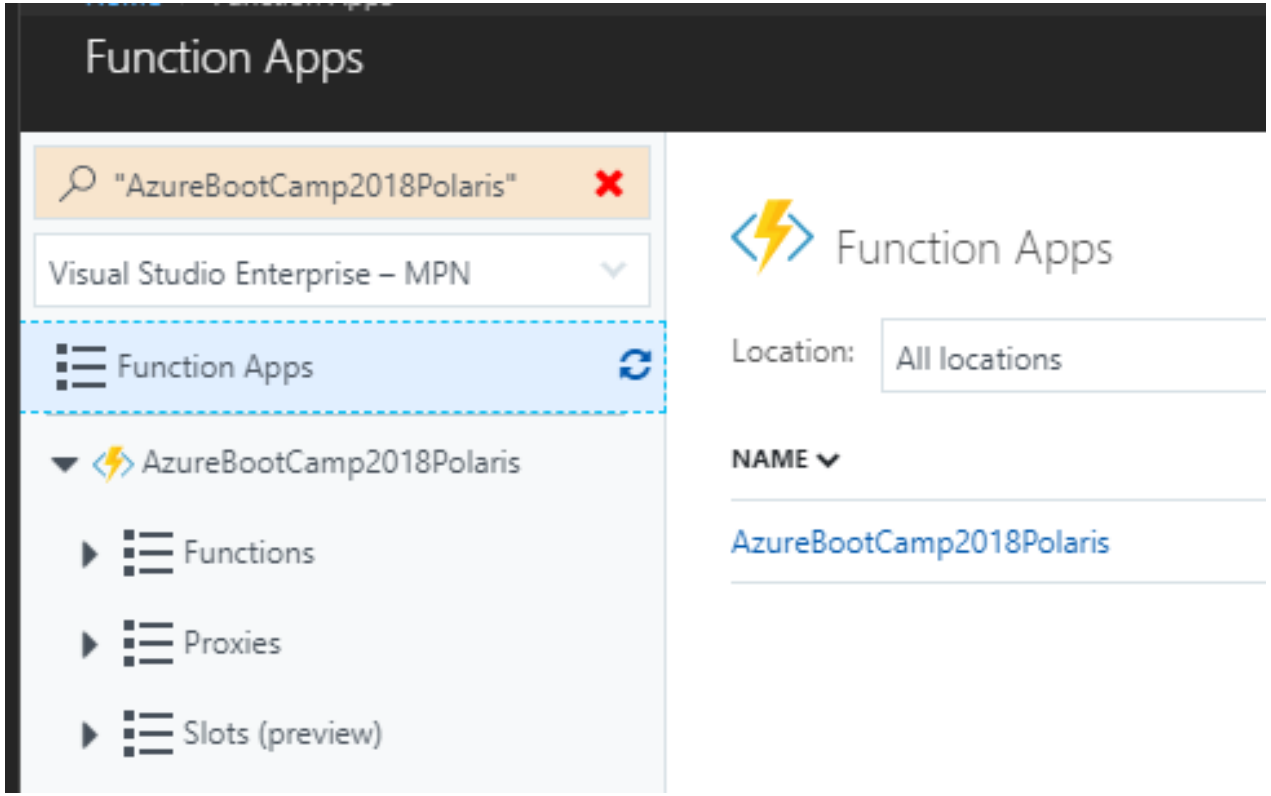
- Real-time stream processing
  - Millions of events per second
- Can handle multiple inputs and Outputs
  - Inputs: IoT hubs, Event Hubs, Blob Storage
  - Output: SQL Database, Azure Storage, Event Hubs, Power Bi, Queues
- Uses SQL-like query syntax for input to Output mapping

Stream analytics basic query



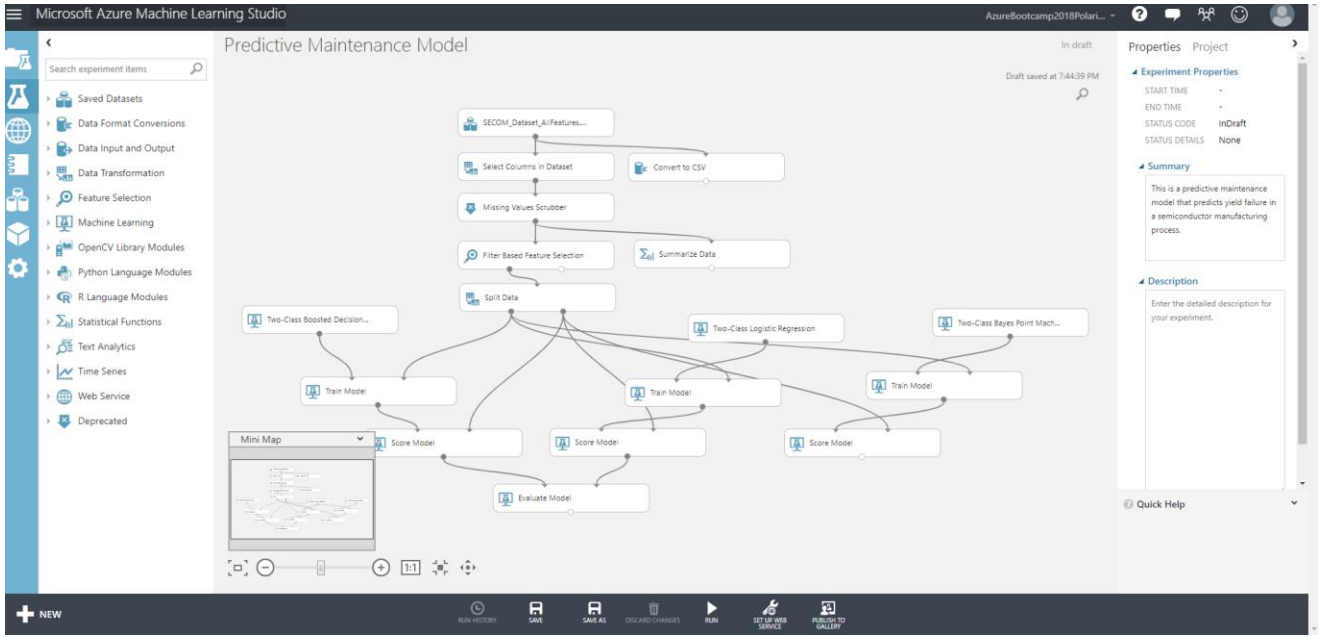
Azure Functions

- Multiple trigger types
  - HTTP
  - Timer
  - Queue trigger
  - Blob trigger
  - Event Hub Trigger



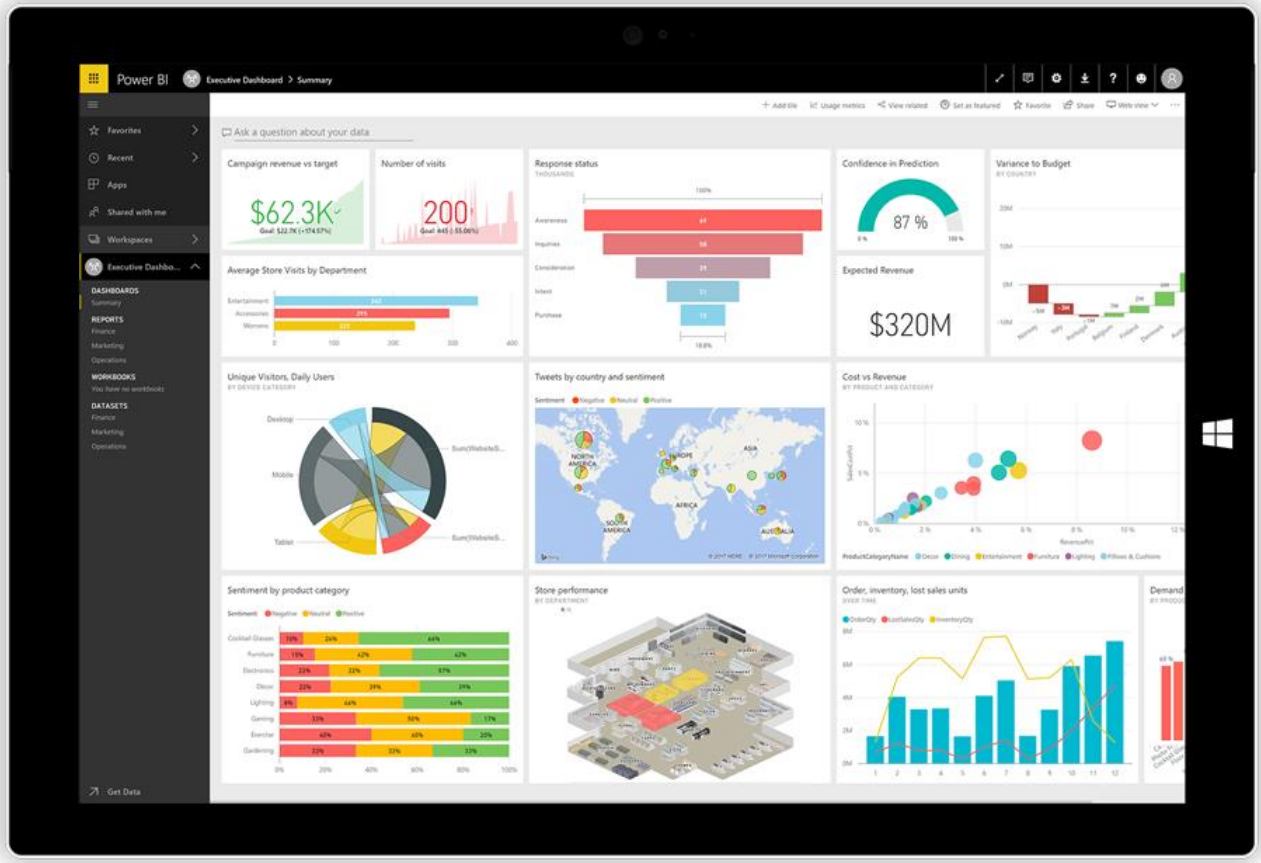
Machine learning

- Created with ML studio
- Outputs a Web service that can be run on a schedule and connected to a database
- Add intelligence to apps and IoT solutions

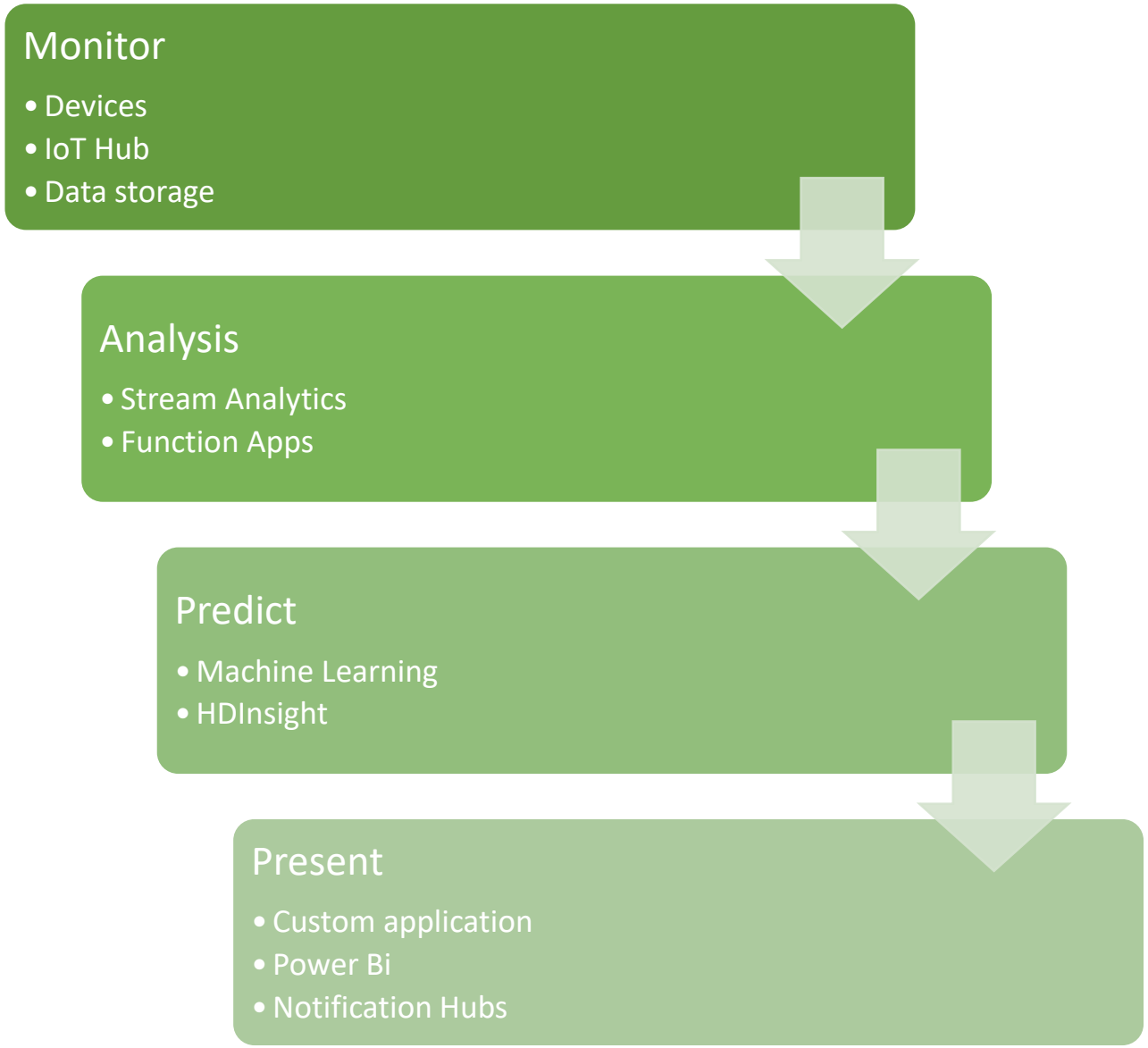


Power BI

- PaaS service
- Create In depth reports
- Embed BI dashboard into other apps



Tying it all together



Beyond IoT Suite

- Processing data
  - Azure App service
  - Function Apps
- Storage
  - Azur storage Blobs, Tables, Queues
  - SQL Database
- Most Azure services can be used, but watch throughput

Lab

https://github.com/Azure-Samples/iot-hub-dotnet-simulated-device-client-app/archive/master.zip

https://www.microsoft.com/en-us/download/details.aspx?id=51657

What are we building